



## Roundtable Consultations: “Developing Appropriate Strategies for Resilient Housing”

Developing appropriate Technologies and Strategies for Housing in Hilly Terrains  
15 December 2018, Kozhikode  
Living with Water-: Developing Appropriate strategies for housing in Kuttanadu  
17 December 2018, Thiruvananthapuram

### Background

Between June 1 and August 18, 2018, Kerala experienced the worst ever floods in its history since 1924. During this period, the State received cumulative rainfall that was 42% in excess of the normal average. During 15-17 August, some areas received 3000 to 4000 mm of rain. The torrential rains triggered several landslides and forced the release of excess water from 37 dams across the State, adding to the impact of floods. According to latest reports by the Government of Kerala, 1,259 out of 1,664 villages spread across its 14 districts were affected. Seven districts were worst hit: Alappuzha, Ernakulam, Idukki, Kottayam, Pathanamthitta, Thrissur and Wayanad-where the whole district was notified as flood affected. The devastating floods and landslides have affected 5.4 million people, displaced 1.4 million people, and taken 433 lives (22 May – 29 August 2018). The following table gives district-wise loss and damage of houses in various districts of Kerala:

District Name	Complete loss of Land & Buildings	Complete loss of buildings	Building damage >75% - needs rebuilding	Total no of buildings to be reconstructed	Partial damaged buildings with conc roof	Partial damaged buildings with non-conc roof	No of HHs who lost HH goods	Total no of buildings affected by flood/landslide
Thiruvananthapuram	7	374	31	412	745	3,575	1,675	4,732
Kollam	11	321	38	370	956	5,072	1,809	6,398
Pathanamthitta	28	856	118	1,002	10,143	23,463	10,877	34,608
Alappuzha	128	1,653	114	1,895	21,054	57,000	21,497	79,949
Kottayam	18	566	128	712	7,007	25,785	8,999	33,504
Idukki	259	1,530	83	1,872	2,019	11,229	6,150	15,120
Ernakulam	153	2,523	293	2,969	73,866	97,538	35,488	174,373
Thrissur	66	3,610	369	4,045	12,286	28,530	16,044	44,861
Palakkad	70	1,622	127	1,819	1,282	11,226	5,730	14,327
Malappuram	49	679	59	787	3,332	10,354	3,831	14,473
Kozhikode	27	314	42	383	2,784	7,126	2,756	10,293
Wayanad	116	629	68	813	3,356	10,444	3,760	14,613
Kannur	13	147	19	179	347	2,765	926	3,291
Kasaragod	2	53	3	58	33	517	223	608
<b>Total</b>	<b>947</b>	<b>14,877</b>	<b>1,492</b>	<b>17,316</b>	<b>139,210</b>	<b>294,624</b>	<b>119,765</b>	<b>451,150</b>

The June–August 2018 disaster caused damage to the housing sector both due to flooding and landslides. Flood damage was caused mainly by the impact of water, especially near rivers, canals etc., the scouring of foundations, the settlement of soil, and also due to inundation for several days. Houses in low-lying areas with low plinth heights were affected by water damage the most, while in the same areas, houses with high plinths and with disaster-resistant features such as plinth and lintel bands were not affected as much.

Many houses were completely destroyed in landslides, mostly in Idukki, Wyanad and some other districts. Almost all these houses were located on mountain slopes that were unstable and would have suffered a similar fate regardless of building typology or technology used for construction. The remains of many of these houses may never be found as the huge landslides swept houses across roads and into the rivers in spate below.

In some places, houses were affected by subsidence and suffered due to differential settlement of the foundation. Subsidence happened in areas with a thick layer of mud, perhaps located on the remains of old landslides. Siting buildings on such slopes could have been avoided had there been regulations that mandated geologic inspection before excavation and construction on such slopes, and if the services of a Geologist had been available.

Many buildings in the flooded areas were either damaged or collapsed because they were constructed without adequate disaster-resistant features such as plinth and lintel bands, as recommended in the NBC. The lack of horizontal bands to hold the walls together resulted in wall collapses, eventually leading to damage to the roof and further collapse. In general, the foundations were in random rubble (RR) in cement mortar; and many of these had inadequate depth, resulting in scouring of the foundation and damage to the walls.

