

## **Cost Effective Environment Friendly Technology in the context of Kerala Economy – A Conclusive Review**

Ham Singh O., ( Corresponding author )  
Department of Civil Engineering, Singhania University, Jhunjhunu, Rajasthan, India  
E mail – hamsingh@ymail.com

Dr. P.R.Sreemahadevan Pillai , Principal  
P.A Aziz College of Engineering and technology, Trivandrum, Kerala, India  
E mail – hamsingholiver@gmail.com

### **Abstract**

This paper deals with the conclusive review of Cost effective environment friendly technology in the context of Kerala economy. The study is carried out with respect to the cost minimization techniques adopted by various agencies in Kerala during the construction of the buildings. The findings of the study along with suggestions for effective propagation of Cost effective technology is formulated in this study with focus on guidelines for implementation of Cost effective technology and programs

### **1. Introduction**

The idea of cost effective construction was initiated by the technical experts of Costford. The appearance of Laurie Baker was undoubtedly a boon. Despite his inclination to European style Laurie Baker laid stress on the curtailment of funds earmarked for the construction of houses. He found that selection of appropriate building materials such as hollow blocks would help in minimising the expenditure of building construction.

Even though Cost ford introduced a cost effective method, the uniform pattern and homogeneous style of designs adopted gave it a monotonous outlook. Costford concentrated on the cost without any botheration of varieties, novelties specialization and fashions.

The effective use of mud is one of the special features of Cost effective technology. This development and rejuvenation of mud architecture is a sustainable solution to the burning problem of housing. This new method which is environmentally sound and energy efficient is highly labour intensive and generates opportunities for employment. Mud is cheap readily available and provides excellent heat insulation by keeping the inside portion of the house cooler in summer season and hotter in winter, in contrast with the usage of steel and concrete. Moreover it is strong when compressed and makes good walls. Nirmithi Kendra offers well designed technology options. The priorities are fixed to fulfill the need in a cost effective manner.

Cost effective technology brings down the over all cost by adopting appropriate house construction techniques. The consumption of costly materials like cement can be limited by adopting innovative designs. The buildings are designed to adore the land profile, thus optimizing the cut and fill involved. Cost effective technology considers the climatic condition in the area and it means that there should be variation in the application of technology and materials prescribed for the economy.. The need for reinforced lintels are totally avoided by the effective use of arches and corbels. Country burnt bricks, sun dried bricks and stabilized mud blocks are such good enough building materials.

Maximum utility with minimum expenditure is the accepted slogan of Cost effective technology. As long as the pioneers fail to adopt appropriate measures for creating any equilibrium in the economic condition in Kerala, it will be absurd to exaggerate our conviction on a cost effective technology.

## 2. Suggestions to improve Cost Effective Technology

Certain guidelines to be formulated from the higher level and conditions to be imposed with the ulterior intention of making dwelling apartments smaller and smaller as per the size of the family. The tax imposed on small size houses should be minimum and affordable. The government should impose rate of taxes on the basis of size of the house. The tax rate should be doubled when the Plinth area is also enlarged. Similarly the Government should fix the maximum size of houses and if there is pressing demand for getting sanction of a house with the proposed Plinth area exceeding the maximum area permitted, Government. should impose additional/ extra super tax or luxury tax.

## 3. Conclusive Review of the Study

The entire research work has targeted at a novel conviction of creating channels in abundant numbers throughout a vast area after ensuring the lowest possible cost and maximum possible convenience. After an elaborate study it can be wisely concluded that the low cost housing concept can be properly implemented by concentrating on two dimensions.

- 1) The structural aspects and the auxiliary ingredients
- 2) Sourcing of various materials, easy availability and cost effectiveness.

Another significant aspect derived at is selection of materials without any contradictory counter parts. Similarly the maintenance of aesthetic equilibrium is inevitable because a state where the majority of population is academically and other wise educated will not be prepared to yield to any design imposed upon them. Besides the research work has concluded with gratitude to the service rendered by the popular medias in Kerala in addition to large volumes of books published by different agencies like Nirmithi Kendra, Cost ford, Sanker's habitat, regular news papers magazines and weekly which could appreciate the taste of public for low cost houses.

It is apparent from the statistical data that major share of consumer and admirers of Low cost housing belongs to the middle class economic strata in lieu of the poor and down trodden sector of the public. It is quite amazing to note that there is a favorable move even from the higher section of upper middle class people and dignitaries of the society who are financially sound. It means that the whole programme scheduled and challenged out in Kerala for the wide popularity of Low Cost housing were not intended exclusively for minimizing the space and area of the houses but also for using several materials on the basis of its costs. In a nut shell a new idea has come to effect. The slogan becomes ' more convenience and maximum fascination with minimum expenditure'.

