SUSTAINABLE – AFFORDABLE HOUSING FOR RURAL KERALA

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ABSTRACT: The current and worsening global shelter situation has become a serious concern, urging the need for scaling up housing supply and has become a focus of policy debate. The reasons and nature of these problems differ from country to country depending on local social, economic and political contexts. The housing situation in Kerala is quite different from other parts of India. Official estimates also predict that if the present trend in house construction continues, by the year 2006 all people in Kerala will have their own houses. However a closer inspection of the current housing scenario in Kerala reveals another side to this overall picture. Despite many positive advances, visible slum like areas still occur in human settlements in rural parts of the state and many inhabitants are deprived of basic facilities like drinking water and sanitation. The shelter problem having a multidimensional nature has its main roots in poverty is aggravated by the scarcity of resources, inadequate institutional capacities and legal and financial framework. It is recognized that adequate shelter for all and sustainable human settlements development cannot be isolated from the broader social and economic development of countries. Also sustainable-affordable housing can not be realized without feasible and environmental friendly technological innovations. This paper reviews the present position of the ongoing PhD research on Sustainable- Affordable housing for rural Kerala and discusses the results so far. It is intend to present a discussion on the following results:

1. The conceptual framework (CF) proposed for analyzing the similarities and differences in the housing problem for developing countries.

2. Review of the present housing situation of the Economically Weaker Section (EWS) in Kerala to understand the problem through a sustainability perspective and analyze the success and failure factors of public intervention for housing the poor.

3. Recommendations for sustainable technological options

Keywords –Affordable housing, CEEF technology, Conceptual framework, Low income housing, Sustainable technology.

1. INTRODUCTION

Kerala, situated on the south- west coast of Indian sub continent is well ahead in the field of social development and better living conditions compared to other parts of India, in spite of its lower per-capita income and a nearly stagnant economic growth rate (Ramachandran, 1997). It is also one of the densely populated States (819 persons/ sq.km) with 3.43% of the total Indian population. The high population density of the state may be mainly due to good climate, fertile land and good rainfall. Over the past couple of decades, Kerala has drawn both international and national attention for its achievements in demographic transition with fertility reaching below replacement level and mortality under five. In terms of per capita income and production, Kerala with an agrarian economy is lagging behind many of the Indian states. However, in terms of Human Development Index and life standard of people Kerala is much ahead of most of other states in India. Also the housing situation in Kerala is quite different from other parts of India. Kerala has got a unique settlement pattern with the dwellings made in individual plots and scattered all over the habitable areas. This is in

striking contrast with the nucleated village system prevalent through out the rest of India. The public housing schemes in Kerala were showing greater performance in terms of magnitude in investment and physical achievements, thus considerably reducing the housing gap (fig.1). About eighty percent of the housing support provided by the state during the last three decades has gone for economically weaker section (EWS) housing. The average growth of houses was sixteen percent during the period of 1991-2001 as against the population growth of nine percent (Government of Kerala, 2004).The official estimates predicts that if the present trend in house construction continues, by the year 2006 all people in Kerala will have their own houses (Government of Kerala, Economic Review 2003). Despite many positive advances, visible slum like areas occur in human settlements in rural parts of the state with many inhabitants still deprived of basic facilities like drinking water and sanitation. Even though the magnitude of private and public investments and Governmental assistance so far were sufficient to solve the housing problems of all the socio- economic groups of the state, the lowest sections of the society are still deprived of the basic facilities (Gopikuttan, G 2002). The recent census report of India (Government of India, 2001) shows that among the total population in Kerala 14% has no access to drinking water and 16% has no toilet facilities. This contradictory situation urges the need of a closer evaluation on the various factors preventing the rural poor from satisfying their housing needs in the midst of increased public interventions and favorable environment.
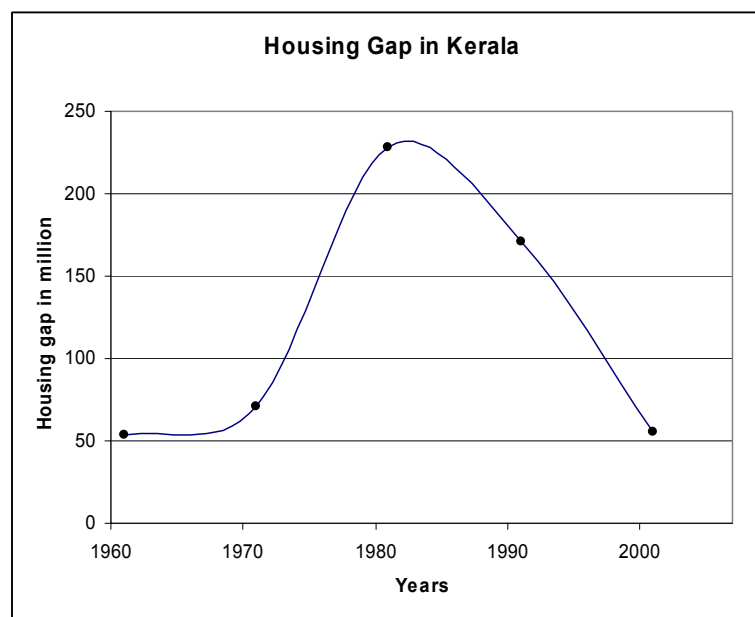