### **Current Status of shelter reconstruction:**

The assessment criteria to estimate the extent of damages to houses is as follows:

1. 15%- Upto 50cms of Water invaded the house or roof tiles have been damaged to some extent
2. 16 – 29% - Damages to the floor or 25% of the roof tiles damaged with damages to electric wiring, plumbing
3. 30- 59 %- Flooding upto lintel level with damages to the windows, doors and walls or more than 50% of the roof tiles damaged with no damages to the structure
4. 60 – 74%- One or more walls fully damaged, or roof tiles lost with no damages to the structure
5. >75% - fully damaged

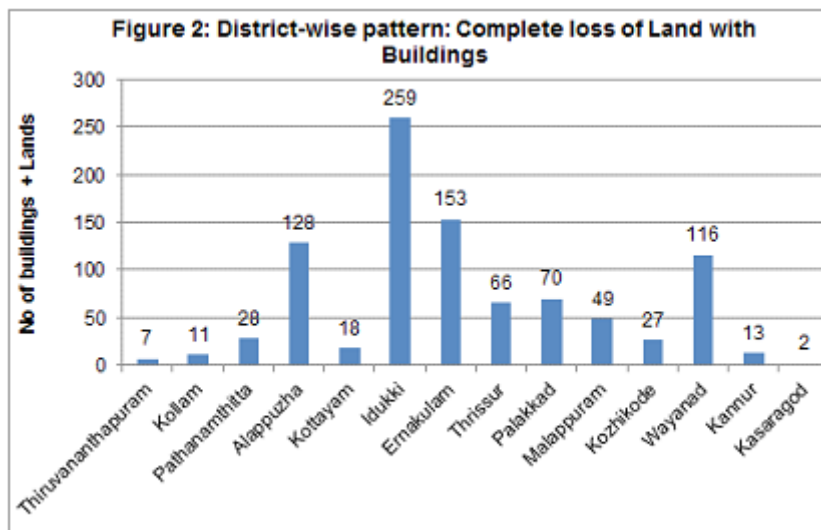
The current policy for the reconstruction of housing is as follows:

- a. Government will pay Rs 4,00,000 for a fully damaged house and parts of this based on the level of damage to people who have documents to prove ownership, have not lost their land and in-situ reconstruction is deemed safe. For people who have lost their land, GoK will either identify alternate land or give Rs. 6,00,000/- for relocation.
- b. People can choose the options of reconstructing on their own or through GoK guidance/ support.
- c. Those who opt to reconstruct on their own will be paid the compensation amount of Rs 4,00,00/- in three instalments based on the progress in construction, which will be verified by the designated officers from the Collectorate.
- d. Those who opt for GoK guidance will have to wait till the GoK assigns the responsibility to their select NGOs/ Corporates/ Donors

GoK has come up with a novel idea of crowd sourcing by putting up the names of the beneficiaries on public domain and inviting sponsors to finance one or more houses. Apart from this, GoK is also supported by Corporate Social Responsibility (CSR) from large and small companies and Industry associations.

GoK has requested all districts to immediately convene Block level meetings of the affected families for deciding on the reconstruction modality. LIFE Mission will also display their 12 models during this meeting. Those families who choose Owner Driven Reconstruction (ODR) can sign the necessary papers and provide official documents like title deed etc for receiving the first instalment of reconstruction funds. Those who need the GoK support for construction, will choose from the approved models and inform the authorities with the relevant documentation.

While everyone acknowledges that ecologically friendly houses are the best option, the need for speed and the lack of adequate local material is pushing the authorities to consider faster solutions. As part of the normal development agenda of the LIFE mission, 2 lakh houses have to be constructed every year for the homeless and Pre-fab is an option being considered by the Government. Various pros and cons of different modalities are still being discussed. GoK had also requested UNRCO to help identify international companies who would be able to deliver top quality prefab houses. No single agency or approach has been finalised.



Source: Rebuild Kerala mobile app., data accessed on 4 October 2018

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*In hilly districts, the majority of the damage to houses was caused by 'Shallow Landslides'. These occur when the hillside soil is saturated Kerala Floods and Landslides 97 due to continuous rainfall. The lost buildings were buried by saturated soil or in some cases slipped over a distance of up to 20 meters to a lower position. Other factors that make the area landslide prone include: (i) the steepness of the slope (>45 degree); and, (ii) the cutting of slopes for buildings or roads. Many of the landslides that occurred during the first two weeks of August 2018 brought down a considerable portion of the mountainside. However, these slides will continue to creep upslope as the precipitation and instability of the slopes continue.*

*Houses located near the side and top margins of the landslide are likely to be affected if the rainfall persists. These slopes need to be examined by geologists and communities relocated, if warranted. In general, constructions along the unstable slopes have to be regulated with the help of landslide hazard zonation maps of at least 1:5000 scale. Hillside constructions are very different from constructions on the plains and separate regulations must apply for hilly localities. Guidance materials should be developed for hillside constructions, as there is inadequate guidance even in the NBC for such constructions*

*PDNA Report*

*Some of the settlements in Kuttanad are below the mean sea level (msl), and though low-level flooding occurs almost every year, many houses have been built with very little plinth heights. In these flood-prone areas some buildings on stilts were not damaged, while others set on low plinths and inadequate depth of foundations were severely damaged. The conditions for construction of buildings in Kuttanad are very different from other parts of the state and building regulations must reflect this.*

*PDNA Report*

## **Challenges:**

Post-disaster shelter reconstruction in Kerala is highly challenging given the divergent geo-morphology of the areas that have faced widespread damages. Idukki and Wayanad, extensively covered by rugged mountains and dense forests, were badly affected during the last floods and landslides. Kuttanad, the rice bowl of Kerala, being land reclaimed from Vembanad Kayal, and below mean sea level, flooding is not a new phenomenon but during the last rains 828 houses were completely and 27104 houses partially damaged. With both homes and livelihoods under constant threat by the changing climatic conditions in this region, there is an urgent need to develop a culture of safety through risk informed planning and development.