Another appreciable lesson is to minimize the area for the construction of housing and utilization of balance area for may positive purposes. There is a new trend in many areas even in the urban sector to make use of the upper roofing of terraces for laying out kitchen gardens.

The concept of housing includes the preconceptions of furniture and other equipments. Formerly it was all done subsequently without any adequate measures. But now a days we give much emphasis not only to the location of the building and the availability of water but each and every item to be furnished inside after the completion of the construction work. . The project should calculate the expenditure in detail at time of preparation of the blue print or plan.

The site plan is prepared perfectly in common with the profile of the land that is the length and width of the area. Necessary modification will have to be made. There should be proper utilization of space, including the design of interiors in the building. Costly wood for joinery, should be avoided. Wooden pillars could be replaced with cement pillars by constructing with 1/5<sup>th</sup> of the expenditure, at the same time maintaining the aesthetic appeal of the wooden pillar.

The Research scholar has found that a detailed study of additional fittings or extra fittings is to be worked out with a view of saving the space and minimizing the expenditure. Even though seemingly insignificant many additional fittings can be installed underneath sofa cum beds and cots. There is no need for extra space for books shelves, soap and mirror stands prevailing. There is the facility of metal strings, screw and steel parts which can be projected out by pronging and can be restored back by bending. These extra fittings in fact avoid many levels of expenditure. Cloth hangers can be fixed behind the bedroom doors. Bags and baskets to place fresh dress, stale dress and valuable pieces of papers can be arranged likewise. If it is applied in the kitchen, the use of wasted steel bars can be made for waste paper, baskets etc.

Proper guidance is required for fixing the entrance points in rooms by doors. It is wise to arrange all the doors in the same direction. Similarly the doors of the bedrooms and bathroom should not be permitted to overlap. It may reduce the facilities of bedroom and bathroom. It may reduce the space of the bedroom. When we consider the maximum and proper utilization of the space of the room, it is better to go after the arguments of fixing of doors in the corners.

There is a general trend to give instructions to have bath attached rooms. The research scholar examined thoroughly the specimen of many houses and learnt that attached bathroom for all the five or more bedrooms are not at all essential. The research scholar now ventures to observe that a general bathroom as was a practice in the earlier period is enough for a house. A building designed with less number of bathrooms constructed inside, would minimize the cost of the building.

In many houses an additional space is provided for an porch. Sometimes it may cover an area exceeding 225 sq.ft. It is pertinent to note that the car porch requires a terrace above and it involves a waste of money. This is being done only with the hope of parking the vehicle in the event of purchasing the same. It is also a waste of expenditure. This eats away the budget of funds allocated for many essential expenditures to be incurred towards plastering, polishing, flooring and other miscellaneous items. This area could be diverted to other beneficial purposes like courtyard, flower gardens and vegetable gardens.

Similarity a through recasting of convictions can be applied regarding this planning. For a terrace of the roof portion, coconut leaves are substituted by tiles. The raw material for tiles is clay and as such there is direct application of natural objects. The introduction of tiles enable numerous families to give up the unnecessary and recurring expenditure of frequent replacing the coconut palm leaves. It gives grace and beauty and the external appearance can be altered. The agrarian concept of rural atmosphere with dried cow dung paste on the floor mixed with black charcoal had undoubtedly a Keralite heritage appearance.

The remodeling of roofs with cement, metal and steel turned out to be an unwanted advent especially in Kerala. It is absolutely in contrast with the climatic condition available in Kerala also. Clay tiles can withstand all the climatic conditions. It won't expand or shrink as the iron and steel. Even if one or two tiles are damaged or broken, the same can be replaced and repaired with minimum expenditure.

In fact the architects and contractors, may look for the propogation of country wood / locally available woods in place of costly woods like Teak, Mahogany. of the building might have preferred concreting on the roof due to the non availability of wood. These locally available woods treated with chemicals, varnished and polished would not only give the appearance of costly woods, but also reduces the building costs.

New fashions, beauty and conveniences can be maintained and introduced without additional expenditure. Cattle breeding is not a profitable business now a days. At the same time cow dung is not available for bio-fertilizers. Beautiful tiles can be manufactured with cow dung and milk and this may induce many unemployed persons in Kerala to start cattle breeding in large scale. The vanished grace may come back and scope for small scale industry will soar simultaneously.

