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STRATEGISING INNOVATIONS IN RURAL HOUSING USING BAMBOO

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ABSTRACT

Bamboo as a substitute to timber, in housing, has occupied the attention of researchers due to concerns of deforestation and the consequent impact on environment. The use of bamboo as a load distributor is well accepted in rural areas. Replacing timber with bamboo as a structural load bearing element could have far reaching consequences for rural housing. This in turn would have implications for greening wastelands and earning carbon credits. However, introduction of innovations is more than a technology issue. The paper deals with a possible approach which could entail acceptability and sustainability of the innovation. Based on field inputs from the State of Jharkhand, the study brings to light that, for better acceptance, it is preferable that minimal changes are introduced in the existing houses, only on those aspects, where constraints and limitations are felt. Thus, going in for a totally new model of innovative housing is not a preferred option. The present paper proposes a participatory approach involving awareness building, through grassroots organisation, supported with skill development to transfer the technology in the rural housing structure.

Introduction

Shelter has occupied the innovative genius of man since times immemorial. The early man depended on the locally available raw materials for his shelter. Later with the need to build large housing complexes, materials which could be standardised and replicated were preferred by the builders. The country side however is still replete with self-built houses using local materials. Since these houses are self-built, the need for replacement of certain degradable materials in these houses have been accepted by the villagers without much ado, and preferred over the so called standardised materials, which require considerable ingenuity to procure in these remote locations. However, with the growing concern on deforestation and the consequent implications on global warming, availability of timber, which played a major role in such houses, especially as the main load bearing element for roofs is increasingly becoming a constraint. Therefore, there is a need to identify alternatives, using locally available raw materials. Bamboo is an appropriate alternative

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to timber since unlike long gestation trees, bamboo culms require regular harvesting, from the time it becomes 3-4 years old, to keep the bush healthy. Thus, availability of bamboo is a green option for housing. Sudhakar *et al.* (2007) and Chugh *et al.* (2009) have brought out the technical viability of substituting timber with bamboo as a structural load bearing element in rural houses. While, identifying the right technology as per the need is an area requiring research, an equally important issue is the methodology of introduction of innovations in technology interventions in the rural areas, with the involvement of the house owners so that it is sustainable and replicable. Jain and Naizi (2005) have discussed at length the participatory rural habitat process using case studies. The framework for technology interventions in rural areas, using the competiveness tools of analysis brings out the issues and the prevalent models of technology dissemination (Chugh, 2008). The cultural and socio-econmic issues including the effect of habit patterns while introducing new technologies in villages have been discussed by Chugh (2009). The World Habitat Awards website list of finalists and winners gives the best practices in these areas. Drawing on these and field studies in the State of Jharkhand, the methodolgy for introduction of technology interventions, to provide an alternative to timber as the main load bearing element in rural houses, using locally available bamboo, is discussed in this paper.

Objectives of the Study

1. To assess the need of bamboo based technology interventions substituting timber as a green option in rural housing.

2. To identify the best possible vehicles for facilitating introduction of the innovations as identified above.

3. To arrive at a sustainable and replicable methodology for dissemination of the technology interventions identified.

Selection of the Study Area : The State of Jharkhand was selected in view of the potential of bamboo and its scope in rural housing in the State. Three districts, Ranchi, Hazaribagh and East Singhbhum were selected for the pupose. All three were districts where the Jharkhand Education Project (JEPC) had undertaken constructions of school buildings using innovative technologies and design. So it was felt that learnings from their experience could be drawn upon.

Ranchi district had a good field presence of the Rama Krishna Mission, a grassroots organisation, involved in bamboo plantation activities in private lands apart from facilitating training in bamboo based products. They have a good partnership with the State's Birsa Agriculture University. This governed the choice of Ranchi district for a field visit.

The choice of East Singhbhum district was governed by the fact that the district is known for private initiatives in cultivation and trade in bamboo based product. The other consideration was that bamboo plantation activities were undertaken by the forest department in the district, apart from active bamboo based research by the Krishi Vigyan Kendra.

Hazaribagh district was selected in view of the information through JEPC sources, of existence of houses with more than 50 year old bamboo in roofs.

Sample Framework : Response on the questionnaire was obtained using multistage sampling. Sample selection was random - purposive. Villages preferred were those where the JEPC constructed school buildings with innovative technologies. This criterion was used so that informed inputs on the learning

from the JEPC experience could be obtained. In the district of Ranchi three blocks namely, Ormanjhi, Angada and Bero were selected as these were the areas of operation of Rama Krishna Mission. Eighteen villages were included in the sample, eight from Ormanjhi, five from Bero and five Angara blocks.

In East Singhbhum district, Ghatsila and Chuklia blocks were selected as they were known for various private initiatives like bamboo plantations, bamboo artefacts and bamboo trade. Ten villages were covered, five from Ghatshila and five from Chakulia blocks.