- 1. Non-availability of local material for mass construction:** Kerala is becoming heavily dependent on the neighbouring states for construction material such as sand and bricks. While alternate construction material like laterite is available in northern Kerala, if used for mass construction it will result in quick depletion. Red earth can be used for rammed earth construction but even this is not available in adequate quantities everywhere. These alternatives may not be best suited for flood prone or water logged areas. There is a fast emerging need to explore alternate, cost-effective and ecologically friendly construction material.
- 1. Difficulty in identifying adequate land for relocation:** Given the nuclear pattern of housing unlike the cluster formation seen in other states, there is a progressive shortage of safe land for housing. Finding adequate land for relocating affected families is a major challenge, especially in Kuttanad and hilly terrains such as Wayanad and Idukki.
- 2. Appropriate Designs:** The design, typology and construction material used determine the overall weight of the building. The load bearing capacity of the soil, proximity to water canals, type of vegetation, are all factors that have to be considered while designing for houses on slopes. This may be beyond the assessment capacities or technical/scientific expertise available at the field level. In some areas, lack of trained expert advice has led to a complete embargo on the construction of houses, delaying the completion of work-in-progress. While “avoiding water” through creating artificial barriers (artificial elevation of land for housing, high plinth, retention walls) has been the common approach followed in flood vulnerable or water logged areas like Kuttanad, it has been recommended that the inhabitants learn to “live with water”. Designs that promote this concept have to be explored, adapted to the socio-cultural context, keeping in mind the aspirations of the people. Houses on stilts, or entire habitation (including schools, shops and health centres) on stilts, are alternate options that can be explored.
- 3. Growing threats of subsidence due to piping effect:** Many cases of subsidence are being increasingly reported from the hilly areas and this was found to be due to a new phenomenon, “piping”. This is a sub-surface phenomenon and hard to detect before construction. However, this threat needs to be acknowledged and solutions suggested either in land siting, typology of housing or even material selection for construction. The communities need to be made aware of this threat and possible mitigating solutions.
- 4. RCC construction and socio-cultural predisposition:** RCC construction is being increasingly accepted as an indication of upward social mobility. Traditional housing material or designs that were eco-friendly are not currently popular and most people prefer RCC construction as is seen across many disasters in many states.
- 5. In-situ vs relocation:** As per the Indian Coastal Zone Regulative Management Act (ICZRM), constructions are not allowed within 500 mtrs of the HTL or 200 mtrs from the river banks. Kuttanad region is close to the Vembanad lake and is also criss-crossed with irrigation canals. The impact of ICZRM on shelter construction in Kuttanad, the experiential learnings of the vulnerabilities, the livelihoods of the inhabitants which are intrinsically related to the aspect of water logging, are all aspects that require to be studied before developing guidelines for land use and shelter reconstruction. There have been suggestions from some officials on exploring a total relocation of people from the slopes to flat land at the foothills, in cluster type housing to be provided by the Government. This may affect the livelihoods and access to services and the communities may not be willing to give up their family land. If they choose not to relocate, then GoK will have to explore other forms of slope protection and stabilisation which is not only expensive but also time consuming.
- 6. ODR vs contractor driven construction:** After GoK announced its approach to post-flood reconstruction, more than 6000 affected families have opted for self-driven reconstruction (Owner Driven). Substantial numbers will also be taken up by civil society organisations or under CSRs. Most families have started repairs on their own as they would like to move out of the relief camps. Although ODR is the most preferred approach from an ecological point of view, lack of skills,

resources, knowledge or time may lead to larger numbers being handled through a contractor driven approach. Either way, there is a need to ensure that the reconstruction/repairs also look at incorporating risk reduction features. The owners need to be aware of the principles and methods of multi-hazard resilient construction.

- 7. Availability of skilled construction workers for multi-hazard resilient construction:** Situated on the west coast of India, Kerala had been relatively safe from cyclones, strong winds or any such natural hazards. Hence, there had been no need for hazard resilient construction practices. Both owners and construction workers have to be sensitised to and trained on multi-hazard resilient construction.
- 8. Sanitation, Waste treatment and management:** Solid and liquid waste management is another challenge that water logged areas face. While there have been models like ecosan toilets, dry composting etc., none of them have been accepted as a viable solution or even a package of solutions that can be insisted upon as a part of the general building rules.