The thickness of the concrete can be reduced by adopting sloping roof designs, ensuring proper drainage of rain water and thereby preventing leakage. The concept of low cost housing carries the ideology of cultivating a trend in human souls that the abodes are mere shelters from rain, mist, wind and heat.

The excess plot area available could be set aside for various purposes like kitchen garden, poultry farming and even cattle breeding. A part of the plot can be sold in emergency which would enable to bring in additional funds for the construction of the building, since the value of land is always on the increasing trend.

Work area store rooms are adjacent items of kitchen, which may not be compulsory. Bricks can be used along with Ferro cement slabs and doors with cheap wood or other soft woods. Readymade racks are available to keep the dishes and bottles on the wall. If sufficient storage is ensured inside the kitchen itself, there is no necessity for the additional store room. The area conceived for the store can be attached to the kitchen and thereby the space of kitchen can be expanded. A spacious store room is not only a luxury, especially for the nuclear families.

An open space on the terrace is beneficial on the basis of hygienic grounds. The Research scholar is convinced that ventilation especially in town areas is a grave issue. Smokeless Cholas are preferable in work area or kitchen. Another significant fact noted is the utilization of space for the staircase. However the staircase should be constructed with a provision for keeping sewing machines or used for placing, television or music systems. for fixing wash business etc thus optimizing the design of the space

In the present context democratic architecture should be the one that is easily accessible for the ordinary people. There lies the prominence of low cost housing. Scattered huts which were the symbols of feudalism have already vanished along with the past. The vasthu architecture in Kerala is being blamed as a kind of restoration of the classic styles. There is a deliberate attempt to alter the structural designs and aspects of construction to that of ancient times. There was a natural and cheapest style of construction in Kerala, which was based on tiles, hay, wood, bricks, sand etc. These materials were locally available in Kerala, and can withstand the climatic conditions of Kerala. The tendency among the socially backward classes of Kerala is to construct houses by imitating the design styles of the upper class sections of the society, which is very harmful. Such decorations can be used for public places and buildings. It is futile to construct pillars as seen in the old fashioned homes. The theory of utility should be practically put into effect. Then we will become aware of the fact that the pillars and charupady are only certain symbolic of bygone days. There is a great influence of Persian and Gulf countries in Kerala architecture. The Pravasis which is the apt word to the gulf returned people have created an unwanted trend based on affluence. We have to formulate plans successfully and make original blue prints only in accordance with the availability of funds. The Pravasi trend of investing huge amount only for residential houses also is not equally acceptable. These too apparent facts made the Research scholar, to propagate Low Cost Housing scheme for the middle class Keralites as well as for upper class sections. Even the people living below the poverty line, also can venture to own their house by using available technology. This 'Home for all' campaign through out kerala has naturally created a feeling of security.

A superstition feature has crept in the view and out look of Kerala people. They observe certain styles only to console their vanities by having wooden charrupady and even a Nadumuttam. They are not prepared to complete the construction with an ordinary flooring or painting. The laying of Mosaic flooring has become obsolete. Ceramic tiles, vitrified tiles, granites, marbles and marbonites are in demand from various sections of the society. In certain areas, the latest trend is to make wooden flooring completely or partially. In such a context the economy of building materials which is a significant factor of Low Cost Housing is to be evaluated to a full extent.

The cost spent for furnishing could be cut down to the minimum One of the notable defects that dissuades the beneficiaries from relying on the Low Cost Housing is its so called weak appearance.

Another method of minimizing the cost by the usage of antique materials, decoration and cornices dismantled from the age old buildings. Those articles can be fixed at suitable locations as per the aesthetic design, which would give a facelift to the building and at the same avoiding unwanted fixtures such as charupadi or marathoonu made of cement concrete and slabs.

The application of Ferrocement in shelves and stands, would replace the conventional concrete slabs and thereby reducing the cost of construction by 30%.

It is essential to convene conferences on the subjects giving opportunity to such persons seeking recognition for the contribution to Cost Effective Technology. The Research scholar prefers to conduct a new housing policy to be evolved and accepted ultimately after high level discussion and dialogue.

The low cost housing designs adopted by Architects Eapen George and Anil Joseph are called E3 houses (Economical, Everlasting and Earthquake resistant), wherein the economic savings of houses amounts to 25% whereas 38% of savings can be expected when flats are constructed with the technology.

