



Growing Capacity in Assam

Proceedings of 2nd Project Workshop on Smart Villages

- *A capacity building initiative in Assam through Assam Engineering College and in collaboration with The University of Melbourne, Australia*

04-07 December 2017

Editors:

Dr Hemanta Doloi
Prof Atul Bora
Dr Sally Donovan



The University of Melbourne
Victoria 3010, Australia



Smart Villages Lab
Culture • Construction • Capacity • Community

Table of Contents

1	Dr Hemanta Doloi - Speech, 4th Dec 2017, AEC	5
2	Linking construction management and project management education for successful project delivery	8
	Abstract	8
	Introduction	8
	Regulation and governance	11
	Relevance, challenges and opportunities in the context of Smart Assam Project	12
	Conclusions	14
	REFERENCES	14
3	Sustainability and construction	16
	Abstract	16
	Why sustainability?	16
	What are the issues of sustainability?	18
	How do the issues of sustainability apply to construction?	20
	Key ideas to share with Assam	21
	References	23
4	The environmentally sustainable Smart Village	24
	Abstract	24
	Introduction	24
	Villages and the environment	25
	The environmental imperative	25
	What is a Smart Village?	26
	A pathway towards the environmentally sustainable Smart Village	27
	Step 1: Understand current performance	28
	Step 2: Understand local context	29
	Step 3: Identify and analyse potential Smart Village solutions	30
	Step 4: Design and implement 'sustainable' Smart Villages	31
	Conclusions	31
	References	32
5	ICT4D for Smart Governance of rural development in Assam	34
	Abstract	34
	Introduction	34

Context.....	35
Smart Governance and ICT4D.....	36
Smart governance for rural development ICT4D model	39
Conclusion.....	45
References	45
6 Significance of culture in architectural design of housing in Assamese Smart Villages.....	47
Abstract	47
Introduction	48
The scope of research within the project	51
Significance of Culture in Architectural Design in Housing.....	52
Developing an approach.....	57
Discussion	58
Conclusions	60
References	61
7 Sustainable construction and Assam type house.....	63
Abstract	63
Introduction	63
Objective	64
Assam Type House (ATH) and its construction in Rural Assam	64
Assam Type House (ATH)-a brief review	64
The Challenges	65
Conclusion.....	66
Acknowledgements.....	67
References	67
8 Assessing the sustainability credentials of residential development projects in Australia	68
Introduction	68
The EnviroDevelopment (ED) program	69
EnviroDevelopment Certification Benefits	70
Foundation and Process Principles	72
Technical Standards	72
The Six EnviroDevelopment Leaves	73
Conclusion.....	81
References	82

Appendix 8.A – EnviroDevelopment Leaves and Assessment Criteria	84
9 Round Table 1: Nature Conservation and Development	86
10 Round Table 3: Sustainable Infrastructure	87
11 Round Table 4: Governance	93
Scope of the roundtable session	94
Communication	94
Reporting	94
Access	94
Incentive.....	95
Local Administration – Moderation (Validating reports).....	95
12 End of Workshop meeting	96

The first day of the workshop opened with a welcoming address from Dr Atul Bora and Dr Hemanta Doloi. A copy of Dr Doloi's speech is now presented.

1 Dr Hemanta Doloi - Speech, 4th Dec 2017, AEC

Good morning.

First of all, it is my absolute pleasure to welcome you all for participating in our second project workshop “Growing Capacity in Assam”. This workshop is part of the collaborative research project between the University of Melbourne and Assam Engineering College. I am Hemanta Doloi, originally from Jorhat and settled in Australia for nearly 20 years. I did my first degree at Jorhat Engg College. I am currently a senior lecturer at the University of Melbourne, specialising in Construction and Project Management. The University of Melbourne is the No.1 University in Australia and 28th internationally. I wish to recognise the Government of Assam for their generous and visionary support for this unprecedented collaboration with a world class University.

Our overall project has three key components, firstly, empirical research for developing new knowledge in housing and infrastructure solutions for Assam (with a particular focus on rural areas), second, Development of a new Construction Management course at AEC for building industry capacity in Assam specific context and third, development of an ICT based Smart Data Platform for connecting the Rural Community and Government. Details of these components will be discussed over next four days in this workshop.

Before I go into any technical discussions, I wish to recognise the exemplary support of a few important colleagues who have been supporting us to come to this stage in our project. Our most beloved teacher and leader (who is serving as the current principal and DTE in-charge) Dr Atul Bora is the first one to mention for his support and guidance from the inception of this project. He has been my guiding force for every single aspect of development of this project.

Then I wish to introduce my five colleagues from Melbourne who have taken time out of their busy schedules to travel all the way to Assam to impart knowledge in this workshop. Among them, Prof Ray Green, who is an expert in Ecology and Landscape Architecture. The first impression of a beautiful city is created only by such skills, which is certainly missing in our Indian cities.

Then Prof Mark Burry, as expert is Digital Architecture. Prof Burry was one of the key members in the early stage of our project who travelled with me twice for difficult negotiations of the project and then again for our last workshop in Dec 2016. Prof Burry now works at a different institution in Melbourne but I am truly appreciative of his commitment in this project.

A/Prof Robert Crawford is an expert in Environmental Sustainability in Construction and a very close colleague of mine at the University of Melbourne. This is his second time to Assam and I truly appreciate his support and the mentorship he has provided to quite a few colleagues including the PhD researchers.

Then we have Dr Sally Donovan, a research fellow in our project based in Melbourne. Dr Donovan is relatively new in the project and she is currently working on a new Book on Smart Villages bringing world experience in the context of Assam.

Mr Geoff Kimm is also a Research Fellow in the project based in Melbourne. Mr Kimm has an Architecture Background with expertise in sophisticated modelling computational algorithms on the built environment. He is involved in developing a smart data platform one of the key components in the project. More of his work will be discussed in the course of the workshop.

I then acknowledge the four visiting scholars from AEC to University of Melbourne who have done a fantastic job giving shape to the new Construction Management course for AEC. The scholars are Dr Pradip Baishya, Dr Sasanka Borah, Prof Jayanta Pathak and Prof Bipul Talukdar. For the first time, the construction management course at AEC is ready to roll out and many of you have had a taste of the subjects developed so far in the short course delivered last week. Very soon, we will have another four scholars come on board and complete the development of this course, having it ready to roll out by 2019.

Last but not least, we have handpicked the two lucky young researchers to conduct fundamental research and support growing Capacity in Assam. They are Miss Velyne Katharpi and Mr Arup Deka. The three-year PhD research program at the University of Melbourne will equip these two young scholars with significant new knowledge in the housing and infrastructure sectors and they will be able to bring back their experience and expertise for application in Assam. Their work will be presented in the workshop as per the program.

I will now go through a few slides just to highlight a few key issues.

Why construction management? And only construction management?

Why not civil engineering? Or why I am sounding like other engineering disciplines are not as important as construction management?

Hemanta Doloi then gave a presentation entitled “Linking construction management and project management education for successful project delivery”

After morning tea Dr Sally Donovan and A/Prof Robert Crawford gave presentations on sustainable development entitled “Sustainability and construction” and “Smart villages and environmental sustainability”.

Participants from the Construction Management course which ran prior to the work shop then presented some of the work from the course followed by lunch.

After lunch Professor Bipul Talukdar gave a presentation on Sustainable solution to flood and erosion problem of Assam, followed by a presentation from Dr Pradip Baishya entitled “Affordable waste management solutions for Smart Villages of Assam”.

The second day opened with presentations from Geoff Kimm on Smart Governance, followed by Mark Burry “Smart village – smart villager: taking stock”.

The two smart village lab PhD students, Velyne Katharpi and Arup Deka then gave a presentation on their thesis topics and progress.

In the afternoon Dr Sasanka Borah gave a presentation entitled “Sustainable construction and Assam type housing” followed by Professor Ray Green’s presentation “Assessing the sustainability credential of large residential development projects.

The day then ended with presentations from IIT Guwahati.

A selection of the presentations were prepared as papers and are compiled in the following section of this report.

2 Linking construction management and project management education for successful project delivery

H. Doloi

Senior Lecturer, Smart Villages Lab, The University of Melbourne

hdoloi@unimelb.edu.au

Abstract

Construction and project management education is an essential first step for successful delivery of projects. Projects are complex entities with delivery processes including people and organisations. In the advent of massive infrastructure development especially in the North Eastern part of India, local skills and professional competencies in the field of construction and project management are vital for growth of the local economy and societal well-being. Projects are temporary entities, and during the development of each project it is important to assess the scope, location, specifications, labour and skills. This paper highlights some of the key issues around the local construction industry and opportunities for development by drawing from some world examples. The scope of the discussion will be limited to the educational needs of professional practice including local relevance.

Keywords: construction management, project management, project delivery

Introduction

The relevancy of Construction Management in project development processes is highly significant. While many countries including India do not have a widespread recognition of construction management as one of the core disciplines in project development, in some other countries especially the Western countries, construction practitioners with relevant professional qualifications are required to undertake all construction activities in the field. Typically, in countries like India, Civil Engineers are responsible for most construction activities in the field.

There is a great degree of construction expertise within the Civil Engineering discipline, , but some field-based activities do not necessarily fall within the typical disciplinary boundaries. For instance, a typical Civil Engineering course may have strong emphasis in structural design and materials compositions and strengths, but such skills may not be relevant in some field-based construction activities. Typical field-based construction activities include site preparation and set-up, award of contracts, contract management, construction activities, sub-contractors and construction activities, construction regulations, control of cost, time management, management of risks and uncertainties, stake-holders management, project completion and handover . These onsite functions are job and market specific, highlighting the need for a dedicated set of professional competencies to effectively carry out construction projects.

construction management entails two distinct activity types, physical and management activities. The scope of the construction management usually comprises the physical construction including physical processes associated with tangible outcomes (ABCB, 2016). For instance, one of the process-oriented construction activities is the engagement of subcontractors through an appropriate construction contract and then administration of the contract to get the physical job delivered. Such an activity is usually well within the scope of a construction professional with specific disciplinary knowledge.

On the other hand, there are many essential activities associated with the management of projects which are not always necessary to deliver a tangible outcome. Some of these management activities include cost, time performance, ensuring meeting quality specification, managing risks and avoiding disputes and litigations, managing stakeholders' expectations, monitoring progress and controlling projects etc. These sorts of activities are usually part of the Project Management discipline which is again a specific skillset required in all projects. Project Managers with a specific project management skill are responsible for overall performance of the project especially from a delivery perspective. Profit and loss are usually the performance criteria for project managers.

Construction Management (CM) Education

Developing skills and competencies that are applicable to local, national and international contexts is one of the key requirements for CM education of construction professionals. In the construction industry, it is important to understand the distinction between knowledge-based and practice-based vocational education (e.g. training). Construction project being highly visual, often the people working in the construction project draw the satisfaction of the physical engagement and tangible activities that contribute to the development of the physical facilities. While the skills for working in physical high-risk construction site is unique in nature, the source of such skills development and progressive mastery of the intrinsic construction knowledge is certainly a point of discussion especially in the context of the emerging economies with high demand in skill development.

Construction projects are complex undertakings and involve a multitude of stakeholders over their lifecycle further complicating the project development environment. To understand the significance of construction education, one needs to understand the dynamics of construction projects, project development environments and the wide variety of stakeholders including their level of stakes and engagement.

The progress of onsite construction activities are directly related to the effort of the construction crews. But then the question is if such a practice is considered to be prevalent onsite, how one can ensure that the work being undertaken by the construction crew is as per the specification. At the end, once the construction is finished, the as-built construction will match the specification including the regulatory requirements and the end product will meet or exceed the expectation of the stakeholders especially the clients and the financiers. A

simple construction worker specialising in a particular task would not be able to take any responsibility for overall compliance in the project and meeting the expectations of the stakeholders.

Building the project to the specification, that complies with regulations and meets stakeholder expectations is a significant responsibility, above and beyond a typical construction workers specialisation. Along with the distribution of responsibilities across the job descriptions such as construction manager, contract administrator, site supervisors, site foremen, quality manager, building surveyors, safety manager etc., there comes the level of underlying competencies coupled with the educations or professional qualifications. This is where understanding of different educational needs comes to play, and this rationalises the educational pedagogy for supporting the growth of an industry to its maturity.

Construction management education is certainly an enabler for building necessary and relevant skills for supporting the industry. The growth and maturity of the industry relies heavily on the level of skills being offered by the professional community. Construction is a highly fragmented industry with a long supply chain encompassing wide range of stakeholders not confined to one local market. Thus, understanding of construction project inducing the long supply chain from a market perspective is much more than a one particular onsite construction activity. The competencies required for dealing with such a construction environment can come only from a specialised construction education which not necessarily to be the part of a vocational training program imparting construction skills for a worker in an activity context.

Project Management Education

While the discussion on Construction Management education in the above section highlights the needs of broader professional skills development among the construction professionals, there is a clear demarcation between the construction and project management education. Skillset associated with the Project Management education is even broader than the construction management and the focus is more on the governance at a project or program levels rather than the site-base construction management.

Figure 1 shows the project management competency framework within the three broad dimensions, *projects*, *people* and *organisations*. The standards adopted in various countries in the world are shown across the three dimensions. As seen, all three dimensions of project management framework is governed by some clear set of competency standards which a project manager not only need to understand but also demonstrate for achieving a required set of skills to be able to perform at the expected level.

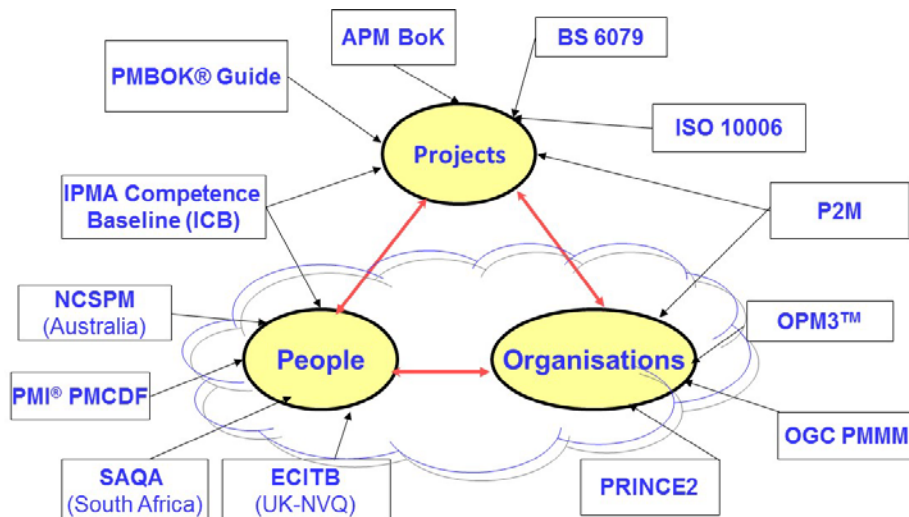


Figure 2.1 Broad competency areas in the Project Management education

In regard to the project dimension, the standards such as PMBOK Guide, APM BoK, BS6079 and ISO10006 are all about how they define a project as a technical entity. These standards assist in meeting the objectives and delivering the project purely from the technical perspective.

The standards such as IPMA Competence Baseline and P2M reflect both project as well as people and organisations dimensions respectively.

In regard to the people standard, NCSPM (national competency standards for project managers in Australia) and the PMI-PMCDF (Project Managers Competency Development Framework from the Project management institute) play dominant roles.

On the organisational dimension, Prince 2, OPM3 (organisational project maturity management model) and OGC-PMMM (office of the government commerce – project management maturity model) play pivotal roles. Organisational dimension in projects is one of the most important elements for ensuring the right sort of governance for delivering the projects and meeting the objectives efficiently.

As seen, understanding, reflections and contextualisation of these three dimensions are fundamentally important while imparting education in Project Management. The focus is thus significantly different from the typical construction management education.

Regulation and governance

As much as the construction and project management education is important, putting all together in a project specific context requires robust governance models. Figure 2 shows a state level governance structure for the Victorian Construction industry where the Minister for Planning heads the entire construction sector within the state. The regulatory body such as the Victorian Building Authority (VBA) plays a pivotal role in regulation and operation of the industry across

every front (Building Act 1993, VBA). The regulatory regime is supported by the relevant building act and the underlying standards.