In Hazaribagh district, Barkatha block was selected, as there were houses in this area where more than 50 year old bamboo was still found in good condition in roofs. Also, bamboo was used for roof construction even in the houses of the local landlords/zamindars. Five villages from Barkhatta block were included in the sample.

From each of the 33 villages so selected, data were collected from around five respondents in each village. 170 respondents participated. A meeting was called of all the villagers, and five respondents were picked at random giving preference to those who had been associated with the training and construction process of the school building so constructed through JEPC using innovative design and technologies.

Methodology

Technology dissemination based on felt need assesment and perceptions enables acceptability and sustainabilty of the technology disseminated. Therefore, the methodology used was a mix of direct and indirect evidence through the collection of primary and secondary data.

Primary data were collected through field visits to the State of Jharkhand to assess the technology interventions required in view of concerns of deforestation limiting the availability of timber and the use of bamboo in the rural areas and its availability, as well as the likely areas where limitation of supply of timber is faced. In addition, data were collected through a structured questionnaire based on multi-stage purposive sampling framework. The cluster and elements were selected as detailed above. The questionnaire was supplemented by open ended interviews and focus group discussions.

Training on the technology to a small sample group followed by reflection in a participatory workshop was adopted to assess the receptivity and thus ease of dissemination through trainings. In addition, it was thus sought to get an insight on the issues involved and to firm up the methodology of technology dissemination. As a test case, possible modules were developed for community mobilisation and training with the involvement of the participants which included representation of the major stakeholders.

Apart from direct assessment based on field visits, secondary data were relied upon for assessing the potential of the State of Jharkhand for dissemination of the bamboo based technology.

Literature survey was conducted to draw upon the initiatives in introducing innovations in rural housing. Key learnings from these interventions were valuable inputs in firming up the dissemination strategy.

Competitiveness tool – Strategy Diamond was used as a strategy for analysis, since this tool enables consideration of all pieces of a strategy in combination rather than in isolation.

Potential of Bamboo and its Scope in Rural Housing in the State of Jharkhand

As per Bamboo Resource Survey in the State of Jharkhand undertaken in 2005 by the

Institute of Forest Productivity (IFP), Jharkhand with 29.61 per cent of its landmass under forest cover has tremendous bamboo resource spread over its hilly tracts. Jharkhand State Forest Development Corporation (JSFDC) project proposal states that the total area under bamboo forest in Jharkhand is 842 sq. kms., mainly confined to the drier parts of the State. The total Geographical Area of the State as per NRSA – Wasteland Atlas of Jharkhand is 79706 sq. kms. 14 per cent of which is wastelands. Considering the tremendous potential of the State, JSFDC submitted to the National Bamboo Mission (NBM) a project spanning over five years, 2007-2012 with a project cost of ₹4655.37 lakh of which the first instalment of ₹100 lakh was received on 7.12.2007. The Project envisages development of nurseries, certification of planting materials, plantation development works, research and dissemination for enhancing productivity, capacity building of farmers and entrepreneurs for better returns from bamboo products. Thus enhancing production and productivity of bamboo based forestry and farming system are the objectives of this project. The bamboo resources in the State would be highly augmented under the project making us believe that shortage of this raw material would not be a constraint in advocating its use in housing in a big way. A detailed bamboo based livelihood survey by Krishi Gram Vikas Kendra brings out marketing as the major problem of the bamboo handicrafts produced by artisans for decorative and functional purpose. Supply chain management is an issue which requires attention as per this study. The focus of these efforts however overlooks the potential of bamboo as a building material. Even though the NABARD (2003) report states that housing uses 20 per cent of the bamboo grown in the country, yet utilisation of bamboo for housing as an economic activity has yet to be tapped by the State. This new focus would have far reaching implications on the supply chain management of bamboo in the State.

The trade, transit and harvesting policies of Bamboo are governed by a series of Government Rules and Regulations. Confederation of Indian Industries and India Development Foundation (2007) has dealt in great detail how the forest regulations in the country are counter-productive to industrialisation of the bamboo sector in the country. If bamboo is used in housing and rural school buildings as a commercial activity to be taken up on a large scale, then the consumption of bamboo would be nearer to the areas of production and the transit rules meant to safeguard the bamboo plantations against unscientific exploitation would really not be a deterrent to its use as pointed out.

Thus, secondary data bring to light that :

1. The State has a rich potential for bamboo based applications.
2. The availability of bamboo is likely to increase in view of the bamboo based project funded to JSFDC by NBM.
3. Housing is an untapped area where bamboo could be profitably employed with implications on its supply chain management.

In view of the potential of Jharkhand for introduction of bamboo based technologies in building construction, the State of Jharkhand was selected for indepth study.

