* 'REDUCING RISK/ PROMOTING SUSTAINABILITY'

A good practice guide

Almora, Uttarakhand

India 2010

contents

executive summary

The art of building cannot ignore the changing climate. Building construction and operation is one of the biggest contributors to climate change. Modern materials have large ecological and carbon footprints, and insensitively designed buildings are consuming ever-increasing amounts of energy to maintain thermal comfort levels.

The second `learning in action' workshop organised by Architecture Sans Frontieres – UK and SEEDS-India,`Vulnerability and Risk: the role of green technology' saw us returning to the Himalayan state of Uttarakhand to explore ways of combining vulnerability reduction and sustainability.

Cement and steel have helped build larger, taller and safer buildings, but at huge costs to the environment. Can we make buildings safer, and at the same time make them environment friendly without compromising on the comfort levels inside?

The workshop aimed to find ways of achieving this. A key activity in the workshop was `harvest mapping', where the participants traced the sources of various building materials and skills, and converted them into financial and environmental costs. Of course the workshop had our usual ingredients of village visits, participatory appraisal, building work, participants falling ill, experimentations with local food, making friends, getting very tired and taking back good memories..!

The support of various organisations and individuals, including Lok Chetna Manch, Mountain Forum Himalaya, Aarohi, Bashabi Dasgupta, Saurabh Popli, Nitin Verma, Neeraj Kapoor and Akshay Kumar was invaluable, and added immensely to the richness of the learning. The heart and soul put in by Sarah Ernst and Andrew Edwards into the workshop facilitation made it a truly experiential workshop. The support from ASF-UK and SEEDS-India is gratefully acknowledged.

Anshu Sharma, SEEDS India

how to use this guide

This guide draws upon well established guidance documents, to create an accessible and all-encompassing set of principles. It is hoped that these form the foundation for a new disaster management plan for Uttarakhand concerning the built environment. Furthermore it is hoped it will be used as a comprehensive tool for built environment professionals, development NGOs and development departments in the region.

The guide is designed to be both general and specific. It highlights many cross-cutting themes which are relevant to shelter design in every rural-urban context of high vulnerability in India, but it is also grounded with specificity particular to the local climate and culture of the region in question; Almora and Uttarakhand at large.

The guidelines are broken down into three main categories: Resources, Shelter, Settlement.

Resources

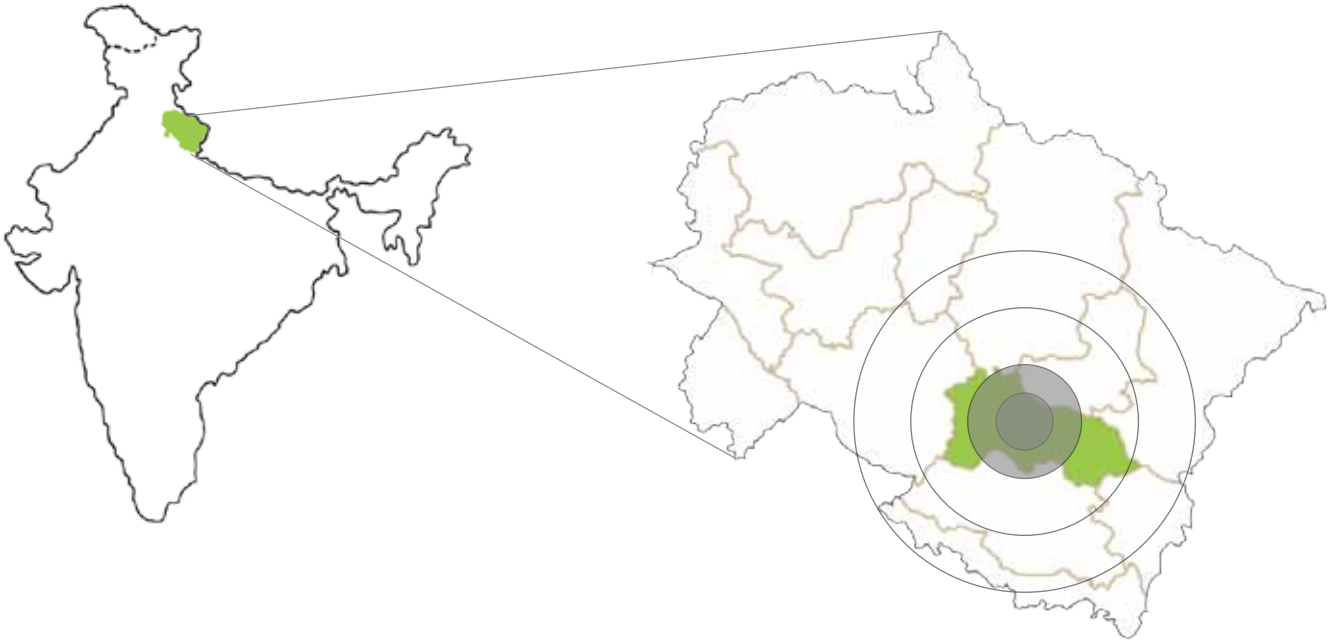
sourcing
production
skills

Shelter

environment and technology
change over time
living standards

Settlement

planning
good governance
services



A map locating the state of Uttarakhand and the region of Almora

geography

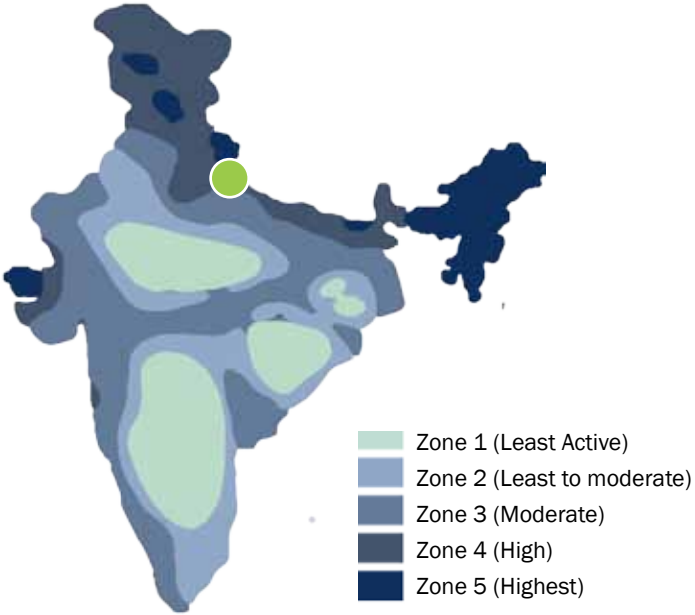
The State of Uttarakhand is located in the north of India sharing international borders with Nepal and Tibet and national borders with Himachel Pradesh and Uttar Pradesh.

Uttarakhand's topography is mountainous ranging from approximately 1100m above sea level to the highest point in the Indian Himalayas at Nanda Devi's peak of over 7800m. As such the State experiences varied temperatures ranging from an average of 18°C – 30°C in the summer months and falling to as low as 5°C during winter months.

Nearly two thirds of the land area is covered by forest despite vast areas being subject to widespread deforestation over the last century. In addition the state is host to considerable biodiversity with rare species of animals and flora and fauna found both inside the 4 major National Parks and in many of its rural areas.

The high proportion of mountainous areas give rise to considerable amounts of rainfall; over 1500mm annually and subject the State to sudden, heavy cloud bursts during the monsoon season.

SOURCE: euttaranchal.com, bharatonline.com 2011



Map of India showing relative earthquake risks (developed from: Building Materials and Technology Promotion Council, Government of India, 2006)

vulnerability and risk

The Himalayan region is one of the most disaster prone and ecologically vulnerable ecosystems in the world. It lies mostly in Seismic Zones V and IV, indicating very high earthquake vulnerability. It is prone to cloudbursts, flash floods, avalanches, landslides and forest fires, with such disasters affecting thousands of lives, houses and infrastructure each year. Many of the hydro-meteorological disasters have been demonstrating an increasing trend in the past decades, and are reportedly set to get worse due to the impacts of climate change (Mountain Forum Himalayas, 2010).

The over-reliance on hi-tech, highly industrialised materials in shelter construction has resulted in a higher dependence on 'foreign' materials and components often imported from a considerable distance. These bear no relation to the resources available locally and do not contribute to the local economy or local skill base. In addition hi-tech components frequently result in a dependence on the original manufacturer for installation, maintenance and modification which makes the product unsuitable in changeable environments.

green technology in north India

Intermediate technologies draw on materials that relate to the traditional vernacular and which are locally available, utilising state of the art research and technology to create green intermediate technologies. Local, natural materials are used where suitable whilst acknowledging the need for the sustainable management of indigenous resources. Traditional materials in the region of Almora are earth, stone, slate and timber, typical of the state of Uttarakhand. The majority of these materials are no longer accessible as a result of illegal logging causing widespread deforestation and excessive quarrying leading to a similar ban restricting new excavation. However, the traditional vernacular in the region demonstrates a construction highly attuned to both the climate peculiarities of the region and a resistance to seismic activity which is acutely lacking in almost all modern un-engineered reinforced cement concrete (RCC) homes.

The challenge is therefore to achieve a new, contemporary vernacular which draws on the knowledge and expertise of the old, utilising local materials without further exhausting heavily depleted resources. Technologies such as treated bamboo frame and Compressed Stabilised Earth Blocks (CSEB) represent an intermediate technology which acknowledges the aspirations for the modern without disregarding the lessons of the past.

The topography of Almora District, Uttarakhand

A typical mix: trdaitional and modern vernaculars

vulnerability and risk:

the role of green technology

The workshop

The workshop explored a range of small innovations in green technology from bamboo prototypes for earthquake resistant building to compressed stabilised earth blocks in the context of vulnerability and risk in the Indian Himalayas. Working alongside a local NGO, participants were able to use participatory tools to engage with the issues affecting the community.

The two week workshop in 2010 is the first part of a six month project to promote appropriate shelter technologies and processes for disaster and climate resilience in the Himalayan Region. It involves collaboration between the local implementing partner (LCM), the implementing agency, (MFH), the lead agency (Church's Auxiliary for Social Action (CASA)) with technical support from partners SEEDS and ASF-UK.

Partners: biographies

CASA - Church's Auxiliary for Social Action
CASA is a leading Indian voluntary organisation, specializing in emergency response, disaster risk reduction and social upliftment for over sixty years. CASA has been promoting appropriate shelter concepts in the disaster management domain for a long time. Its work on appropriate shelter includes the post Uttarkashi earthquake shelter programme in Uttarakhand.

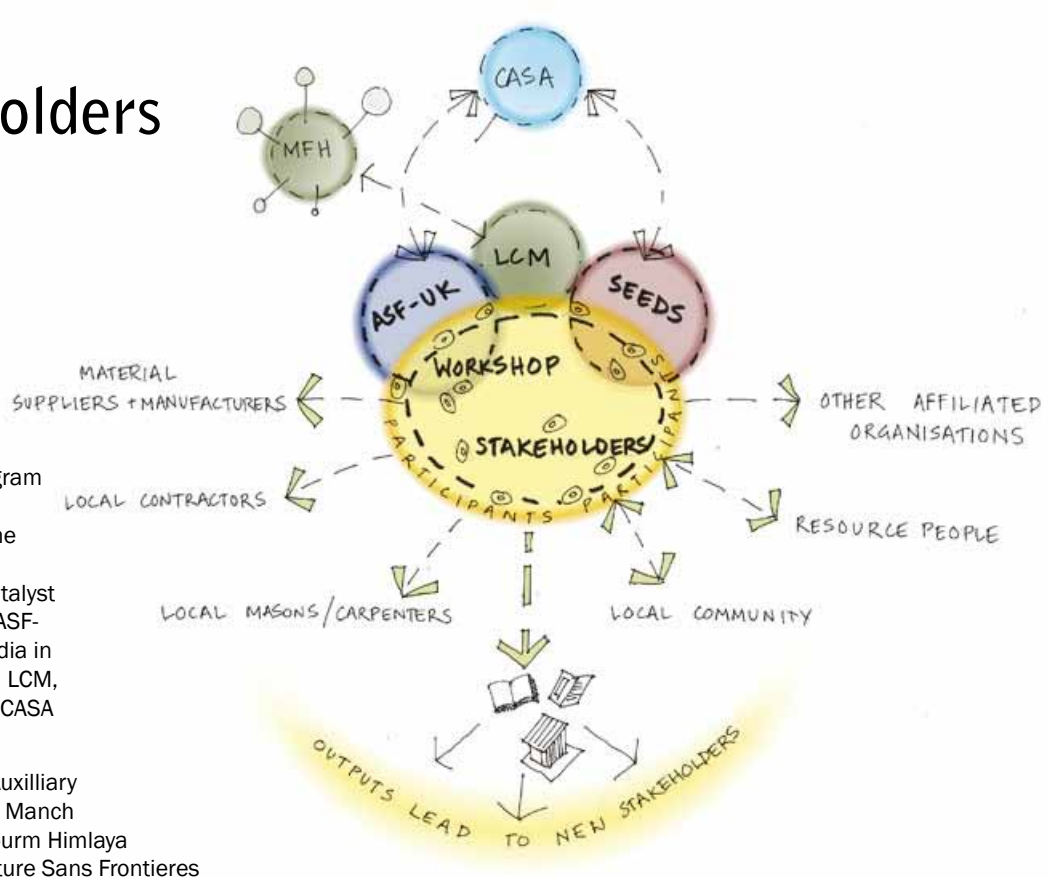
LCM - Lok Chetna Manch
Lok Chetna Manch has been working with communities in the Kumaon region of Uttarakhand on development and environmental conservation related issues for about thirty years. The agency is widely recognized, and has been awarded, for its work on sustainable development in the region. LCM is also a member of MFH.

MFH - Moutain Fourm Himlaya
Mountain Forum Himalayas is a is a network of established voluntary organizations across the Himalayan states of Hi achal Pradesh and Uttarakhand. The collective works to promote good governance, environmental sustainability and disaster risk reduction.

ASF-UK - Architecture Sans Frontieres
A leading education charity based in the UK, ASF-UK trains built-environment professionals to be more relevant to the agenda of development, and by supporting networks with local partners, helps to build organisational capacity. Through workshops, grassroots activities and lecture programmes, the organisation promotes ethical practice, particularly in the most vulnerable habitats.