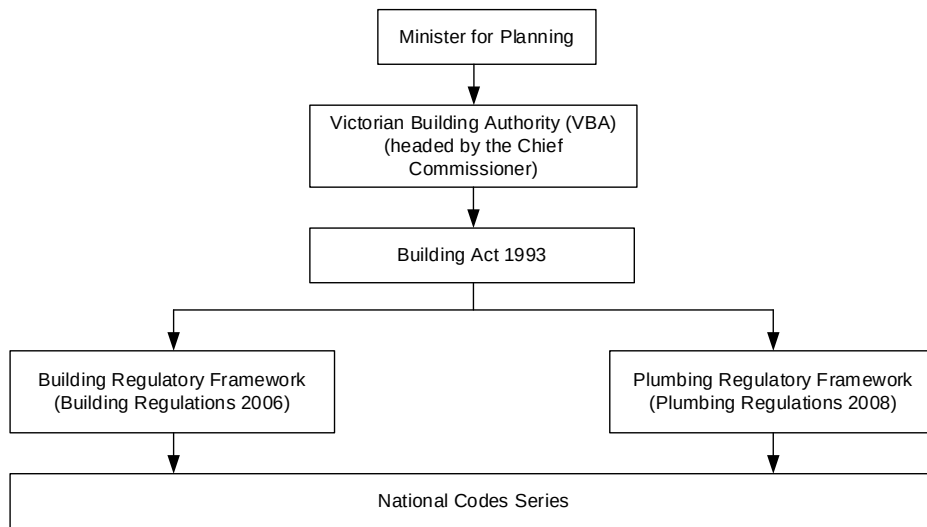


Figure 2.2 State Level Governance structure (Victorian context) (Source: Australian Government, Building and construction Industry)

Relevance, challenges and opportunities in the context of Smart Assam Project

Figure 2.3 shows the overview of the current Smart Assam project where capacity building in Constructing Management is one of the key dimensions in the Smart Villages initiatives in the State of Assam, India. While the other two dimensions in the project focus on the creation of new knowledge and policies for supporting rural development and building smart villages, the construction management capacity is one of the key enablers for making it happen (Sawhney et al, 2014).

In the context of smart villages in Assam however, construction management education not only need to be context specific but also the availability of the resource must be taken into consideration to be relevant. Evaluation of the challenges and opportunities for developing the construction management capacity by taking into consideration of local needs, requirements including available resources is a difficult task.

As the smart villages program focuses essentially on the rural development and community empowerments, local knowledge of the project development environment including the culture, value, demography, education and skills of the local community will need to be carefully assess when developing education program relevant to the State of Assam.

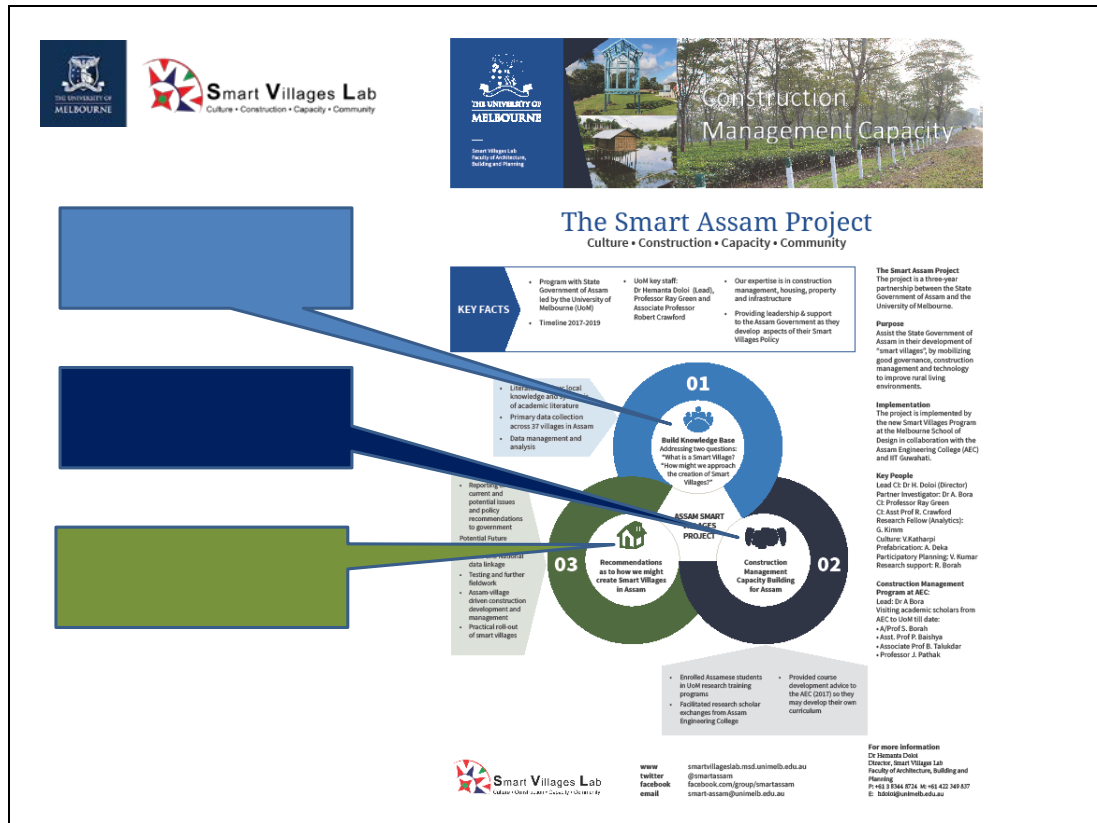


Figure 2.3 Scope and Elements of the Smart Assam project

Figure 2.4 depicts a bird's eye view of the slums in Mumbai City in India. In regard to the slum community and their housing challenges, no current education can provide a solution within the mainstream literature. However, taking the education as an enabler, the success will rely on the contextualisation of the local knowledge and apply into the practice that results in the change of society with relevant targets and achievements.



Figure 2.4 A Bird's Eye View of the Slums in Mumbai City in India (source: Shutterstock photo ID 668979172)

Conclusions

In this paper, I not only tried to emphasise the need for relevant professional education but also show a clear connection of knowledge application by linking Construction Management and Project Management education for successful project delivery. While both construction and project management education are fundamental for facilitating healthy, sustainable and productive environment for supporting the wellbeing of the people in the society, how the education is perceived and how its applied in the location specific context is what eventually would determine the success and failure of the professional effort in long run.

In the Smart Village research initiative, we have tried to integrate the educational dimension with the research and policy dimensions so that a holistic understanding of the community development with accurate application of relevant knowledge is realised in a context specific environment. In the context of Assam or even in India, customisation of the professional education is not a desirable criterion but an essential requirement for addressing the ground challenges and harnessing the potential of local community in the overall modernisation process. No public policy will be effective until and unless the education policies especially in the technical education sector are devised with a clear reflection of local condition that have to potential for empowering the community within the community itself. A rigorous testing and validation is required for benchmarking the professional education with the parameters of local relevance and with demonstrated maturity for devising results application in local environment.

REFERENCES

ABCB (2016) <http://www.abcb.gov.au/Resources/Publications/Corporate/> 2016-17-Business-Plan. Date accessed 14/11/2019

Building Act 1993, VBA Website: <http://www.vba.vic.gov.au/practitioners/legislation>

VBA (2013), Building and Construction Industry Security of Payment Regulations 2013.

CIDC (2010), Construction Industry Development Council, Established by Planning Commission (Government of India) and the Construction Industry

Masurkar, Y. S., Attar, A. C. (2014). Investigating the Causes for Failures in Construction by Taking a Case Study. Current Trends in Technology and Science. ISSN: 2279- 0535. Volume: 3, Issue: 5 (Aug-Sept. 2014)

Sawhney A., Agnihotri, R and Paul, V, (2014) "Grand challenges for the Indian construction industry", *Built Environment Project and Asset Management*, Vol. 4 Issue: 4, pp.317-334.

Shirur, S. and Torga, S. (2014), Indian Construction Industry: Challenges for the Construction Managers, *IOSR Journal of Business and Management (IOSRJBM)*, Volume 16, Issue 4. Ver. III (Apr. 2014), PP 65-66.

3 Sustainability and construction

Dr Sally Donovan

Research fellow, Smart Villages Lab, University of Melbourne

Donovan.s@unimelb.edu.au

[Abstract](#)

Sustainability is a critical concept when considering the path forward for construction in Assam. It is a critical concept that underpins a smart village, for a village needs to be sustainable to survive. The key issues to consider are: local materials, construction processes, energy, waste, emissions and water. These need to be considered within the aim of sustainable development: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” (United Nations, 1987).

Currently there are very few projects meeting current needs without sacrificing future generations. The key question to consider is how will Assam produce smart villages that show how it is possible to not only serve current generations but future ones as well? It starts with understanding that the economy is a subject of the society, which is a subset of the ecosystem. That is there is no society, no people without an environment, and there is no economy if there are no people.

So how can we develop in a way that protects the environment, and if possible, improve it creating extra capacity and resilience for the future. Then how do we support the people, the society and then the economy, or the system of exchange within society. Sustainability is usually discussed in relation to the management of water, waste, energy. What is often forgotten is that there should be equal if not more attention paid to the people. That is, the most efficient building with people in it that do not understand or care how to use the building will be more wasteful than an inefficient building with people in it that care and manage the building well. Sustainability is also about developing in a way that protects the health and wellbeing of people, to support them to be able to participate, be educated and contribute to the development.

Keywords: sustainable construction, sustainable development

[Why sustainability?](#)

We hear the word sustainable a lot these days, but why has it become such an integral component of new development? To gain a better understanding of this consider some of the consequences of unsustainable development that have become our everyday life.

Atmospheric pollution, especially from fossil fuel burning, is a visible part of everyday life in urban areas all over the world. Direct inhalation of polluted air has been shown to cause heart and lung diseases, especially in the most

vulnerable members of our community such as children and the elderly (NASA, 2017). Some pollutants have also been shown to have a chemical reaction with building materials, for example sandstone reacts with PM₁₀, causing this to decay and start to crumble (Turkington, Martin, Viles, & Smith, 2003). The impacts of this pollution are not limited to the urban areas where they are largely generated. Ozone pollution that is created from the chemical reaction between the O₂ naturally occurring in the atmosphere and PM₁₀ emissions from fossil fuel burning has been shown to inhibit plant growth (Preston & Tingey, 1988). The long-range nature of this pollutant has resulted in reduction of crop yields in agricultural regions, leading to a loss of income for farmers. If pollution emissions continue to rapidly increase, in the future this could potentially lead to food shortages. Plus of course many of these pollutants are greenhouse gases potentially contributing to climate change and its associated impacts.

Flooding is another environmental issue that causes significant damage, particularly in the state of Assam, India. Of course, we can't control the rain, although there appears to be a link between increased flooding incidents and the accumulation of greenhouse gases in the atmosphere (Kim et al., 2017). However, we can try and incorporate resilience against flooding into the design of new developments. However, this is only one aspect of sustainable design. We also need to consider the siting of our buildings. Are they in a particular flood prone location? Is there a more appropriate site? Can we develop a flood barrier by planting more trees or other plants between the village and the water source? Amending agricultural practises has also been shown to reduce flood risk. Modern tilling methods compact the soil making it less absorbent. By using alternative planting approaches and allowing the soil to be more natural will allow it to absorb more water, reducing risk of flooding (The Environment Agency UK)

Similarly, the risk of other natural disasters such as earthquakes should be considered and any need for resilience incorporated into building design.

Droughts are another very serious environmental issue brought about by unsustainable development. Humans cannot survive without water for drinking and cleaning. Thus, human settlements tend to crop up around waterways. Once established, these settlements come to rely on the water not just for the basics, but fishing industries develop, once people obtain boats the water provides a convenient transportation route, often with no need for fuel or expensive and frequent maintenance associated with road transport, to mention a couple. Human settlements will also inevitably need to grow crops, and natural water sources will also be diverted for irrigation purposes. However, in the past attempts to grow crops unsuitable for the climate, for example growing water intensive cotton plants in arid regions have led to serious environmental damage. Perhaps the most famous example of this is the Aral Sea. Sitting on the border between Kazakhstan and Uzbekistan, it was once the fourth biggest inland lake in the world (France 24, 2017). However, the two rivers that fed the sea were diverted for irrigation of various crops, but mainly cotton, which saw the lake begin to dry up. The sea was reduced by 80 percent between 1960 and

2000. It was not until the World Bank established a dam project in 2005 that the sea has started to regenerate. This devastated the many communities that had emerged around the sea, many of whose livelihoods were based around the fishing industry. The area where the sea used to be is now a desert surrounded by ghost towns.

The generation of energy is an essential component of any modern development, but the method of burning fossil fuels for energy generation has been extremely harmful to our environment and ultimately our health.

Failure to manage our solid waste has also led to contamination of all aspects of our environment including:

- Water, where we can directly ingest through drinking and washing, or indirectly through eating fish and birds. It can also lead to the death of fish taking away a source of food and a source of income for anglers;
- Soil contamination potentially accumulating in plants that we eat either directly or indirectly by eating animals that graze on these plants;
- Atmospheric emissions including greenhouse gases.

In all the examples described above the ultimate consequences of unsustainable development are negative impacts on human health. If we continue to develop in the same way these impacts will worsen, threatening our survival. Therefore, it could be argued that developing in a sustainable way is essential to our survival.

The most famous definition of sustainable development “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” From the 1987 Brundtland report tells us that at the design stage of any new development we must ask ourselves: what affect will this development be having on the environment, on society, and thus on the economy, when my children or grandchildren are my age?

[What are the issues of sustainability?](#)

The first thing that comes to mind when the word sustainability crops up is the environmental issues, and indeed careful management of environmental resources is essential to our continued survival. The environment provides us with clean air to breathe, water to drink, and food to eat, the fundamentals of life. Further to this, it supplies us with building materials for construction, fuels for energy generation and all the other essentials to ensure we are not just surviving but thriving. Thus, without sustainable management of the environment people cannot exist.

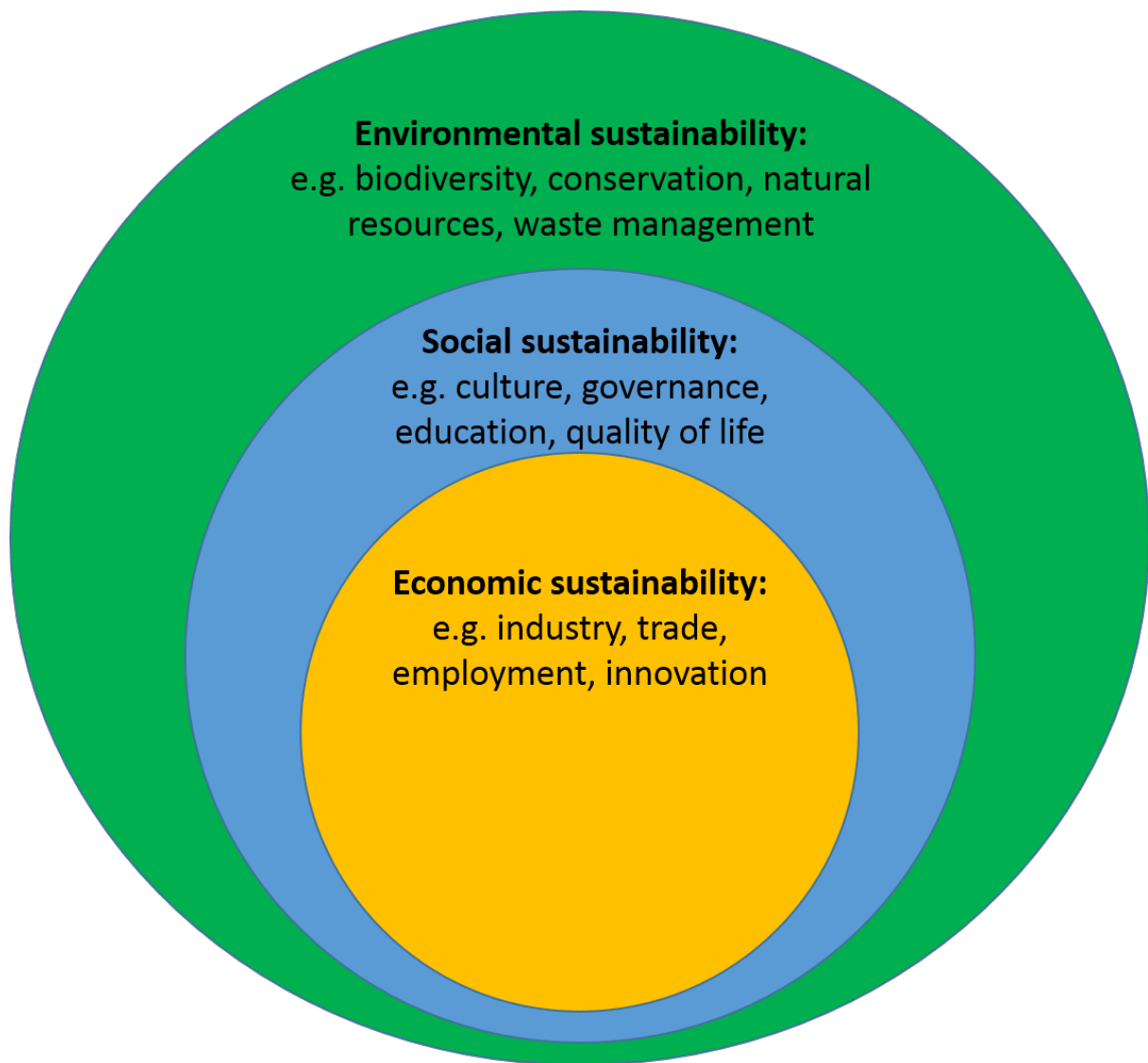


Figure 3.1 The issues of sustainability

Figure 3.1 shows that while the environment is key to sustainability, it is not the only component. We also need to consider social sustainability. A sustainable society needs thriving cultural traditions, good governance, and effective and accessible education programmes. These things are essential to provide a quality of life beyond basic survival, so that we can thrive.