Innovations in the Study Area-Initiative of Jharhand Education Project Council in School Building Constructions : An important initiative in the State as regards introduction of innovations in building construction was the interventions of the Jharkhand Education Project Council (JEPC). The JEPC used the participatory methodology for constructing school building using innovative technologies.

As has been documented by Pailwar and Mahajan (2005), Kapur (2006), Dayal (2006),

community mobilsation and participatory approach have been the strength of the JEPC. The JEPC has a rich tradition of innovative school building construction through the active participation of the village education committee. These committees are constituted from among the villagers for ensuring participatory management of schools. Village education committees have been formed from among the villagers through a community mobilsation exercise. The members of the commmitte comprise functionaries designated as a President and Vice-president. Jointly with the Head Teacher of the school the functionaries of the committee could draw funds placed at its disposal for the construction of the schools. The JEPC, through the active participation of the village education committees of the school consisting of local villagers/stakeholders, had trained and constructed school buildings using innovative technologies.

As pointed above, the JEPC used innovative technologies in School Building Construction. The design and development of the school buildings and the innovative features was undertaken through workshops conducted, focussing on use of local materials, cost-effective technologies and child-friendly features. The innovations introduced included using stub foundation, damp proofing through use of waste mobile, rat trap bond brickwork for thermal comfort, filler slabs for cost-effectiveness while maintaining the strength of the structure, arches on doors and windows, as well as hexagonal construction of the classrooms instead of rectangular classrooms to make the room more spacious and child-friendly. The construction manual had been prepared and revised through involvement of stakeholders (JEPC, 2003). These constructions had been undertaken with full people's participation after due training to construction workers, VEC menbers and volunteers from among the community. Jointly with the Head Teacher of the school the functionaries of the committee could draw funds placed at its disposal for the construction of the schools. So they were trained not only in construction work but also on accounting aspects.

Initiatives in Introduction of Innovation in Housing :

Initiatives in introduction of innovations in housing are many. However, study of a few brings out the key learnings from these experiences which could be beneficial for arriving at a strategy.

The National Housing Programme of Costa Rica (1986-1990) : This programme was the winner of World Habitat Awards in the year 1990. It focussed on the use of bamboo for social housing. Therefore, it was studied. It was started with the aid of Dutch Government in Costa Rica. It was an integrated project involving cultivation of bamboo as well as training for self-built houses (Chaves and Guteierrez, 1988). The houses had the advantage of being low cost, supported with technology interventions. The National Foundation of the Bamboo (Funbambu) carries on the activities. However, the programme could not sustain itself with the initial momentum. This was because the level of activity of the Foundation in the construction area totally depends on Government policies in regard to popular housing (Adamsons and Lopez 2001).

Ashraya Reconstruction Project-Orissa : Ashraya was recognised by UN-Habitat as one of the ten best Indian habitat projects for the year 2000-2001. This project was initiated by CARE India in response to the 1999 Orissa cyclone. The key features were community managed Core House project and setting up of the Building Material Services Bank (BMSB). Technology innovations were introduced to make the houses cyclone resistant. Apart from identification and adoption of cost-effective

technologies the design building processes were envisaged to be adaptable and acceptable to the community. The BMSBs functioned as supply nodes for building materials and skills. Training and community involvement was an integral part of the project. The BMSBs set up networks with local artisans to provide a continuous upgrading of skills through training. The project brings forth the advantage of the tri-sectoral partnership linking the corporate sector, the development sector and the Government. It also highlights that community processes take time to establish. Transportation of building materials is the biggest hurdle (Jain and Naizi, 2005).

Owner Driven Housing Processes-Gujarat: Jain and Naizi (2005), documented the owner driven housing project initiative by an NGO, UNNATI undertaken as a reconstruction programme in response to the earthquake in the State of Gujarat in 2001. They brought out that an owner driven process factors the needs and preferences of the families in designing the houses and determining the technologies which would be adopted for subsequent sustainability. Awareness camps, training programmes and technical support are an integral part of this strategy.

Innovative Rural Housing and Habitat Development in Kuthambakkam Village : This initiative was a finalist in the year 2005 list of World Habitat Awards (World Habitat Awards website, 2009). It seeks to improve housing conditions in the Kuthambakkam village through the use of innovative, appropriate technologies such as stabilised compressed earth blocks, to replace thatched huts in the village with safe durable housing. The project was initiated by Trust for Village Self-Governance (TVSG), a charitable trust established in 2001. Training of masons and villagers in the new technology was an integral part of the project. However, one of the key barriers was the initial resistance by the local village community towards the new building techniques. However, effective use of Gram Sabhas to discuss and take collective decisions and encourage local people to take ownership of the process of development, helped overcome the barrier.