The roof of E3 house was made of Funicular shells and pre-studded beams. While the expected period of conventional house is 60-70 years, E3 apartments ensured the durability of about 150 years. According to the report by SERC Chennai these E3 houses have the capacity to withstand any type of earthquake occurring in India. Their technology has introduced vast changes in the roofing as well as in the foundation. The weight of the Centre structure of these pre-studded beams was used for the Construction of bridges formerly. The height of such a beam is only 10 cm, while the breadth is below 8 cm. It will be only 2½ cms at the top. Two steel rods are used in the upper levels and three high carbon Steels are inserted to pre-empt the white ant attack.

The deep perusal of graphic data of reliable experiments enabled the Research scholar to derive at certain conclusions with acceptable suggestion with the ulterior objective of making the project precise and perfect. The Low Cost Housing still seems to be far away from its achievement throughout Kerala.

A Question immediately creeps up as to why there is no deliberate instruction for the use of locally available building materials for the Construction of houses. A comparative study discloses that huge palace like buildings, mansions and ordinary houses have demonstrated that there are variations in the form of model of such houses.

#### **4. Findings**

There is no harmony between theory and practice in many of the activities associated with Low Cost Technology. Practical knowledge is highly required to implement any theoretical aspects. The Research Scholar laboriously remarked many of the scattered realities dominating over the imagination of an average Keralite in the contemporary firmament. Accordingly it has been revealed that there is a mad and wild pursuit behind many novel ideas. The statistics and reliable data with graphic representation and models have established another fact that in spite of boundless restrictions, a tendency that has gradually developed especially during the last decade to minimise the expenditure set apart for the construction of house. They are willing to forego their earlier inclination for luxurious apartments on the ground of twin aspects.

1. The possibility of diverting the funds for certain other reliable and profitable investment or productive purposes.
2. The new awareness of the knowledge acquired by them regarding the aesthetic senses.

A pertinent positive aspect that the Research scholar points out is the uniformity and the homogenous appearance of the newly constructed Low Cost Houses. Apparently a lofty principle of socio-economic quality can be perceived in these identical structures. Nirmithi Kendra could create a new slogan by adding environmental friendly technology as a suffix to cost effective technology. The practical experience acquired by the officials and organizations of Nirmithi Kendras have concrete proposals to put forth.

A profound influence of the Low Cost Construction activities of Nirmithi Kendra is viable in the Kerala economy.

## 5. Suggestions

Drastic and bold steps only can save the visible income about the problem of population. An apparent suggestion of the research scholar sprouted from the research oriented study of the subject is that the government should further reduce the existing rate of Plinth Area of individual houses as well as other residential quarters with a view of minimizing the expenditure and reducing the per capital expenditure involved in the affair. The nuclear families consisting of 3 or 4 member require a minimum area for their dwelling purpose. Hence the ordinary house or the concept of dwelling her become mere places for dining and sleeping. There is no need of a house with Plinth area of 2000 sq.ft for such a tiny family. They can never afford the total expenditure incurred for the construction as well as its maintenance. A general awareness program should also be there to convince the people of the need of a convenient but small house.

Another significant suggestion of the Research Scholar is the inclusion of both theoretical and practical aspects of the Low Cost Housing construction technology in the curricular by education institutions.

The Research scholar accepted a new concept of ensuring participation of the beneficiaries in the process of construction. The family members themselves can participate in the construction of their own house. It will reduce the expenditure for the construction also. Interlocking system is purely a novel idea and it will reduce the quantity of cement consumed. A varnish coating is sufficient to make them more durable and save them from getting damaged. Another important suggestion of the Research Scholar is that the beneficiary should be prepared to make use of only two closing doors, one in front of the house and another in the rear. All other doors inside are decorative and unwanted doors and windows should be avoided, which will minimize the cost.

## 6. Recommendations for propagation of Cost Effective Technologies

- Educate the beneficiaries on the different cost effective materials and techniques. Listing of options showing the cost of construction using different materials and construction techniques
- There must be involvement of voluntary agencies (with/without technical expertise) in the mass housing schemes to monitor the different stages of construction, especially the construction of plinth, giving guidance in the selection of appropriate materials and technology.
- There is shortage in the availability of conventional building materials in many places the economy in order to be obtained by the use of appropriate cost effective construction techniques, which will make use of locally available materials and labour.
- Use of local building materials in maximum extent possible can bring about cost effectiveness. s.