The final tier of sustainability is the economy. The word economy immediately suggests money, but is that all the economy represents? The true role of the economy is to establish a system of exchange within the society, by allocating value to the components of the ecosystem we use to generate our income. For example, consider that each household in the village participates in an income generating activity. One household might be growing corn; another is growing rice and a third is raising chickens. To produce a complete meal, you would need all three of these products. Therefore, the rice growing household would want to keep enough for their requirements then exchange the rest for chicken and corn to complete their meal. The economy's role is to allocate value to each product,

in this case chicken, rice and corn, thereby setting up a fair system of exchange so that all three households have a complete meal. This in turn supports an equitable society ensuring all households are having their needs met, which in turn reduces the risk of crime. It also supports the ecosystems we depend on for survival by ensuring one household is not required to produce more than the others, leading to them “overfarming” the land, and depleting it of the nutrients that promote plant growth. This would be unsustainable because the land would not be able to support plant growth in the future, and the children of that household will not have a source of income when they reach adulthood.

How do the issues of sustainability apply to construction?

For construction to be sustainable, each of the three tiers of sustainability described in the previous section must be incorporated. As mentioned, we rely on the environment to provide our building materials. We need to consider whether the building materials we use are potentially toxic. Although they might seem safe, as the materials begin to decay or become damaged in the future, they could release toxins impacting the health of our children and grandchildren. For instance, the widespread use of asbestos during the 1900s has left a legacy of hidden danger in buildings throughout the world. Asbestos related diseases that were previously prolific in members of asbestos mining communities, and the construction industry, are now showing up in plumbers, and other home renovators, oblivious to the deadly dust they are inhaling as they go about their work (Australian Safety and Compensation Council, 2008). We don't like to think of our children dying from a horrible disease, but want them to live a full, happy and healthy life. Therefore, we need to ensure we don't leave hidden dangers like asbestos.

We also need to consider the availability of building materials. If we establish a system of construction that relies on materials that are in limited supply, at some point in the future supplies will run out and the construction system will be rendered redundant. To be sustainable our building materials must be renewable, and we need to ensure that we are replenishing their stocks as we use them.

We also need to consider the impact our construction activities are having on the land. If trees and other plant life need to be removed to make room for buildings, could this be displacing wildlife? Are we altering the natural landscape in a way that is going to increase vulnerability to natural disasters? We also need to ensure our construction activities are not contaminating the land as we are likely to be using it to grow our food and will therefore end up ingesting it.

Emissions to air and water can arise from buildings during both the construction and operational stages. Avoiding the emission of toxic pollutants into these media is essential as we will end up breathing or drinking these substances, impacting our health.

Providing energy to our buildings is an essential component of modern construction. The source of this energy must be given similar consideration as

the building materials. It must not release toxic chemicals into our environment and must not be in limited supply. If we design an energy supply system reliant on a type of fuel that is in limited supply, it will run out at some point in the future leaving our children or grandchildren with no energy.

Finally, the way we manage our waste needs consideration during construction: What waste is being generated? Could this have been avoided? If not, can this be used in another capacity, or recycled into a different useful product rather than discarded? Can it be used as fuel for energy generation? If it cannot be redirected to one of these outlets and requires disposal to landfill, this must be managed in a sustainable way by establishing a landfill with engineered controls that prevent the release of these contaminants into the environment.

In terms of social sustainability, we must incorporate the needs of the building's future occupants at the design stage. For example, if multiple generations are living together the design may need to incorporate separate areas for children to play and learn, and areas for elderly people to relax. Maintaining the cultural identity of the future occupants is also important. Some cultures require segregated areas for men and women due to religious beliefs, others have special cooking and dining arrangements that may need to be catered for. In rural communities, many households are involved in agricultural activities and may require areas in their house for storage of grain, or for raising livestock. These must also be incorporated into the design. Without taking these factors into consideration, the occupants of the building will not be able to thrive.

The economy supports environmental sustainability by allocating value to the resources used for building, preventing overuse, and encouraging replenishment of stocks. It also supports the society by providing funds for other buildings communities need, such as schools, and health centres and for the infrastructure that goes alongside buildings in the community, such as waste and sewage management, water, energy and transport facilities. This ensures an equitable society with low risk of crime where all community members are not just surviving but thriving.

[Key ideas to share with Assam](#)

The design of a basic sustainable house should follow the four following steps.

Firstly, you need to understand the climate. Whether it is hot or cold, or maybe it's hot in the summer and cold in the winter, so the design will need to incorporate some flexibility. If the climate is wet and humid, the building materials could be at risk of rotting and must be designed with resilience to this. Inversely if the climate is dry the building could be vulnerable to fires, and the design should incorporate provisions to protect against this.

Secondly you need to consider the building materials available to you. As described earlier these should be locally available and renewable. You also need to ensure these supplies are replenished. Then you need to determine how these

materials can be used to create comfort and protection required based on the climate conditions identified in the first stage.

Thirdly you need to consider the required functionality of the house. Who is going to be living there? Are there multiple generations? Do they have religious beliefs that require dedicated spaces in the house to be incorporated into the design? What cooking techniques do they employ; how do they eat?

The fourth consideration is the skills required to carry out the construction. Are there people in the local community with the skills to perform the construction and any maintenance required later? It is important that construction skills are locally available so that buildings can be maintained in optimum condition. It is also important that the household occupants are familiar with the sustainable features incorporated into the design of the house. If the occupants do not understand these, they may behave in a way that fails to take advantage of the sustainable features, leading the house to operate in an inefficient and unsustainable way.

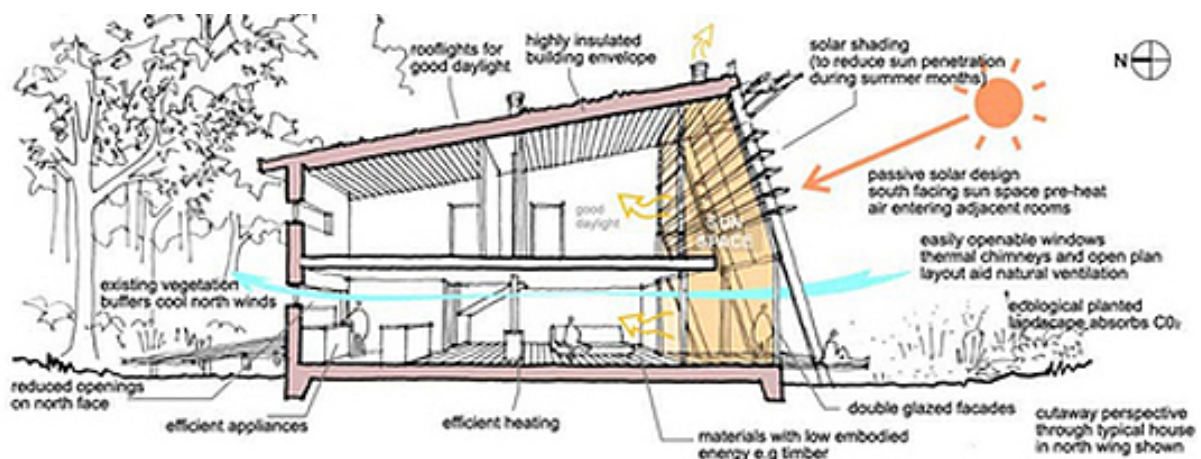


Figure 3.2 Features of a sustainable house for Melbourne climate

Figure 3.2 illustrates a house designed to suit the climate in Melbourne. Melbourne has very cold winters and very hot summers, therefore, housing design needs to incorporate flexibility to cater for both occurrences. The house contains insulation in the walls, ceiling and flooring, as well as double-glazed windows. All these features help the house to maintain its internal temperature, whether it is being heated in winter, or air-conditioned in summer. All the appliances are energy efficient, and the house has a lot of natural light, minimising electricity requirements. The south facing side of the house is largely made of glass but incorporates a flexible shading system which allows the occupant to block out the sun light during the hot summer days, while allowing maximum heat and light in during the winter. If the occupant was not familiar with the purpose of this sustainable feature, they might fail to use it correctly. Failing to shade this side of the house during the hottest summer days will make the house extremely hot causing a surge in the amount of electricity required for

air-conditioning and refrigeration. It is also important to note that sustainability features are not limited to the building itself, but also exist in the surrounding landscape. For example, large deciduous trees are planted outside some of the windows. During the summer these trees will be full of leaves, blocking the heat from the sun from entering the house, while during the winter they lose their leaves, allowing maximum warmth and light into the house during the colder months.

References

Australian Safety and Compensation Council. (2008). Preparing an estimate of the national pattern of exposure to asbestos in cases of malignant mesothelioma. Australian Government, Canberra

France 24. (2017). Dried-up Aral Sea springs back to life. YouTube. Retrieved from www.youtube.com/watch?v=pk4v0uu5rkY. [Accessed 10 November 2017]

Kim, Y., Eisenberg, D. A., Bondank, E. N., Chester, M. V., Mascaro, G., & Underwood, B. S. (2017). Fail-safe and safe-to-fail adaptation: decision-making for urban flooding under climate change. *Climatic Change*, 154(3-4), 397-412.

NASA. (2017). The ozone we breathe. Retrieved from https://earthobservatory.nasa.gov/Features/OzoneWeBreathe/ozone_we_breathe2.php [Accessed 10 November 2017]

Preston, E. M., & Tingey, D. T. (1988). The NCLAN program for crop loss assessment. In W. W. Heck, O. C. Taylor, & D. T. Tingey (Eds.), *Assessment of crop loss from air pollutants*. Dordrecht: Springer.

The Environment Agency UK. Structural measures for flood risk management. Retrieved from http://www.ioutsidedesign.co.uk/Case%20studies/FCRM/section8_3_6.html [Accessed 10 November 2017]

Turkington, A. V., Martin, E., Viles, H. A., & Smith, B. J. (2003). Surface change and decay of sandstone samples exposed to a polluted urban atmosphere over a six-year period: Belfast, Northern Ireland. *Building and Environment*, 38(9-10), 1205-1216.

United Nations. (1987). *Our common future: Report of the world commission on environment and development*. Report A/42/427 United Nations, Geneva.

4 The environmentally sustainable Smart Village

Robert H. Crawford

Associate Professor, Smart Villages Lab, The University of Melbourne

rhcr@unimelb.edu.au

Abstract

Environmental sustainability is a critical global challenge. Housing and infrastructure demand huge quantities of resources and result in significant environmental effects. The creation of 'smart villages' offers a unique opportunity to redefine how housing and infrastructure systems interact with the natural environment and explore solutions for improving their environmental sustainability. The concept of the Smart Village has a heavy focus on using technological solutions to enhance the existing networks and services available within a village community. This inevitably leads to an increase in resource use (both for construction and operation) which can be counter-productive to improving the environmental sustainability of villages. With environmental concerns becoming increasingly integral to decision-making, the design and implementation of Smart Villages must consider the potential environmental implications and performance of Smart Village solutions if they are to be considered truly 'smart'. This paper proposes a four-step process for identifying, analysing and implementing solutions for achieving an environmentally sustainable Smart Village. This involves an integrated design process where the current environmental performance of a village is assessed (step 1), the local context is analysed to determine what resources, skills and expertise are locally available (step 2), potential Smart Village solutions are identified and analysed (step 3), and the Smart Village is designed and implemented, with the assistance of trained professionals and village communities (step 4). This process is equally suited to identifying and analysing technological Smart Village solutions as it is for alternative construction methods and materials, which may be more primitive. By using this process in the design and implementation of Smart Villages, greater confidence is able to be placed in ensuring that potential solutions, both technological and non-technological are not creating greater environmental issues than already exist within villages. It can also be used to provide a better understanding of current village performance and that of potential Smart Village solutions so that opportunities for further environmental improvements are able to be identified and prioritised.

Keywords: smart villages; sustainability; environment.

Introduction

The idea of Smart Villages is a relatively new phenomenon, taking learnings from the Smart Cities movement and contextualising them in relation to the challenges and characteristics unique to typically smaller, more remote, less populated and less developed communities. The European Commission (2016) defines a Smart Village as a village who's "traditional and new networks and services are enhanced by means of digital, telecommunication technologies,

innovations and the better use of knowledge, for the benefit of inhabitants and businesses”. This definition of ‘smart’ tends to imply a technological solution to aspects such as healthcare, education, housing etc. It lacks a consideration of the sustainability dimension, particularly from an environmental perspective. While digital and telecommunication technologies can play an integral part in improving amenity, access to services and quality of life for people living in village communities, the environmental sustainability of these communities is at least equally important.

Villages and the environment

In some ways, villages are no different than cities. They require natural resources to support the livelihoods of their inhabitants and produce waste that must be managed. One of the main differences is the scale of these and the ability to manage them. Other challenges can be access to resources, goods, services and expertise. There are three main natural resource inputs required for the various aspects of a village to function (from the initial construction of its buildings, roads, bridges and essential services infrastructure, to its operation, and ongoing repair and maintenance). These include energy, water and raw materials (Figure 4.1). The use of these resources results in the production of waste, that must be managed, and the release of pollutants into the environment. These resource demands and outputs of waste and pollutants are having a detrimental effect on the environment and human health.



Figure 4.1 Inputs and outputs associated with a village

The environmental imperative

While there is a global trend towards urbanisation, over-population of cities, especially without appropriate supporting infrastructure, has been shown to have serious consequences on resource availability (for example, the 2018 water crisis in Cape Town, South Africa (Maxmen 2018)) and the health and wellbeing of their inhabitants (for example, due to the high levels of air pollution in Delhi, India (Rizwan, Nongkynrih et al. 2013)). As population increases so does the demand for housing and infrastructure, further increasing the demand for

resources and the waste and pollution produced as part of construction and other associated activities. For example, it is predicted that at least 200 million new houses will be required in India alone by 2030 (Planning Commission (Government of India) 2008). This is driving exponential growth in global resource demands. For example, the demand for minerals, ores, fossil fuels and biomass are predicted to be 2.5 times greater in 2050 than it was in 2010 (UNEP 2016). Demand for energy is on a similar trajectory, also expected to be 2.5 times greater in 2040 compared to 2013 (IEA 2015). Demand for fossil fuels has seen a rapid increase in global carbon dioxide levels, contributing significantly to climate change (IPCC 2014), and reduced air quality (with half of the world's population living in countries with unsafe air quality (Yale University 2018)). Evidence shows that the built environment (buildings, in particular) is responsible for a significant proportion of human induced resource demands and environmental impacts. This includes 36 per cent of global energy use and 39 per cent of carbon dioxide emissions (UN Environment and International Energy Agency 2017). Increasing demand for housing, lifestyle changes and rising expectations, especially in developing countries, will only further exacerbate the demand for materials, changes to land-use and increases in greenhouse gas emissions and pollutants emitted into the environment. The most critical issue with this is that not only are the Earth's resources finite and being rapidly depleted, but the ability for it and humans to cope with the damage that is already being done is also limited.

What is a Smart Village?

A Smart Village uses digital and telecommunications technologies and other innovative solutions to enhance the networks and services that exist within a village community (European Commission 2016). Access to critical services, such as healthcare and education are often much more difficult in villages due to their remoteness and lack of infrastructure and investment. Important elements of what makes a village 'smart' may include: education and training in e-literacy skills, e-health and other basic services, circular economy approaches to agricultural waste, using technology to promote local products, and specialisation for agri-food projects, tourism and cultural activities (European Commission 2016).