Azadpura Rural Housing Project, Madhya Pradesh : The Project was awarded the HUDCO – Sir M. Viswesvarayya award in 1997. A finalist for the World Habitat Awards in the year 1999, it was implemented under Government of India's Indira Awas Yojna(IAY) among the *sahariya* tribals by TARAgram, a Development Alternative building centre. It sought to upgrade vernacular building systems using local materials, local skills with the involvement of local community. Built with concrete blocks, compressed earth and mud mortar, micro-concrete roofing tiles were used for each building. Awareness raising, regular technology orientation, training of local artisans and design development of houses with owner participation were the key processes adopted. Jain and Naizi (2005) pointed out that in terms of sustainability and scaleability, the initiative performed well as it could involve the families to make them contribute more than the stipulated minimum for the project, in spite of their poor background. Also masons guilds could be formed with the new technologies. However, since the scheme was grant based and supply driven, its replicability is limited. The guidelines of IAY give flexibility in terms of design and technology choices to the family and thus dovetailing with this scheme could be profitably used in introducing innovations.

The key learnings from the above experiences are :

1. For innovations to be acceptable, participation and ownership of the community are a must.
2. Owner driven interventions are preferable.

3. Government partnership while desirable, dependence on government funding would entail vulnerability to changes in Government policies. However, dovetailing with Government schemes like IAY could be profitably used as a starting point.

4. Community ownership is a long drawn process and requires sustained efforts.

5. Training of construction workers as well as householders is an essential ingredient for successful technology transfer.

6. Innovations based on local materials are desirable as transportation of materials to rural areas is a hurdle.

Need Assessment of Technology Input Requirements

The study was conducted in the State of Jharkhand to understand and assess the availability and use of bamboo in the construction of houses in the State and need assessment as regards technology gaps. Field investigations revealed that the rural people primarily use bamboo as load distributors on roofs with timber as the main load bearing element. Due to the long gestation period of trees and growing concern on deforestation, availability of timber becomes a limitation in such construction. Timber is used for making doors and windows also but this is not a limitation as villagers are able to locally innovate with available materials. Most of the houses were made of mud walls with sloping roofs made with earthern tiles.

While responding to the questionnaire, 66 per cent of the respondents indicated that availability of bamboo is easy. Only 34 per cent of the respondents indicated that wood availability is easy. Though bamboo requires replacement after a couple of years, this however is not a constraint as the material and expertise is locally available. Further, it was clarified during discussions that only certain bamboo pieces as per requirement are to be replaced and enmass replacement of the entire bamboo in the structure is not normally done. This input gives insight into the fact that, when we think of introducing an innovation in rural housing sector, we have to design structures which can be easily replaced and maintained using local materials and expertise. Focus group discussions further revealed that the availability of bamboo is easy as compared to timber. The villagers are very comfortable using bamboo in their houses as load distributors. However, in the absence of knowhow on using bamboo as replacement for timber as a load bearing element, their dependence on timber continues.

The type of roof preferred, whether sloping or flat, was considered an important input for development of the bamboo based load bearing structure for roof. Hence inputs on this were specifically taken, 74 per cent of the respondents preferred sloping roofs. During interaction with villagers it emerged that both alternatives, sloping and flat roof would need to be given in demo constructions. Some preferred sloping roof as it drains the rain water while others prefer flat roofs as that enables multistoried constructions.

Regarding the expertise employed for house constructions 91 per cent use local expertise for technical support, 98 per cent respondents preferred self-constructed houses, yet 92 per cent of the respondents reported employing labour for masonary work, 83 per cent would prefer brick walls if given a choice. Yet during interaction it was revealed that for self-built houses they still go in for mud walls as availability of bricks could be a problem.

One very significant finding during the field visit came to light with the visit of village Gungapecho, Block Barkatta in the district of

Hazaribagh. Three houses all belonging to the local landlord. The roof was built with closely spaced layer of thin round bamboo *lathi bas/ pahari bas* in the local parlance which was identified as *Dendrocalamus strictus*. Topping this layer was a thin layer of *Khajoor* leaves and then a mud plaster. The bamboo was tied together with natural fibres and the walls were of mud and cattle dung plaster. The main load bearing element was the timber beams to which the bamboo was tied with natural fibres. This roof served as the floor for the upper storey storage space for keeping grains. Closer look revealed, one house constructed in 1985, another more than 50 years old, and another which was constructed more than 80 years ago. Interaction with house owners brought out that non-availability of timber often becomes a problem in the constructions.

The management of the forests in the State rests with the village forest committee constituted with Government Resolution. The committee has rights on allocation of the proceeds from the forests. Interaction with village forest committee members in the village *Moota* and *Banlotwa* of *tana Sikri* in Angara block, close to the forest areas, revealed that in such villages, availability of timber is not a constraint. The committee is able to allocate timber as per the housing needs of the villagers, through scientific harvesting of the trees in the forest under their management. However, the availability of timber in villages further from the forest is a limitation.