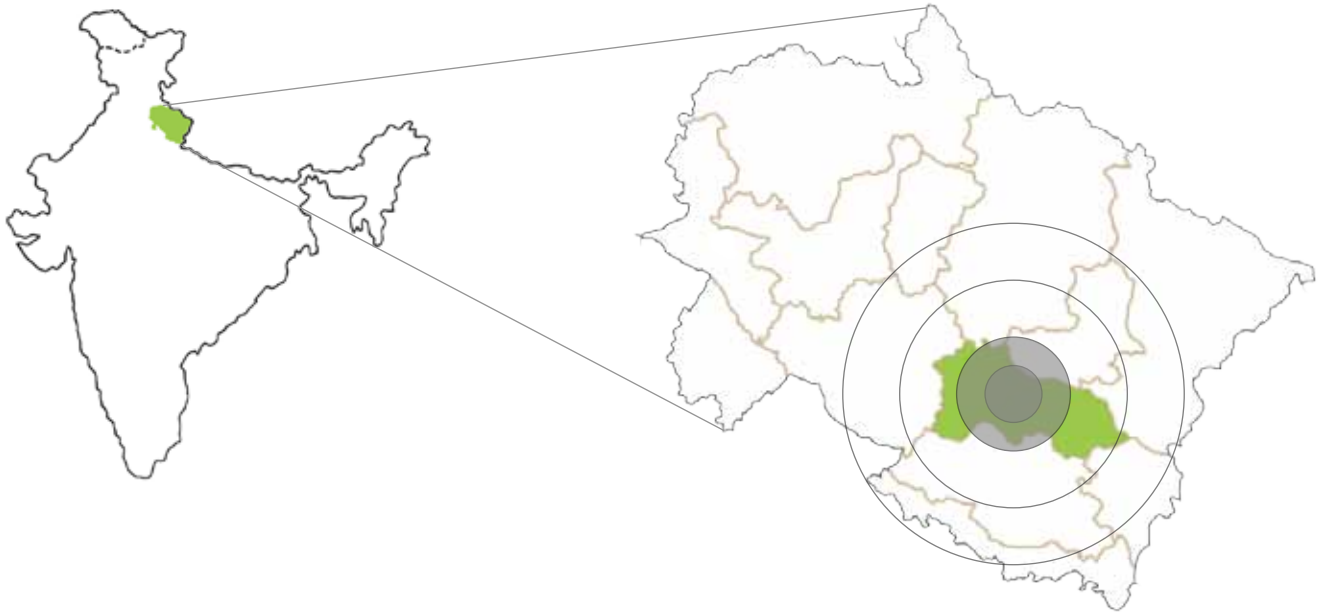
SEEDS - Sustainable Environment and Ecological Development Society
SEEDS is a technical support organization with over fifteen years of technical experience in working on architecture, engineering and habitat planning issues in the areas of disaster response, risk reduction and sustainability.

stakeholders



The adjacent diagram illustrates the key stakeholders in the project which has evoled out of a catalyst workshop run by ASF-UK and SEEDS India in collaboration with LCM, funded in part by CASA

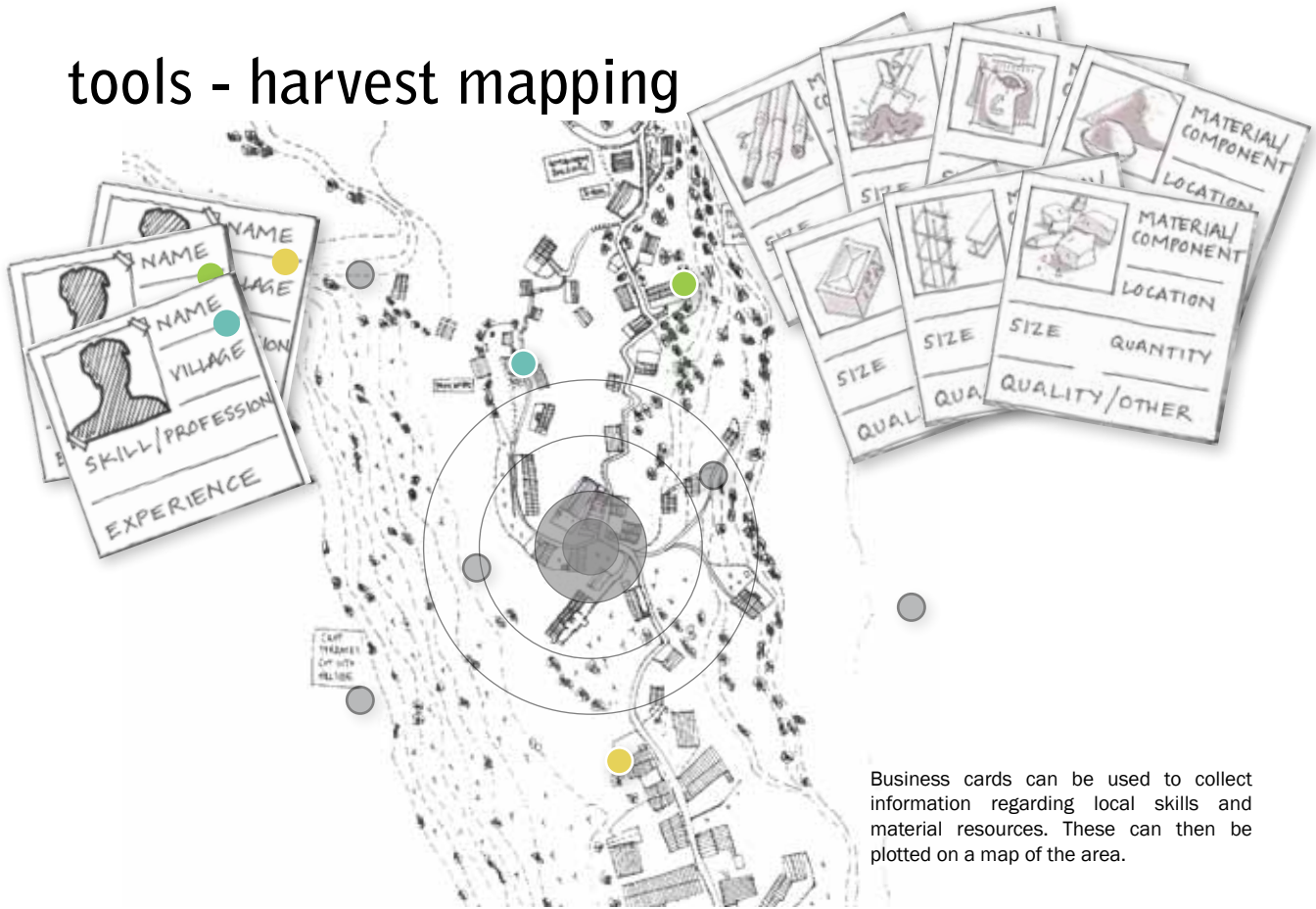
CASA - Church's Auxilliary
LCM - Lok Chetna Manch
MFH - Moutain Fourm Himlaya
ASF-UK - Architecture Sans Frontieres
SEEDS - Sustainable Ecological and Environmental Society



A HARVEST MAP is an ethical enterprise method of achieving sustainable construction. A map of the area surrounding a proposed building site or development can identify potential resources; materials, skills and knowledge that can be used to inform how a building project is designed and constructed. It has the potential to be a catalyst upon which future building projects or enterprises emerge. The mapping is usually restricted to a series of villages, up to 30 miles from the site.

A harvest map was conducted for the region surrounding Ranikhet in Almora. Information was gathered using a 'business card' system for available skills, labour and locally available materials. Knowledge was gathered from local partners and informal interviews with the local community. This system is easily replicable and could be up-scaled to form a body of local knowledge available to all.

tools - harvest mapping



Business cards can be used to collect information regarding local skills and material resources. These can then be plotted on a map of the area.

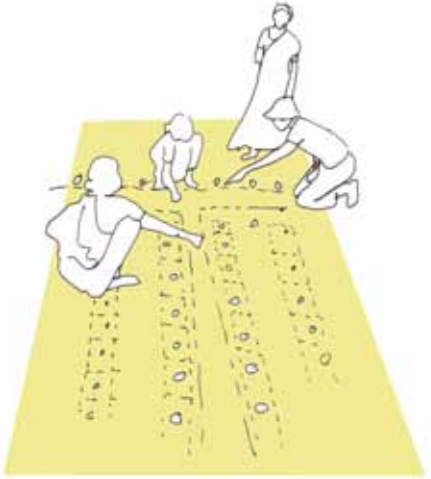
Participatory Rapid Appraisal (PRA) is an empowering way to work in a community, where surveys are abandoned in favour of collaborative discussion and mapping of ideas. Maps can be drawn with the communities' involvement, to locate people, families and resources, and consider density, topography, geography and resources. The process is the first step to building trust and rapport when working in the community. In doing so, the information that is generated is shared, and not extracted, and you may find the answers to questions you never thought to ask.

Mapping

Mapping creates a visual representation of all or part of a community and can display many different types of information at once. They are useful to generate discussion, and compare different perceptions of the community.

Transect walks

Transect walks normally follow on from mapping a community. They are a spatial data-gathering tool used in order to observe the people, surroundings and resources of a community



Mapping can take place on the ground, sand or a piece of paper, for the community to draw their neighbourhood.

tools - participatory rapid appraisal

Sequencing tools
Sequencing tools are time-related data-gathering tools which can help understand an overall community and/or different individual's histories

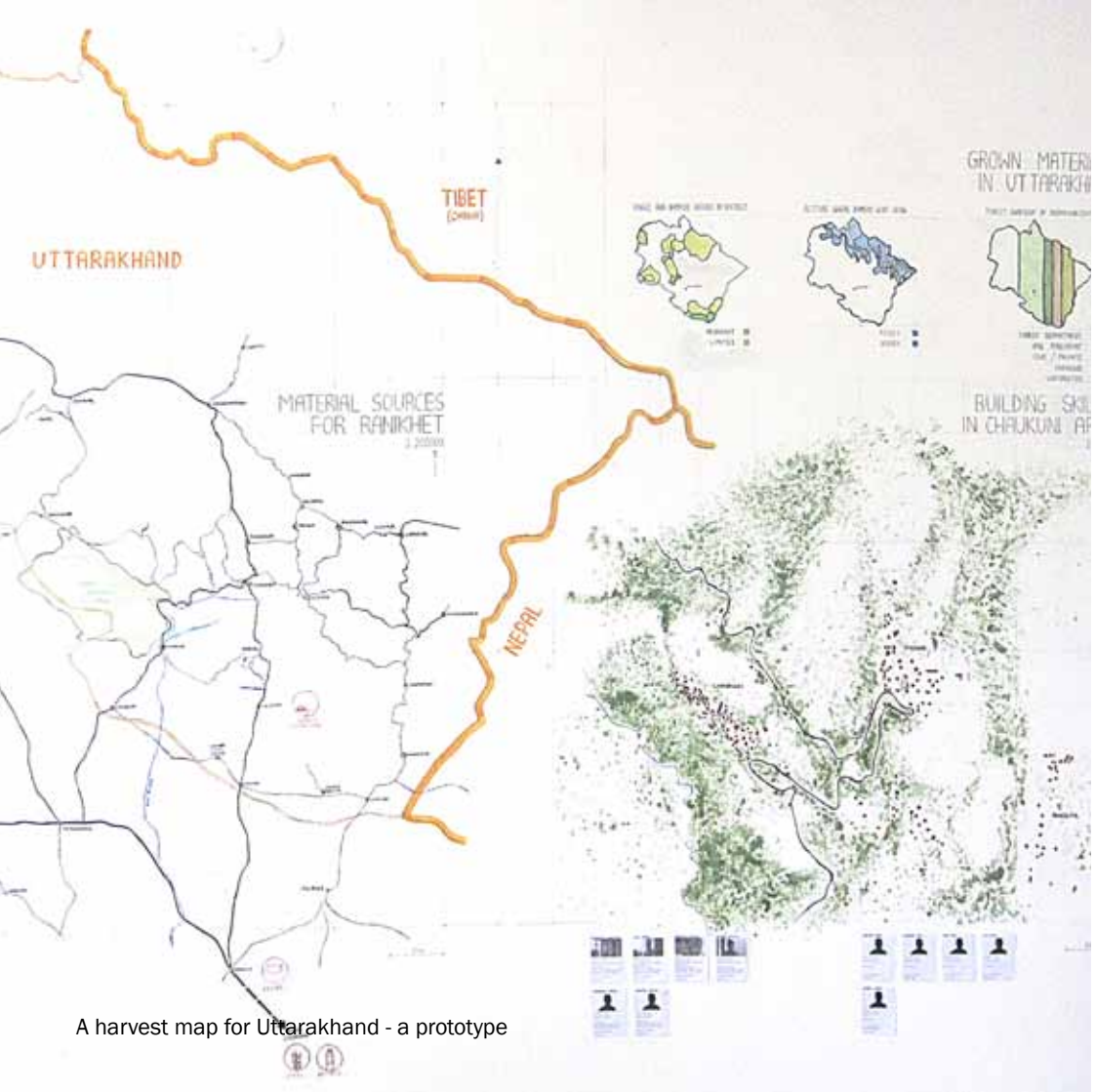
Diagrams
Diagrams can be used for gathering social data. Types of diagrams are: Chappati diagrams, Flow diagrams and Venn diagrams.

Problem trees
Problem trees can be used to identify the root causes of problems and to highlight the causes and affects between them. This can be used to come to an agreement on core objectives and activities to tackle the problem.

Matrices and Pair-wise ranking
Matrices can be used to score and evaluate issues and solutions. Pair-wise ranking can be used to compare several items by comparing two items at a time. Each item is compared to every other item in the group.

Diagrams can be used to collect and organise information

Matrices can be used to evaluate issues and solutions



A harvest map for Uttarakhand - a prototype

PRA in Chakuni Village, Almora, Uttarakhand

resources

sourcing

production

skills

shelter

environment & technology

change over time

living standards

settlement

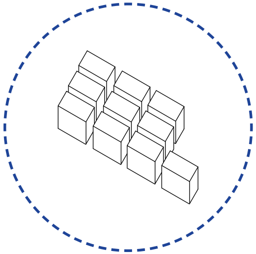
planning

good governance

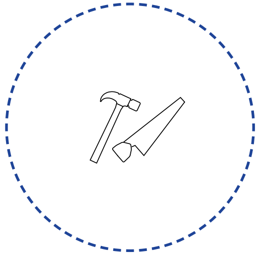
services

resources

sourcing

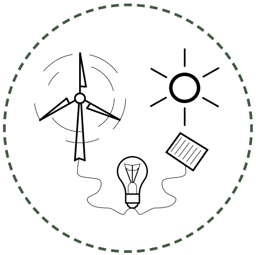


production

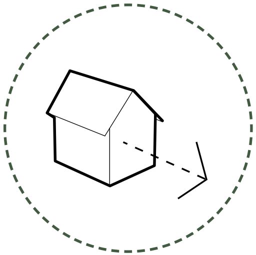


skills

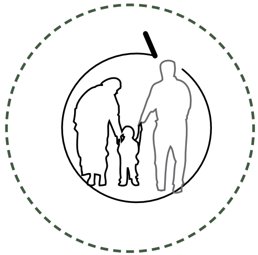
shelter



environment & technology

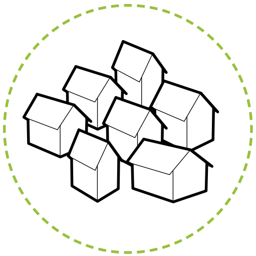


change over time

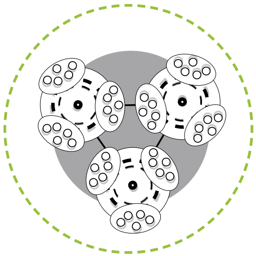


living standards

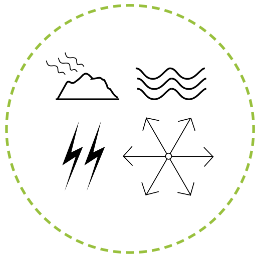
settlement



planning

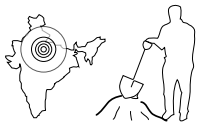


good governance



services

sourcing



production

skills

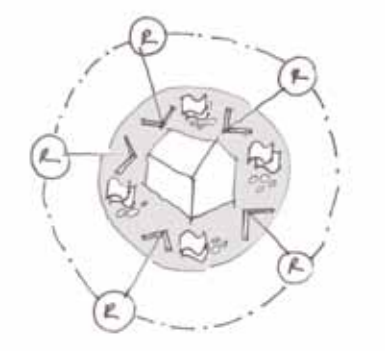
local resources

A design that draws on, but does not deplete, local resources. The selection of materials from sources within the bioregion, to minimise embodied energy through transportation, and support local markets.

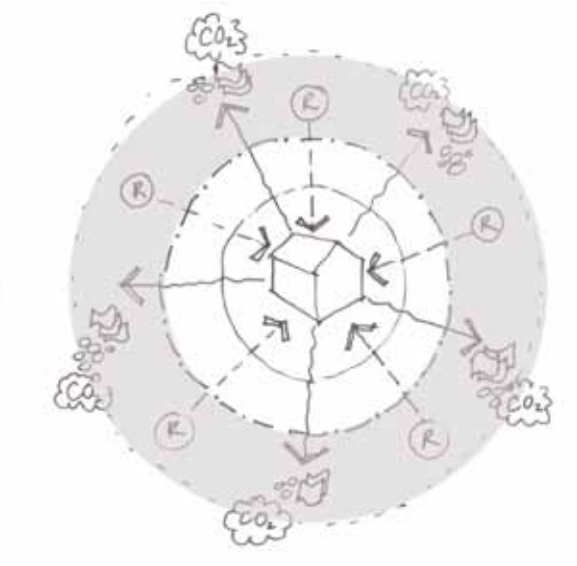
Embodied energy is a term which refers to the amount of energy required to produce a given quantity of a material or product. In this context it refers to the energy from heavy industry and transportation, and is assumed a negative outcome of industrial manufacturing processes resulting in the production of greenhouse gases and the depletion of finite resources.

If a community can source and produce their own construction materials locally, they will ensure capital and valuable knowledge will be retained locally, building resilience against future shocks and stresses.

The workshops utilised the participatory tool of harvest mapping which is defined earlier in the guide to explore the idea of sourcing materials locally. The harvest map process not only highlights the vaulable resources available locally but also provides a methods for collating contacts, prices and resources that are currently lacking which might suggest opportunities for new enterprise.