Fig.1. Housing Gap in Kerala 1961-2001

This paper presents a review of the ongoing research on Sustainable Affordable housing for Kerala. It is intended to make a discussion on the various results so far. The paper is organized in five sections. Section 2 introduces a conceptual framework for analyzing the housing problems in developing countries. It helps in defining and analyzing the problems from the perspective of beneficiaries, and supports the formulation of effective policies. A review of the present housing situation of the economically weaker section in Kerala and an analysis of the success and failure factors of public intervention for housing the poor based on this framework are discussed in Section 3. The fourth section presents the results of the evaluation of present building process in Kerala and recommendations for affordable technological solutions. Section 5 is the conclusion.

2. HOUSING ISSUES: A FRAMEWORK FOR CONCEPTUALIZATION

Housing being a basic need of human beings persists globally as a problem irrespective of the economic status of the countries, but differs in its nature and gravity. The perceptions of housing problem vary even from individual to individual, rural to urban and obviously from country to country both in terms of quantity and quality. The concept of homelessness is one that varies greatly among nations and often reflects the political climate rather than the reality of deprivation (Tipple, G. and Speak, S., 2005). The multidimensional nature of housing issues urges the reconciliation of the interests of different stakeholders for being sustainable. Sustainability in housing may be understood in terms of ecological sustainability, economic sustainability, technological sustainability, cultural sustainability and social sustainability (Islam, N., 1996). Value focused thinking can be a useful tool in structuring objectives and criteria. Hence the conceptual framework for sustainable- affordable habitat (fig.1) has been formulated to achieve housing development by balancing social progress, enhancing economic growth, propagating innovative technology along with conserving and protecting the environment and natural resources for future life and development. All these four objectives are interdependent to each other and supposed to have equal importance with respect to Sustainable - Affordable habitat.
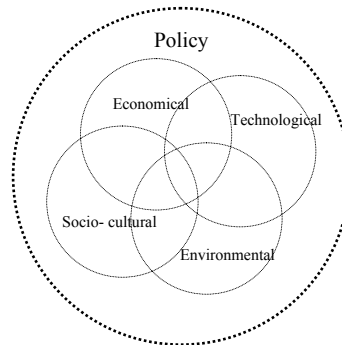

Fig.2. CF: Conceptual Framework for Sustainable – Affordable Habitat

The proposed framework for Sustainable-Affordable habitat (fig.1), figures out the inter relation between the four aspects of sustainability and clarifies the need for an effective policy framework. It describes habitat as a way of developing and maintaining the living environment that support human health (both physical and psychological), satisfying their shelter needs with the help of sustainable technological solutions along with protecting and preserving the nature for future generations. An efficient policy framework is necessary to coordinate the actions of different stakeholders involved. This framework is a combination of two equally important phases. The first phase (CF$_1$) enlists the requirements and analyses the housing issues based on various criteria corresponding to different aspects of sustainability (Nair, D., et al 2005). The second phase; Strategies for Sustainable - Affordable Housing (CF$_2$) assist in formulating policy recommendations supporting Sustainable-Affordable habitat based on the guidelines evolved through the analysis of phase one. The succeeding section will be dealing with the second phase in detail.