Under the aegis of Rama Krishna Mission in Angara block bamboo plantation was up on private lands. This is apart from the ubiquitous presence of bamboo in and around the villages of the three districts where the field visit was undertaken. The State is rich in bamboo resources with bamboo bushes near habitation, villages and in homesteads.

It was evident from field inputs that

1. There is huge potential for use of bamboo as a housing material in view of its availability close to the villages, and, comfort level of villagers regarding its use in rural housing.

2. Scientifically harvested bamboo bushes in and around houses in habitations could play an important role in the year round supply of mature bamboo timber even while maintaining green ecology and attendant multiple benefits.

3. The availability of timber is a constraint in those villages which are away from the forest areas. Though there is no such limitation in villages close to the forest where the management rests with the village forest committees.

4. Villagers are very comfortable with using bamboo in houses as a load distributor though they still depend on timber as the main load bearing element in houses.

5. The knowhow on replacing timber with bamboo as a structural load bearing element in roofs in houses while addressing a felt need would require training and awareness building before it is accepted by the villagers.

6. Since most of the houses are self-built, an owner-driven approach to training and contruction is desirable.

7. Skill building of construction workers in the innovation is also a requirement, since local expertise is drawn upon in house constructions.

Dissemination Methodology Issues for Acceptability and Sustainability of Innovations

The JEPC used innovative technologies in school building construction using the

participatory approach. Whether a similar methodology as adopted by JEPC could be recommended or were there gaps? Could dissemination take place with the school building as a model? Learnings from the JEPC experience were therefore, considered essential to identify the issues while firming up the dissemination methodology.

The extent to which JEPC training was imbibed by the VEC members was an important question requiring inputs. Regarding the training imparted by JEPC on school building construction, 24 per cent of the respondents had undergone the process out of whom 72 per cent of the respondents identified the knowledge of use of rat trap masonary and filler slabs and felt that this technology was of advantage for the school building so constructed. Regarding the perceived benefits derived from the new technology, several respondents indicated multiple benefits. Thus they were counted as 305 responses and percentage worked out accordingly. Twenty three per cent of the respondents indicated that the technology resulted in cost savings, 27 per cent indicated material saving and 18 per cent labour saving while 19 per cent identified the strength of the structure as a benefit. Fourteen per cent indicated other benefits like thermal comforts, spacious design etc. During interaction, the masons and the skilled labourers, who built the school buildings with the new technology, could explain the features as well as the benefits, fairly accurately.

Regarding adoption of the innovative features of the technology, used by JEPC for school buildings, in construction of houses, it was revealed that some used the filler slabs. It was indicated that the innovations require construction of *pucca* houses, which the economic conditions of many in the community did not permit. Also the responses specify lack of awareness and difficulty in mustering the expertise and materials for house constructions using the innovations incorporated in school building. Responses also indicate lack of a reason to adopt these techniques in view of an existing house which was serving their needs. However, during focus group discussions it emerged that even where there was awareness of the use of new technology and design in the school buildings constructed by the JEPC, yet adoption in their own houses was not significant as the villagers were not convinced of the appropriateness of their use in their own dwellings.

By and large, the requirements of the State funded school building were perceived to be as distinct from the requirements of the villagers for their own house. Thus, ownership of the technology was not felt by the community and the construction workers so as to adopt it in their own houses. Further, it emerged that the villager has a strong mindset of their own on what is good for them and so solutions have to factor in the factor of acceptability for adoption. So change has to be minimal and not large scale. Thus, replacing present methods of construction by new ones would be acceptable only as regards those features as will fill in the gaps and satisfy a felt need. The felt need however would require a pre-requisite of awareness generation exercise, through facilitated discussions, for the need to emerge from the users. The villager finds it difficult to accept a new technology, more so in housing, till it is tried and tested for its safety. So it may take some years for any technology to be adopted in a large scale.

Another factor which emerged was that skills imparted to labour for construction does not necessarily mean that it will facilitate acceptability of the technology by the community for construction of their own houses. However, it is essential to train the construction workers in the new technologies so that this resource is at hand when a

householder undertakes construction of their houses.