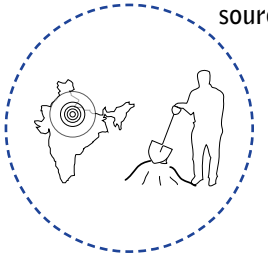


Resources and money kept inside locality reducing CO_2

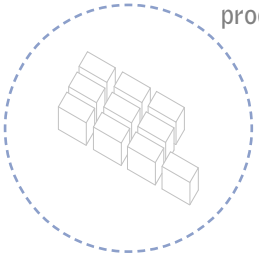


Resources brought into area money extracted outside increasing CO_2

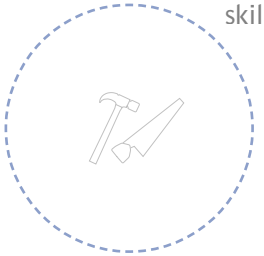
sourcing



production



skills



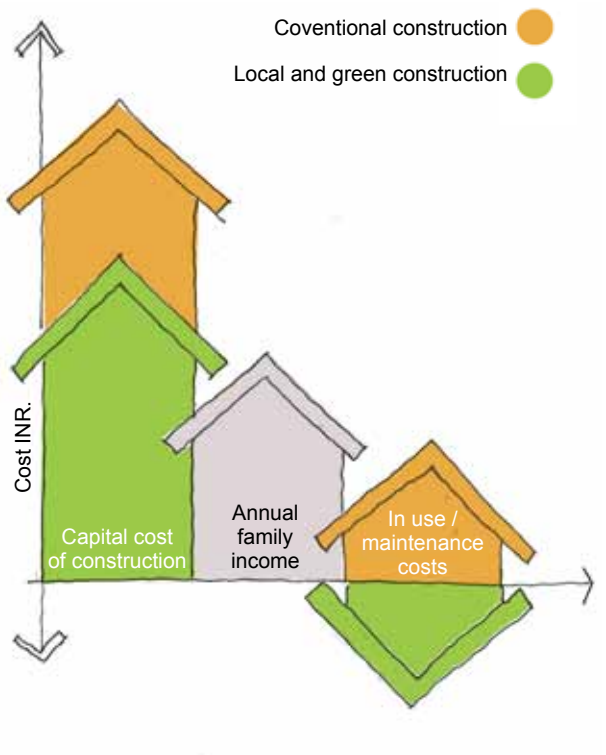
economical

A shelter that is achievable to build and maintain within a family's means.

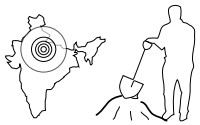
A shelter design which considers not only the capital cost of construction, but the life-span of the building, and how easy it is to maintain

The need for shelters to be incrementally buildable, adaptable and evolve as a process remains as crucial today as when I. Davis first published Shelter After Disaster in 1972. The whole-life cost of the building must be taken into account whilst also ensuring excessive technologies and over-industrialised components are avoided as these can stop families from starting reconstruction or compromising safety and security.

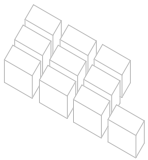
Students of the workshop investigated methods of combining kuccha materials (usually natural materials such as bamboo and mud) and pukka materials (usually concrete and masonry). They explored how kuccha materials could be used as infill within a solid frame which could be replaced at a later date by pukka components. This would reduce the initial cost of the shelter and ensure its use over a longer term. A similar approach was taken by SEEDS India during the Balasore Ashraya Yojana 2008 where beneficiaries were encouraged to contribute elements of the construction in exchange for the provision of an overall structure and some pukka infill materials.



sourcing



production



skills

low embodied energy

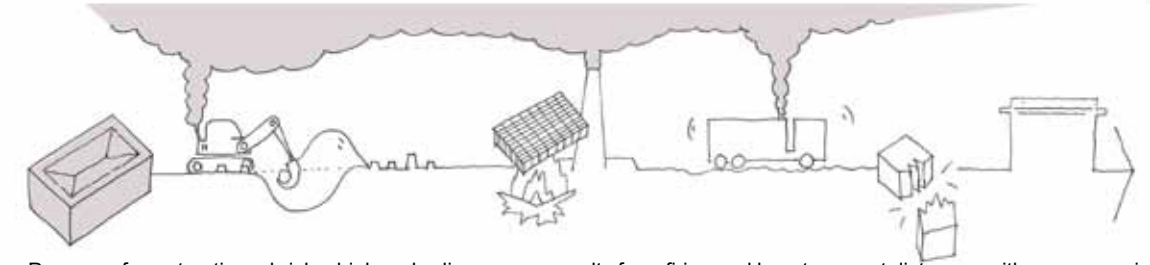
Materials should be chosen in order to minimise the embodied energy of the whole construction process.

By selecting locally available, labour intensive rather than manufacturing-intensive components, not only is the embodied energy and therefore harmful impact of the shelter minimised but the product also ensures new jobs and opportunities for enterprise resulting in additional benefits to the local economy.

The process of manufacturing and transporting a fired clay brick is compared with a Compressed Stabilised Earth Block (CSEB) to show the difference in embodied energy:

* Clay brick, travelling no more than 30Km is estimated at 5250 MJ/m3
* CSEB at between 4-8% cement is between 420-810 MJ/m3

(Calculations from embodied energy of raw materials – Satprem Maïni, Auroville Earth Institute, 2008)

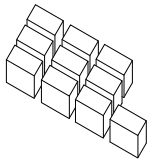


Process of constructing a brick - high embodies energy results from firing and long transport distances with no economic benefit to the local community

Process of constructing a CSEB - minimal embodied energy from local sourcing and use of natural materials, cement is used, despite its harmful environmental impact to increase the quality of the blocks

sourcing

production



skills

natural over industrial

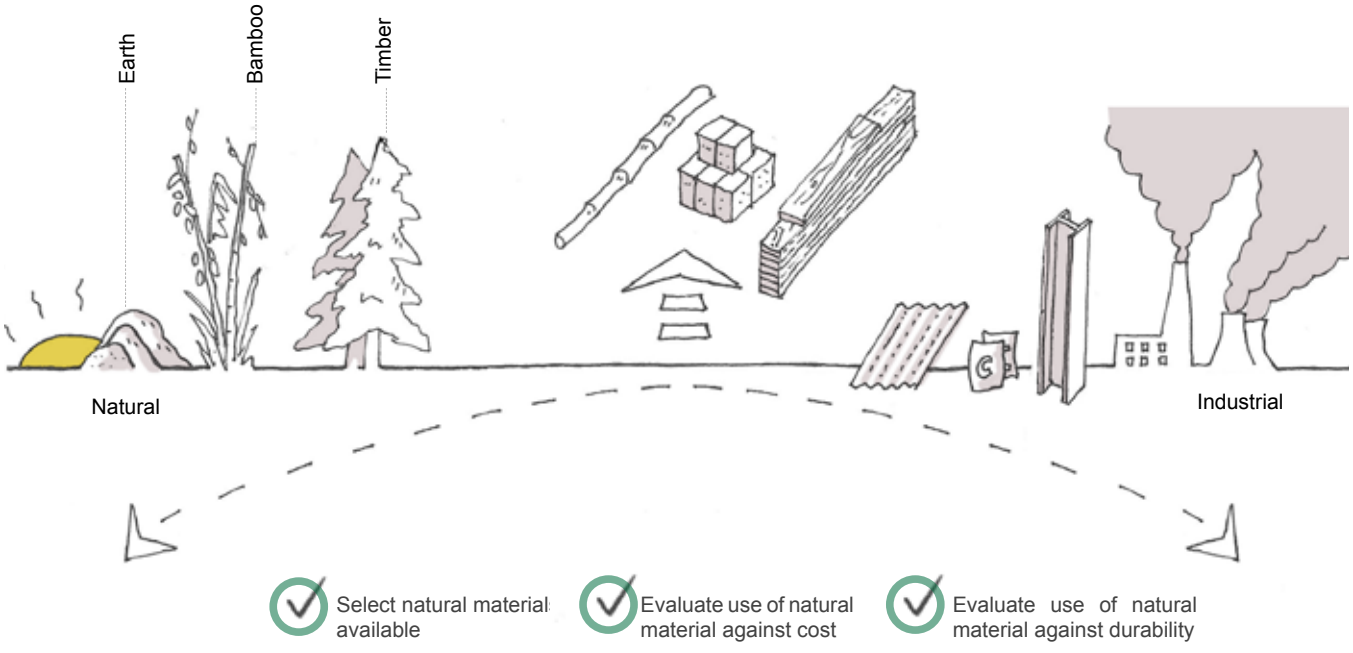
A preference should be given to natural over industrialised materials and components. This should be considered alongside a cost-benefit analysis of the environmental impact of each process versus its properties and longevity.

Non-toxic
Minimising the use of materials with toxic or harmful substances implicit in the manufacturing process, or end product, at all costs.

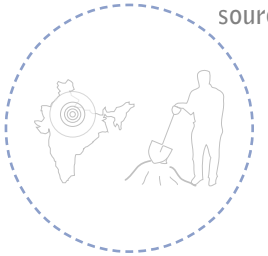
Avoid monstrous hybrids
Avoid where possible the use of products or components where combinations of materials are chemically bonded together, hindering the possibility of reuse. deconstruction and recycling in the future.

When choosing between industrial and natural materials, it is not the case that all industrialised materials should be rejected on environmental grounds. Each material/ component should be considered in terms of their comparative costs in relation to their value added.

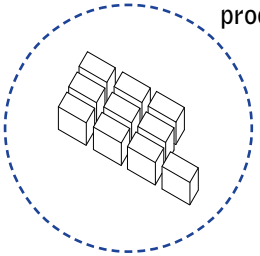
Through research and experimentation during the workshop the students and professionals concluded that intermediate, or hybrid technologies provided the best value. CSEB blocks were compared with typical CEB or mud wall. While the addition of cement in the mixture of the block raises the embodied energy and overall environmental impact of the component, it was concluded from experimentations during the workshop and field experience during earlier projects by SEEDS that the additional strength and useful life of the component as a result of this addition is an acceptable trade-off.



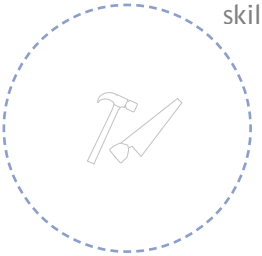
sourcing



production



skills

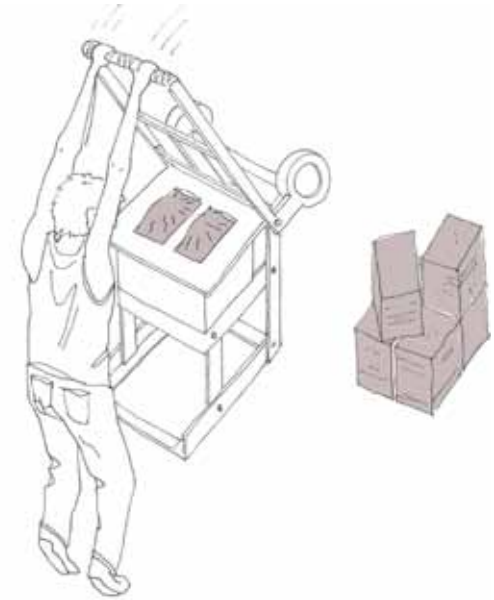


easily replicable

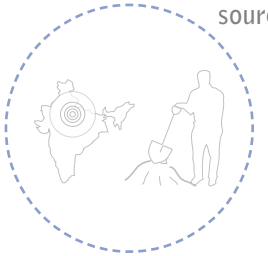
Materials should be chosen where supply chains can grow in capacity and be easily sustained. Components and resources which are limited to a single location or known to be in short supply should be avoided.

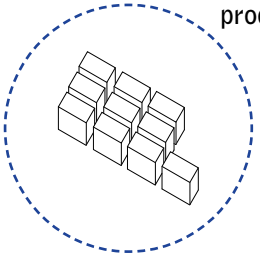
It is crucial that the energies given to testing and evolving better building techniques are replicable and can be easily scaled-up. Given the massive task of reducing risk in the region of the Indian Himalaya it is crucial that efforts are strategic and consider efficient techniques and processes which are quickly and simply disseminated after a disaster as well as in preparation for the next disaster.

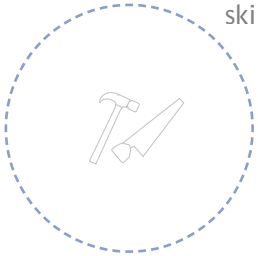
This is demonstrated through the use of technologies such as CSEB and bamboo construction where the processes and techniques are easily replicable, as are the tools and machinery required to manufacture such elements. However the materials themselves and skills used during the manufacturing process can and should be entirely local.



Simple, replicable technologies such as the manual compressed earth block making machine should be favoured over one-off crafted elements or heavily industrialised mass-produced components



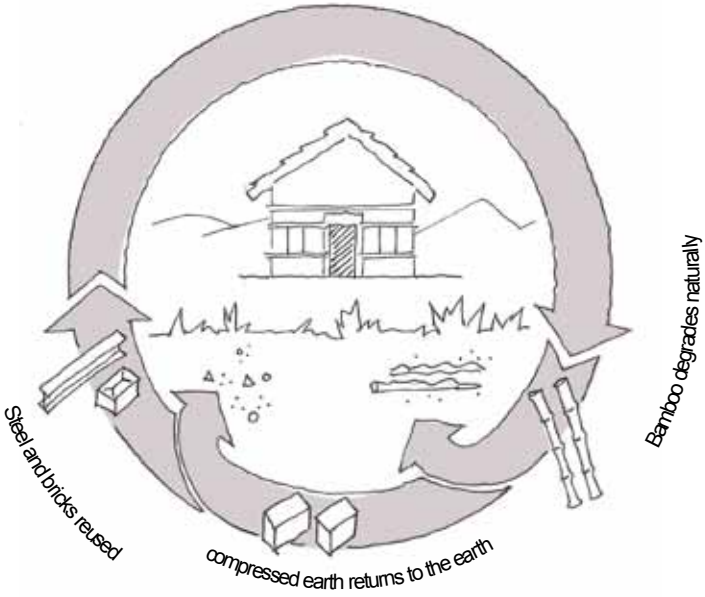




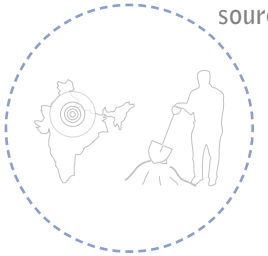
reusable / recyclable / biodegradable

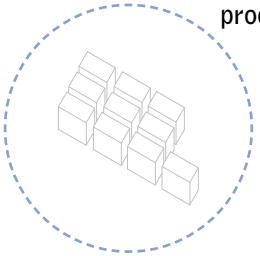
All materials and components selected for the design are considered in relation to the components individual life-cycle cost and possibility for reuse and recycling following demolition or deconstruction.

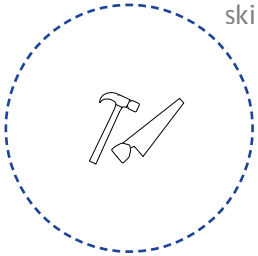
Methods of joining and bonding all materials and components allow for easy modification, adaptation and maintenance. Screws and bolts are selected over nails and complex composite materials are avoided where possible.



This diagram shows the cycle of materials from use to re-use and biodedgrading.





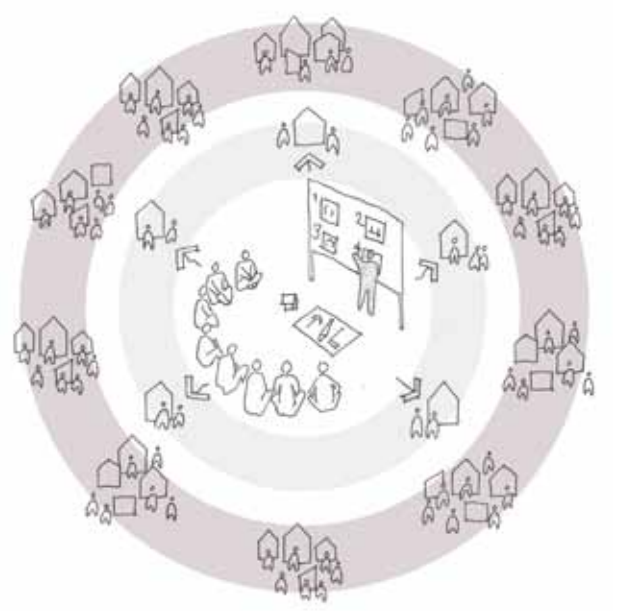


building capacity

A construction process that utilises local skills where possible, and builds the capacity of local masons and carpenters through knowledge transfer and training opportunities.