2.1 Strategies for Sustainable – Affordable Habitat

The problems of sustainable housing concern both formal and informal housing provision, as well as policies that regulate housing provision (Agenda 21). A hard-core policy framework is inevitable to the efficient working of implementation systems, which can optimise the limited

resources and integrate the various actors for achieving sustainable- affordable housing. It is also inevitable to co-ordinate the activities of all the actors for creating a 'pull' from the side of users rather than a 'push' from the authorities. At strategic level, sustainable development principles and approaches should be integrated into policy strategies and the planning process. The second phase of the proposed framework (CF$_2$) can be considered as a mechanism to achieve the objectives derived from the analysis of phase I (CF$_1$). It identifies four essential strategies such as: Policy measures for socio- cultural sustainability (PSC), Policy measures for economic sustainability or Affordability (PES), Policy measures for technological sustainability (PTS), Policy measures for environmental sustainability (PEVS) to realize sustainable- affordable housing.
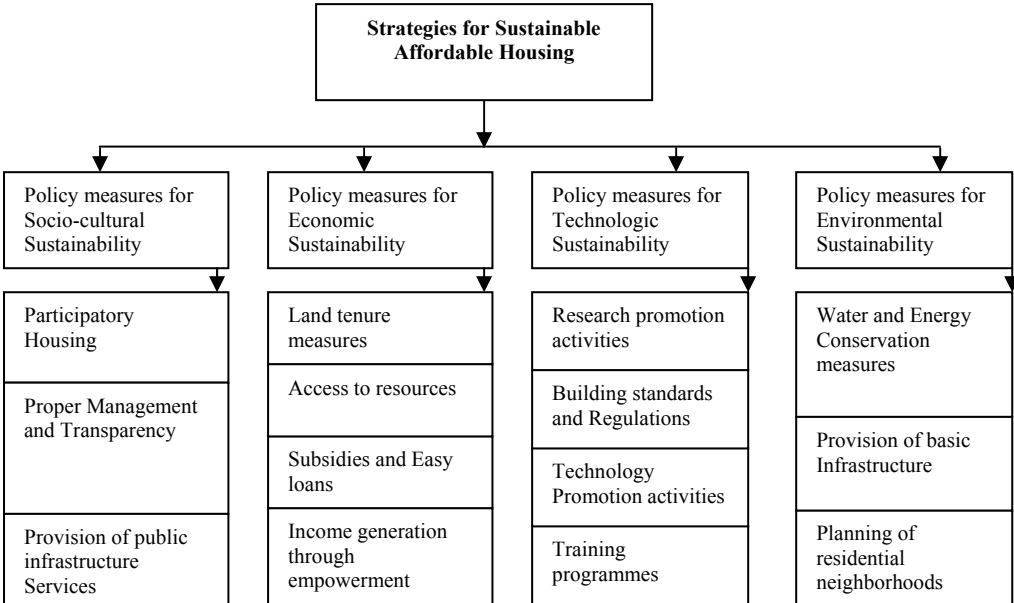

Strategies for Sustainable Affordable Housing

Policy measures for Socio-cultural Sustainability	Policy measures for Economic Sustainability	Policy measures for Technologic Sustainability	Policy measures for Environmental Sustainability
Participatory Housing	Land tenure measures	Research promotion activities	Water and Energy Conservation measures
Proper Management and Transparency	Access to resources	Building standards and Regulations	Provision of basic Infrastructure
	Subsidies and Easy loans	Technology Promotion activities	
Provision of public infrastructure Services	Income generation through empowerment	Training programmes	Planning of residential neighborhoods

Fig.3. CF$_2$: Strategies for Sustainable-Affordable housing

Section 3 presents a briefing and evaluation of the public housing schemes in Kerala based on CF$_1$.