As global population continues to increase, there is a strong argument for improving living standards and access to healthcare, education and other services to the inhabitants of villages, to at least the level available to those living in cities. This approach may not only help to balance out and better manage the resource, pollution and other challenges facing many of the world's expanding cities, but also provide a better quality and more equal living standard to those living in villages, unable or unwilling to move from village communities. It can also encourage village communities to build upon their existing strengths and develop new opportunities. Figure 4.2 shows the relatively primitive nature of some villages.



Figure 4.2 North-East Indian Village (Source: Wild Frontiers Travel (2018))

However, a push towards the development of Smart Villages must not be treated in isolation of the longer-term environmental consequences. Smart Village solutions must consider the context of resource availability, waste and pollution management and human health and wellbeing to ensure long-term sustainability. For example, there is little point in a technological solution for better communication, education and healthcare services if the natural resources used for the provision of these technologies (e.g. energy and minerals) are easily depleted or cause indirect environmental or human health concerns, resulting from the release of greenhouse gas emissions or pollutants, for example. What is needed is a model for Smart Villages that not only enhances the services and networks within villages but that also ensures that these villages are environmentally (as well as financially and socially) sustainable. Surely a village cannot be considered ‘smart’ if it ignores or pays mere lip-service to the ever-increasing global environmental sustainability concerns.

Therefore, the aim of this paper is to define a pathway towards environmentally sustainable Smart Villages.

[A pathway towards the environmentally sustainable Smart Village](#)

Environmental sustainability is often considered using a retrospective approach (Figure 4.3). The problem with this is that decisions (material choices, and solution design and selection, for example) are often locked in and difficult to change. This often means that a compromise is necessary, and decisions are modified, or solutions ‘retrofitted’ to address environmental sustainability goals for particular housing or infrastructure projects. This leads to sub-optimal solutions that can potentially be even more wasteful and inefficient than business-as-usual options. The more preferred approach for designing Smart Village solutions that address environmental sustainability concerns is an

integrated approach (Figure 4.3), where environmental criteria are a key driver in the development of Smart Village solutions from the outset. This approach enables maximum potential environmental benefits from the optimisation of resource use and minimisation of waste and other environmental effects. It can also provide opportunities for better cost optimisation as a reduction in resource demands and waste production often leads to reduced costs.



Figure 4.3 Different approaches to integrating environmental sustainability into Smart Village solutions

In order to facilitate this integrated approach to the development of Smart Village solutions, a four-step process is proposed. This includes Step 1: Understand current performance, Step 2: Understand local context, Step 3: Identify and analyse potential Smart Village solutions, and Step 4: Design and implement 'sustainable' Smart Villages.

Step 1: Understand current performance

It is important to understand how a particular region, country or village currently performs from an environmental perspective in order to identify opportunities for improvement and to provide a benchmark for the performance of potential Smart Village solutions. Depending on the scale of the information required, various sources of this information exist. For example, the Environmental Performance Index (Yale University 2018) provides environmental performance data at the country scale across a total of 24 environmental performance indicators (Figure 4.3).

Country Profile INDIA



2018 EPI Country Rank (out of 180)

177

EPI Score [0=worst, 100=best]

30.57

Population (millions)

1324.2

Land Area (sq. km)

2,973,190

GDP (PPP 2011\$ billions)

8,067.7

GDP per capita

6,093

SDG Index*

58.1



Country Scorecard

Issue Categories Rank

Environmental Health

180

9.32

Air Quality

178

5.75

Water & Sanitation

145

15.8

Heavy Metals

175

16.77

Ecosystem Vitality

140

44.74

Biodiversity & Habitat

139

49.13

Forests

68

23.54

Fisheries

53

59.37

Climate & Energy

120

44.77

Air Pollution

131

37.49

Water Resources

107

58.83

Agriculture

125

21.98

0 25 50 75 100

Environmental Performance Index Score

Figure 4.4 Environmental Performance Index for India (Source: Yale University (2018))

Other tools and frameworks can also be used to provide an understanding of a region's current environmental performance, such as the UN Sustainable Development Goals (UN 2018). A survey of community members and observation of specific village communities can also provide the empirical evidence needed to best understand the current performance and issues being faced within a village.

Step 2: Understand local context

A critical element of improving the environmental performance of a village is to understand its current characteristics and context. This step involves exploring the local resources available, such as materials, energy and water, and determining the ability for these local resources to be more widely used in the construction and operation of a village. An understanding of locally available skills and expertise is also essential, especially as maximising the use of these to

meet specific village community needs is a key component of creating a sustainable Smart Village.

By closely aligning the selection of construction methods and materials with community needs, expertise and skills it is also possible to meet social sustainability goals. While the ultimate goals may be to improve the environmental performance of a village, current community expertise may not be conducive to maximising this environmental performance. If new construction techniques or better performing construction materials are shown to perform better from an environmental perspective than current practice, then further training and education of villagers may be necessary. This can then be supported by other Smart Village solutions, such as e-learning.

Step 3: Identify and analyse potential Smart Village solutions

This step involves identifying potential Smart Village solutions considering the contextual information gathered in Step 2. Appropriate solutions for one village may not be the best solution for the next village. It is important that each potential Smart Village solution for improving environmental performance is assessed in the context of each village. In addition to considering the contextual aspects of potential alternative construction methods, materials or systems and their appropriateness (Step 2), each potential solution for improving the environmental performance of a village must be analysed from a life cycle perspective. This involves quantifying the total input flows (energy, water and resources) and output flows (waste, emissions and pollutants) over time, to determine whether net environmental benefits are able to be realised and ultimately whether or not a potential solution is environmentally sustainable. This should also be used as an opportunity to identify areas for further improvement in the way things are currently done and in the proposed alternative solutions, in the interests of striving towards achieving an environmentally sustainable Smart Village.

A number of approaches exist for analysing the environmental performance of Smart Village solutions, such as Bioregional's One Planet Living (Bioregional 2018) (Figure 4.4) and The Living Future Institute's Living Building Challenge (Living Future 2017). More in-depth analysis is also possible using sophisticated life cycle assessment data and techniques, as outlined by Crawford (2011).

 Health and happiness Encouraging active, sociable, meaningful lives to promote good health and well being	 Local and sustainable food Supporting sustainable and humane farming, promoting access to healthy, low impact, local, seasonal and organic diets and reducing food waste
 Equity and local economy Creating bioregional economies that support equity and diverse local employment and international fair trade	 Sustainable materials Using sustainable and healthy products, such as those with low embodied energy, sourced locally, made from renewable or waste resources
 Culture and community Respecting and reviving local identity, wisdom and culture; encouraging the involvement of people in shaping their community and creating a new culture of sustainability	 Sustainable transport Reducing the need to travel, and encouraging low and zero carbon modes of transport to reduce emissions
 Land use and wildlife Protecting and restoring biodiversity and creating new natural habitats through good land use and integration into the built environment	 Zero waste Reducing waste, reusing where possible, and ultimately sending zero waste to landfill
 Sustainable water Using water efficiently in buildings, farming and manufacturing. Designing to avoid local issues such as flooding, drought and water course pollution	 Zero carbon Making buildings energy efficient and delivering all energy with renewable technologies

Figure 4.5 Bioregional's One Planet Living assessment criteria

(Source: Bioregional (2018))

As part of identifying and analysing potential solutions for achieving an environmentally sustainable Smart Village it is important to identify the associated training and education needs for their implementation. This capacity building could take the form of higher education or on-the-job training for villagers.

Step 4: Design and implement 'sustainable' Smart Villages

The final step in the proposed process for identifying and implementing sustainable Smart Village solutions is to design and implement the selected solutions. This should involve the village community as well as trained professionals (designers, engineers, contractors etc.). This will not only help ensure that certain construction standards are met but will also help to maximise the opportunity for villagers to be trained in any aspects of this process that may be appropriate and develop skills and capabilities that will enable them to modify and maintain buildings and infrastructure systems. This will provide an element of ownership and promote a greater feeling of engagement in the Smart Village upgrade process.

Conclusions

Smart Villages must go beyond a purely technological solution to enhancing the existing networks and services of village communities. At a time when environmental issues are of utmost concern, promoting the utilisation of more of the very resources that have been responsible for these current issues is unsustainable and outright negligent.

This paper proposes a four-step process for identifying and implementing sustainable Smart Village solutions. This involves a holistic and integrated

approach to identifying appropriate solutions for improving the environmental performance of villages. It goes beyond a purely technological approach and relies on community engagement and an understanding of the local context, particularly in relation to available skills and resources, and local issues.

While environmental concerns are of utmost importance, we should not forget about the other aspects of sustainability – social and economic. These should also be considered when assessing any potential solutions for Smart Villages that might be proposed.

References

Bioregional. (2018). "One Planet Living." from <https://www.bioregional.com/oneplanetliving/>.

Crawford, R. H. (2011). Life Cycle Assessment in the Built Environment. London, Taylor and Francis.

European Commission (2016). EU Action for Smart Villages. Brussels.

IEA (2015). India Energy Outlook: World Energy Outlook Special Report. Paris, International Energy Agency.

IPCC (2014). Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge, United Kingdom and New York, NY, USA, Cambridge University Press: 851.

Living Future. (2017). "Living Building Challenge." from <https://living-future.org/lbc/>.

Maxmen, A. (2018). As Cape Town Water Crisis Deepens, Scientists Prepare for "Day Zero". Nature. US, Scientific American.

Planning Commission (Government of India) (2008). Eleventh Five Year Plan 2007-12. New Delhi, Oxford University Press.

Rizwan, S. A., B. Nongkynrih and S. K. Gupta (2013). "'Air pollution in Delhi: Its Magnitude and Effects on Health'." Indian Journal of Community Medicine : Official Publication of Indian Association of Preventive & Social Medicine **38**(1): 4-8.

UN. (2018). "Sustainable Development Goals." from <http://www.un.org/sustainabledevelopment/>.

UN Environment and International Energy Agency (2017). Towards a zero-emission, efficient, and resilient buildings and construction sector. Global Status Report 2017.

UNEP (2016). Global Material Flows and Resource Productivity. An Assessment Study of the UNEP International Resource Panel. M. F.-K. H. Schandl, J. West, S. Giljum, M. Dittrich, N. Eisenmenger, A. Geschke, M. Lieber, H. P. Wieland, A. Schaffartzik, F. Krausmann, S. Gierlinger, K. Hosking, M. Lenzen, H. Tanikawa, A. Miatto, and T. Fishman. Paris, United Nations Environment Programme.

Wild Frontiers Travel. (2018). "In Pictures - North East India: Meghalaya Tree Bridges, Assam and Nagaland." from https://www.wildfrontierstravel.com/en_AU/destination/india/group-tours/2001596/north-east-india-meghalaya-tree-bridges-assam-nagaland/in-pictures.

Yale University. (2018). "2018 Environmental Performance Index (EPI)." from <https://epi.envirocenter.yale.edu/>.

5 ICT4D for Smart Governance of rural development in Assam

G. Kimm

Research Fellow, Smart Villages Program, The University of Melbourne

geoff.kimm@unimelb.edu.au

Abstract

Aligned with smart villages, smart governance can identify and address gaps between services provided to communities, the needs of communities, and support for self-reliant interaction within communities. This working paper presents ongoing work on a survey-based information communication technology for development (ICT4D) model for smart governance and an associated proof-of-concept software tool, with an emphasis on an Assamese context.

Keywords: Smart Villages, ICT4D, GIS, Smart Governance, Assam.

Introduction

Although the development situation in Assam, India, is in recent years improving, there is still a considerable gap between the availability of data in useful form within levels of government and to the public, and the insight demanded of data by adopted development goals and rural needs. This gap affects areas and creates needs within them such as communication to facilitate people working together; governance architecture that adapts to new technology; sub-state level governance to provide better data access to those who need it; integration and digitisation of disparate sources of data; and monitoring and evaluation to provide credible and adequate data for actionable insight.

In response to this gap, the Smart Villages Program (SVP) at the Melbourne School of Design, the University of Melbourne, is conducting as part of its research into use of Smart Cities approaches for rural development an internet-supported survey of rural household needs and conditions on the island of Majuli, Assam. This survey is supported by a work-in-progress framework for rural development through Smart Governance supported by Information and Communication Technologies for Development (ICT4D).

The objective of the ICT4D system is a small, scoped intervention to provide actionable insights particularly at local level as best can be provided as an outcome of the survey process. It is not intended to transform existing government structures, as this is beyond the scope of the project, but could assist internally-led transformation of government processes. Further, the approach is neither designed to, nor intended to, supplant any data-gathering or geographical information system by, or of, any department of the Government of Assam.

Context

The State of Assam, India, has in current years improved in its economic outlook, yet still has significant disparity of conditions and opportunities between urban and rural citizens (Government of Assam 2018a). Rural citizens, who at 86 per cent of the Assamese population number in excess of 25 million people, suffer disadvantage as measured by many metrics both with respect to the urban Assamese population and to India as a whole. In the 2011-12 period, 33.9 per cent of rural Assamese citizens fell below the poverty line, compared to 25.5 per cent for all rural Indians and 20.5 for urban Assamese. Assam ranks only 26th in literacy among the states of India; in urban areas literacy is at 88.5 per cent, yet in rural areas it is at 69.3 per cent and only 60.1 per cent for rural females. The rural Infant Mortality Rate (IMR) in 2014 was, at 52 deaths of infants under one year old per 1,000 live births, well above the national rural level of 43, and greatly above the Assam urban level of 27. Rural provision of electricity is greatly below that in urban areas: although 84.1 per cent of urban households use electricity for lighting, only 28 per cent of rural households do so. There is a significant lack of communications access in rural areas of Assam with only 39.18 telephones per 100 people, compared to 132.26 per 100 in urban areas and a national average for rural areas of 48.04 per 100 (Government of Assam 2017).

The Government of Assam (GoA) has since 2005 adopted fiscal reform measures that are stated to be “a key factor for attaining higher economic growth”, however, while the Gross State Domestic Product for the 2011-12 to 2015-16 period averaged 12.5 per cent annual growth, the disparity between rural and urban welfare has not significantly narrowed (Government of Assam 2018a, 2017).

In 2016, the GoA adopted the *Assam 2030: Our Dream, Our Commitment* (Assam 2030) policy framework with provisions to improve the living standards of rural Assamese and reduce the rural-urban divide (Government of Assam 2016). The framework adopts and expands on the goals of the United Nations Development Programme’s Sustainable Development Goals (United Nations Development Programme 2015).

The targets contained in Assam 2030 are ambitious. For example, under *No Poverty*, it aims to reduce Assam’s poverty rate from 27.3 per cent in 2015 to 0 per cent in 2030, and under *Zero Hunger*, it aims to double the agricultural productivity and incomes of small-scale food producers (Government of Assam 2016). Beyond the difficulty of achieving any such target in isolation, complexity is introduced by conflict between goals of the framework; for example, the ability to double agricultural productivity is made more difficult to achieve – although reasonably so – by environmental aspirations of other goals.

The GoA also has supporting aid programs designed to address specific issues on the ground and improve development outcomes in the long term by leveraging funding allocation. One such program is the proposed expenditure by the State Agriculture Department of Rs. 2000 lakh (approximately \$4M AUD) to establish

800 mini oil mills with packaging units to support local oil markets and employment generation. A similar scheme for 2014- 15 was the provision of spice and pulses grinding mills, power weeders, and paddy transplanter to rural women's self-help groups under the Chief Minister's Vision of Women & Children (Government of Assam 2017).

To achieve development goals such as those of Assam 2030, and to effectively implement supporting aid programs, is a substantial demand of existing governance frameworks. Indeed, the GoA acknowledges this in its Assam 2030 vision, and explicitly recognised as amongst the 'critical challenges' the issues listed hereunder (Government of Assam 2016).

- A. Communication: to bring together people to work harmoniously;
- B. Governance architecture: to reinvent governmental systems, and exploit rapidly changing technology, to better predict and shape the future.
- C. Sub-state level governance: to assist these levels in achieving development goals.
- D. Integration and digitisation: to capture and synthesise knowledge from disparate sources.
- E. Monitoring and evaluation: the 'dearth of credible and adequate data, and weak monitoring and evaluation systems, pose a serious challenge'.

Smart Governance and ICT4D

To address these challenges, there is need for informational support of governance process to measure needs and conditions, formulate and implement policy, and assess outcomes. Government hence requires the ability to have information that is up-to-date, comprehensive, relevant to evolving issues, and accessible in part or whole to appropriate levels of government and sections of the community. Use of a smart government approach supported by ICT4D intervention can provide this.