The conventional mass housing models may not be appropriate enough for the conditions that exist in Kuttanad and in hilly terrains like Idukki and Wyanad. There is a need for exploring/ designing other models that are better suited not just for the present but also taking into consideration more such events that may be dangerous for their lives, homes and livelihoods.

### **Round Table Consultations:**

It is in this backdrop that the Govt of Kerala with support of UNDP organized Round Table Consultations for ideas on Housing in hilly areas that are prone to landslides on 15 December 2018 in Kozhikode and for ideas on Housing for Water logged/Flood prone areas on 17 December 2018 in Thiruvananthapuram. The round table consultations had the following objectives:

- Recommend considerations for appropriate technologies, designs and materials for construction of resilient houses in hilly terrains and in flood prone/water logged areas.
- Share good practices in overcoming the challenges of relocation in the above terrains.
- Suggest adaptable good practices for building resilience in housing

### **Participants:**

Approximately 50 participants were expected to attend the roundtable. The participants would be:

1. Experts in post-disaster reconstruction in landslide and flood prone areas
2. Collector/s and elected representatives of the affected districts
3. Policy makers and planners involved in Rebuild Kerala reconstruction
4. Civil society organisations and community representatives

## WORKSHOP REPORTS

### **ROUND TABLE 1 - Developing Appropriate Technologies and Strategies for Housing in Hilly Terrains held in Calicut on 15 December 2018.**

The Round Table on Developing Appropriate Technologies and Strategies for Housing in Hilly terrains was attended by the concerned government officials and representatives of NGOs from the landslide affected districts of Idukki and Wayanad.

Smt Annie George, State Co-Ordinator, UNDP, in her opening remarks briefed the objectives of the Round Table. Shri Manish Mohandas, Project Co-ordinator, (Resilience), UNDP, New Delhi, welcomed the participants and pointed out that the scientific and democratic approach taken by the Government especially the Disaster Management Department in dealing with the disaster. The Government also decided to pursue a scientific approach in assessing the post disaster needs with the assistance of UN Agencies, which is the first in the country. The importance given to disaster resilience and mapping of eco fragile zones are also laudable, he said. The proposal from the Government to organise these round tables to seek ideas and views from the larger DM practitioners and experts in the country itself reflects the commitment to seek the best solutions to the challenges being faced in the reconstruction of houses.

The Minister for Revenue and Housing Shri E. Chandrasekharan in his inaugural address, appreciated the efforts of the UNDP and other agencies engaged in formulating opinion on mindless construction activities and unsustainable development practices. The ownership of land doesn't give licence to do anything on their land, the Minister said. The Minister also pointed out that the recent events of landslide occurred in the hilly areas should be an eye opener to all of us. The thinking on the part of the land owners that construction can be made anywhere and everywhere is a serious issue especially in the ecologically fragile regions of the western ghats.

Pointing out that due to the land reform measures and end of feudalism, 8.5% of the people have become land holders. Some have occupied government lands, river banks, mountain sides and started constructing without proper planning, which contributed to severe natural disasters. The existing shortcomings and flaws in the regulatory mechanism have to be corrected as we are more prone to disasters in the wake of climatic changes. The unity of the people of Kerala shown in facing the disaster should also be there in the rehabilitation phase as well he added. Even when so many people have rendered homeless we have the irony of 12lakhs houses kept locked in many parts of the state. The rebuilding exercises are not only to provide houses but also of building disaster resilient houses. Though more than three months have elapsed since the disaster, we were able to find stakeholders and collaborators to help us with the construction of new houses. He hoped that Round tables like these would be of great help in sharing the lessons learned and in finding solutions to the post disaster housing needs.

In his special address, Shri Sambasiva Rao, District Collector Kozhikode stated that Kerala has set world standards in facing disaster. Efforts should be there to put an end to the abuse of nature and its resources. Proper planning process is needed.

Shri. G Padmanabhan of UNDP in his special address stated that the acceptance of the Government and understanding of the fact that we are paying the price for abusing the nature and its resources and the non observance of rules and regulations itself is a great thing. The challenges in the reconstruction are many. Long term housing planning which should be seen in the context of habitation development. Since land is at a premium and supply being short in Kerala, feasible options have to be found out. The challenge in front of the Government is how to construct fast. We cannot entrust the construction to a company as it is not sustainable. We also need to address the wrong development practices and the vulnerabilities we created in the past. The people should be given awareness about build back better concepts that they can practice to make a disaster resilient Kerala as envisaged by the Government.

Joe John, Project officer, KSDMA proposed vote of thanks.

The technical session on voicing concerns started at 11.30 by Shri N.S.K Umesh, IAS Deputy Collector Wayanad, Shri Sabu Varghese District Planning Officer, Idukki and Prasoon G. Das, Urban Designer, Blue Clay Architects and Associates.