3. PUBLIC HOUSING SCHEMES: KERALA

The public housing approach in India had gone through a series of changes over the years since independence before getting its present form of National Housing and Habitat policy. It exhibits a similar kind of policy shift as in other developing countries from the earlier Public Housing phase (Phase I) to the present whole sector development concept (Phase III) through sites-and-services or aided self help (Phase II). The present phase (from 1994 onwards) in housing policy (NHP-1998) addresses the issues of Sustainable development through housing development. This is truly a mirror image of the whole sector development concept of UN and World Bank and is also well reflected in the present housing schemes (Credit cum subsidy scheme for rural housing, rural building centres, Total housing scheme etc.) of the country. State intervention in the housing sector in Kerala was initiated in 1950. Until 1970 it was limited to implementing the schemes of Central Government and the progress was unimpressive mainly because of the low priority to housing and lack of machinery to implement housing schemes. Now there are as many as twenty agencies implementing housing schemes in the government sector. Rural Development Department, Kerala State Co-

operative Housing Federation, Kerala State Co-operative Agricultural and Rural Development Bank and Nationalised Banks are the major Government departments in the housing sector other than Kerala State Housing Board. The first massive housing scheme, The One lakh housing scheme (OLHS) for the poor with community participation was implemented in Kerala during the year 1972-76. This was the pioneering initiative of the State Government and it marked a remarkable change in the low-income housing scenario of Kerala. Later, during the Ninth Five Year Plan (1997-2002) with the decentralization movement, local Governments also started getting involved in different development activities. Total Housing scheme (1998) was introduced during this period with the concept of whole sector development with the local or self Government as the implementing agencies. Despite the positive trend in the housing conditions, a close analysis shows that the poor and lower segments in the society very often do not get the necessary assistance for the actual construction and completion of houses. Though the poor manage to get support, projects often fail due to many reasons. It is difficult to carry out the evaluation of all the schemes due to their enormous numbers and is also not necessary due to the similarities among the schemes. Hence a proper selection has to be done from the major schemes for making the evaluation more meaningful.

3.1 Sustainability Analysis for selected schemes

Three schemes are identified from each phase on the basis of their representative nature in policies with those of the international agencies, their uniqueness in implementing agencies and other peculiar characteristics. The following table gives an overview of the selected schemes. It presents the details including the specification of the schemes with regard to the criteria for beneficiary selection, mode of finance, implementing agencies, type design prescribed and other special characteristics.

The first phase of the conceptual framework (CF_1) discussed in the previous section is employed for the sustainability analysis of the housing schemes. It has been carried out in two stages, such as:

1. **Analysis I (Perspective of Government):** - This has been done to understand the perspective of the Government while formulating the housing programmes. It can be discussed and analysed on the basis of the information from the official reports and documents on the corresponding schemes and from other secondary sources.
2. **Analysis II (Perspective of beneficiaries): -** This has been done to get an insight into the real housing situation of the beneficiaries. Also the mismatch, if any, in the perceptions of the government and beneficiaries can be identified through this analysis.

Analysis II has been done in two stages (IIa and IIb). First stage of this analysis (IIa) is based on the author's observations from the field and the second stage (IIb) is based on the information from the household surveys. The observer's evaluation in Analysis II has been done in order to make a comparative evaluation between both the perspectives using a common tool. Since each household do have their own perception about sustainability, it may not be possible to bring them into a common scale. Instead, an observer's view point can be used to evaluate the real situation using the conceptual framework as in Analysis 1. Whereas the analysis from the user's perspective (Analysis IIb) has been done to assess the real housing problems of the beneficiaries, their needs, requirements, difficulties faced during the building process, feasibility of technology options, and accessibility to resources etc. Case

studies from the household surveys and Statistical Package for Social Sciences (SPSS) are employed at this stage of analysis.