Smart governance, as part of smart cities, provides an approach for improving the lives of citizens within smart communities through better outcomes and processes of governance. Meijer et al. (2015) identify four perspectives on smart governance which we used to inform our approach to ICT4D for smart governance of rural development in Assam.

- 'Government of a smart city' through good policy and administration, and in which extant government structures and process require no change, and smart governance is narrowly considered to relate only to those activities of a smart city.
- 'Smart decision-making', in which extant government structures and process require little or no change, and smart governance is emphasised to be the process of innovative decision making.
- 'Smart government administration', in which greater change of extant government structures and process is necessary so that smart governance can synthesise for better community outcomes procedure, data, infrastructure, and institutions.

- 'Smart urban collaboration' predicated on increased and more efficient interaction and communication between government and community, and in which any transformation within government complements the transformation of organisation outside of government.

Of these, 'government of a smart city' inhibits the scope and goals of any ICT4D intervention, and 'smart government administration' relies on formulation of government process and restructuring beyond the scope of an ICT4D intervention as considered within this paper, whereas 'smart decision-making' and 'smart urban collaboration' support leveraging of a survey-based ICT4D intervention to transform information flow between government and community for better outcomes for communities and processes of governance.

Further, Meijer et al (2015) distinguish between what smart cities *are* (including smart governance) and *aims* of smart cities (such as smart energy, smart building, smart mobility, smart infrastructure, smart technology, smart healthcare, smart environment, or smart economy). We extend this in our approach to smart villages to consider smart villages as not prescriptive with respect to goals: goals exist and are categorised in smart villages theory, but the details are not immutable, and the theory instead indicates a framework, methodology, process, or approach for obtaining development goals. Such goals may come from local policy such as Assam 2030.

Although a definition of ICT is implicitly understood by most people, the meaning of ICT4D is more nebulous. Broadly speaking, it is to use ICT to achieve 'good' in the context of development, and may address areas such as growth for eradicating extreme poverty and hunger; equality for universal education, literacy, gender equality and empowering women; health to improve child mortality and maternal health, and to combat HIV/AIDS, malaria, and other diseases; or sustainability to support development without depopulating or degrading the environment. ICT4D programs may be informed by formalised development goals provided by NGOs and other bodies, such as the Sustainable Development Goals of the United Nations Development Programme, and those goals adopted in Assam 2030 (United Nations Development Programme 2015, Government of Assam 2016).

In Assam in progress at the state and national levels are ICT programs that fall within the ICT4D gamut, even if not explicitly recognised as doing so, in the domains of citizen services, intra-government services, and citizen connectivity.

In the domain of citizen services are:

- eDistrict. To provide state-wide government to citizen (G2C) ICT service delivery of such things as registrations and certificates (Government of Assam 2018b).
- Common Service Centre (CSC). Rollout of 4375 front-end delivery points providing to rural citizens government, private and social sector services via ICT with intent to promote rural entrepreneurship, build rural capacities and livelihoods, and enable community participation and

collective action for social change (Assam Electronics Development Corporation 2017a).

- State Portal & State Service Delivery Gateway (SP&SSDG). Operates for citizens as a unified, central source of government information (Government of Assam 2018c).

In the domain of intra-government services are:

- State Data Centre (SDC). A physical centre currently under development for ICT infrastructure hosting including central data repositories, application backend servers, and citizen information/services and state intranet portals (Assam Electronics Development Corporation 2017b).
- Assam Wide Area Network (ASWAN). Commissioning of 304 Points of Presence (PoPs) with minimum of 2 Mbps links for multiple uses including the connection of all government offices in the state under the Horizontal Connectivity project. ASWAN will also support the National Registrar of Citizens (NRC) update program utilising 114 of its PoPs and the e-District project utilising 160 of its PoPs (Assam Electronics Development Corporation 2017b).

In the domain of citizen connectivity are:

- Internet access via Optical Fibre Cable & wireless Access Point technologies (The Hindu 2017):
 - Bharat Sanchar Nigam Limited (BSNL) plans to connect all gram panchayats in Assam with optical fibre internet access with a target for 2017 of 70 per cent of all gram panchayats connected.
 - BSNL will supplement this optical fibre connectivity with 3,000 wireless access points.
- Household bank accounts: each Indian household is to be provided with a bank account (BBC 2014).
- Mobicash digital wallet by BSNL and SBI which is a digital wallet for use on even low-specification smartphones. It will be extended to 40,000 BSNL outlets throughout the northeast of India and can be used for paying bills and transferring funds between individuals (The Telegraph India 2017).
- Aadhaar system of identification, under which is issued to all Indian residents a unique 12-digit number associated with their demographic and biometric data.

While these programs are extensive and worthy, they do not fully address the challenges of achieving goals such as those of Assam 2030 and effectively implementing targeted aid programs; in particular, they do not allow fully for assessing needs, condition, and impact, nor respond fully to the 'serious challenge' to provide monitoring and evaluation through 'credible and adequate data' (Government of Assam 2016).

Smart governance for rural development ICT4D model

To formulate a smart governance rural development ICT4D model, we examined government-community relationships in the context of development objectives and existing ICT program areas, with emphasis on response to the challenges identified in and selected from Assam 2030 and guided by application of 'e-governance relationships' discussed below.

Allied with smart governance is the concept of e-governance, which, through the use of ICT, can recast and improve interaction between citizens, government, and business (Davison et al 2005).

- Government to citizen (G2C): to provide citizens with access to a variety of government services, which they otherwise, traditionally, would need to access in person, if at all. A nuance here is the concept of two-way communication, in which citizens may respond to or message government on issues such as voting, or feedback.
- Government to business (G2B): providing to business information such as best-practice guidelines to services such as tendering platforms. Like G2C, there can be two-way communication in which the flow of information is from business to government.
- Government to government (G2G): to facilitate communication and processes within and between government departments and levels to improve efficiency and cut costs.
- Government to employees (G2E): improving communication between government and employees, and availability within government structure of information on each.

These relationships may also work conversely, for example the government-to-citizen relationship has the complement of citizen-to-government.

Of these e-governance relationships, we selected two as being most suited to the unique Assamese rural development conditions and extant government processes, to formulate a smart governance model for rural development ICT4D model. As well as government-to-government, and government-to-citizen and its converse citizen-to-government, we added an additional relationship that on cursory inspection is not part of 'traditional' e-governance: citizen-to-citizen communication.

This citizen to citizen (C2C) relationship facilitates communication between citizens; the involvement of government is to identify needs within communities with the aim of inducing greater self-reliance. These smart governance interventions should not supplant the mechanisms villagers have for self-sufficiency. To illustrate, in a survey of e-retailing in Chinese villages Leong et al (2016) identified a process of birth, expansion, and renewal leading from early adopters engendering community interest to government redefining its role in an increasingly autonomous community. The citizen to citizen relationship offers to

government smart governance support for ‘bootstrapping’ economies and social synergies within communities.

With the relationships between government and community assessed, we interpreted the challenges selected from Assam 2030 as requirements of an ICT4D model for rural development:

- A. communication: to engage citizens by supporting presentation of data to citizens, and, alongside, allowing reporting of issues to government;
- B. governance architecture: assisting new governmental approaches;
- C. sub-state level governance: providing actionable data and insights to lower levels of government;
- D. integration and digitisation: assimilate the gamut of collected data to facilitate analysis and insight;
- E. monitoring and evaluation: provide a means to find conditions on the ground and report needs and opinions of citizens.

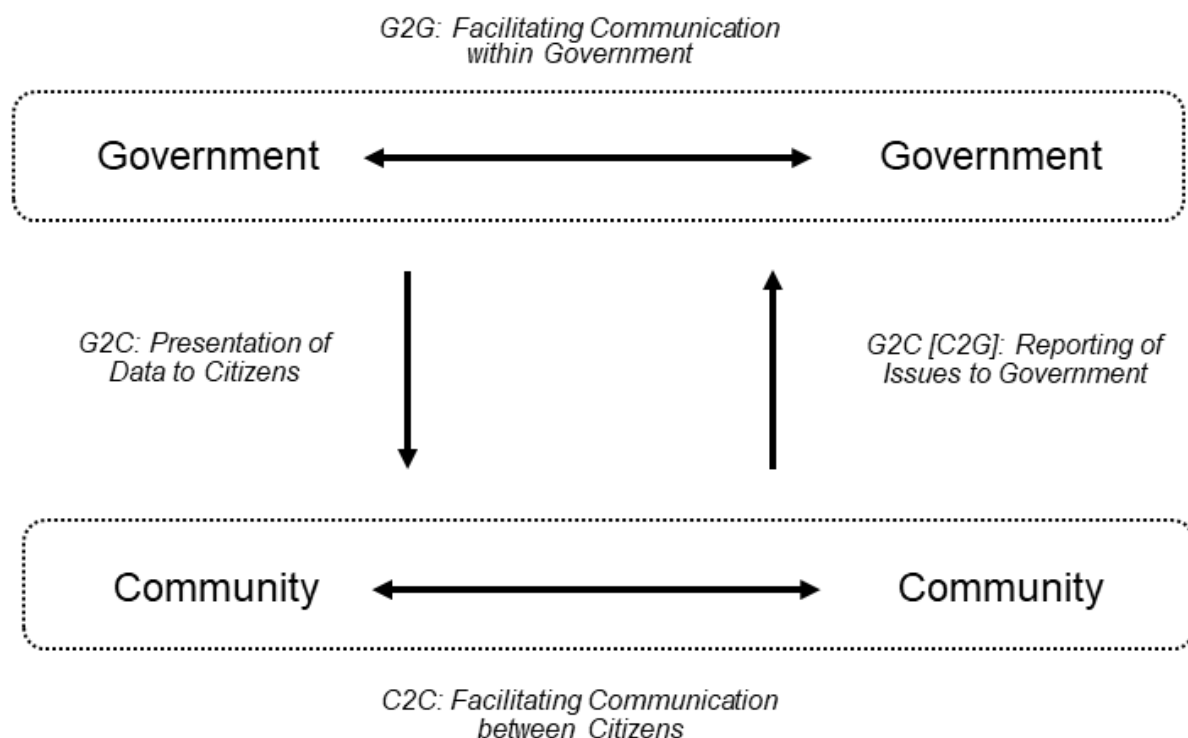


Figure 5.1 Diagrammatic representation of the Smart Villages Program’s Smart Governance for Rural Development Model

The resulting model, shown in Figure 5.1, provides a minimal-intervention and gradual-introduction approach for introducing smart governance into rural

communities through ICT4D supported with surveying, and offers a framework upon which can be hung multiple ICT4D interventions. The objective of the model is, at the core, simple: identify the needs of the community, such as infrastructure or service, and facilitate the formulation and application of solutions.

Software Proof of Concept

A software tool was developed to demonstrate aspects of selected ICT4D communication flows and functionality within the Smart Governance for Rural Development ICT4D model (Figure 5.2).

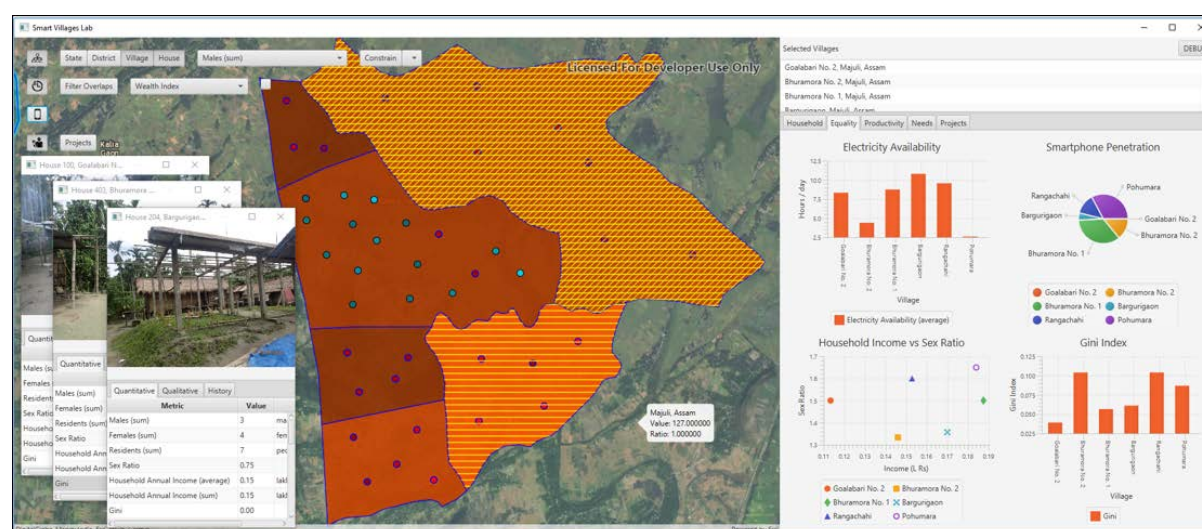


Figure 5.2 Smart governance for rural development ICT4D model demonstrator

The essence of the proof-of-concept is the household as the atomic survey unit, and which is incorporated as the lowest level of a geopolitical hierarchy including also village, district, and state.

Building atop this geopolitical hierarchy, the tool demonstrates four complementary 'layers' of communication flows. It is a hybrid of both proof-of-concept and prototype functionality across and within these layers. It contains proof-of-concept features to verify concepts are viable and can be implemented, to explore technologies, and to allow knowledge to be shared within the SVP team. It contains prototype features to convey possible user experience of the tool, and to streamline and guide further development.

Further, the tool in current form is a 'vertical slice' of proposed or tentative functionality – it contains a selection of features representing the essence of the SVP ICT4D model research and is not intended as a fully-featured package. The tool can be developed through this proof-of-concept and prototype vertical slice stage to a minimum viable product form for pilot project testing.

The layers of the tool are:

- a prototype core SVP survey layer including data, metrics, and analysis aspects;
- a proof-of-concept layer of departmental project data bound to geo-political regions of the survey layer;
- a proof-of-concept layer of smartphone integration exploring technology for feedback integration and community-based issue reporting; and
- a nascent proof-of-concept layer of automated surveying utilising machine learning technologies.

The prototype core survey layer provides metrics and analysis of the data of the SVP survey framework. The framework is designed within the flow of the SVP ICT4D model to provide a rapid, flexible, and inexpensive means of accessing the conditions within and needs of rural communities.

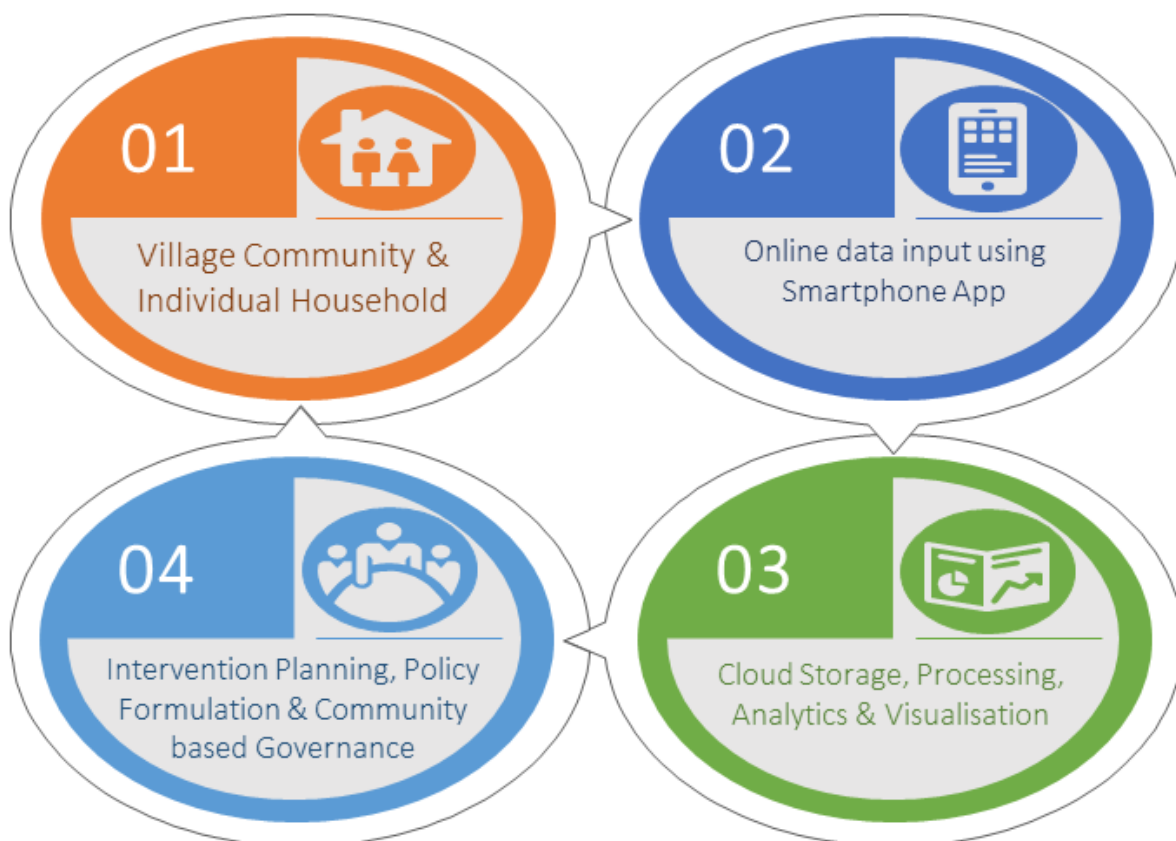


Figure 5.3 Smart Villages Program survey framework (Source SVP / R. Borah)

The Smart Villages Program survey framework offers a cyclical mechanism to assess community needs, act on those needs, and reassess in view of those interventions (Figure 5.3):

1. In the initial step, village communities of interest are identified, and individual households within them are mapped.
2. Householders provide data via a smartphone app.