With the spurring of construction activities in the rural areas under *Sarva Shiksha Abhiyan,* Indira *Awas Yojna* etc. the need to look into local materials to sustain such activities becomes imperative. Bamboo based structural element could be one such alternative. Inputs from Jharkhand Education Project Council (JEPC) sources revealed that there is acute shortage of bricks in the district of Ranchi itself so much so that the requirement of bricks for construction work under the *Sarva Shiksha Abhiyan* is becoming hard to meet. Against a requirement of 27978200 bricks in a year the total availability in the district is 27600000 bricks. Thus taking into account the demand for SSA alone the shortfall is to the extent of 378200. This has to be further viewed in the context of requirement of .0204 cubic metre of soil for one brick totaling to a requirement of 570755 cu.m. of soil in a year to meet the requirements of SSA alone. This has implications in terms of land degradation too. Considering that the brick based consumption has its adverse impact on the ecology, JEPC has been looking for alternative technologies in line with the mandate of SSA. Thus, bamboo based construction of buildings in such areas could help overcome this constraint and could be an effective alternative. That apart, interaction with the JEPC experts revealed, that a number of school buildings had been built in the past with foundation for single storey constructions. Shortage of land and increase in enrolment requires vertical expansion by construction using light weight materials like bamboo. Thus, the JEPC would require whole bamboo structures. Their requirements would be therefore, different from that of house owners who prefer minimal changes to the existing structures only to the extent of addressing the limitations due to difficulty in getting timber.

Thus, field investigations reveal that:

1. In order for a technology to be adopted by the community, change has to be minimal, addressing felt needs of the community. Unless there is a felt need, a new technology even if perceived as a better one, need not be adopted in the construction of the houses by the community.

2. Technology innovations in State constructed school buildings, even if introduced with proper training and full participation of the community, do not necessarily lead to ownership of these technologies by the community, for their own housing need.

3. Economic conditions also determine the extent to which new technologies in State funded *pucca* buildings is adopted by the community for its own houses.

4. Skills imparted to construction workers do not trigger introduction of a new innovation in construction technologies of houses in rural areas. However, this is an essential requirement for introduction of any innovation.

5. The bamboo based technology requirements in school building constructions could be different from that in the house constructions. Thus, different strategies and technological interventions may be required for the two building types, viz, houses and school buildings. Therefore, introduction of innovations in school buildings may not always have the desired demonstration effect so as to trigger and facilitate introduction of technology intervention in the construction of houses.

Evolution of a Methodology for Introduction of Innovation in Houses

Evolving a methodology of introducing the innovation in the field was undertaken through participatory workshops. To get an idea of the ease of dissemination and acceptability of the innovation using parabolic shape of the bamboo arch, a five-day long hands-on training was conducted at *Divyayan*, the rural technology centre at Rama Krishna Mission (RKM), Ranchi. The trainers were master artisans from IIT Delhi. The expertise of RKM was also drawn upon. The trainees were youth from the rural areas, undergoing holistic two-year long capacity building at *Divyayan,* RKM, with the objective of infusing entrepreneurship and other related skills. They had a rural background and their own houses in their village employed bamboo.

Using the methodology prevalent in interventions taken up by the JEPC, the training was followed up with a reflection cum module preparation exercise with the involvement of the trainees and the various stakeholders. The stakeholders who participated were rural people involved in bamboo work, bamboo artisans, as well as the users of bamboo application including housing. The expertise available with the Jharkhand Education Project Council (JEPC), the State Forest Department, Jharkhand State Forest Development Corporation (JSFDC), Rama Krishna Mission (RKM) were also drawn upon. This workshop was of four-day duration. The trainees shared their learning from the hands-on training with other participants. The various issues involved were discussed and modules for training and community mobilisation were prepared with the participation of the trainees, experts and the stakeholders. A consensus emerged on the following points:

1. Technologies can be effectively disseminated to a community only when there is a felt need for it.
2. The felt need in a community emerges through informed awareness building using scientific community mobilisation techniques.
3. The needs in a community have to factor in availability of resources- materials and manpower.
4. Since change is dislocating, identification of technology needs starts from what is existing. Those gaps in an existing technology are required to be identified which are to be bridged through technology interventions in order to address the needs. Thus, minimal change should be effected. Bringing in a totally new housing structure is therefore, not recommended.
5. Additionally, skill transfer is essential to provide the services and technical inputs. This requires training.
6. The output and input linkages could be provided by grassroots based organisations with closer link to the community and with infrastructure for wider networking. For the State of Jharkhand, Rama Krishna Mission with its Rural Technology wing was found to be most appropriate for this purpose.
7. Partnership of JEPC and JSFDC was considered desirable for drawing upon their resources both in terms of expertise and initial financial support.
8. Dovetailing with IAY wherever possible was also considered desirable to supplement the resources.

The outcome of the workshop was the preparation of modules for training and community mobilisation by the participants. This exercise also gives a measure of confidence in the ownership of the

methodology evolved by the participants. The key features of these modules are given below.

Module for Community Mobilisation : This would involve

1. Facilitators making entry into the community through conversation, dance drama troupes – *kala jhatha,* participation in activities of the villagers to engage them in conversation. Door to door contact could also be an essential feature of establishing contact.