Table1. Overview of selected Public Housing Schemes – Kerala

Housing Schemes	Specifications			Remarks
	Type design	**Beneficiary**	**Mode of finance**	
One Lakh Housing Scheme OLHS) 1972-76 Implementing Agency State Government	The type design was unique for the entire state. Each unit has two houses in a back-to-back position with the longer central wall as the common wall between two houses with in a total plinth area of 23m²	An Economically weaker section (EWS) household with out house plot was eligible to get a house under this scheme.	Beneficiaries had to pay a nominal amount in eleven equal instalments Government raised the funding by collecting donations from the public, free labour from members of voluntary agencies and the entire people were involved in the project	Based on Provider approach , **Phase I** First scheme implemented by the state government. Poor beneficiary participation. Beneficiaries were shifted from their native places to occupy these houses.
Indira Awaas Yojana **IAY** **1985-96** Implementing Agency Central Government	No type design prescribed for this scheme except that the plinth area of the houses should not be less than 20 square meters. Construction of sanitary latrine and smokeless Chula forms an integral part of IAY houses.	The households were people below poverty line living in rural areas belonging to Scheduled castes (SC) or Scheduled tribes (ST), freed bonded laborers and non-SC/ST.	This is a fully subsidized scheme and under this the entire money was distributed to the beneficiaries in four equal instalments. The beneficiaries were able to receive the instalments only after the completion of each specified stage of construction.	Aided Self- help/ Mutual help approach, **Phase II** This scheme was restricted to the people below poverty line having at least 80 m² of land. Due to this a large number of deserving families were not able to get the benefit from this. As this was a centrally sponsored scheme, the scheme was designed by the central Government and was unique for the whole country. It never took considerations of the local conditions. The funding of the Central Government was not sufficient. Even though the sanitary latrine and smokeless Chula were the integral parts of this programme, due to the lack of sufficient funding, most of the interviewed households were not able to construct these.
Total Housing Scheme **1998- 2001** Implementing Agency **Local/Self Government**	Core house concept was adopted and allowances made for future expansion. This core house was roughly worked out to be about 30m², including a living room, a bedroom, a kitchen and a toilet. Beneficiaries had given the freedom to design their own house plans according to their needs.	People below poverty line were identified and beneficiaries were selected based on the selection criteria. Scores were assigned for beneficiaries based on these criteria and the score sheets were submitted in support of selection of beneficiaries.	Financial assistance to the beneficiary households was provided in the form of grant of Rs. 35000 to construct houses costing not less than Rs. 44000. Local self Governments in the districts made an initial deposit of Rs. 10000 per house on the basis of which HUDCO sanctioned a loan of Rs. 35000 per house. The Grama Panchayat (Rs. 7000), Block Panchayat (Rs. 1500) and District Panchayat (Rs. 1500) shared the deposit amount. HUDCO sanctioned the loan amount for a fixed term of 11 years at an annual average interest rate 10 per cent	Facilitator or Habitat development concept, **Phase II** First scheme implemented by the local governments

Fig.4 (i to iv) present a comparative report of the results on various aspects of sustainability of the selected schemes based on both the perspectives. It is interesting to see that the selected schemes show a gradual improvement in the perspective of the Government (AI) towards the problem with respect to total sustainability as it moves from OLHS to THS (1970 to 2000). But the real situation in the field (the observer's perspective, A IIa and A IIb) is quiet different from the concept and only show minor variation between the schemes. This verifies the mismatch between theory and practise. Also the values of sustainability are far less than what was anticipated. Even the Total Housing Scheme, which was formulated with the concept of whole sector development through housing, could not rise to that novel objective of sustainable housing in practise. This shows the inefficiency of policies in bringing concept into practise.
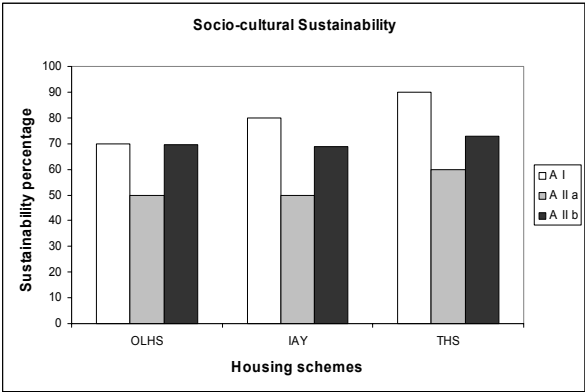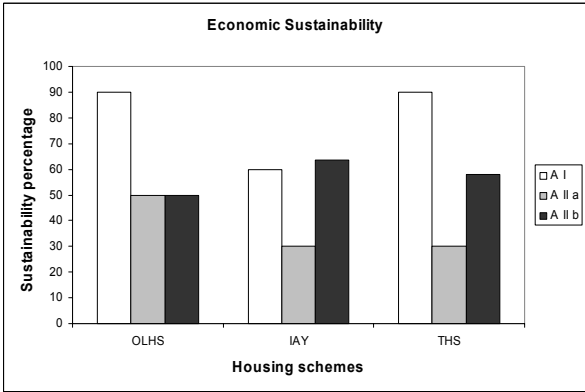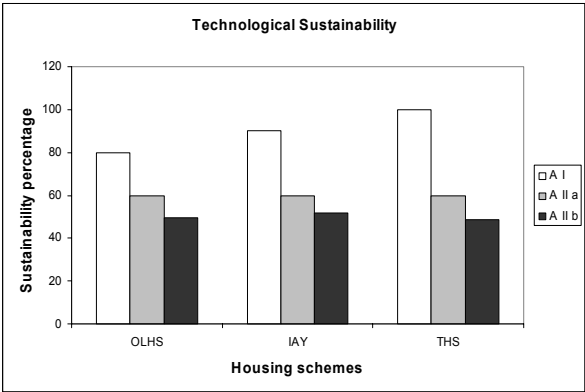