3. The data is uploaded to cloud storage, where it is processed, and then analytics and visualisation are provided to decision makers as shown in the demonstrator software tool.
4. Decision makers can undertake intervention planning, policy formulation and community-based governance. The effectiveness of changes can be tested in a new cycle.

While the survey in its early form must be administered through using predefined questions by a field worker going house to house within a community, the process is extensible to using smartphone apps that may be used by household members directly and updated remotely.

The proof-of-concept layer of departmental project data provides decision makers with an overview of projects planned for, or being undertaken in, a rural community so that it can be seen if needs are being planned to be met, or if projects in place to meet needs are in fact successful in doing so. Users can access project data in two ways, from a top-down departmental perspective – whereby a particular department and any, or all, of its projects may be selected – or a bottom-up geographical perspective – whereby a geopolitical area may be selected to show the projects active within it. This layer, while focused on departmental projects, is a proof-of-concept of general integration with government departments.

The layer of smartphone integration provides a proof-of-concept for community engagement through bi-directional flow of information between community and government, and between community members themselves. The current framework allows geo-positioned community reports annotated with images and prose to be logged and viewed in the bespoke *SVP Engage Android™* smartphone app, with these being updated in real-time in the software demonstrator. This framework is extensible to many uses, such as presentation of data to citizens, reporting of issues to government, or citizen infrastructure ownership.

Smartphone integration can be used to present policy and infrastructure proposal to citizens so that they can be informed about how funds are being allocated, and which infrastructure works addressing local issues are underway or proposed, and they can offer feedback and comment on the information presented to them on the basis of which government may adjust proposals and moderate policy.

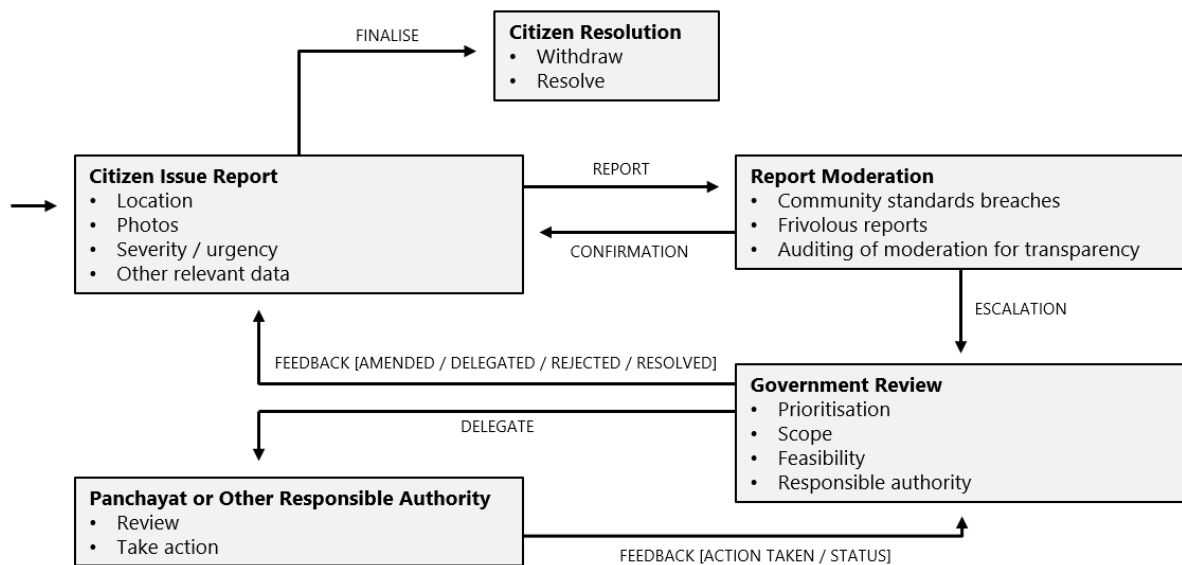


Figure 5.4 An ICT4D model for citizen reporting of issues

Reporting issues to government in smartphone integration acts as a converse of presenting policy and infrastructure proposal to citizens; reports are entered into the system directly by citizens, not by government. The processing of these reports must be embedded in a government process which considers issues such as maintenance of goodwill, respecting bottlenecks, exacerbation of negative sentiment, management of transparency and appropriate content, and user identification – an example model is given in Figure 5.4.

A speculative proposal for smartphone integration is to assist citizens to claim management of a resource in their locality. This ICT4D system could allow community groups to volunteer to mind and maintain some part of a resource associated with a significant environmental issue or section of infrastructure in which they have an interest. A fully-fledged system might include a smartphone app with intra-community messaging, issue geotagging, and issue tracking functionality, however a prototype is likely possible using online mapping and forum services.

The layer for automated surveying provides a framework for a proof-of-concept utilising machine learning technology to allow a way to make an ultra-rapid survey of a village. It exploits the outcome of the SVP survey process of a data set of a standardised house photo and questionnaire record of each house surveyed. By labelling the photos with selected corresponding survey data, a machine learning model may be trained to classify standardised house photos from as-yet-unsurveyed villages. Although it remains to be tested in-field what metrics can be well derived, it is anticipated that this approach might yield swift and low-cost initial analysis of a village that can guide further surveying or funding allocation.

Conclusion

The work-in-progress smart governance for rural development ICT4D model and proof-of-concept software tool presented in this paper provide potentially a non-disruptive and incremental path for survey-based intervention in communities to assess needs, conditions, and policy impacts. While the current model as tested in fieldwork is limited to use of a relatively-static survey design, it is extensible to flexible survey designs that target specific issues or neighbourhoods and operate in real-time for live updating of data. Moreover, the approach could be applied to development contexts beyond rural situations. The approach complements existing ICT developments in Assam, and is not designed nor intended to supplant any data-gathering or geographical information system by or of any department of the Government of Assam; however the approach may aid transformation of government processes through 'smart decision-making', with smart government as the process of innovative decision making, and 'smart urban collaboration', with smart government predicated on increased and more efficient interaction and communication between government and community. The on-going survey-based fieldwork on the island of Majuli, Assam, will verify the applicability of this model and proof-of-concept tool, and guide in which direction it should be further developed to best meet the needs of both government and community.

References

Assam Electronics Development Corporation (2017a), Common Service Centre, <http://csc.amtron.in/>, Date accessed 27/11/2017

Assam Electronics Development Corporation (2017b), Projects, <http://www.amtron.in/node.php?lnk=undrNegp>, Date accessed 27/11/2017

BBC 2014, India's Narendra Modi launches bank accounts for all, <http://www.bbc.com/news/world-asia-india-28962762>, Date accessed 27/11/2017

Davison, R. M., Wagner, C., & Ma, L. C. (2005). "From government to e-government: a transition model", *Information Technology & People*, Vol. 18, Issue 3, pp280-299.

Government of Assam (2016), Assam 2030, <https://transdev.assam.gov.in/portlet-innerpage/assam-2030-our-dream-our-commitment>, Date accessed 03/01/2018

Government of Assam (2017), Economic Survey Assam 2016-17, <https://des.assam.gov.in/information-services/economic-survey-assam>, Date accessed 03/01/2018

Government of Assam (2018a), State Income, <https://des.assam.gov.in/portlets/state-income>, Date accessed 03/01/2018

Government of Assam (2018b), e-District Project, <http://www.edistrict.assam.gov.in/eDistrict>, Date accessed 03/01/2018

Government of Assam (2018c), SSDG & State Portal, <https://it.assam.gov.in/schemes/ssdg-state-portal>, Date accessed 03/01/2018

Leong, C. M. L., Pan, S. L., Newell, S., & Cui, L. (2016). "The Emergence of Self-Organizing E-Commerce Ecosystems in Remote Villages of China: A Tale of Digital Empowerment for Rural Development", *Mis Quarterly*, Vol. 40, Issue: 2, pp.475-484.

Meijer, A., & Bolívar, M. P. R. (2016). "Governing the smart city: a review of the literature on smart urban governance", *International Review of Administrative Sciences*, Vol. 82, Issue: 2, pp.392-408.

The Hindu (2017), BSNL to connect 1500 gram panchayats through OFC in 2017, <http://www.thehindu.com/sci-tech/technology/BSNL-to-connect-1500-gram-panchayats-through-OFC-in-2017/article17013202.ece>, Date accessed 27/11/2017

The Telegraph India (2017), Digital wallet, https://www.telegraphindia.com/1170218/jsp/northeast/story_136420.jsp, Date accessed 27/11/2017

United Nations Development Programme 2015, Sustainable Development Goals, <http://www.undp.org/content/undp/en/home/sustainable-development-goals.html>, Date accessed 03/01/2018

6 Significance of culture in architectural design of housing in Assamese Smart Villages

Velyne Ingti Katharpi¹, Hemanta Kumar Dolo² and Sally Donovan³

¹ PhD Student, Smart Villages Lab, The University of Melbourne

² Senior Lecturer, Smart Villages Lab, The University of Melbourne

³ Research Fellow, Smart Villages Lab, The University of Melbourne

Abstract

This paper intends to demonstrate the gap in understanding and knowledge between the assumption of the rural development department and the expectation and perception of the rural communities. For the research, a brief comparative analysis was conducted between a traditional rural house design and the rural house design option under the “Housing for all” scheme of the Pradhan Mantri Awaas Yojna Gramin (PMAYG). The PMAYG scheme is a housing scheme by the Department of Rural development under the Government of India. As part of their housing scheme, they developed an “Appropriate and affordable rural housing for all” scheme for states that were reported to have a lower development and housing rate. According to the scheme, the government collaborated with the United Nations Development Program (UNDP) India and Indian Institute of Technology (IIT), Roorkee to research and design rural housing options that were suitable to the physiography and culture of the context. It was compiled as ‘Pahal- a compendium of rural housing typologies’ (UNDP, 2017). The state of Assam was divided into five zones based on physiographical features. The design studied was one of the six in the compendium for the state of Assam. Considering the diversity in ethnicities of the people living in the state, the design of the house failed to reflect the diverse ethnic cultures of the people living in the area. This indicated an oversight of the significance of culture and considerable high level of generalisation of the results. The methodology is observed to include more interactions with government officials rather than with the rural inhabitants. In cases where interactions involving the rural inhabitants, the whole population of the village is not considered. This paper proposes a variation in the existing bottom-up methodological approach by modifying few steps and considerations made to define a culturally inclusive and sensitive research design.

Keywords: Critical Regionalism, Culture-Sensitive, Bottom-Up approach, Housing, Context.

Introduction

Developing only the urban sector is not feasible in the current situation where the population in cities keeps increasing due to rural migration to cities for jobs and better quality of life, as the load of development would heavily fall on the urban sector. As shown in Figure 6.1, 68.9 per cent of India's population live in rural and remote areas, and 21.9 per cent live below the national poverty line. Further to this the illiteracy rate is 36.9 per cent of which 25.5 per cent is urban and 42 per cent is rural. It seems to indicate a gap in policy making and implementation of policies and programs regarding rural development (Government of India, 2011; Reserve Bank of India, 2013).

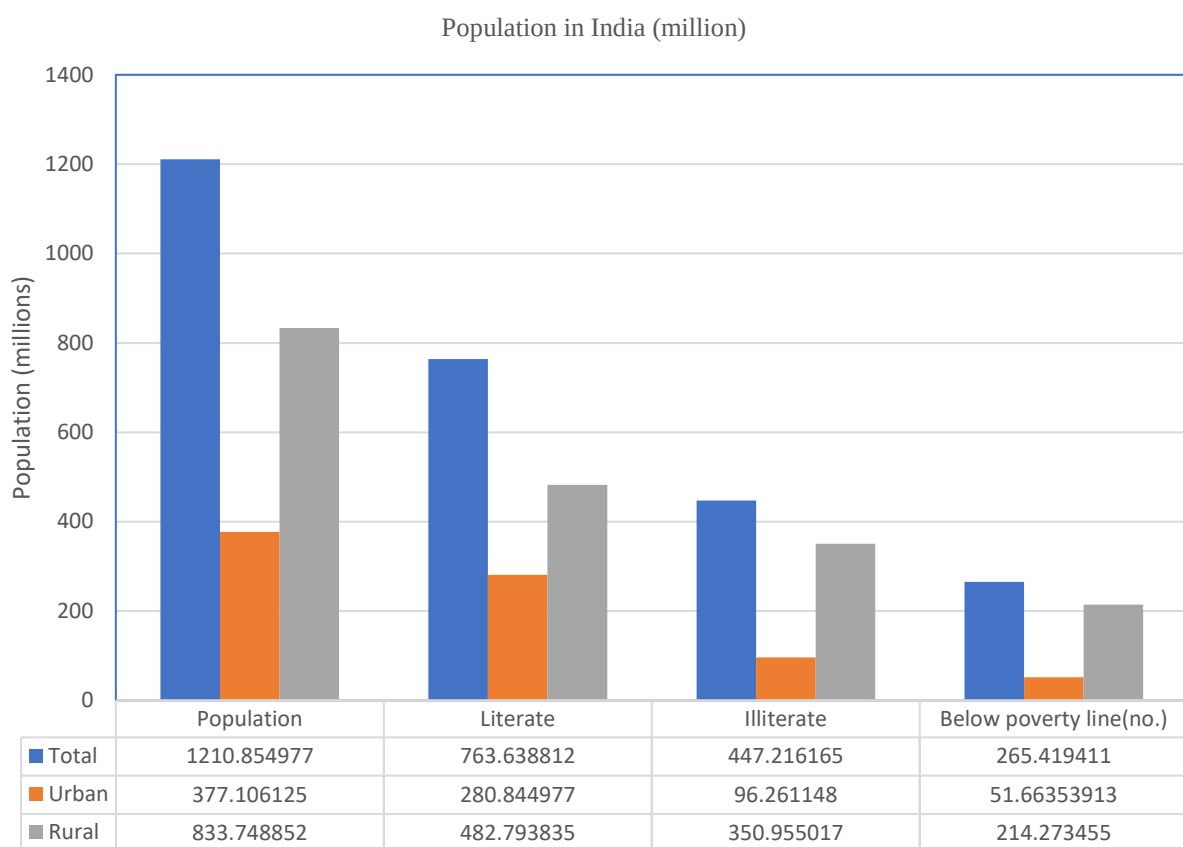


Figure 6.1 The rural urban divide in India (Ahmad & Raza, 1993; Reserver Bank of India, 2013; Taher, 1993)

However, the current scenario of rural development continues to pressure the urban sector towards urbanisation while the gap of development widens. It is necessary to plan and implement policies that cater to the needs of the less fortunate for better overall development, so that the rural sector also “carries its weight”, in a manner of speaking, and ensures a better overall developmental approach for the country.

According to 170 Demographic and Health surveys from 65 countries analysed by Young (2013), four out of five people migrated to the urban areas while only one out of five migrated back to a comparatively less urbanised or rural and remote area despite the urban areas having lower income and living standards. It was found that people moved to the cities and towns from rural and remote areas for better education, higher income and better living standards. This indicated the role of migration as a contributing factor to inequalities in living standards in both urban and rural areas leading to the rural urban gap.

It has been quoted by Gandhi (1962), "If the villages perish, India will perish too. It will be no more India". This statement was made to encourage local trade and use of local means to develop the nation. Gandhi's intent was to mobilise the masses of India who reside in the villages, as shown in Figure 6.1.