2. Preparation of *nazri naksha* through Participatory Rapid Assessment (PRA) exercise (Kumar 2002). However, in areas where there is resistance to mapping as was indicated in certain *ultra* dominated areas, this step could be dispensed with. This would not be essential in areas where the Rama Krishna Mission has a good grassroot base but could be used even there as a tool for self-assessment of the needs by the villagers.

3. Organising group meetings with the community for discussions could take place on availability of bamboo, use of bamboo in houses and the possibility of using it as a main load bearing element and thus reduce dependence on timber. Audio visual aids could be employed to build up awareness and confidence on its use as a load bearing element in houses. Discussion would also cover the possible advantages. The prevalent practice and the limitations need to be brought out by the community through facilitated discussions by experts. Information given by experts is also valued by the community, so experts should also be involved in these discussions.

4. During the workshop the participants devoted a session in preparing mock conversations, small skits/drama, stories, songs to bring home the key issues involved. These could be used as tools, but more importantly, the villagers could be encouraged to similarly prepare songs, dramas and stories which would be shared with the group. This exercise is expected to improve the involvement of the villagers.

5. During the community mobilisation exercise participants for the training and potential sites and householders for demo construction would be identified. It was felt that two houses for villagers from among the participants should be constructed during the process of training. These would serve well as a demonstration effect, which would be more effective than demonstration through State funded and owned buildings.

Training Module : The training would be hands-on, in which two demo houses from those of among the participants would be constructed. It would be of five-day duration and involve

1. Prior to the training certain preparatory exercise would have to be done. Scientific harvesting of bamboo and treating it through leaching for nearly 45 days would have to be undertaken. Thus the training would have to be planned at least two months in advance. Prior identification of skilled trainers, listing of tools and materials also need to be done before the training is scheduled. The trainers should include skilled artisans as well as experts with a good knowledge of bamboo especialy its scientific harvesting and treatment.

2. The training would be focussed only on to the gap area of substituting timber with bamboo parabolic arches as the main load bearing element. Construction of bamboo based doors, windows and roof would also be included in the training. However, construction of mud/ brick wall will have to precede the training.

3. The training should be undertaken just after *Holi,* in the months of April to September. This is recommended since bamboo clearing starts soon after rains in the month of October and goes on till March.

4. A group of 32 participants was considered to be best, so that they could be split into four groups of eight participants each. The participants should be identified during the community mobilsation exercise to include 15 progressive householders interested in getting their house constructed with the new technology, 4 farmers engaged in private bamboo cultivation, 7 construction workers and 6 bamboo artisans.

5. Before the hands-on training on the actual construction of bamboo arches is undertaken, a session with bamboo experts should be scheduled. This would involve discussion on the advantages of bamboo over that of timber, scientific harvesting of bamboo, treatment of bamboo and its maintenance and care.

6. A session on the existing house construction and the gaps in technology is also required to be scheduled so that the trainees approach the hands-on training with full understanding.

7. The hands-on training have to involve demonstration of the load bearing capacity of the parabolic shape and the types of bamboo which would be best for this application.

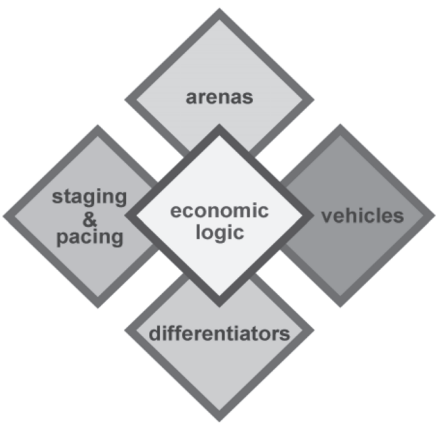
8. The assembly of the structure on to the house is an important component of the training.

9. During the training those participants who can function as helpers to master trainer in future trainings would be identified.

Analysis of the Strategy

Hambrik and Fredrickson introduced the Strategy Diamond in 2001. It highlights the choices and the choice gaps in the proposed strategy. It enables consideration of all pieces of a strategy in combination rather than in isolation. It suggests that a good strategy should include answers to questions of the four facets of the diamond as in Fig. 1 (Hambrik and Fredrickson in www.provenmodels.com)

Fig. 1 : Strategy Diamond



Chugh (2008) used the strategy diamond as a tool for analysis from the competitiveness perspective to arrive at a framework for technology interventions in the rural areas. This tool can also be used to summarise strategy and strategy intent regarding introduction of

technology innovation, as proposed in the foregoing discussions, in rural housing, using the four corners of the diamond as below:

Arenas : Where will we be active?