Shri N.S.K Umesh Sub Collector Wayanad stated that the disaster started in Wayanad on August 8<sup>th</sup> itself. Due to the lack of smart phones in the area the visuals could not be uploaded and the national media also was focusing more on the rest of the state. Only 2 to 3 percent of the district has habitable area and the rest are forest, plantation and paddy fields. The worst landslide in Wayanad had destroyed a school and a bus stand. The main challenge and concern is the identification of land for the construction of houses and how they can be constructed and what technology has to be adopted. The district's tribal population is scattered and precariously placed. Is cluster housing a solution for rehabilitation especially when some tribes do not mix with others. The houses built with locally available materials like bamboo though viable, it is difficult to convince people to buy those. The mindset of the people needs to be changed in using these alternative materials. He urged UNDP to hold a Round table in Wayanad with the local stakeholders.

Shri Sabu Varghese District Planning Officer, Idukki stated that more than 1000 landslides have occurred in the district, of which 57 were severe. The main challenge in Idukki district is identification of land, appropriate technology and material management. Increase in the cost of raw materials and its non availability are major issues. Another concern he pointed out was that the choice of appropriate technology. The tribals in Idamalakkudi are not willing to accept RCC houses. The idea of relocating people may not be feasible, he said.

Prasoon G Das from the Indian Institute of Architects, Calicut chapter explained that the GIS mapping they did immediately after the flooding, and mapping of the vulnerable zone was different from the zonation done by the CESS. Coordinating with the Town planning officer, Calicut they created an app to study 450 houses situated in the hazard prone areas of Calicut, Malappuram and Wayanad districts. Their study revealed that the damages were more in urbanized areas of Wayanad district than other parts. The buildings constructed in less than 5 years back were the most affected by landslides. Gaps found in the identification of zonation is an area of concern, he said. Recommendations made in their presentation were disaster mitigation, suitable residential building plans, capacity building, policies and strategies, land use policy, etc.

Dr Manisha Sudheer, Amritha Centre for Wireless Networks and Application said that the IOT system and early warning system started in Amritha Campus in 2006. They use different kinds of sensors and they have 24x7 operational system which is multilevel. 1 lakh people benefitted from this and the Call Centres were operated by the students. She spoke about establishing an integrated risk management platform and also of crowd source application.

Shri Hari Kumar of Geo Hazard shared his experiences in Orissa during the Super Cyclone of 1999. 10000 deaths occurred during the cyclone but during cyclone Phailin in 2013 the death toll was only 23. Now Orissa is one of the best disaster resilient states in the country. The aspirations of the people to live in concrete houses as a mark of upward mobility is a matter of concern. In our municipalities though we have civil engineers we do not have geologists and Geo hazard analysts. Practical solutions for these problems have to be found out. Demarcation into zones, Slope modification regulations, guidelines for hillside construction are highly needed, he said. Eco-friendly and locally available materials are to be introduced. Inclusive design incremental houses, participatory approach, owner driven houses with extended support artisans training are also needed for rebuilding a Navakeralam.

Harsha Sreedhar, Principal Architect, Institute for Green Habitat, shared his experience of working in Meghalaya where a major earth quake occurred in 1897. Despite this, people still prefer stone construction there. The efforts are on to conduct interactive workshops and promoting Assam type construction. The session also discussed the problems of relocating people. Since there are livelihood



issues, we cannot uproot people from their familiar surroundings. Though there are specific mining regulations it is not understood by the people and the regulations need more teeth. Community living and need based houses are to be promoted. The need for larger vision and permanent counselling system should be there in the villages. Harsha Sreedhar said that acceptance of alternate building technology is a matter of concern. Government buildings should be built with such technologies so that people will get encouraged to use such methods. The idea of innovative technology should get into the psyche of the people. The issues of confidence and prestige in owning pucca houses with concrete and mortar is also a major problem.

The afternoon session was initiated by Dr. V, Suresh, Member, CM's Advisory panel on Recovery. The unbuildable land in the hilly areas are to be identified he said. The PDNA document which was prepared in the shortest possible time has covered all aspects of the disaster. The vision and solutions to understand what are the dos and dont's is needed. He said that the regulatory mechanisms and norms are also necessary. Capacity building, training of local masons for bringing disaster resilient element in the construction should also looked into.

Dr Rajendra Desai, the next speaker stressed the need for Retrofitting of buildings. Making small changes to the existing structure is five times cheaper than reconstruction and faster too. And it can be done in phases, he said. Greenest option for reducing vulnerability should be brought in since it's a preemptive measure.

The day's proceedings were summed up by Shri G. Padmanabhan of UNDP and Dr.V Suresh.

## **ROUND TABLE 2 - LIVING WITH WATER: Developing Appropriate Strategies for Housing in Kuttanad**

In his keynote address, Dr, Venu , CEO, Rebuild Kerala Initiative, stated that though many models were suggested, owner-driven construction was the mode selected by most people. Speedy, hazard-resistant and disaster-resilient construction is the need of the time.