## 7. Guidelines for implementation of Cost Effective Technologies

### 7.1 Design

1. Design of houses must be with expansion possibility and must ensure light and ventilation even after the expansion is made.
2. The units must have minimum number of habitable rooms and temporary service rooms.
3. Avoid unwanted decorative work.
4. Wherever possible the house must be designed so that the minimum number of costly conventional elements used in the design.



### **7.2 Materials**

1. Maximize the use of locally available building material to complete the construction of houses within the limited resources.
2. Option table must be prepared at market rate with different material combinations and must be shown to the beneficiaries.

### **7.3 Technologies**

1. Cost effective technology must be employed in mass housing schemes for the people below poverty line.
2. Techniques must ensure beneficiary participation on self-help basis for construction, maintenance and also in future expansion.
3. The beneficiaries must consult and seek help from NGO's for the construction of houses by using cost-effective techniques and appropriate usage of alternative materials.

### **8. Suggestions for implementation of Cost Effective Technology programmes**

1. Voluntary agencies must offer technical guidance in procuring materials, restricting plinth areas, monitoring and giving guidelines in the selection of materials and technology.
2. The technical expertise of agencies like Nirmithi Kendra, Costford, Hudco etc. must be utilized in promoting the use of cost effective technologies for the housing of people below poverty line.
3. Prior to such schemes, the rural labourers may be given training in cost-effective technologies so as to create a pool of skilled labourers for the successful implementation of such schemes.

### **9. Conclusion**

After a detailed analysis of the pros and cons of the application/ economy of cost effective technologies of low cost housing in Kerala, a study with special emphasis on the impact/ propagation in the Kerala scenario, the Research scholar feels it well and good to conclude that the Kerala Economy with all its limitations and facilities is indebted to the different projects relating to low cost construction of dwelling houses.

It is clear from the survey beneficiaries had gone in for implementation of cost effective technique in various government sponsored programmes at least partially. Of the 246 houses surveyed only 85 units had opted for cost reduction techniques. The average saving in the cost of construction per such unit in each zones like coastal area, mid land area and high land area were 20-25%, when compared to conventional techniques.

Hence it could be concluded that if almost all houses under the Government sponsored and self introduced programmes, adopt cost reduction techniques, involving NGO's there might have been savings of about 20 to 30% in the total expenditure.

From the analysis, it can be understood that, the people had a lack of awareness of cost reduction techniques and alternative building materials. So the voluntary agencies must involve in a greater way in mass housing schemes to strictly monitor the different stages of work, to make the beneficiaries aware of the cost reduction techniques, giving guidance in the selection of materials and techniques and collective procurement of building materials.

## References

7. C.S. Vargheese (2000) – “ Graha Nirmathiyil, Ariyenda Karyangal” *Vidhyarthi Mihtram publishers.*
8. Chandrarasekharan C(1975). : “Wood use in kerala and its implications on forest land use and development” *Kerala Forest Research institute Trivandrum .*
9. Dr. Anantha Bose IAS (2002)
  - Housing in Society Kerala
  - Chemistry of Building material
  - Glimpses of Architecture
10. Dr. Achuthan, Vincent Paul & Balagopal(2002) – is “Ninglkoru Veedu” (Malayalam)  
publishing house.
11. Laurie Baker(2002) - Mud, Bricks work, Common buildings
12. Laurie Baker (2001) - Schools,Hospitals
7. Appropriate technology for low- cost housing, *A.G. Madhava Rao & D.S. Ramachandra Murthy*
8. Cost effective technology for the 21<sup>st</sup> century. *Nirmithi National Institute of habitant management.*
9. Laurie Baker( 2002) , “Houses - How to reduce Building costs," *Costford*
10. G.C. Mathur (2001) Low cost housing in developing countries
11. M.B.Achwal (2003) Laurie Baker the Master craftsman



This academic article was published by The International Institute for Science, Technology and Education (IISTE). The IISTE is a pioneer in the Open Access Publishing service based in the U.S. and Europe. The aim of the institute is Accelerating Global Knowledge Sharing.

More information about the publisher can be found in the IISTE's homepage:

<http://www.iiste.org>

The IISTE is currently hosting more than 30 peer-reviewed academic journals and collaborating with academic institutions around the world. **Prospective authors of IISTE journals can find the submission instruction on the following page:**

<http://www.iiste.org/Journals/>

The IISTE editorial team promises to review and publish all the qualified submissions in a fast manner. All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Printed version of the journals is also available upon request of readers and authors.

### **IISTE Knowledge Sharing Partners**

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digital Library, NewJour, Google Scholar