As a realisation of this profound saying, there has been a notable shift in the focus of development in recent years. It was observed that building smart cities is impossible without enabling smart villages (Shukla, 2016; Vswanadham, 2013). As an effort to achieve the overall development of the country, the Consolidated Plan of Smart India was proposed by the Department of Urban Housing and Infrastructure, and the Ministry of Rural development (ZeeNews, 2016). The plan was to create 100 smart cities and 10 smart villages.

Assam

Assam has a population of 31.2 million people. 86 per cent live in rural areas, 38.5 per cent are illiterate, and 31 per cent live below the poverty line as shown in Figure 6.2. Assam is home to 115 ethnic groups (People of India project). 79 (69 per cent) identify themselves regionally, that is belonging to the northeast region, 22 (19 per cent) locally, that is belonging to the state of Assam, and 3 trans-nationally, that is languages that are spoken in India as well as other neighbouring countries, as shown in Figure 6.3 (Government of India, 2011; Reserver Bank of India, 2013). This ethnic diversity across the state indicates an even greater variation in the definition of social acceptance of a "smart village". In fact, culture should be defined as the fourth pillar of sustainability along with the economic, social and environmental pillars of sustainable development (Frampton, 1998).

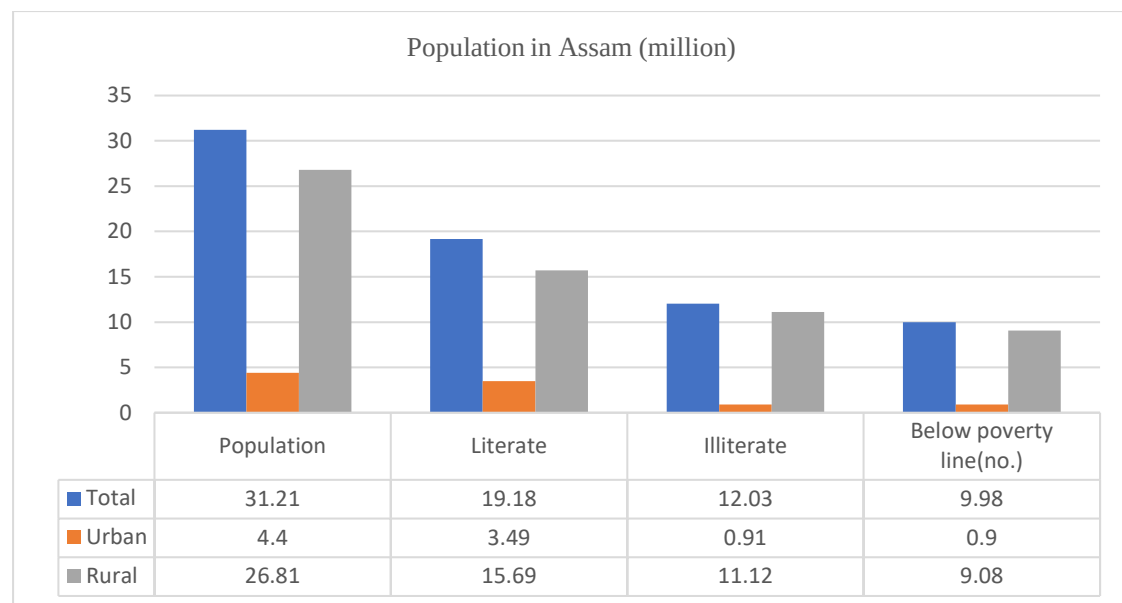


Figure 6.2 Rural urban gap in Assam (Ahmad & Raza, 1993; Reserve Bank of India, 2013; Taher, 1993)

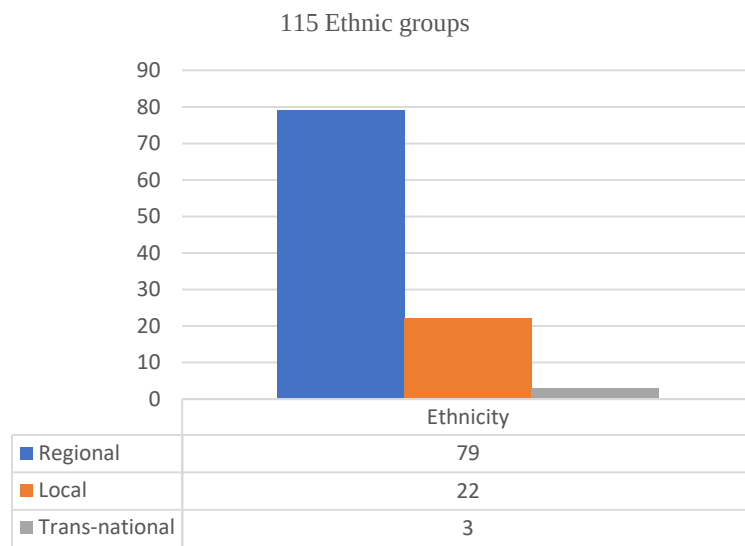


Figure 6.3 Ethnic Groups in Assam (Government of India, 2011; Reserve Bank of India, 2013)

Pradhan Mantri Awaas Yojna Gramin (PMAYG) scheme is a housing scheme by the Department of Rural Development under the Government of India. As part of their housing scheme, an “Appropriate and affordable rural housing for all” scheme was developed for states that were reported to have lower development and housing rates compared to the rest of the country. The government collaborated with the United Nations Development Program (UNDP) India and Indian Institute of Technology (IIT) Roorkee to research and design rural housing options that were suitable to the physiography and culture an example of which is described within this paper.

This paper is divided into three parts: brief, approach and results. The brief refers to the background and scope of the research within the Smart Assam Project, which intends to develop research and capacity for housing and infrastructure in rural and remote areas of Assam. The approach refers to the understanding of what has existed in the rural communities and their expectations as the primary stakeholders, and the perspective of the government departments and development organisations as secondary stakeholders. The results refer to the gap of understanding between primary and secondary stakeholders and discussion on closing that gap.

The scope of research within the project

As part of the response to the imbalance in the socio-economic situation of the state, the Smart Assam Project is an initiative that aims to develop smart villages for Assam (Doloi, 2016). The project objective is to conduct research that creates a smart data platform as well as a new construction management course tailored to the context of Assam and its stakeholders, that is, the users, the manufacturers, suppliers and the environment.

The three broad aims of the Smart Assam Project are:

- a) Comprehensive assessments of construction skills, knowledge, materials, technology and processes in relation to growing challenges of housing and infrastructure needs in cross cultural context and devising strategies for building capacities, improvements and growths including historical and cultural implications in future urban conditions in relation to the Smart Village program;
- b) Development of frameworks for comprehensive integration of community in terms of the specific needs and requirements and strategies for achieving optimal social value outcomes in housing and infrastructure projects in Smart Village context. The framework will be demonstrated using selected project case studies in Assam and for providing guidance to relevant authorities, industries and policy makers on how to maximise the opportunities for communities by successful planning and delivery of housing and infrastructure projects within the Smart Village program.
- c) Professional development and local capacity building in research, education and training required for supporting Smart Village program and underlying issues associated with the urbanisation and development processes across the state.

One of the criteria that ensure a smart village is the retention of the essence of the village. That is the soul of the village, unique to villagers that means they feel at home, a part of that community, which defines a unique cultural context for each village (ZeeNews, 2016). To realise the aims of the project along with the consideration of the cultural context of each village, my research has been aimed at understanding:

- a) The social acceptance of the proposals made by the secondary stakeholders, which are non-governmental organisations as well as government departments for development.
- b) The impact of architectural design of houses on the life and culture of the inhabitants.
- c) The suitability of the house designs according to the socio-economic culture of the inhabitants.

[Significance of Culture in Architectural Design in Housing](#)

PMAYG is the most recent version of the rural housing and infrastructure scheme in India, which was originally called the Indira Awaas Yojna (IAY). IAY provided financial support as well as suggestions for rural housing for

the beneficiaries, however, a compendium of rural housing designs was never produced under the scheme. Pahal -a compendium of Rural housing typologies- was designed and compiled by the UNDP, Indian Institute of Technology (IIT), Delhi and the Central Building Research Institute (CBRI), which was carried out under “Appropriate and affordable rural housing for all” under PMAYG. This section demonstrates the reflection of culture in the traditional rural house as compared to a housing solution provided by the department of rural development in the compendium.

This new scheme topologically categorised Assam into five zones as shown in Figure 6.4 (UNDP India, 2016), based on:

- Vulnerability to natural Hazards
- Physiography and access to building materials
- Cultural compatibility characteristics

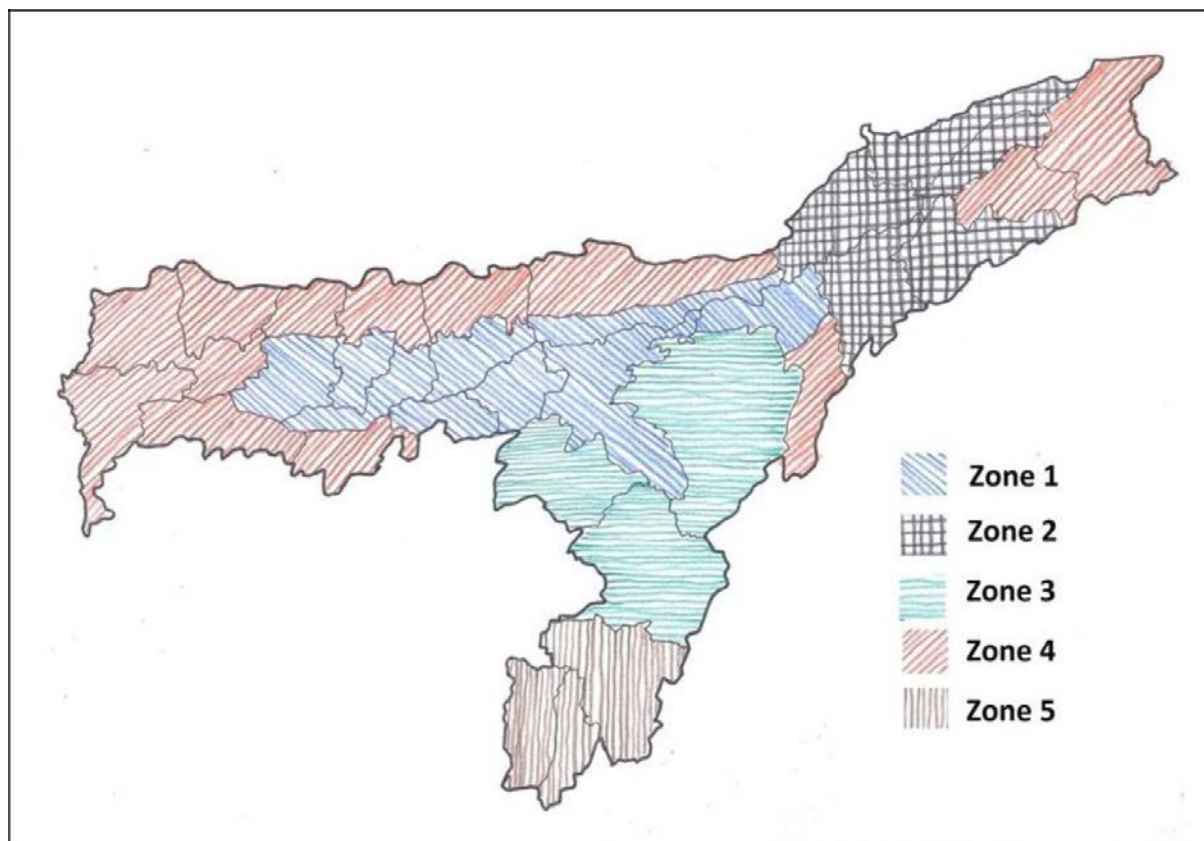


Figure 6.4 Zoning for house designs- Assam (UNDP India, 2016)

According to the zoning criteria described in Table 6.1, the districts of East Karbi Anglong, West Karbi Anglong and Dima Hasao fall under Zone 3 of the classification shown in Figure 6.4. Unlike other zones, zone 3 has higher vulnerability to cyclonic windstorms, earthquakes and landslides due to the elevation of the hill ranges (Mikir, Rengma and North Cachar) in the region. It has more than 75 per cent forest cover which also serves

as a resource of timber, bamboo and stone. The districts of the region fall under the administration of the Karbi Anglong autonomous state (Karbi Anglong East & West) and Dima Hasao autonomous council and considered sixth schedule area due to the highest concentration of tribal communities in the state.

Table 6.1 Zoning Criteria for Zone 3 (UNDP India, 2016)

Vulnerability to natural Hazards	Low vulnerability to flooding and erosion Medium to high vulnerability to cyclonic windstorms High vulnerability to landslides
Physiography and access to building materials	This is a predominantly hilly zone which includes the Mikir, Rengma and North Cachar hills. The average elevation ranging from 300m to 900m, with the highest elevation of more than 1300m, in peaks in Mikir range of Karbi Anglong and Barail range of NC Hills This zone has the highest forest cover in the state, with more than 3/4 of the zone covered with a mix of moist semi-evergreen, mixed deciduous and bamboo forests. Access to bricks for house construction is difficult in the zone. There is abundance of forest resources of timber, bamboo and stone.
Cultural compatibility characteristics	This zone has the highest concentration of tribal communities – Dimasa Kachari, Karbi, Kuki are the main tribes with Khasi, Zeme Nagas, and Barmans, being some of the others. The culture is marked by an intricate link with forest resources for daily living and house construction. Majority of the houses have traditionally been built with natural materials like timber and bamboo. Elevated houses are common in the sloping terrains. Wooden posts using secondary timber are most commonly used for structural framing of houses. Interwoven bamboo mats are the most common wall material. There is some use of concrete block masonry in houses which is an appropriate alternative to brick masonry.

Case Study: Traditional house in Zone C

As the area covered by Karbi Anglong is more than two-thirds of Zone C, a traditional Karbi house as shown in Figure 6.5, has been analysed in depth in a previous paper (Katharpi, Doloi, & Week, 2017), that describes the spatial use of the house by the inhabitants. This correlation between spaces, gender and culture is demonstrated by Mustafa, Hassan, and Baper (2010) through the use of space syntax to compare modern and traditional house layouts in Erbil City, Iraq. The spaces are colour coded per level of privacy and arrows are indicative of the circulation and connectivity within the house. The following observations were made:

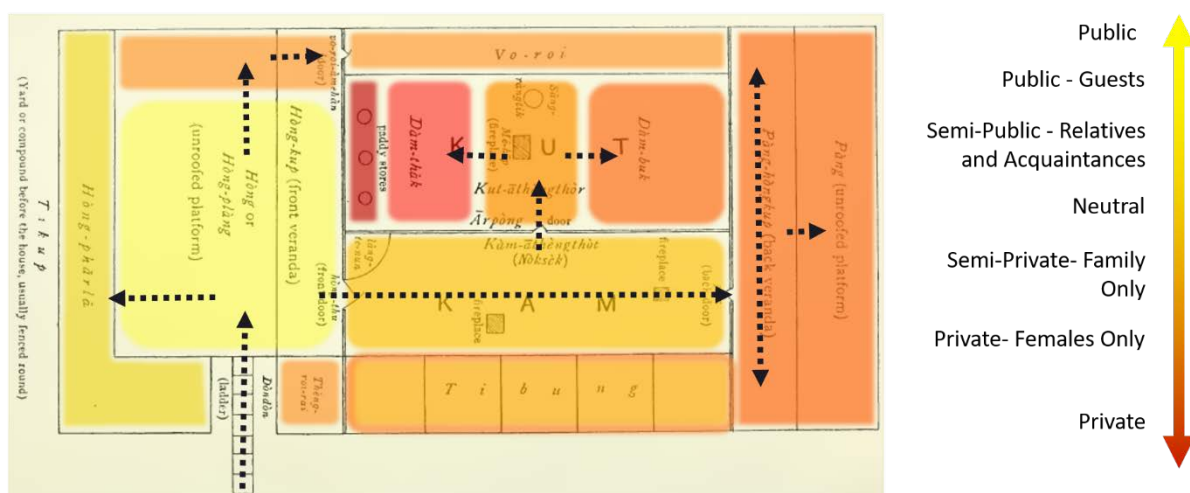


Figure 6.5 Karbi Traditional House (Stack & Lyall, 1908)

- Distinction among spaces for guests, close relatives, and members of the family
- Spaces dedicated for females of the house
- The kitchen is the centre around which the rest of the house is laid out
- Ample open space for outdoor activities
- Ample space for storage within and around the house
- Raised plinth for keeping cattle, firewood, bamboo, hay etc. along with safety from wild animals
- Orientation on door swing depended on the privacy and layout of the room inside
- Location of storage and utilities were away from the main circulation areas, opposite to the main entry

- Spaces were arranged from public to private in the order shown by the colour bar, red indicating private and yellow indicating public.