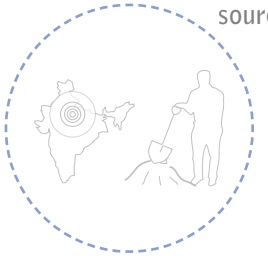
It is important that post disaster and long term development planning does not consider shelter as an isolated entity. Instead, the entire process of shelter should be considered as an opportunity to rebuild or strengthen livelihoods at a local level and enable the transfer and cross fertilisation of new skills and ideas.

Throughout SEEDS programmes on post disaster and disaster risk reduction and mitigation, there is a core idea of building capacity through training and skills transfer. This is most evident through the SMA (SEEDS Masons Association). The SMA was created to develop a pool of safe construction skills and knowledge amongst masons following natural disasters. The SMA now contains over 1000 members. As part of every post disaster construction or training project SEEDS undertakes, new masons are given rigorous training in safer construction, the most promising and dedicated of whom will be offered membership to the SMA.

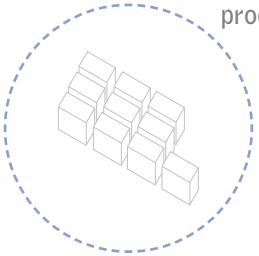


Training and capacity building workshops empower local masons and community members to upscale and transfer safe, sustainable construction methods to new districts

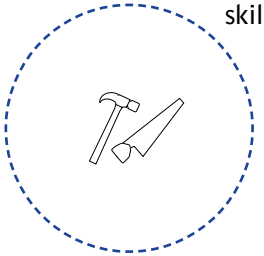
sourcing



production



skills



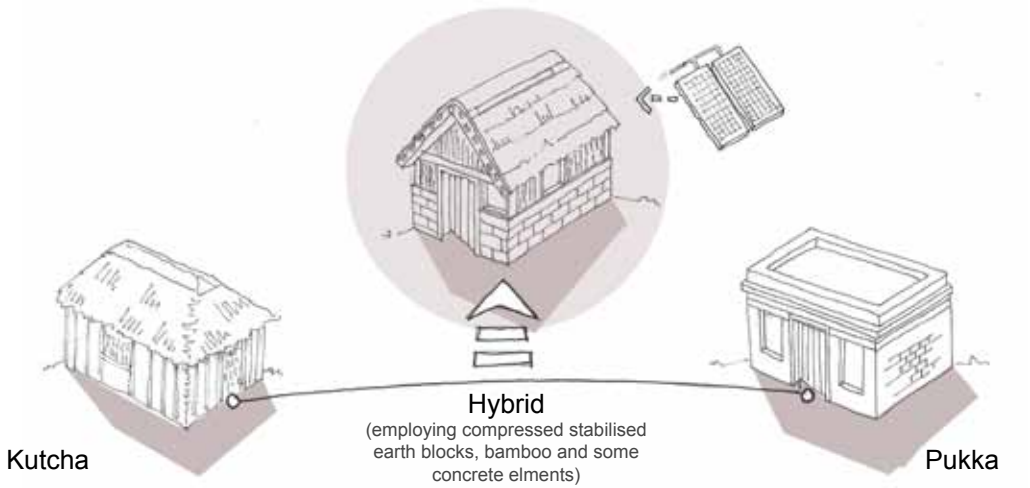
intermediate technologies

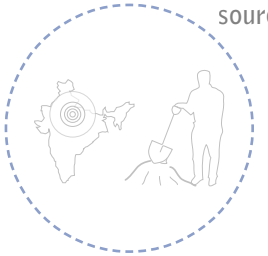
The use of materials that relate to the traditional vernacular whilst utilising state of the art research and technology to create green intermediate technologies. Local, natural materials used where suitable whilst acknowledging the need for the sustainable management of indigenous resources.

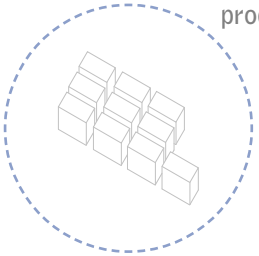
Earth, stone, slate and timber, are traditional materials used in house construction in the region of Almora and are typical to much of Uttarakhand.The majority of these materials are no longer readily available. Illegal logging has caused widespread deforestation and excessive quarrying has led to a ban restricting new excavation. The traditional house construction worked well in the local climate and demonstrated a resistance to seismic activity, which is lacking in almost all modern un-engineered RCC homes.

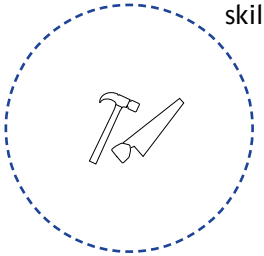
The challenge is therefore to achieve a new, contemporary vernacular which draws on the knowledge and expertise of the old, utilising local materials, but without further exhausting heavily depleted resources. Technologies such as bamboo frame and CSEB represent just such an intermediate technology which acknowledges the aspirations for the modern without disregarding the lessons of the past.

Diagram illustrating the range of traditional, modern and intermediate technology.









local livelihoods / enterprise / markets

The procurement and processing of materials should utilise and reinforce local networks of production and exchange to promote local livelihoods and expertise.

Current trends are moving towards greater centralisation and industrialisation of materials and component manufacture which is leading to a loss of expertise, jobs and enterprise local to rural-urban areas. The guide advocates a reverse in this trend to smaller, locally specific enterprises which ensure labour, skills and capital are retained within the local community.

This methodology was used during the construction of 400 transitional shelters and 200 sanitary units as part of the Balasore Ashraya Jojana. A material yard was set up within the locality of the affected area, utilising locally available labour to make the various components required. The shelters were designed to allow for off-site prefabrication locally which enabled higher levels of quality control and efficiency. Components included RCC columns, reinforcing rods, bamboo trusses and CSEB. All the labour was sourced from surrounding villages overseen by a local contractor, facilitated by the SEEDS project team.

The workshop mapped out the skills and labour locally available as part of the harvest map process. Groups developed a simple business card system which recorded the contact, skills and location of all masons. It was a simple yet highly effective system which began to form a database of skills and knowledge which was left behind for use and further development by the host NGO.

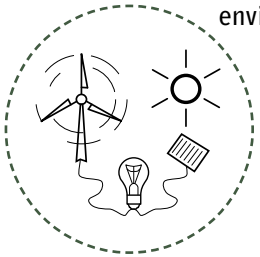
The diagram shows the potential of a shelter to utilise local resources and how this might create networks within the area.

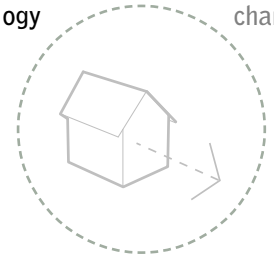
The reality of sourcing non-renewable resources in Almora

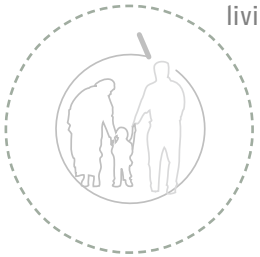
Ecological degradation from mining in Almora

Replicable techniques

Sustainable local resources







low-tech

A design which favours low-tech approaches over highly industrialised components and processes, will ensure the design is easily adaptable and replicable under varying conditions and constraints.

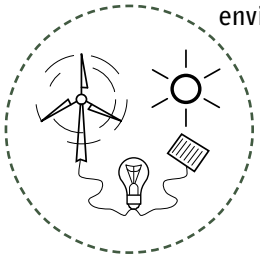
The over-reliance on hi-tech, highly industrialised materials in shelter construction has resulted in a dependence on 'foreign' materials and components often imported from many thousands of miles away. These often bare no relation to the resources locally available and as a result present no benefit to the local economy or local skill base. In addition hi-tech components often result in a dependence on the original manufacturer for installation, maintenance and modification which makes the product unsuitable in changeable environments.

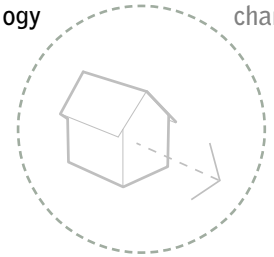
The workshop tested the use of CSEBs manufactured from a manual block making machine which could be easily transported and therefore implemented locally, without the use of expert skills or highly technical tools and costly maintenance. In contrast a hydraulic block making machine could produce blocks of a far greater strength, with a locking profile which does not require the use of motar during construction. The hydraulic machine however is not easily transportable, is costly to run using a diesel motor, is approximately 5-6 times the capital cost of the manual machine equivalent and expensive to maintain requiring regular servicing from a specialist engineer. For the remote region of Uttarakhand where transport links are restricted to narrow and winding roads the manual machine possessed a number of advantages over the hydraulic equivalent.

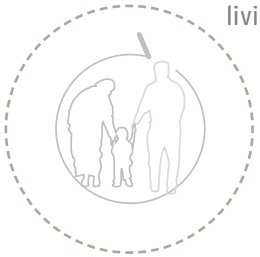
Tool belt

Guidelines

The aspiration is a shelter which is buildable with the most basic tools and instruction





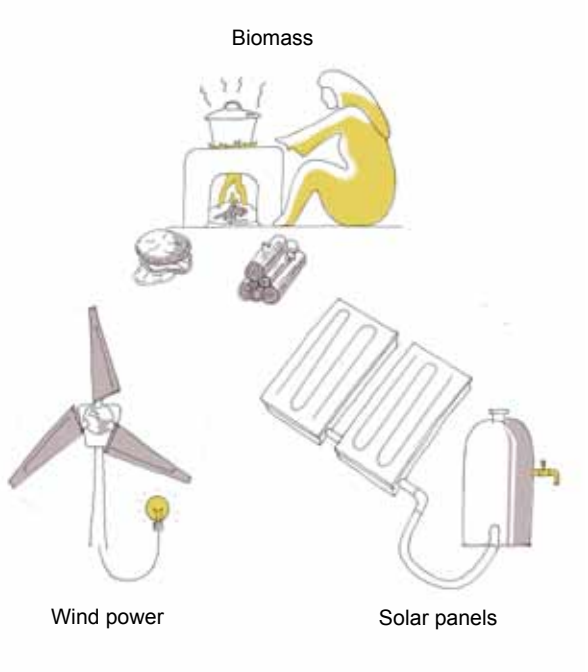


green-tech

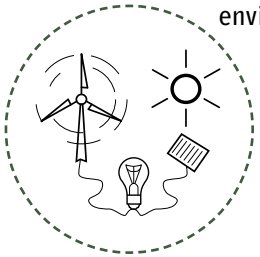
Where appropriate and economically viable, the designs seek to use all available green technologies which will lower the operational energy and subsequent carbon emissions of the shelter.

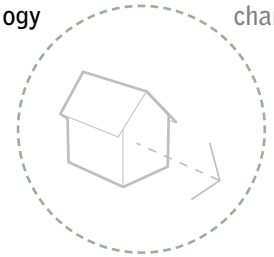
The design should consider all operational energy and resource requirements including any waste outputs from a shelter or cluster of shelters. Solar thermal and solar electric panels are considered a priority whereas biomas stoves may also be a viable and efficient alternative to open fires during winter months.

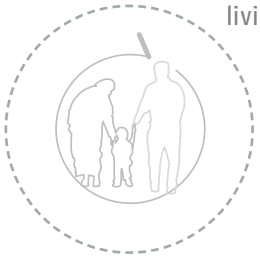
An NGO located in the north of the district of Almora, Uttarakhand, called Aarohi demonstrates the value of utilising appropriate green technologies such as solar thermal and solar electric panels which provide clean and free hot water and electricity. Given the often high initial cost of such systems appropriate incentives provided to families and communities would result in a dramatic increase in the uptake of green technology. Where organisations are considering the provision of green technologies as part of a shelter strategy, community or cluster level systems might be considered to save cost and encourage community engagement.



Three renewable sources of energy





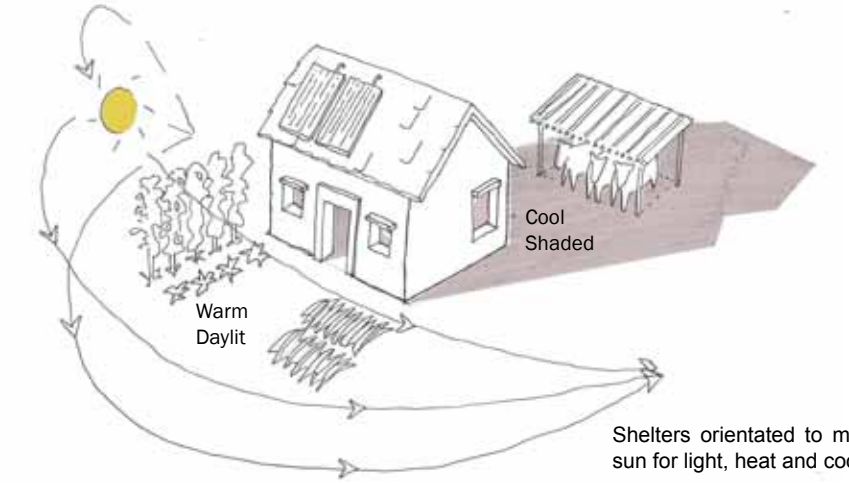


orientation

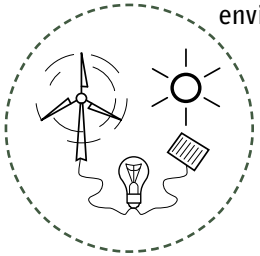
The orientation of the shelter takes into account any risks presented by the topography including restricted access and considers the sun's path and the opportunity to maximse natural light and solar energy.

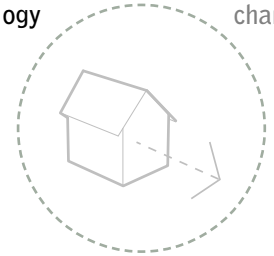
The appropriate orientation of a shelter can have a massive impact on reducing the risk of damage to a structure in future disasters, will enable passive environmental strategies which reduce the need for heating and cooling and can result in more enjoyable, healthier living environment.

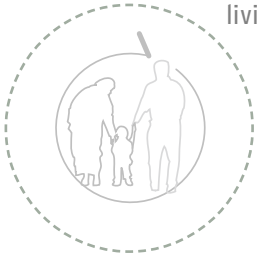
The shelter design options developed during the workshop considered the impact of orientation on the comfort of the occupants. The groups studied climatic charts and used sunpath diagrams to calculate the size, orientation and angle of any openings to the shelter for optimum ventilation and use of natural daylighting.



Shelters orientated to maximise the use of the sun for light, heat and cooling







thermal comfort / climatic appropriateness

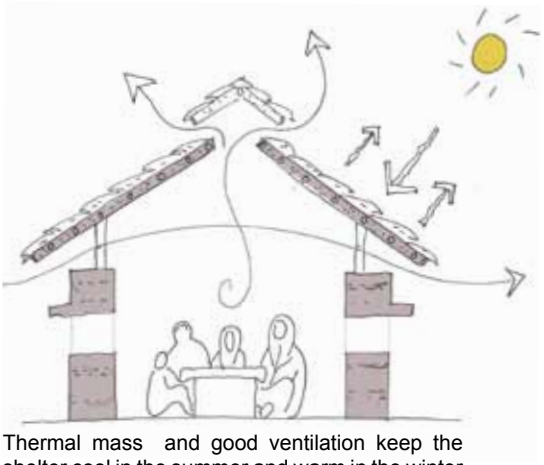
A design which responds to the local climate and ensures comfort for occupants through all seasons at all times of the year.

Shelter strategies seek to reduce overheating during summer months and also maintain warmth and comfort during the often freezing winter months.