Fig. 4   (i)
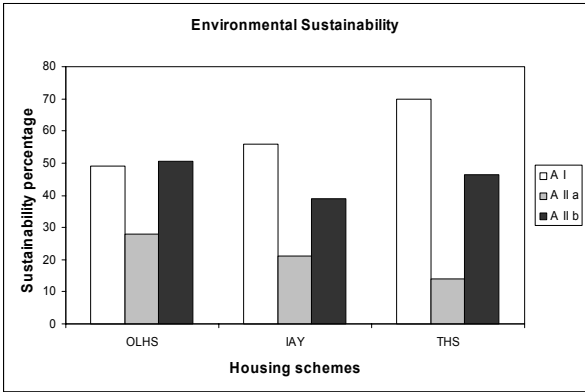

Fig. 4 (ii)

Fig. 4 (iii)

Fig. 4 (iv)

Fig. 4(i, ii, iii and iv) Comparison of different aspects of Sustainability between the housing schemes from the perspectives of Government and users

Based on these results, this study on the evaluation of public housing schemes in Kerala came to certain important conclusions such as:

- All the selected schemes have low values of sustainability and also there is no significant variation in the values between the schemes. This proves that irrespective of the different policies of Government, the representative schemes selected for evaluation from each phase of policy does not show much difference in the end results and all of them seem to have partially failed in achieving their goal of sustainable housing. Along with this mismatch in the perceptions of Government and beneficiaries on the concept of housing programmes were clear and contributed to the failure of programmes.

- The excessive importance of economic sustainability on comparing to the other sustainability aspects shows that total sustainability of the selected schemes has more dependence on the purchasing power or economic status of the households in providing housing over the policy initiatives of the Government. This shows the importance of affordability of the household as well as the inefficiency of policies in the selected schemes for achieving sustainable housing.
- Among the selected schemes, the socio cultural sustainability and technological sustainability do not show significant variations (AIIa and AIIb). This shows that, even though there were different policy approaches over the years (1970 to 2000) for housing the poor in Kerala, they performed in a conventional way in practise rather than their innovative approaches in the concepts especially in the case of socio cultural and technological aspects. And this verifies the need for proper implementation strategies.
- The least significance of environmental sustainability from both the perspective of Government and the beneficiary households is one of the main reasons for the development of slum like human settlements in the rural areas of Kerala.
- The evaluation of the public housing schemes in Kerala also indicates the need for affordable housing solutions with sustainable and feasible technological innovations.

The succeeding section will be the presenting the guidelines for selecting technological options and suggesting recommendations for technological sustainability in housing and affordable options.

4. SUSTAINABLE TECHNOLOGICAL OPTIONS

Traditional building technology in Kerala, based on locally available materials like wood, laterite, thatch and mud give way to the modern technology based on cement, steel and burned brick in a comparably short period of time ranging from thirty to fifty years. Even though the modern materials are more expensive than traditional materials, their easy availability and popularity made the technology more accessible and acceptable. The paradigm shift in the housing policy from a Public housing approach to one based on aided self help during the beginning of 1980's facilitated the introduction of cost effective technology in the housing sector of Kerala. Several non-governmental organizations sprung up in early 1980's with affordable technological options. Mr Laurie Baker, the well known British born architect, settled in Kerala, took the lead in this effort. Based on his principles, alternative technology (AT) initiatives and institutions like Centre of Science and Technology for Rural Development (COSTFORD) and Nirmithi Kendra came up in the eighties to save the poor from the exploitative tendencies of the intermediaries. All these initiatives in Kerala were based on the assumption of abundant supply of labour and availability of indigenous building materials. Their focus was to create maximum employment opportunities and to provide livelihood security to the poor by constructing their own houses. Government of Kerala supported the AT initiatives in the state through financial assistance and providing facilitative environments. But the Cost Effective and Environmentally Friendly (CEEF) technology innovations in Kerala could not gain that momentum and hardly make any changes in the building process, even though they had many affordable options, especially among the poor. The evaluation of the public housing schemes in Kerala shows that despite the continued efforts of CEEF technology institutions in Kerala, the dissemination of these technologies to those houseless people who are in need of affordable solutions has not been very successful. It clearly points towards the ignorance of beneficiaries and their difficulties in the accessibilities towards affordable technological options (Nair, D., et. al 2005). Hence a comprehensive analysis based on the various aspects of sustainability has been done for the selection of the