Dr. P. H. Kurian, Additional Chief Secretary, Revenue and Disaster Management, in his special address, said that in Kuttanad the add-on portions of most of the houses were destroyed. Availability of land is a major concern. Six hundred people in Kuttanad have opted for reconstruction in their own land and around 6,000 people have already availed the first instalment of the financial assistance. People have realised the need to build houses on strong stone foundations. Considering the additional costs required to make the houses disaster resilient, the per unit financial assistance should be increased. Block-level Building Facilitation Centres are being established and building materials should be made available at subsidised rates. The aspirations of the people should be taken into account, and the houses need to be constructed fast.

Dr. T.M. Thomas Isaac, Minister for Finance and Coir, in his inaugural address, stated that the floods provided an opportunity for a thorough, natural cleaning of the bed of the backwaters in Alappuzha. Decentralised solid waste management as well as liquid waste management ought to be put in place. House boats are a major source of pollution in Kuttanad. Focused intervention is needed to control the pollutants brought in by the rivers and the unscientific use of the fertilizers. Considering that the housing sector suffers from the non-availability of construction materials, it is time to experiment with alternative materials like coconut fibre, which can be processed to withstand salinity and electric conductivity. This can be a game changer in constituting the ultimate green solution to wood.

In his thematic remarks, Dr V. Suresh, Member, CM's Advisory Panel on Flood Recovery, stressed the need for a policy on shelter and technologies to be used for permanent sustainable solutions. Among the pressing concerns are: Identification of proper sites; planning elevation level; additional plinth area; traditional and cost-effective measures; the limitations of the terrain and difficulty in transportation of

materials. Also highlighted were aspects of rebuilding (whether owner-driven or through a system of construction contractors), the need for strengthening the Training Centres, the training of the Local Self-Government Department (LSGD) engineers, finance and feasible practical solutions for Kuttanad.

Paucity of land is a matter of concern and certain parts like Kuttanad's R Block are uninhabitable. A lot of money is spent for pumping water every year. The situation is not similar to Holland. Most of the properties are in the hands of benamis. In places like Kainakari, people reside on the slopes of bunds. The cleaning of Kuttanad and reconstruction should be done at the same time. There should be a distinction between public and private buildings. The Kerala State Financial Enterprises (KSFE) has taken initiative to build a flood shelter, which will be managed by the panchayat, for which the money will go to a separate fund. Future public buildings in Kuttanad, like hospitals, should be disaster-resilient.

Technical Session 1 was chaired by Shri Suresh, Member, CM's Advisory Panel on Flood Recovery. In the session on voicing concerns, Smt. Swarnamma P. S, Deputy Collector, Disaster Management, Alappuzha, said that though Kuttanad is subjected to floods twice a year, this year's was the worst since 1924 and drowned almost all of Kuttanad and Chengannoor. She said the financial assistance is not sufficient; 607 people have already received Rs 95,200 assistance under the State Disaster Relief Fund (SDRF). Pending land disputes are being cleared through joint verification. Smt. Swarnamma also pointed out the paucity of funds for the maintenance of the Thottappally spillway, which cannot be operated due to salinity and high tide. Though it was built to control floods, the Thannermukkam bund is not fully operational as only two-thirds of the bund has been built. Though the farmers themselves build mud banks, floods lead to inundation. The Allepey-Changanacherry Road, which was built in 1957, needs to be reconstructed as it was not built to scientific standards, and suffers from poor drainage. Availability of drinking water in the area is also a real concern.

The next speaker in the session was Hari Kumar, Regional Coordinator, Geohazards. He pointed out that in Orissa, the Great Cyclone took more than 10,000 lives, but the cyclone of 2003 resulted in only 23 deaths. There are many lessons to be learned from our experiences. Resource mapping and flood hazard mapping, and control measures in building rules should be brought in. Preparedness of the people for floods, evaluation of critical services, siting issues, hazard zonation maps, services of geologists and geo-technical engineers to ensure disaster-resilient construction which is sustainable, eco-friendly and inclusive for the disabled, are important concerns in the rebuilding phase.

G. Padmanabhan spoke on behalf of the Owner Driven Reconstruction Consortium (ODRC) and mention that while owner driven construction seems to be the preferred option by many of the owners, if appropriate support services are not provided owners will find it

R.D. Padmakumar, former General Manager of HUDCO, spoke about the owner-driven house delivery system which was started in 1980 by COSTFORD with the help of small groups of barefoot architects through a participatory method. Micro-zonation is needed and there should be clear understanding that there should not be any construction on the slopes of the embankments. Though pre-fab is another option, model housing should be the ultimate aim.

P. B. Sajan, Joint Director, COSTFORD, spoke about cost-effective disaster-resilient construction. Bamboo is an alternative building material which is abundant in Kerala. The life of concrete is 60 years while the life of bamboo, if treated properly, is 70 years. It is renewable, carbon-negative and cost-effective. It generates local employment and there are technologies by which bamboo can be prefabricated. Bamboo reduces the use of cement as it can be used as piling material instead of concrete, with lime reinforcement. Building facilitation centres should be established in all blocks.