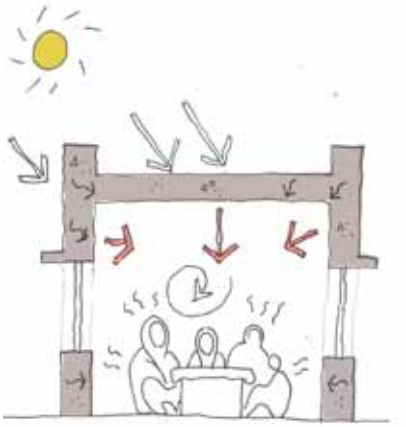
The traditional vernacular in the region predominantly utilised locally available stone, slate and earth as part of their construction which possess considerable thermal mass* ensuring a balanced and comfortable internal environment throughout the course of the year. Spaces can be heated and ventillated without the need for considerable energy inputs. By contrast the modern vernacular draws on the aspirations of urban living; RCC frame with brick infill and large openings which dramatically reduces the thickness and therefore the mass of the building fabric considerably reducing the thermal mass and stability of internal temperatures.

As part of the workshop, groups investigated various compositions of local materials with an agenda to create a building fabric of thermal mass which also respond to the aspirations of modern living. Options included CSEB with mud render and stabilised mud reinforced bamboo frame.

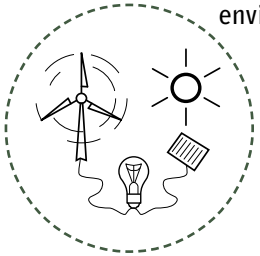
*Thermal mass is a concept in building design which describes how the increased mass of a building counters temperature fluctuations by absorbing heat over the period of a hot day and then emitting this heat back during the cooler nightime.

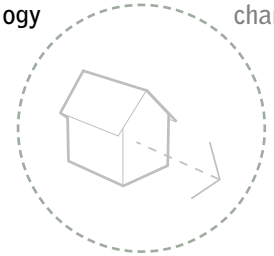


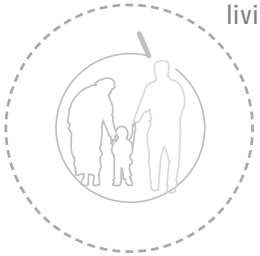
Thermal mass and good ventilation keep the shelter cool in the summer and warm in the winter



Conventional pukka concrete construction results in overheating in the summer and cold temperatures in the winter







disaster resilience

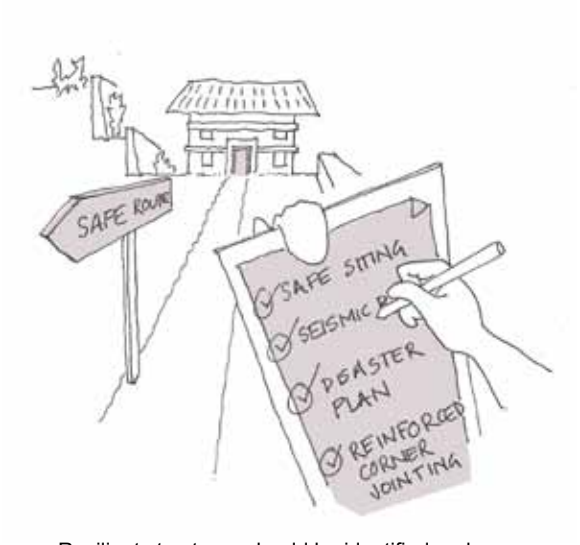
A shelter which employs disaster risk reduction measures ensuring the shelter will demonstrate resilience in any natural disaster.

The shelter design should consider any risks in the local area, which could include earthquake, flash flooding, severe storms including cyclonic winds and heavy snow which are not uncommon during the monsoon and winter seasons.

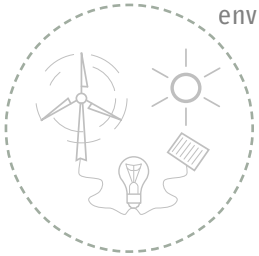
The traditional building style of northern Uttarakhand known as Koti Banal utilised traditional materials often building to great heights whilst possessing excellent seismic resilience. The Koti Banal technique demonstrates a hybrid timber-reinforced stone masonry system. In the lower parts of the walls the timber logs are interconnected establishing a very solid ring beam while the timber elements on the upper parts are mainly of a reinforcing purpose. The walls further transfer the loads to a stone-filled base platform which is the continuation of a stone foundation. The technique ensures sufficient flexibility and strength to respond excellently in the event of an earthquake. Examples of Koti Banal structues over 4-5 storeys in height, in excess of 100 years of age still exist today despite suffering many earthquakes over their lifetimes.

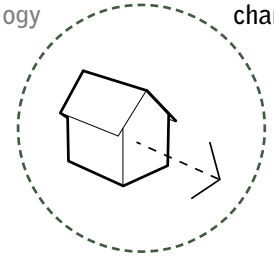
[Earthquake Engineering Research Institute (EERI) and International Association for Earthquake Engineering (IAEE) HOUSING REPORT Timber-reinforced Stone Masonry (Koti Banal Architecture) of Uttarakhand and Himachal Pradesh, Northern India]

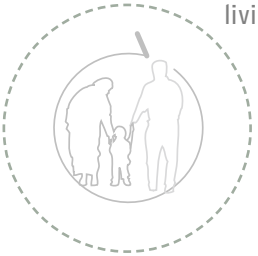
In contrast to the Koti Banal building style is the modern use of unengineered RCC which is often employed on the edge of steep slopes without the appropriate degree of reinforcement or structural banding. The structures are entirely rigid owing to the nature of concrete and therefore cannot flex or tolerate any seismic activity. The result is a highly vulnerable structure prone to cracks and collapse in the the event of even moderate earthquakes.



Resilient structures should be identified and promoted within a community







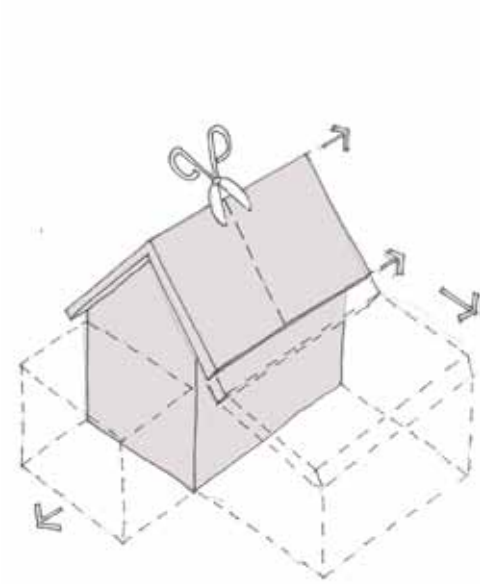
adaptable

A shelter that is adaptable both functionally and structurally in order to respond to the changing needs of the occupants and changing climate. Specifically, the shelter is also extendable and able to be changed over time.

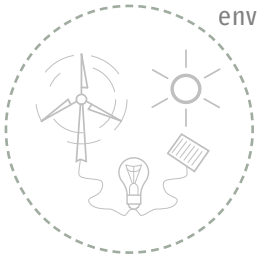
Extendable
In anticipating the growth of families and settlements; a design which facilitates safe and economical expansion.

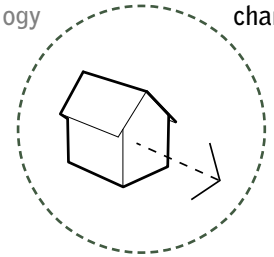
Incrementally changed
A design which can structurally and spatially adapt to changes of family size and custom with economical ease, without the need to demolish or drastically change the overall structure.

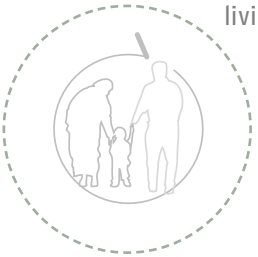
Students of the workshop considered the adapability of a shelter design in relation to SPHERE space standards and a limited budget. It was proposed in one example that the sehlter could incorporate an external covered space which could be infilled with walls at a later date when additional funds and materials were available. As a result the shelter can evolve and expand over time in conjunction with changing constraints of resource availability, capital and lifestyle.



Structures capable of adapting over time to changes in family structure and use





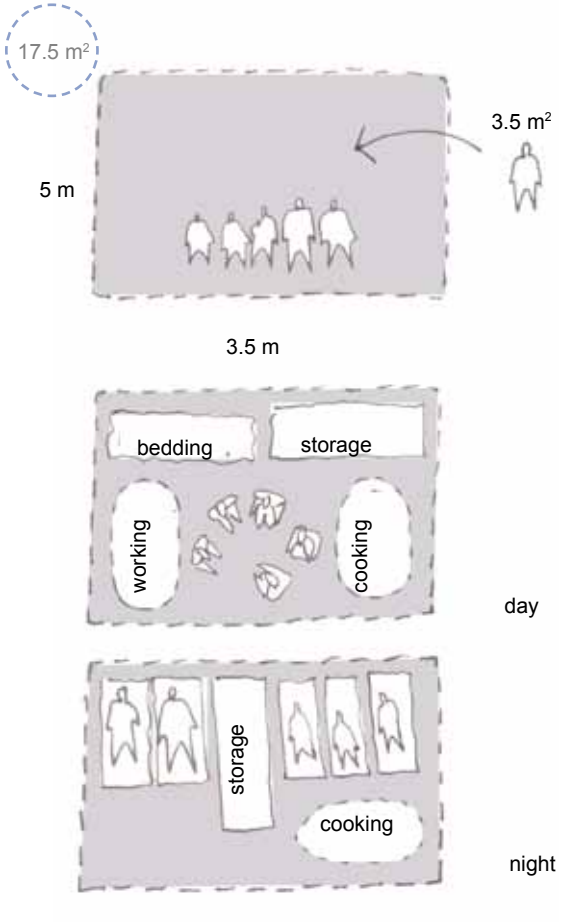


spatial standards

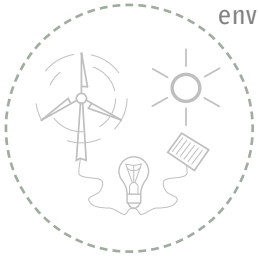
A design which meets the minimum international space standards for shelter, referencing SPHERE guidelines of 3.5m^2 / person as a minimum.

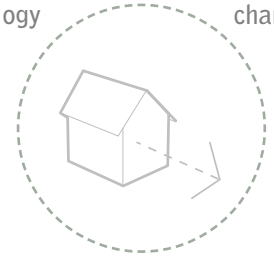
The sphere standards represent the minimum standards to be attained in shelter, settlement and non-food items, and embody the principles and rights in the Humanitarian Charter. Within the standards for shelter, 3.5m^2 represents the minimum covered floor area per person, and is suggested for most climates and contexts. In cold climates where families will spend the majority of time inside, and urban contexts where external space is limited, meeting this standard is particularly important. Where it is not possible to meet the standard, steps should be taken to meet the spatial requirements as soon as possible, and adequate roofing and structural support provided in the interim period.

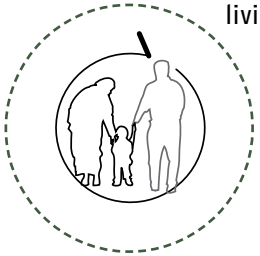
During the workshop basic spatial standards were considered by the shelter design group, and the internal spatial layout was planned according to activities that would take place in the home.



Floor plan of shelter design showing allocated space for different activities







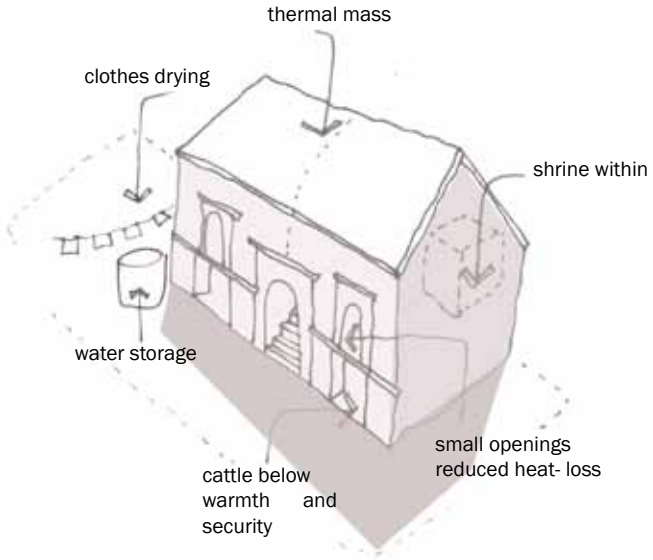
spatial qualities

A functional layout, natural light, and ventilation all contribute to a positive internal living environment. This should be achieved through a good understanding of current lifestyles and the qualities of the traditional vernacular.

Spatial qualities can at times be seen as a luxury, when the emphasis is on the speed and cost effectiveness of the shelter implementation. However, basic consideration of layout, light and ventilation can have a significant impact on quality of life, and health and well-being. They arise from good planning and consideration and value of the traditional vernacular.

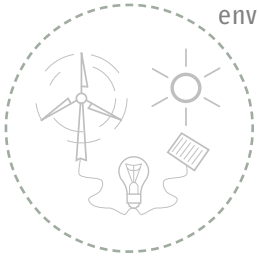
The traditional vernacular is designed in such a way to provide a comfortable internal and external living environment.

- air quality
- light
- ventilation
- thermal comfort
- space

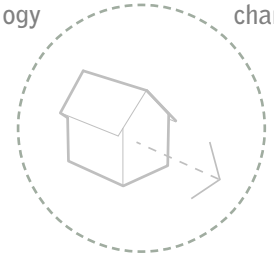


qualitative elements - locate these on shelter design

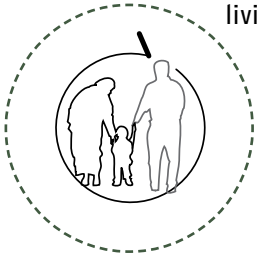
environment and technology



change over time



living standards



aspirational

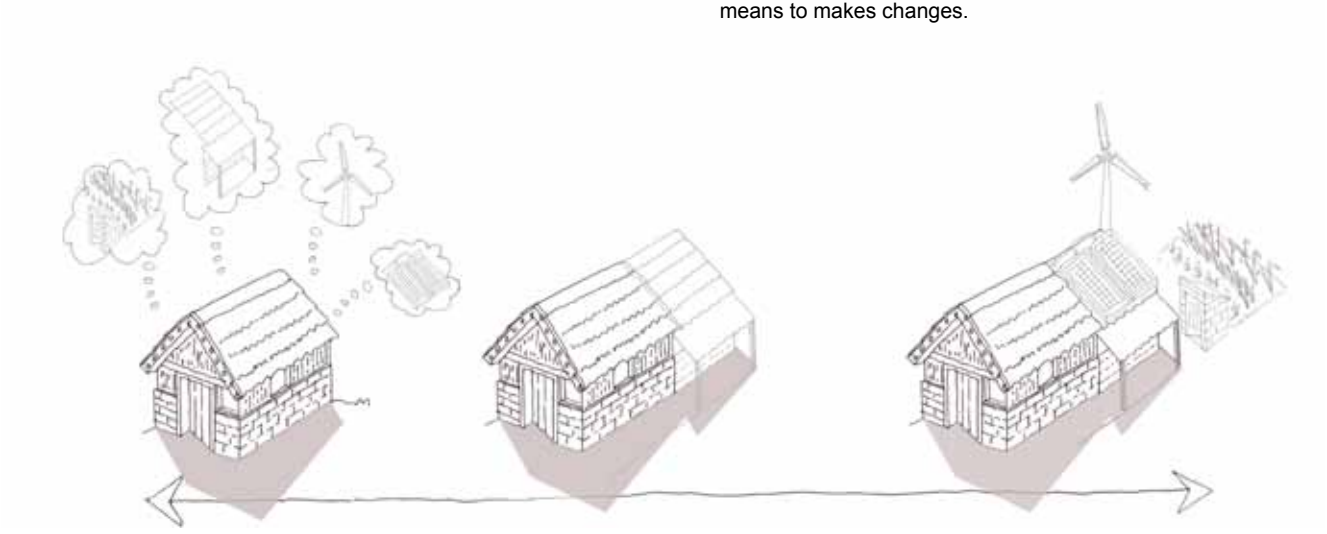
A prototype shelter design which is aspirational for all levels of society combining both function, beauty, and demonstrate innovation and consider the present and future needs of the occupants.