suitable technological options according to the requirements of Kerala. It points towards the need for affordable, environment friendly building materials suitable to the requirements of users. Also sustainable construction in Kerala demands minimum infrastructure, unskilled labour and accessibility to resources. It also demands innovations in renewable resources to make locally available materials sustainable.

The evaluation of the present building process in Kerala put forwards certain guidelines for the selection of sustainable technological options for affordable housing under each aspect of sustainability as follows.

(i) **Socio-cultural Factors** - Acceptance, awareness and feasibility of technological options can be considered as the basic criteria for socio cultural sustainability. The increasing popularity of certain CEEF technology alternatives (hollow or solid concrete blocks, pre cast door and window frames) shows the importance of decentralised production which enables self help or mutual help and improves the feasibility in sustainable constructions. The new alternatives should have the following specifications to support sustainable affordable housing in Kerala. They are:

- It should favour decentralised production with utilisation of local resources.
- Alternative technological options should be able to prove their advantages over prevailing options within a reasonable time period.

(ii) **Economic Considerations** - Technological options which demand minimum infrastructure, basic resources and unskilled labour requirements can improve the affordability of sustainable constructions. Hence the specifications for affordable technology in the context of Kerala can be grouped as:

- Utilization of locally available materials
- Technologies which demand minimum infrastructure, resources and know-how
- Unskilled labour requirements
- Less labour intensive

(iii) **Technological requirements** - Most of the prevailing technological alternatives in Kerala showed good results with regard to technological factors and the un-sustainability of the options were mainly due to other factors. At the same time, the evaluation agrees with the need for innovative technological options from renewable resources.

- Innovations and promotion of technology utilizing renewable resources

(iv) **Environmental considerations** – Similar to technological factors, environmental factors also demand universal specifications more than local criteria. The evaluation of the present building process in Kerala points towards the need for

- More locally produced environmentally friendly alternatives in the building process.
- Utilization of local waste materials
- Utilization of renewable and reusable materials
- Less energy intensive technology

4.1 Choice of sustainable technology options

The evaluation of the prevailing technological options in Kerala suggests the utilization of locally available renewable materials in the building process for both improving the affordability of technological options and making it sustainable (Nair, D., et. al 2006). From the analysis it became clear that laterite; the locally available material is the only present sustainable option for walling. A renewable building alternative from local resources as walling option can be a good choice for affordable housing. The significance of straw bale

construction (SB) comes in this respect. Especially in Kerala with more than fifty percent of population depending on agriculture, rice straw is available as a local waste in most of the places. Along with rice straw, rice husk is also a waste product from the paddy fields. The potential of rice husk ash (RHA) as a cement replacement material is excellent. RHA pozzolana can be suggested as an alternate option for cement in secondary building applications.

Why Straw bale and rice husk ash? Utilization of both SB and RHA in the building process will be more promising in another way if it can accelerate the paddy cultivation as it is an immediate necessity in Kerala. Declining paddy cultivation is a growing concern in the State as it results in many of the environmental problems. The area and production of rice which was steadily increasing till the mid seventies had to succumb to economic pressure due to the promotion of cash crops like rubber, banana, and tapioca and also due to the growth of construction sector. This resulted in the decline of more than half a million hectors of area under paddy cultivation during the last two decades (Government of Kerala, 2004). Conversion of paddy fields means abandoning a highly developed and complex wetland agro ecosystem and hence affecting the environmental balance. Long stretches of paddy fields are now kept barren or used for clay mining or developed as house plots in the State. This has created a lot of environmental problems in the neighbourhoods such as water logging, in adequate drainage facilities, non availability of drinking water etc. These factors also support the necessity of finding out more value added products from paddy fields other than rice to retain the environmental balance and protect the natural ecosystem.