In the post-lunch Technical Session 2, pre-fab construction was the focus area which began with a presentation by Prof. Jayakrishnan of TKM Engineering College, who shared his experience of constructing pre-fab structures for flood victims. The design criteria were: sustainability, cost effectiveness, and timely

delivery. The houses, which were completed in 28 days, were built in 2-3 cents of land, with hardly any space for vegetable gardens.

The next speaker, Dr. Shintto Paul, Head of Structural Design Unit, ULCCS, spoke about the advantages of pre-fab structures such as strength and stability, resistance to moisture ingress, and comfort and convenience. Having a durability of 50 years, it is safe from thermal insulation.

Rather than individual houses, cluster housing should be the option. In areas like Kuttanad, where soil is weak and flood level is high, pre-fab houses can be built by raising the plinth area and strengthening the foundation. The load needs to be assessed, and tests undertaken for differential settlement and usage of grillage foundation. Even though construction of 500 square feet is not feasible, construction above 950 sq feet is feasible.

The Technical Session 3 on inclusive housing started with the presentation on ability-induced concerns by Shri. Joe John, State Project Officer, KSDMA. Being living as differently abled itself is a disaster, and such people should be empowered by creating a barrier-free environment. Most of the relief camps were not disability-friendly. The existing and new constructions have to be disabled-friendly, with ramps with sufficient slopes, hand rails, user-friendly toilets, etc. Audio visual aids, and early-warning system for the visually impaired are also needed. The stipulations in the National Building Codes must be adhered to.

Session 4 on appropriate sanitation technologies was handled by Dr. R. Ajaya Kumar Varma, Executive Director, Suchitwa Mission. The septic tank technique is not feasible in water-logged areas. Eco-friendly biotank alternatives should be used. The use of ready-made toilets and waste collection in Jangars and its disposal was a major problem during the floods. The Ambalavanan District Coordinator, UNICEF, also spoke about the technologies suited for water-logged areas such as high-raised drum-type toilets. Shri. Rahul Padhak, WASH engineer, AQUA PLuS, talked of the various options for providing safe drinking water.

While summing up the day's proceedings, Dr. Suresh raised the issues concerning the techno financing regime and the insurance component for temporary shelters.

## KEY RECOMMENDATIONS

At the opening session of the roundtable in Kozhikode, the Minister for Revenue Shri E Chandrasekharan mentioned the commitment of the Government to pursue a “build back better” approach to build a Nava Kerala. He mentioned that shelter cannot be visualised independently, but it has to be a holistic approach that respects nature. He urged the participants to come out with specific recommendations that the Government can include in the housing policy as well as pursue actions under the larger Rebuild Kerala initiative.

District authorities and other government functionaries mentioned the challenges in hilly areas - most of the land vulnerable to landslides, lack of safe land, predominantly tribal population with low literacy and depending on land for livelihood, inadequate availability of material and skills for house construction, landslides damaging newly constructed houses, and socio economic factors played a role in the nature and kind of shelter damages.

In the case of Kuttanad the concerns expressed by Dr. T.M. Thomas Isaac, Minister for Finance and Coir; Dr. Venu, CEO, Rebuild Kerala Initiative; and Mr. P. H. Kurian, Additional Chief Secretary, Revenue and Disaster Management are: most of the people are opting for owner-driven construction but there is serious lack of capacity and knowledge to facilitate provision of hazard-resistant and disaster-resilient houses quickly. It is a challenge to meet all the aspirations of the people in Kuttanad due to lack of availability of safe land, and houses to be constructed on strong foundations within the funding provided by the Government. Tourism Industry is the main cause for high levels of pollution in Kuttanad. Cleaning up the existing ecosystem with provision for arresting future degradation, and allowing developments based on the carrying capacity of Kuttanad is becoming difficult. The potential to develop locally available material such as coconut fibres and bamboos have not yet been explored.

### **Key Recommendations**

The discussions at both the meetings by more than 45 participants each till the last session of the day recommended several points. The key recommendations are as follows:

- The current level of early warning doesn't cover adequately landslide and that needs to be improved so that the district authorities are in a position to provide timely warning and evacuate people from vulnerable areas.
- Detailed hazard zonation maps, including micro-zonation maps will have to be prepared for hilly areas and low lying areas such as Kuttanad, and developments should be permitted by keeping in view the scientific analyses of the vulnerabilities and guidelines based on it.
- Slope stabilisation of the highly vulnerable areas, including the areas that experienced landslides should be undertaken using eco-friendly technologies. The expertise from local/national appropriate agency and geo-technologists as well as other experts could be sought for this.
- Housing construction in the affected areas and beyond should be seen as an opportunity to boost the livelihood options and development of local economy. Therefore, forward and backward linkages for appropriately treated material, technical support during construction as well as post construction services are required. Model demonstration buildings/houses, preferably by Government agencies, should be constructed for people to understand the application of vernacular technologies using locally available and treated /processed material. Apart from aesthetics, these units should demonstrate menu of design options, cost implications and the green technologies that could reverse/arrest the effect of human actions on environment.
- If desired, pre-cast sections of the building, such as factory made doors and window frames that could ensure centralised quality assurance could be promoted with the understanding that the local people would be employed for erecting these after the necessary capacity building.