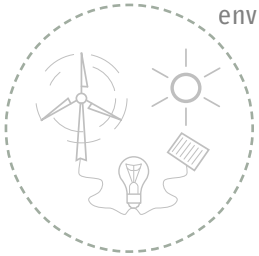
Aspiration is the feeling of hope or ambition to achieve something or reach a goal, often driven by exposure to alternatives and innovation.

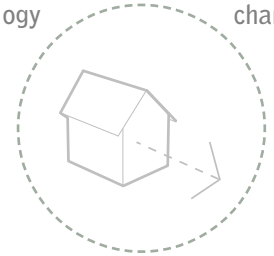
Exposure to the construction being employed within the urban environment is one of the factors that has lead to the changes in construction techniques used in the community; in the choice of materials and spatial arrangement. Interviews with locals suggested techniques were being imported from urban areas.

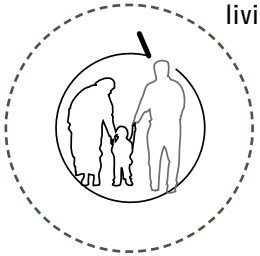
The workshop considered the design of a shelter which would allow and encourage aspiration, but with sustainability in mind.

The diagram illustrates how a modest house can allow for aspirations and change over time as the users have the means to makes changes.









culturally appropriate

Design proposals which represent and support the local culture by enabling religion, social structures, established customs and the general way of life to continue and adapt in the future.

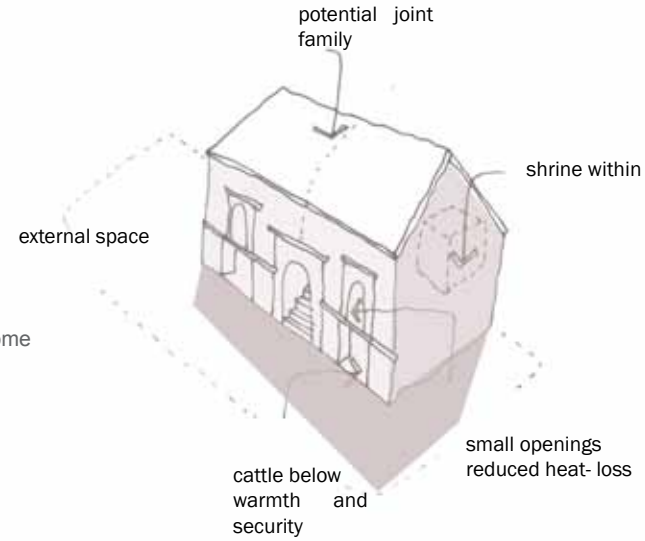
It is essential that the design of the shelter and the materials used are culturally and socially acceptable. It helps if they relate to the local materials being used already, and do not have any negative association. 'The orientation of the individual shelter or covered area, the sizing and layout of the space provided, the positioning of door and window openings for adequate access, lighting and ventilation, and any internal subdivisions should reflect local practices where these are known to be safe.' (Taken from the SPHERE STANDARDS)

The design group considered the important features of the traditional vernacular construction and how a shelter constructed from different materials could also be culturally appropriate.

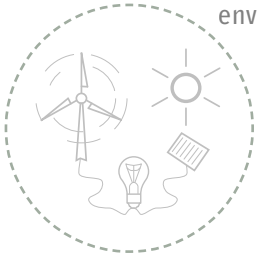
The group found out that In the area where the workshop took place bamboo is associated with the transportation of dead bodies. As a result it is considered very auspicious to use it for any form of construction within the home.

- male and femal space
- sequence of spaces
- large courtyard and open spaces
- joint family system
- areas for storage
- location of fire
- cattle close to home
- shrine
- small openings

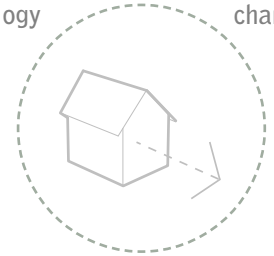
Diagram highlighting the important features of traditional vernacular construction



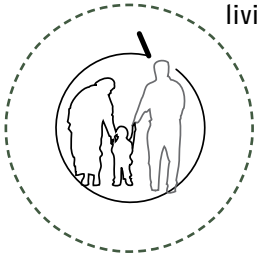
environment and technology



change over time



living standards



positive impact

A design which increases the health and safety of its occupants, encourages biodiversity with minimal negative environmental impact and which promotes social cohesion and development

If shelter is understood as a process and not just a product, (as explained by Ian Davis, Shelter after Disaster) the process of shelter design and construction has the potential to have a positive impact on lives and livelihoods if devised in fair and just way.

All of the SEEDS projects ensure that rehabilitation is empowering.They aim to build capacity of the community through ownership transfer, promotion of a culture of safer building practices and at the same time bridging the gap between knowledge and practice. The community can be involved in the process of rehabilitation by contributing to the preparation of a model rehabilitation programme and through training and confidence building.

This diagram shows the steps from vulnerability towards resilience:

1. assess traditional and contemporary vernacular housing

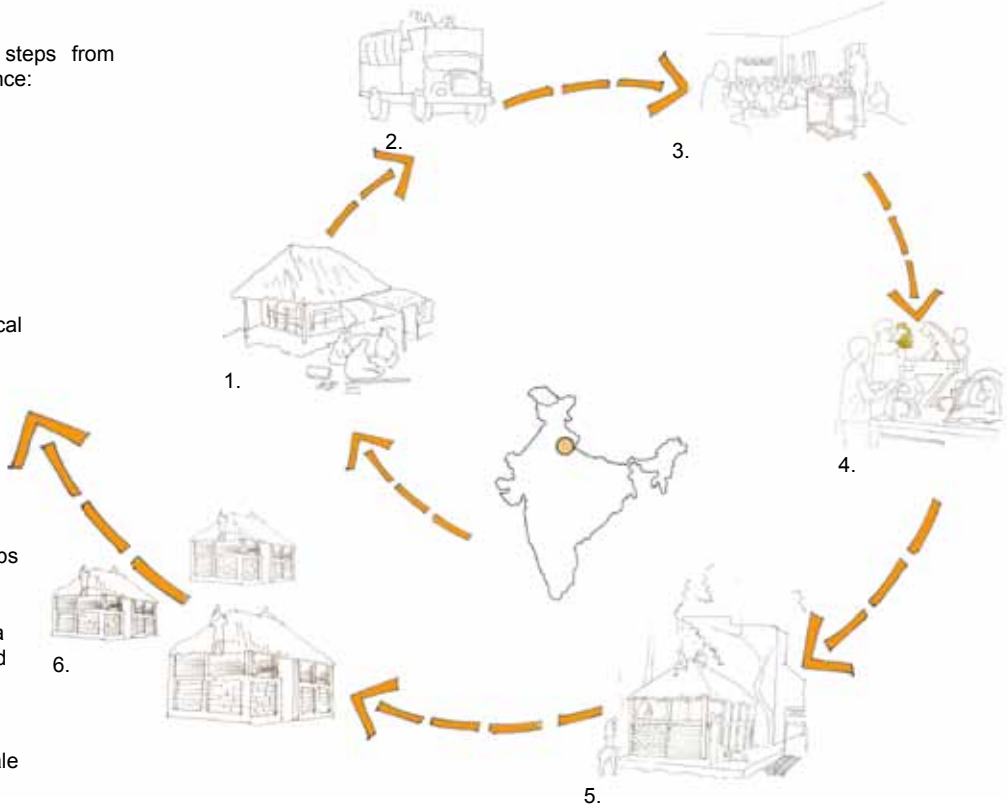
2. consider availability of local resources, skills and labour

3. conduct sensitisation workshops with local community on safe and sustainable construction

4. organise mason and contractor training workshops in appropriate technology

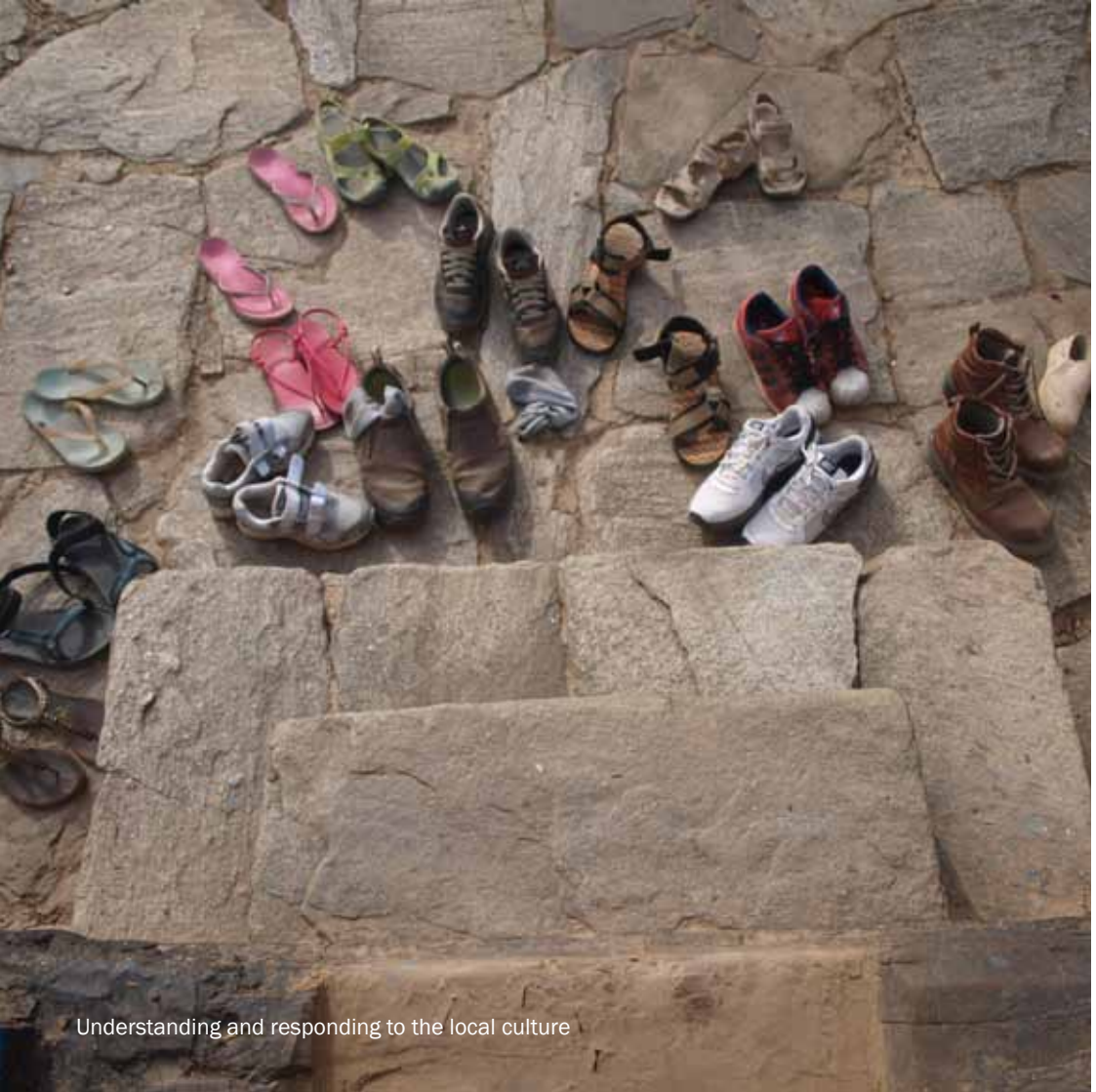
5. construct a prototype of a locally appropriate, safe and sustainable shelter

6. support the process of construction on a larger scale



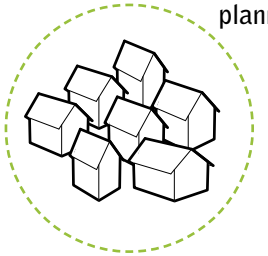
Using green technology when appropriate

Utilising local skills and local knowledge



Understanding and responding to the local culture

Building a new vernacular - utililsing local materials



spatial layout and proximity

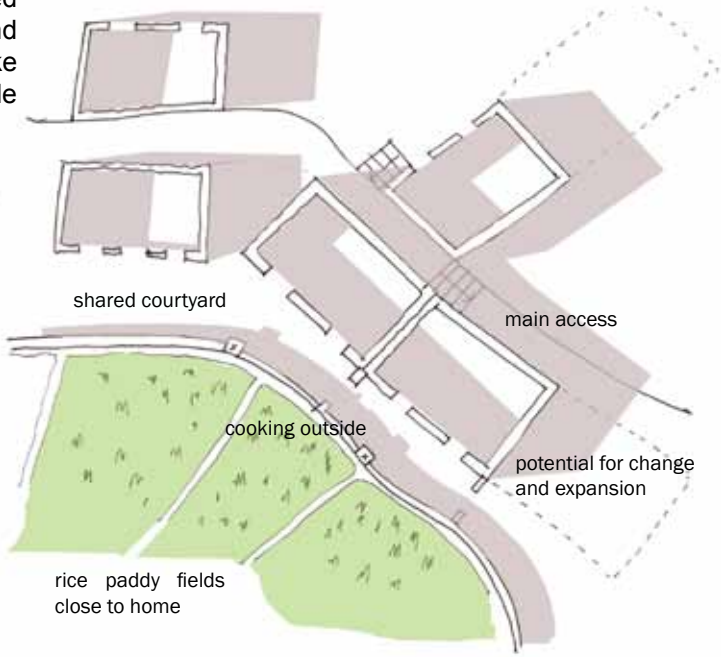
Siting of homes to allow for proportional amounts of public and private space, which considers future expansion and mitigates against the spread of fire or building collapse.

Relationship to land and livelihood
Consider location of housing in relation to land and livelihood opportunities to make it economically and socially viable for people to work and live within the community.

Allowing/planning for change and expansion
The creation of a community forum for facilitating and discussing safe and sustainable strategies for future development in an inclusive way.

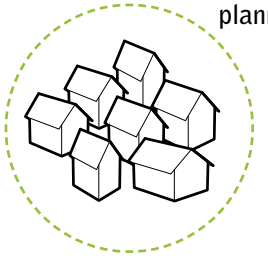
Villages built on slopes in the Himalayan region are organised as small clusters of houses which share external space, and at times access to resources such as water and crops.

In the village where the workshop was based there was a strong relationship between land and livelihood. Rebuilding should always take place on or as near to owners sites as possible during reconstruction.