Significance of Rice husk ash: A sustainable alternative to cement can provide a significant contribution towards the provision of low cost building materials and consequently to affordable shelter. Each tonne of Portland cement produced releases approximately the same quantity of carbon dioxide (Worrel et al. 2001). Building materials constitute more than half of the total construction cost for an average residential building in Kerala. A substantial part of this is the cost of cement. About 50% of the Portland cement used in building construction is consumed for secondary construction applications such as masonry and plastering. The strength requirements in such works are of the order of 4.0 MPa, while Portland cement is ideally suited for applications with strength requirements in excess of 15.0 MPa. It is also not adequately appreciated that pure Portland cement mortars are harsh and lack the plasticity that is very much needed in masonry construction. Lime-pozzolana cements can replace Portland cement in such secondary construction activities (Jagadish, K, S and Yogananda, M, R, 1988). Experimental research has conducted as part of this research to develop a sustainable affordable alternative from rice husk ash to replace cement for the secondary building applications.

Significance of Straw Bale construction
Significant savings in energy use- Straw bales as building materials enable a significant reduction in energy usage. It can be achieved in two areas such as (i) Energy used to make it available as a building material (embodied energy) and (ii) reducing residential energy consumption for either heating or cooling.
Ease and speed of construction- Compared to many other eco-friendly building techniques like, cob and rammed earth, SB is fast and easy. The main advantage is its lesser weight with regard to its larger unit size which allows rapid construction with minimum infrastructure. The finishing of the walls is labour intensive but much easier compared to cob and rammed earth techniques, it replacing.

Structural requirements- The lesser dead weight of straw bale walls compared to the other building techniques necessitates minimum footings only. At the same time they are strong enough to support roof structure without additional beams and posts. Stable straw bale walls are also safe against earth quake forces.

Better insulation properties giving comfortable interior environment- Straw bale wall is superior to most conventional building techniques in thermal insulation(R value 50), fire resistance (90 minutes) and sound insulation (55dA). The combination of the bale mass with plastering on both sides, create a very effective insulation giving good dynamic thermal behaviour.

As straw bale is a permeable material which permits the movement of air on both sides, the quality of air inside the room can be improved by keeping the air fresh. Also it is found that higher moisture retention in straw bale homes leads to a decrease in respiratory disease for residents (McRae 2000).

Unskilled labor - The essential techniques and knowledge required to build a straw bale house can be learned with in a short period of time, even for those who have no building experience. Owners through community workshops build most of the straw bale buildings.

Utilization of a waste material- A large drive for the emergence of SB building in 1980's in California was to avoid the large scale burning of waste rice straw causing environmental problems. For every tonne of grain harvested, about 1.35 tonnes of rice straw remain in the field (Kadam et al 2000). The search for alternative renewable building materials and the problems in waste straw disposal resulted in the current SB revolution.

Adaptability of design - The adaptability of a straw bale technology allows flexibility in design.

Affordability - SB building is equally affordable to all the sections people due to the easy availability of material and unskilled labour requirement.

Building with locally available, unprocessed materials especially wastes, significantly reduces the consumption of energy and secondary resources needed for extraction, processing, fabrication and transportation. SB and RHA are promising in this regard. In Kerala, straw and rice husk being abundantly available as agricultural residues. Promoting these two alternatives in building industry can certainly contribute towards realizing the dream of "shelter for all" and lead to sustainable future.

5. CONCLUSION

Sustainable- Affordable Housing from the user's perspective can be defined as one that is 'affordable' and 'accessible' to them to 'satisfy their housing needs'. The evaluation of the public housing schemes in Kerala advocates the importance of effective policies for making Sustainable housing accessible and affordable to the poor. The dissemination of technological innovations along with newer sustainable technological alternatives is also inevitable and contributes to affordable housing.

The further works remaining in this research is the formulation of region specific strategies based on the conclusions arrived from the analysis for realizing the goal of whole sector development through housing.

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