For acceptability of any new intervention and thus its sustainability, change has to be minimal. Chugh (2009) brought out how long established habit patterns can be a deterrent to introducing innovations in a rural setting. Innovations in housing are therefore, accepted only if they address a felt need with minimal changes as to effect living patterns. In the current situation in the State of Jharkhand where bamboo is available within the village premises and availabilty of timber a constraint, it is the need of substituting timber with bamboo which requires to be addressed. Thus instead of going for a completely innovative design of a house, it is best to introduce only the innovation which seeks to overcome this limitation. The primary use of timber in rural housing is as the main load bearing element in roofs. Bamboo parabolic arches as structural load bearing elements can effectively replace timber in such houses (Sudhakar *et al.* , 2007 and Chugh *et al.,* 2009).

Vehicles: How will we get there?

State driven interventions are not able to generate ownership by the community. So it is best that these innovations are driven by organisation with good grassroot contact. At the same time the organisation should have the capacity to provide the input and output linkages. For the State of Jharkhand, Rama Krishna Mission was found to be most apt. It has a long track record of working in the rural areas around Ranchi. It has a good rural technology centre. It has worked in partnership with the Birsa Agricultural University in the country side. It was felt that supported by the JEPC and the JSFDC it can be an effective vehicle. The technology support could be provided by the researchers and technical hands in the bamboo unit at the Indian Institute of Technology, Delhi, with whose support the initial hands-on training was conducted at RKM. In due course RKM could develop rural entrepreneurs to make the process self-sustaining and replicable.

Differentiators: What are our strengths to accomplish goals? how will we win?

Since the innovation is expected to meet the felt needs of the community and addresses a technology gap it is expected to be accepted by them in due course. The ease of construction with minimal processing gives the confidence to believe that replication and technology dissemination for mass production would be relatively simple.

Since value added use of bamboo in housing is in the vicinity of the area where they are grown, therefore, trade and transit restrictions on transport of bamboo elsewhere would not apply. Moreover, unlike long gestation trees bamboo culms require regular harvesting from the time the culms become 3-4 yrs old, to keep the bush healthy. Thus, continuous availability of bamboo for housing purposes is an eco-friendly option. This therefore, would be a good means of greening the wasteland and earning carbon credits as well. The consequent increase in demand for bamboo for such constructions could have far reaching consequences for economics of bamboo in the rural areas as well as on the supply chain management, once, high value added returns could be generated due to local market potential instead of the need to transport bamboo to distant areas for further value addition. This apart, use of locally available bamboo, thus doing away with transportation of building materials from distant areas, is also an energy saving measure resulting in an eco-friendly utilisation system. The use of bamboo parabolic arches as load bearing elements in roofs is thus a 'green' option for housing.

Staging: How will we obtain our results? What would be our speed?

Systematic programmes of community mobilisation and training would be the means of achieving the results. Construction of demo houses of some of the participants, during the training, would generate confidence in the people to adopt the technology for their own houses. Upgrading the skills of the construction workers and bamboo artisans would further aid the process as it would give them added livelihood opportunities. Involvement of bamboo cultivators in the training develops in them the confidence of ready market due to housing activities. Since change requires time for its acceptability, therefore, continous and sustained presence and support of RKM would be an essential ingredient in ensuring sustainability and replicability. Moreover, it will also ensure continous support for technology inputs as well as input and output linkages. The modules for community mobilsation and training would be further refined with usage. For further trainings, trainers would be developed from among the trainees. Thus, a series of community mobilisation exercises followed by trainings would be an essential ingredient. In the process a group of rural entrepreneurs could be developed for further sustainability and replicability of the intervention. Though the intervention would not depend on State support, yet programmes like the IAY which offer flexibility for adoption of a new technology, while enabling the house owner to have financial support from Government could be dovetailed with the programme. Where financial constraint may be a factor in finding volunteers for such construction, this dovetailing could be helpful in building the initial demo structures and thereafter sustaining the intervention among this category of house owners.

Conclusion

The study brings out that substituting timber with bamboo based load bearing structural elements in roofs of rural houses addresses a felt need in areas where supply of timber is a constraint. However, introduction of innovation in rural housing would be most acceptable when change is minimal, only on those aspects where limitations are felt. Demonstration through State funded building constructions may not always be viewed with a sense of ownership by the community. For sustainability it is best to depend on organisations with good grassroot presence of sustained interaction with the community. This supplemented with owner driven construction of demo houses is essential for involement and confidence building in the householder. Skill upgradation of house owners, construction workers and related stakeholders like bamboo artisans is also an essential ingredient. The consequent increase in demand for bamboo for such constructions could have far reaching positive consequences for rural economy and ecology through proper supply chain management, avoiding the long distance transportation of bamboo. It would have also implications for greening of wastelands and earning carbon credits. The introduction of innovation will also encourage rural entrepreneurship leading to prosperity of the area.

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