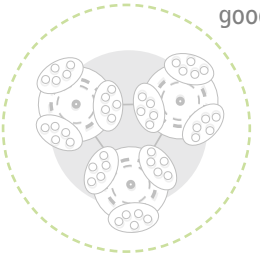


A diagram showing the existing cluster layout and potential for expansion.

planning



good governance

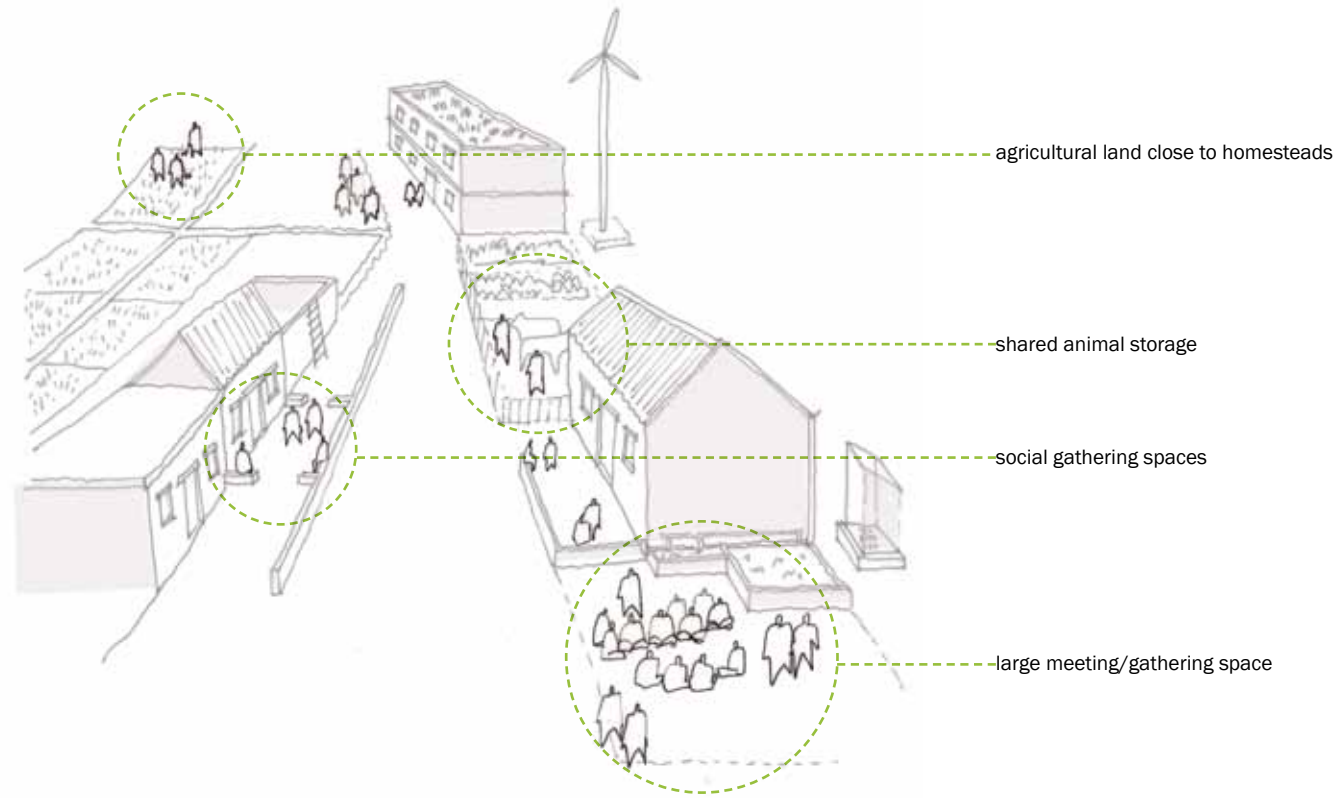


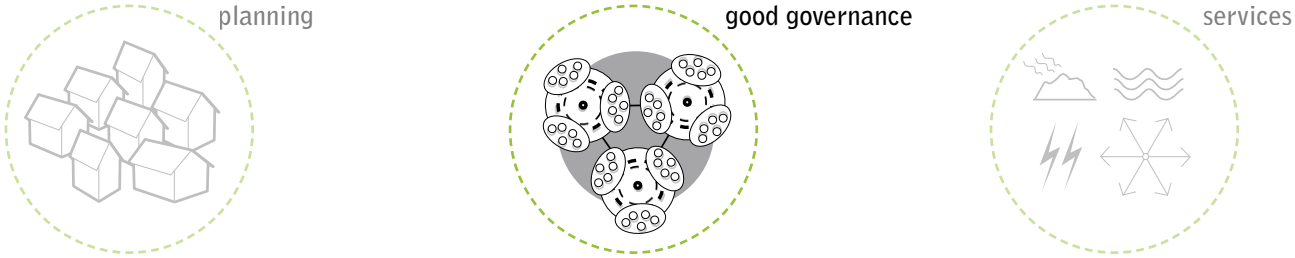
services

enabling community

A layout and planning process which facilitates the clustering of homes to promote a sense of community, and enables interaction between neighbours and the potential sharing of resources.

Certain elements of planning are necessary to facilitate and enable community. These include proximity to neighbours, common beliefs, and shared resources.





good governance strategies

A framework for governance within the village which is transparent and fair for all, including the formalisation of groups and associations which facilitate networks of communication on local skills, safe building methods and available resources.

Governance is defined by the World Bank as 'the exercise of political authority and the use of institutional resources to manage society's problems and affairs' and relates to the activity of governing. 'Good governance has 8 major characteristics. It is participatory, consensus oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law. It assures that corruption is minimized, the views of minorities are taken into account and that the voices of the most vulnerable in society are heard in decision-making. It is also responsive to the present and future needs of society.' (UNESCAP http://www.unescap.org/pdd/prs/ProjectActivities/Ongoing/gg/governance.asp)

The panchayat structure is the governance structure that exists within villages across India. The “Panchayat” is an assembly (yat) of five (panch) wise and respected elders chosen by the village community. The role of these assemblies traditionally was to settle disputes between individuals and villages, but today the Indian Government has also decentralised several administrative functions to the village level.

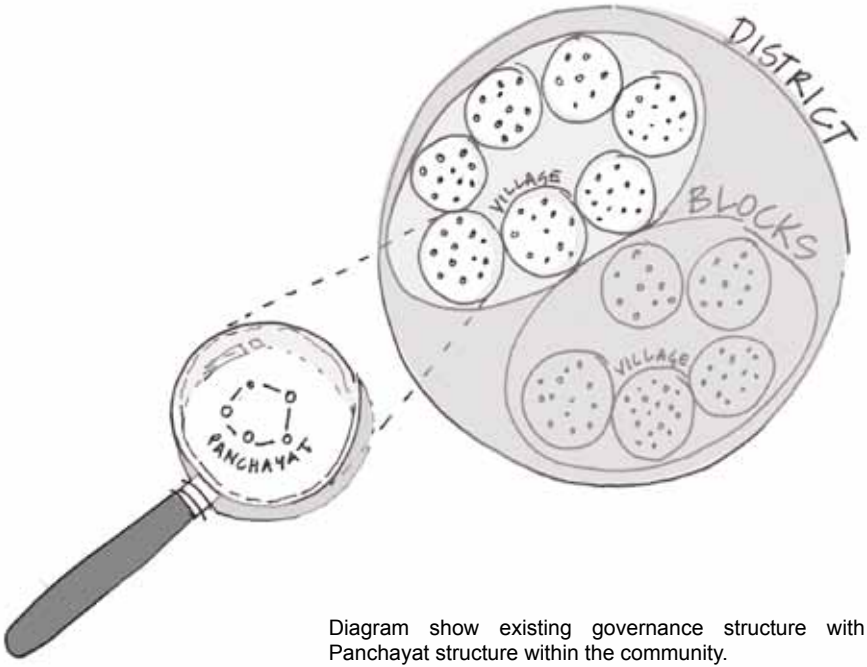
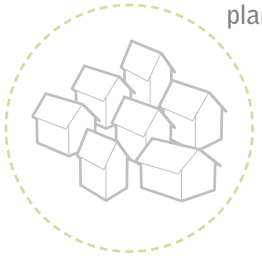
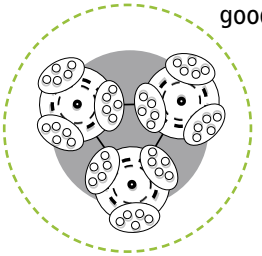


Diagram show existing governance structure with the Panchayat structure within the community.





managed infrastructure

Shared infrastructures are managed through a community forum which meets periodically to consider maintenance and development issues.

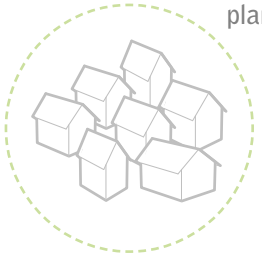
If infrastructure is to be managed and developed on a local level the community needs to consider who will maintain the infrastructure and how it will be financed.Local management is not always possible and therefore in these cases advocates in the community should be identified to represent government or service companies.

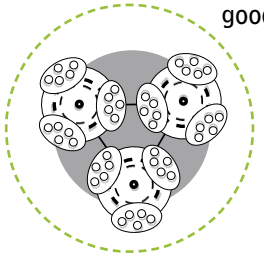
This diagram suggests key local infrastructure within a village.

sources of heat and light

water sources

roads and paths





disaster management planning

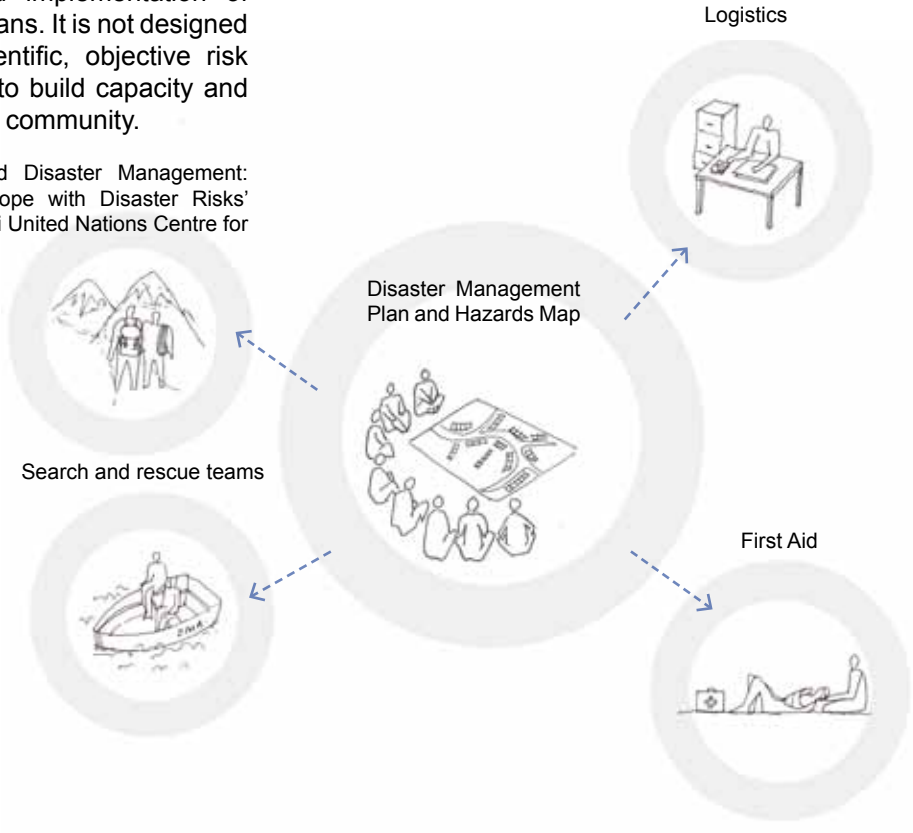
Implementing a community disaster management plan based on the hazard map, which raises awareness within the community and proposes strategies for reducing risk and planning for a future disaster.

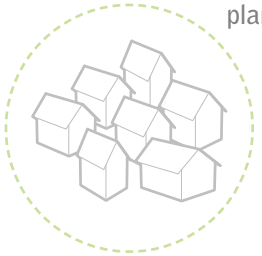
hazard mapping
A map of the village or local area which identifies all existing and potential hazards, which is disseminated throughout the settlement. This encourages them to evaluate their own situation

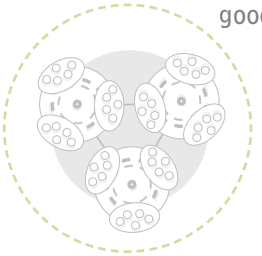
A community disaster management plan encourages the community to analyse their local conditions as they see them, and be involved in decisions regarding management of resources, contingency planning and implementation of community development plans. It is not designed to exist instead of a scientific, objective risk analysis, but alongside it, to build capacity and transfer resources in to the community.

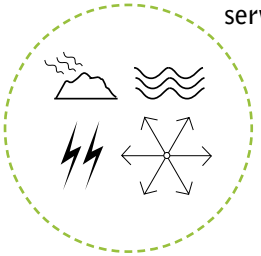
(Taken from 'Community Based Disaster Management: Empowering Communities to Cope with Disaster Risks' Bishnu Pandey and Kenji Okazaki United Nations Centre for Regional Development, Japan)

Components of Disaster Management Plan









water and sanitation

An approach that promotes improved water and sanitation practices, recognising the needs of women and children, and acknowledging the cultural shift required in places to accommodate change.

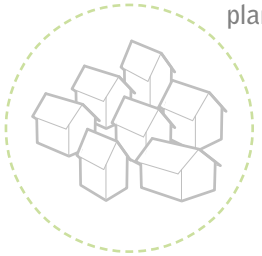
Open defecation is a widespread practice in rural India, partly due to cultural factors and a lack of proper understanding on hygiene. Women suffer the most with regard to sanitation especially in flood conditions when families are lodged on roof tops.

SEEDS have tried to include water and sanitation components along with shelter strategies. These have varied from shared community latrines with attached bathrooms in the case of Barmer, Rajasthan and one sanitation unit per two families in Balasore, Orissa. Building toilets alone cannot change behaviour, but through sensitisation workshops with the community and ongoing dialogue there is a gradual shift in behaviour towards trial and investigation of the new sanitation units.

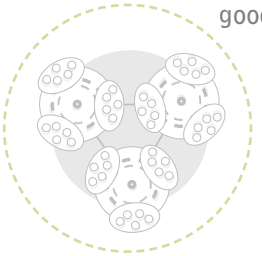
The steps to changing attitudes and behaviour towards sanitation

Sensitisation workshops | Sanitation prototypes | Personal sanitation units

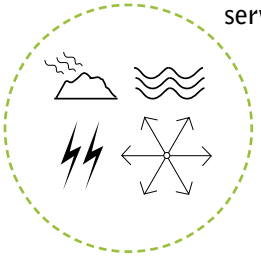
planning



good governance



services



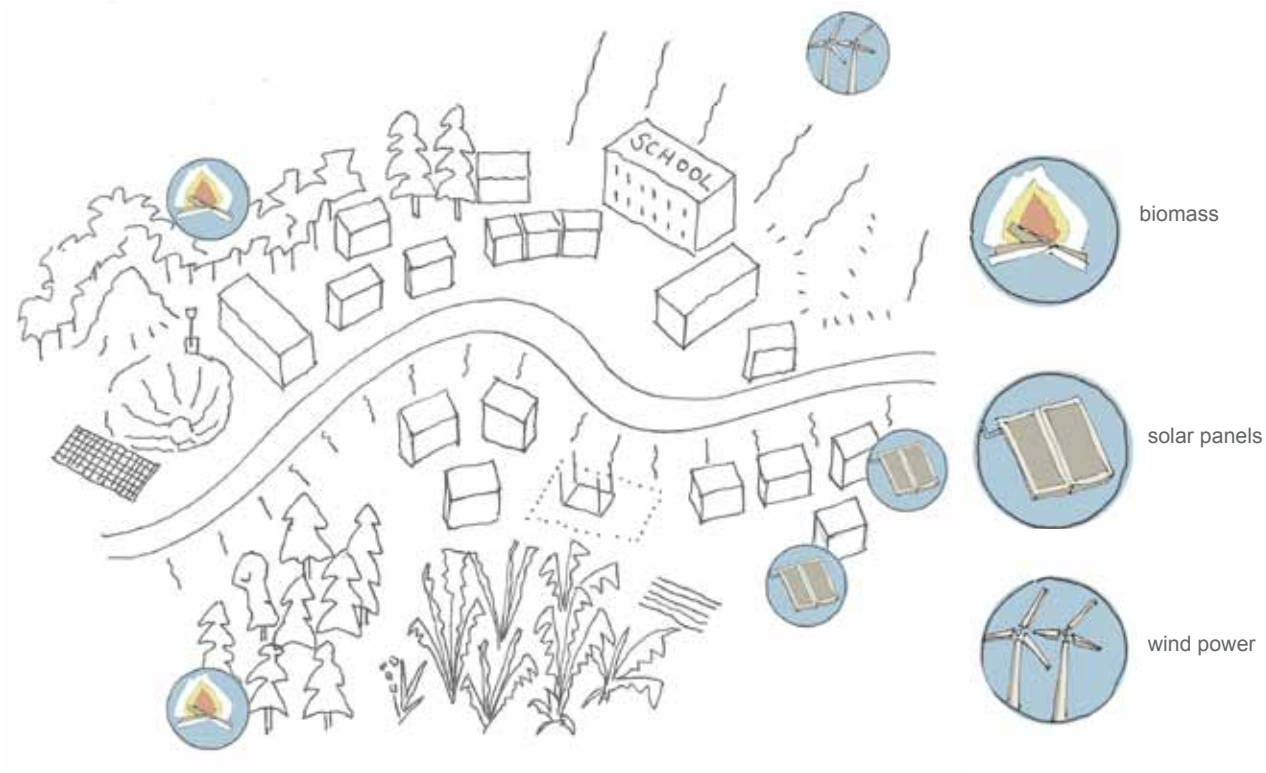
energy

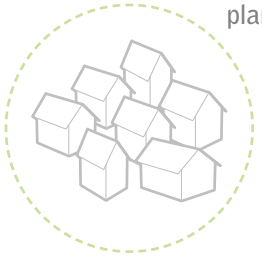
Considering community level micro-generation and management using renewable energy technologies to generate safe, clean energy at a local level

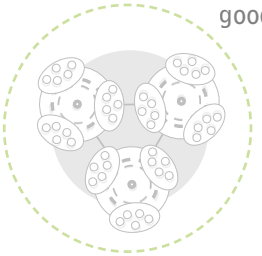
Micro-generation and renewable energy at a local level can be useful to members of rural communities for a number of reasons. It can allow the necessary light in the evening within the home, for children to complete their homework and for income generation projects to continue.