- The focus should be on a habitation concept rather than a housing concept. This opportunity should be utilised not merely for reconstruction but for looking at a holistic approach towards sustainable habitation that has relevance to the normal development activities in the state.
- Retrofitting is much cost effective than reconstruction of partially damaged (15-75%) houses based on gradation such as G1, G2.... etc for which guidelines have to be prepared. Technologies exist and these can be promoted by preparing a retrofitting manual in local language with easily understandable and consumer friendly visual depiction of do's and don'ts for construction features
- ODR is a right choice for sustainable solutions. However ODR can be effective only if enabler services that facilitate assistance to families for reconstruction efforts of their own houses are put in place. These services should cover provision of information on technologies, design and material options, finances, access to building materials, support for access to land, engineering services and skills upgradation.
- Codes and Rules that promote disabled friendly facilities and public buildings, as per National Building Code of India 2016, have to be incorporated in Kerala Building Rules and enforced.
- Government has to establish a robust monitoring mechanism which keeps track of the stage-wise progress and disbursement of funds and grievance redressal system.
- The building facilitation centres being established by the Government should be seen as an opportunity to strengthen the existing facilities such as the Nirmithi Kendras so that the existing infrastructure in these centres can be utilised and the existing gaps can be strengthened. The requisite exposure and expertise should also be developed through existing institutions and training centres. These Building Facilitation centres should be developed as multi-purpose support centres for technology transfer, training, and building material /components outlet points and construction support and guidance centres.
- Considering the flood vulnerability of the Kuttanad area it is imperative to consider cluster housing, in such areas where the soil is weak and flood level is high, pre-fab houses can be built by raising the plinth area and strengthening the foundation. The load needs to be assessed, and tests undertaken for differential settlement. Such cluster houses could be provided in safe locations either on artificial mounts or on higher stilts with all amenities and the siting should be such that it is not very far from their agricultural lands. This would involve more scientific analyses and creating massive awareness necessary for people to change their mind set and opt for living in cluster houses.
- Alternative locally available building materials and proven technologies should be utilised. Specifically, use of stabilised and strengthened mud blocks, bamboo applications and products with compressed coconut fibres and coconut pith were suggested. Development/treatment of these materials to ensure durability.
- In areas like Kuttanad, where soil is weak and expansive and flood level is high, light weight prefab houses with smaller element precast options can be built by raising the plinth area and strengthening the foundation. The load needs to be assessed, and tests undertaken for differential settlement and usage of grillage foundation.
- Twin leach pit systems and septic tanks technologies are not feasible in water logged areas. Eco friendly bio-digester or chemical toilets sanitation alternatives should be used. The need for separating the sewage and effluent disposal was stressed, to not overload the fecal sewage treatment units.
- There is a need for a policy on shelter and technologies to be used for permanent sustainable solutions. Among the pressing concerns are: Identification of proper sites; planning elevation level; additional plinth area; traditional and cost-effective measures; the limitations of the terrain and difficulty in transportation of materials. There is need for strengthening the Training Centres, the training of the Local Self-Government Department (LSGD) engineers, municipal and panchayat level functionaries up to block level on finance and feasible practical solutions for Kuttanad.
- The Housing options in flood affected areas of Kuttanad and hill slopes in Wyanad and Idukki etc will entail additional costs for strengthening features and a 25 % increase should be permitted in housing cost options for these areas.

- The Kuttanad and lake precincts need special environmental safeguards and correction measures including dewatering and desilting efforts for not reducing the hydraulic path at Thottapalli and Thannermukkam spill ways and other such sensitive outlet areas. Further, special efforts should be taken to ensure that none of the urban and rural settlements around the lake be permitted to dispose off the untreated sewage and sullage into the lake and thereby enhancing the pollution level of the water body. Similar efforts would be needed for House boats with appropriate chemical toilets or other sanitation options before letting out the untreated liquid effluents into the lake.
- Housing Guidance and Housing Counselling service backed with technology transfer and other resource inputs should be made available in all cases where, repair, renovation, retrofitting and reconstruction work is already taken up by the affected families
- Where piped treated drinking water supply is not available, supply of potable water for drinking and other consumption purposes, of right quality, be ensured using appropriate technology options to remove brackishness, turbidity, pathogens, bacteria and viral loads.