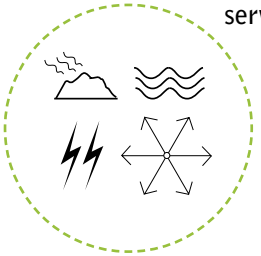
An energy network which is not dependent on a grid offers greater resilience, self sufficiency and pricing control at a local level. A village could consider how clusters of housing could be used to generate energy.

This diagram suggests key points for energy generation within a village.









waste disposal

Strategies and practical measures in place to reduce waste generation, organise collections and sorting to facilitate reuse and recycling.

Currently urban India has hundreds of thousands of informal sector waste-recyclers, comprising waste pickers, waste buyers and waste reprocessors. They bear the brunt of the city's consumption and offer it the only recycling services it has. (Chintan)

Diagram showing potential for different waste stream to be collected and recycled where possible

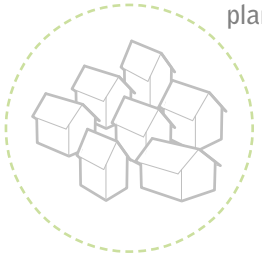
waste collection points

food waste compost

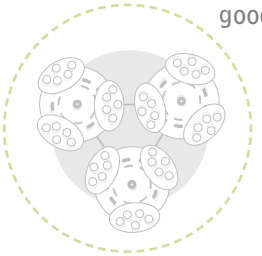
burning of non-recyclable waste

recycling collection point

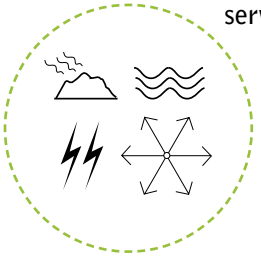
planning



good governance



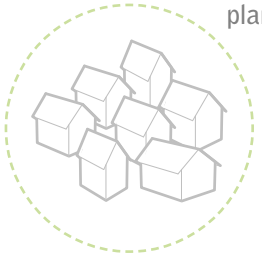
services

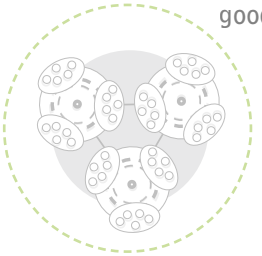


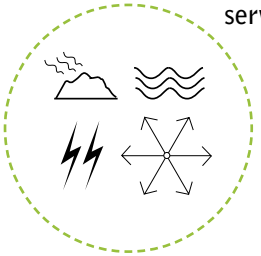
emergency access

Clear routes through the village to allow for both everyday trade and distribution routes as well as access during emergencies for sick and injured people and aid distribution.

Diagrams showing benefit in planning process to accomodate within everday transport links and emergency access.







lines of communication

Identify a series of verbal and technological lines of communication which are used to disseminate knowledge and information on everyday issues and which also help to initiate a response in the event of a disaster.

This might be as simple as electing a group of indivduals who stand on a 'disaster preparedness committee' to oversee the communication and dissemination of disaster preparedness measures to the community. Equally this might be as sophisticated as an online system or paper database storing family names, contacts and the possible risks faced by each family.

Diagram showing village plan with potential for different communication lines

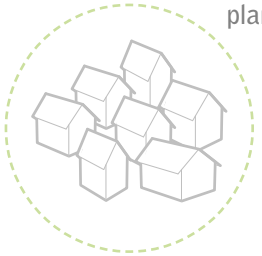
STD phone points

notice boards with local information

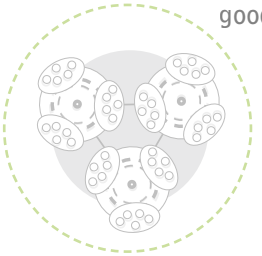
people with cell phones

radios

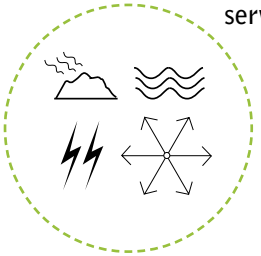
planning



good governance



services

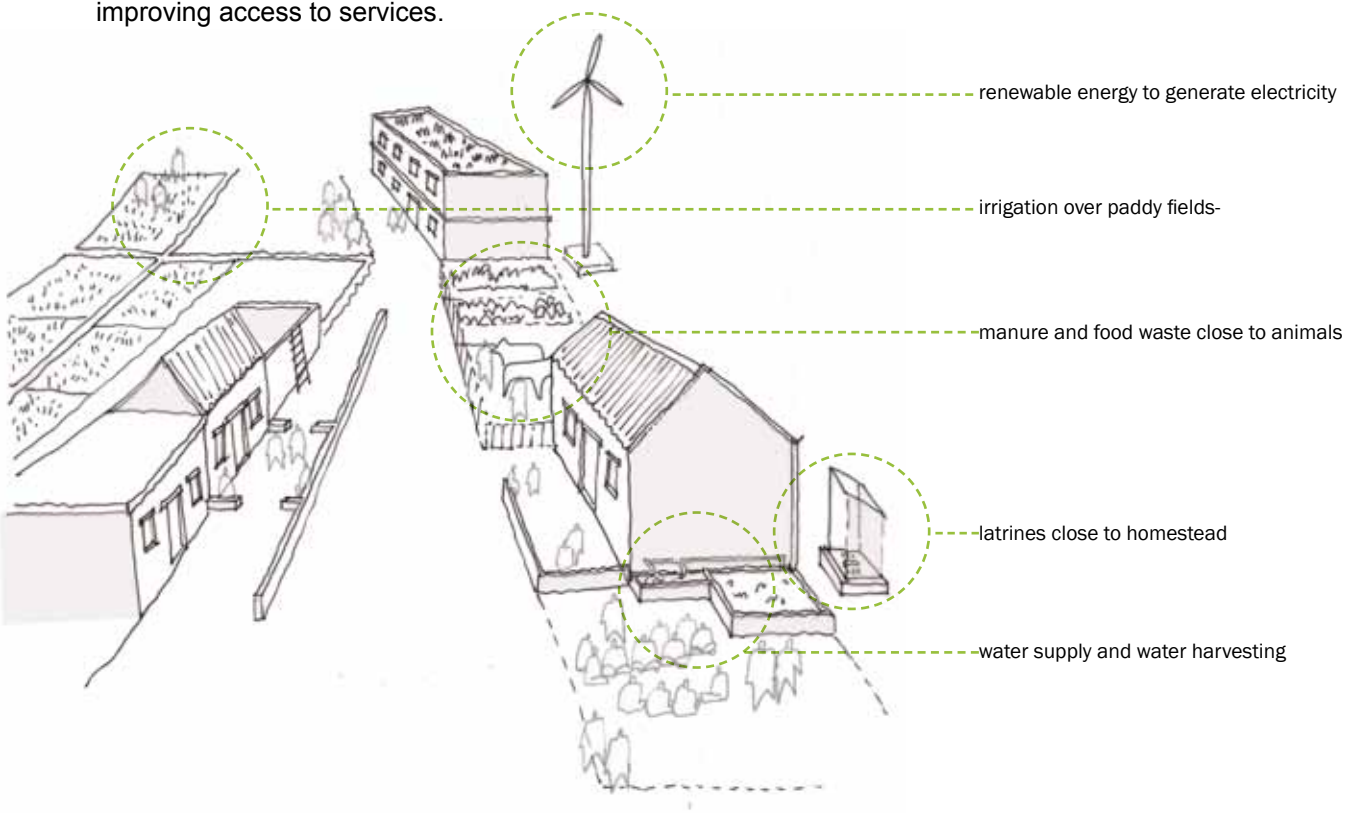


access to services

The ability for all members of the community to access services such as water and electricity close to their home.

Services are managed by a local group or organisation where this is permitted by community cohesion. This might be members of a community or part of the Granpanchayat governance structure. The group ensure no members of the community are excluded from the use of communal services and all attempts are made to make services equitably used, managed and maintained.

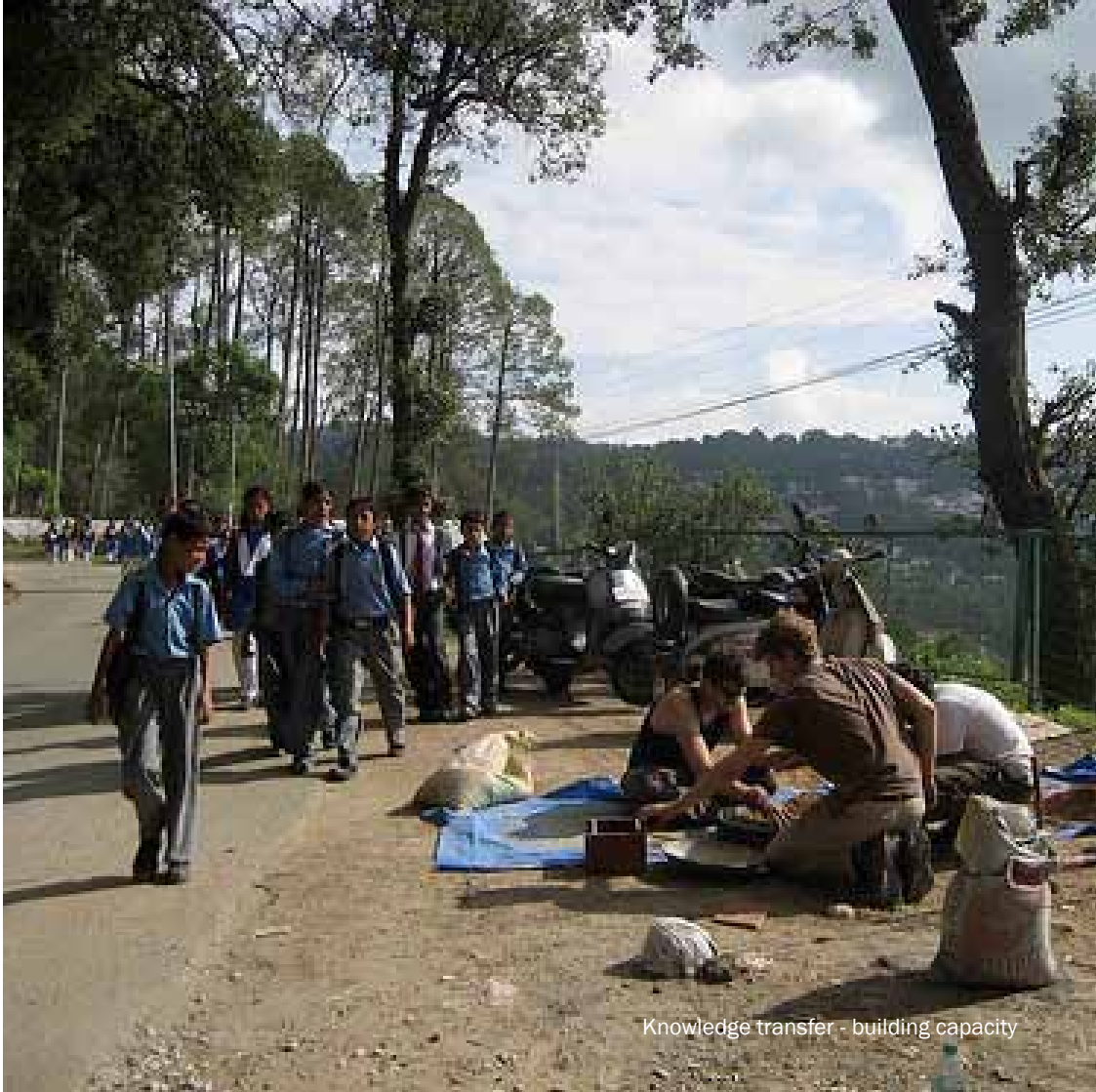
During the workshop students mapped the existing services and also considered their distribution and additional needs. Existing services were compared with what the groups considered necessary for every self-sufficient settlement and made porposals for methods of improving access to services.



Planning for the site context - planning for the cultural context

Process over product - engaging community

Enabling community in Almora, Uttarakhand



Knowledge transfer - building capacity

conclusions

From a set of guidelines and continued material testing, the programme will embark on a series of design sensitisation workshops. These will engage local community and key stakeholders in discussions about locally appropriate, disaster resilient shelter prototypes. A shelter prototype, as with a workshop, can be a vital catalytic tool for transferring ideas, skills, knowledge and awareness. The programme will evolve through the training of local masons and networking with local suppliers and manufacturers, to facilitate the building of additional prototypes, adapting to new challenges in each location. This will build on the successful mason training programmes initiated by SEEDS India in post-disaster situations across India and most recently on a large scale in Bihar.

Over 2 million people were displaced by the shock flooding in Bihar in August 2008. Houses were damaged beyond repair by the flood water, and communities were forced to take refuge on higher ground. Due to the scale of the damage and complexity of needs, SEEDS developed a strategy for rehabilitation through training and education in appropriate construction technology. A material hub was established in a centralised location to cater for 20 villages in 2 blocks close to a local rural market place, a main road and a canal. The hub includes an exhibition area where there are models of disaster resistant construction details, as well as a model house prototype. The prototype promotes local materials; brick and bamboo, and is designed to be earthquake and flood resilient. The hub offers an opportunity for daily interaction with community members, training programmes for artisans, bamboo treatment and enterprise activity for local skills. The spaces can also be used for meetings with members of surrounding villages and community mapping through focus group meetings.

the next step...

Phase 2 of the programme will look at continuing and expanding the field studies and workshops to cover shelter technologies across the two neighbouring states of Uttarakhand and Himachal Pradesh. Documentation of relevant technologies from the region will be supplemented with advanced testing and research on select materials and technologies, and the construction of further prototypes at strategic locations in the region. Advanced guidelines on appropriate shelter will be developed alongside further sensitisation and training workshops for local stakeholders in two states.

By using the same model in one region, and then across the state, and then in neighbouring states, it will be possible to assess the structure and effectiveness of the approach and make adaptations where necessary. The programme structure is designed to be relevant to other regions of India. In each area, specific guidelines can be developed from the generic good practice guide framework alongside a harvest map of resources and skills and an analysis of traditional and contemporary vernacular. Workshops can be useful at this stage to generate a lot of information quickly. Following on from the research phase, a region specific intermediate or hybrid technology for appropriate construction can be developed and tested alongside mason training and community sensitisation workshops, before a prototype is built.

The model can be scaled up from local village knowledge centres to regional and even global knowledge hubs. This will enable good practice to be shared at all levels. The hope is that they will engage the key decision makers in government with the importance of appropriate shelter construction to build resilience in communities pre-disaster, and build capacity of both government and the humanitarian aid community to be better positioned to respond effectively to disasters with appropriate shelter rehabilitation interventions. The overall disaster and climate resilience at region and country level will be enhanced.

appendix

Useful references:

Tools

Harvest Mapping	- Architecture 2012 + others, *www.superuse.org* - Architecture Sans Frontières UK (ASF-UK) *www.asf-uk.org* - Open Architecture Network (OAN) *openarchitecturenetwork.org*
Participatory Rural Appraisal	- Institute of development studies Sussex (Eldis) *www.eldis.org* - International Institue for Environment and Development (IIED) *www.planotes.org*
Material Technology	- Auroville, *www.earth-auroville.com / www.aurovillebamboocentre.org* - Engineers Without Border (EWB) *www.ewb-uk.org* - International Network for Bamboo and Rattan (INBAR) *www.inbar.int* - Uttarakhand Bamboo and Fiber Development Board (UBFDB) *ubfdb.org*
Organisations	- Practical Action, *www.practicalaction.org* - Engineers Without Border (EWB) *www.ewb-uk.org* - Mountain Forum Himalaya (MFH) *www.mfhimalayas.org* - Church's Auxillary for Social Action (CASA) *www.casa-india.org* - Shelter Centre, *sheltercentre.org* - Habitat for Humanity (HfH) *www.habitatforhumanity.org.uk*
Guidelines Response	- SPHERE: Humanitarian Charter and Minimum Standards in Disaster *www.sphereproject.org*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