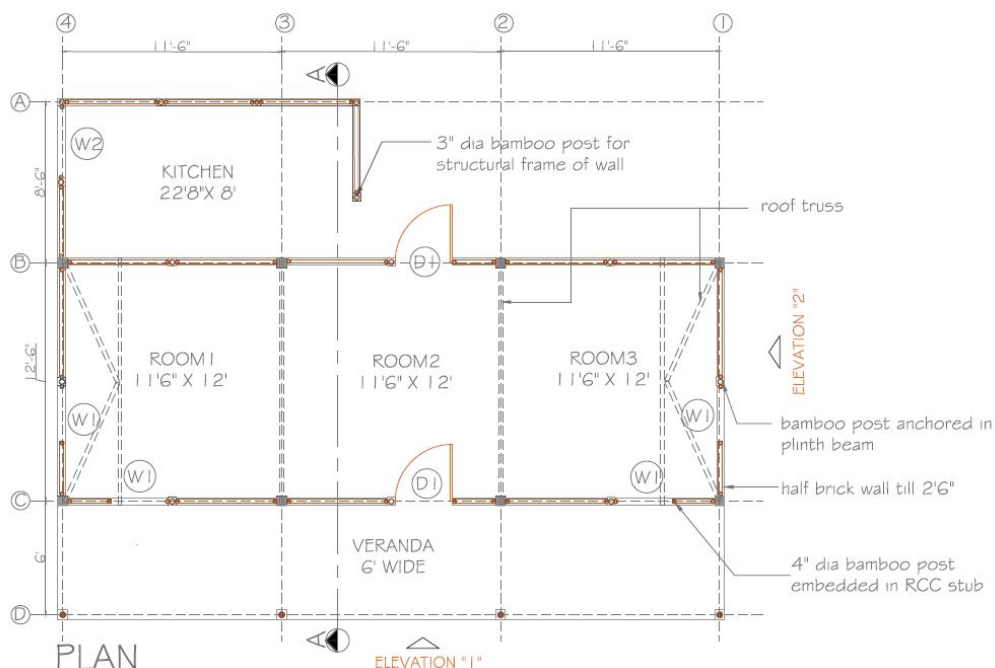
The analysis of the plan clearly indicates how the culture has influenced the layout of spaces, and inversely, how the layout of space has ensured a certain social expectation among the inhabitants and community that defines the culture of the Karbi. However, considering the drastic change in political, physical and cultural context due to accessibility through telecommunications, the rate of cultural accumulation and assimilation will increase and before long, the vernacular architecture of the Karbi community would not be suitable. In which case, we would have to be critical of the kind of infrastructure and housing proposed in the region.

Appropriate and affordable rural housing typology for Zone C

Unlike the traditional house, the appropriate and affordable house designed by PMAYG is built directly on the ground without any raised platform. The layout does not indicate which area would be dedicated for females of the family, or which would be for the guests. The kitchen appears to be treated as a component that can be attached or detached from the main house since the entry has been disjointed from the house.

The observations made on this plan indicate that the design is inappropriate to the Karbi culture. It shows the displacement of traditional vernacular housing to a contemporary version of what outsiders to the Karbi community assume suitable housing is meant to be. It does display the intent of providing an affordable housing option, however, fails to bring forward the suitability of the housing option, indicating that it may not be appropriate for the community.

Figure 6.6 Appropriate and Affordable Rural Housing in Zone C, Assam –



Pahal (IIT Delhi, CBRI, & UNDP India, 2016)

Developing an approach

Socio-cultural factors of a community influence the house form created by the builder, while climate, materials and construction are modifying factors of the house form (Rapoport, 1969). The observation of the plans in Figure 6.5 and Figure 6.6 both indicate this difference in the basic house form for rural house designs for the same community living within the same physiographical context, which is Zone C.

This observation begs the question: “what was the difference in approach that resulted in different house forms within the same context?” To answer this question, the methodology adopted by UNDP India (2016) to arrive at Pahal under the “Appropriate and affordable rural housing” scheme was studied. The methodology included data collection in four phases as described below:

Phase 1- The District level phase data was collected through a questionnaire circulated to the Project Director-District Rural Development Agency (PD-DRDA) to collect information covering geographic parameters, disaster vulnerability, features of IAY housing, socio-economic parameters, construction, materials and recommendations to overcome IAY challenges.

Phase 2- The Block Level phase involved interaction with the Block Development Officers at identified blocks, discussing the typology of rural houses, local flood patterns, access to materials and challenges in implementation.

Phase 3- The Participatory Design Exercise involved consulting with a group of 20-25 people from the local community about their aspirations of a house, including some beneficiaries on the IAY list. This led to a representational drawing of an IAY house on paper which was presented to the entire group including the block level administrative team.

Phase 4- The final settlement level phase, which was the most detailed level of interaction and documentation, included visiting selected villages to study recently constructed IAY houses. House owners and local building material producers were interviewed to investigate their experiences on constructing their houses from sourcing the materials, interaction with the masons and block level technician team and design preferences. Local masons were also interviewed regarding the construction practices and preferences.

The following observations were made of the methodology:

1. The housing typologies were differentiated from each other due to the demarcation of the state of Assam into five zones as seen in Figure 6.4 (UNDP India, 2016).
2. The cultural characteristics that the researchers observed were focused on the materials used and the current construction practises rather than the social culture of the communities.
3. The preliminary research included more recent events rather than the historical context which would have aided the researchers to understand different communities better.
4. The interactions during the field research involved government officials of the PD-DRDA rather than the rural inhabitants.
5. In cases where the interaction involved the inhabitants of rural areas, the sample set criteria excluded people who did not already have a house built under the IAY scheme that provided financial help and guidance for rural housing.
6. Despite Assam having a varied identity of different cultures and over 100 ethnic communities, only 17 out of 11,366 villages, from 10 out of 32 districts were studied for the research. The field research exercise resulted in 6 typologies for the 5 zones across the state, indicating the generalisation of the research approach and, hence, the results as well.

Discussion

In response to the observations from the existing methodology and with guidance from research in related fields, the following inferences were made:

Culture and history of a community:

In the context of this research, the definition of culture is the product of cultural ecology, which is the repeated intersections of Environment, Community and Interactions (Bourdieu, 1986; Steward, 1972). That is, the social norms, practices, beliefs and values of a community are formed by the influence of the environment, and the value system that dictates their interactions with one another within the environment (Lareau & Weininger, 2003). To ensure successful integration of culture as a significant factor to the design of socially acceptable rural housing, it is crucial to understand and study culture of the community. In contrast to physio-geographical zones previously demarcated for the state of Assam, the focus area for the research would be based on distinction of the

ethnicities and the social culture of the communities and the factors that influence them, which result in distinct identities among each village.

To avoid generalisation of the approach as well as the results, the number of village communities would have to be narrowed down along with the geographical radius for clarity in the focus area of the research.

With the mention of “repeated intersections” it assumes that these interactions need a certain length of time to form the culture of the community, and hence indicate the need to include the historical context of the community as one of the factors influencing the evolution and formation of culture. The inclusion of the historical context as part of the research would provide the researcher with a reference to observe changes and the response of the community to the environmental, social or economic changes that may have taken place over time since the establishment of the village community.

Rural perspective and other socio-economic factors:

The emancipatory research paradigm supports the inclusion of factors that influence the cultural ecology as it allows for the consideration and inclusion of multiple ‘realities’ (contexts) shaped by various factors (Groat & Wang, 2002). This encourages the consideration of age, gender, education, occupation and other aspects that can influence the decisions made by an individual or a family. The sample set selection would be based on the socio-economic factors, such as, the number of individuals in the family, the age of the individuals, the occupation of the individuals in the family, the education level of the individuals, their previous village of habitation, the social standing of the family in the community, etc.

As part of the criteria to define a sample set for in-depth study of houses, the methodology discussed in this paper had opted to include only houses that had been constructed by the beneficiaries of the IAY scheme. Though these selection criteria helped in narrowing down the sample set for the in-depth house study, it excluded the section of the community who were not beneficiaries of the IAY scheme. Since the IAY scheme provides the beneficiaries with financial support and options for rural housing, the sample set excludes the options of rural housing that are based on the skill and knowledge of the community who have not opted for the IAY scheme.

This is an instance of how the methodology may not be as inclusive in gathering the cultural rural perspective along with the skill and knowledge of the community. One of the crucial elements of the research is to develop the skills and knowledge keeping in mind the historical and

cultural context of the community, hence interactions with the community need to be increased during data collection. Interactions with the community during the field research are crucial to the research as they would enable the researcher to gather the user perspective and expectation. The community interactions will enable the researcher to re-discover the tried and tested community knowledge that has been developed and handed down through generations.

Conclusions

The significance of understanding the cultural context of the place is important as culture of the community influences the house form of traditional housing. The comparison of the layouts of a traditional house versus the rural housing typology proposed by the PMAYG scheme has demonstrated the disparity in the environment designed for the culture and interactions of a community. The rural community's perspective on their environment of cultural ecology is different from the assumption made in the research methodology of the PMAYG rural housing scheme. The significant element in the criteria for studying the rural perception of their culture and cultural environment is clear from the differences in design of the layouts of the traditional house and the proposed housing option by the PMAYG scheme.

The methodology used by the appropriate and affordable rural housing scheme was shown to lack community involvement or in-depth research into the culture and history of the community. Discussions supported by the theory of emancipatory paradigm research and the importance of understanding the cultural ecology of a community have facilitated in defining the factors to be included into the research methodology.

This paper confirms the necessity to include cultural and historical contexts as influencing factors that can enable a culturally sensitive research methodology that would result in culturally sensitive housing options for the rural community. The inclusion of cultural and historical contexts of the community in the data collection and analysis of the research would provide long-term solutions and long-term acceptability of the solutions. A thorough process of data collection and analysis that incorporates data on the environment, community and interaction, would result in a better understanding of the cultural ecology that is specific to a culture of an ethnic community in Assam.

References

- Ahmad, A., & Raza, M. (1993). *Social structure and regional development: a social geography perspective : essays in honour of Professor Moonis Raza*: Rawat Publications.
- Bourdieu, P. (1986). The Forms of Capital. In J. G. Richardson (Ed.), *Handbook of Theory and Research for the Sociology of Education*.
- Doloi, H. K. (2016). Practices focusing on housing and infrastructure sectors in Assam and Australia – An initiative of ‘Smart Villages’ research. Retrieved 20/11/2017, from Melbourne School of Design, University of Melbourne
<https://msd.unimelb.edu.au/research/projects/current/cross-cultural-analysis-and-capacity-building-in-construction-management>
- Stack, E. & Lyall, C. J. (1908). *The Mikirs*. London: Government of Eastern Bengal and Assam.
- Frampton, K. (1998). Towards a Critical Regionalism: Six Points for an Architecture of Resistance. In H. Foster (Ed.), *The anti-aesthetic: essays on postmodern culture* (pp. 17-34). New York: New Press.
- Gandhi, M. K. (1962). *Village Swaraj*: Navajivan Publishing House.
- Government of India. (2011). *2011 Census Population Enumeration*. India: Ministry of Home Affairs Retrieved from http://www.censusindia.gov.in/2011census/population_enumeration.html.
- Groat, L. N., & Wang, D. (2002). *Architectural research methods*: New York : J. Wiley, 2002.
- IIT Delhi, CBRI, & UNDPIndia. (2016). *Pahal- A Compendium of Rural Housing Typologies*.
- Katharpi, V. I., Doloi, H. K., & Week, D. (2017). *Significance of Culture and Education in Developing Smart Villages in India*. Paper presented at the AUBEA, RMIT, Melbourne.
- Lareau, A., & Weininger, E. B. (2003). Cultural capital in educational research: A critical assessment. *Theory and Society*, 32(5), 567-606. doi:10.1023/B:RYSO.00000004951.04408.b0
- Mustafa, F., Hassan, A., & Baper, S. (2010). *Using space syntax analysis in detecting privacy: a comparative study of traditional and modern house layouts in Erbil city, Iraq* (Vol. 6).
- Reserve Bank of India (2013) Table 162: Number and percentage of population below poverty line. Retrieved from <https://www.rbi.org.in/scripts/PublicationsView.aspx?id=15283> [Accessed 10th November 2019]
- Rapoport, A. (1969). *House form and culture*: Englewood Cliffs, N.J., Prentice-Hall.

- Shukla, A. K. (2016, July 13, 2016). Why a smart villages scheme makes sense? *The Hindu Business Line*. Retrieved from <http://www.thehindubusinessline.com/opinion/why-a-smart-villages-scheme-makes-sense/article8844976.ece>
- Steward, J. H. (1972). *Theory of Culture Change: The Methodology of Multilinear Evolution*: University of Illinois Press.
- Taher, M. (1993). *The Peopling of Assam and Contemporary social structure*.
- UNDP India. (2016). *Appropriate and Affordable Rural Housing*. Guwahati: Ministry of Rural Development, Government of India
- Vswanadham, N. (2013). Smart Villages and Smart Cities. In *Ecosystem-Aware Global Supply Chain Management*.
- Young, A. (2013). Inequality, the Urban-Rural Gap, and Migration*. *The Quarterly Journal of Economics*, 128(4), 1727-1785. doi:10.1093/qje/qjt025
- ZeeNews (Producer) (2016). PM Modi talks about smart cities and smart villages. Retrieved from <https://www.youtube.com/watch?v=3CokKbBBIVc> [Accessed 6th August 2016]

7 Sustainable construction and Assam type house

Sasanka Borah

Assistant Professor, Department of Civil Engineering, Assam Engineering College, Assam, India

sasankaborah.ce@aec.ac.in

Abstract

Assam is a state in the north eastern part of India. About 86 per cent of the population of Assam lives in the rural areas. The Assam Type House, a common housing typology, was introduced during the colonial rule and is constructed by using locally available materials such as bamboo, wood, Ekra and mud, with the roofing made of Kher (a type of grass), asbestos or iron sheets (where available). However, the use of the traditional materials is currently being replaced by bricks, cement plaster, and reinforced concrete pillars. This trend is due to the general belief that concrete structures are generally stronger and more durable as compared to the traditional Assam Type House. This has led to challenges in sustainability of the traditional construction industry in Assam.

This paper tries to put forth the various issues relating to Assam Type House and its acceptability in the present scenario in the state of Assam.

Keywords: Assam, Kher, Ekra, Assam Type House

Introduction

Assam is a state in the north-eastern part of India comprising an area of 78,440 Km², with its capital located at Dispur (26.14°N, 91.77°E). Geographically; it is located to the south of the eastern Himalayan mountain range. The mighty river Brahmaputra flows through the heart of the state of Assam from the east to west, dividing the state into south bank and the north bank.

The population census of India, 2011, reports that the population of the State of Assam is 31,205,576. Table 7.1 below provide a statement of parameters associated with the population status of Assam.

Table 7.1 Population status of Assam

Population	Growth rate (%)	Area (sq.km)	Population Density	Sex Ratio (female per 1000 males)	Literacy ratio	Rural Population
31,205,576	17.07	78438	398	958	72.19	26,807,034

85.9 per cent of the population of Assam lives in the rural areas, and there are 26,395 villages in Assam (source: pnrdassam.nic.in). The main livelihood of the rural population of Assam is agriculture. However, with rapid increase in the population and decreasing livelihood avenues in the rural areas, migration towards the urban areas seeking a better livelihood have been observed. This has caused many problems; the urban centres have become over populated with the increase of the migrant population and are not able to provide basic civic amenities to the citizens. Further, not all the migrant population finds a better livelihood. Alternatively, if the rural population can be provided better options of living in the rural areas, it may stop the migration of the rural masses to the urban areas.

Objective

This paper attempts at providing a first-hand insight of the present situation in the state of Assam regarding the construction and management of Assam Type House (ATH) and the challenges it faces in the present times.

Assam Type House (ATH) and its construction in Rural Assam

The various traditional construction practice and housing types prevailing today in different regions of the world have evolved based on technology transferred from one generation to the next by word of mouth or by some documentation by practicing masons and end users (Patwari, 2017). What is important is that these construction practices often have characteristics that address the prevalent local conditions of weather and other environmental and natural hazards viz. earthquakes, flood, and cyclone (BMTPC, 1999). There is much to study and learn from these housing practices. The ATH is one such construction practice which has the potential to emerge again as one of the most sustainable, flood resilient and earthquake-safe housing in the north-eastern part of India.

This form of construction was promoted by the government in the past, and the Assam Public Works Department had the specifications for such buildings in their standard and schedules, encouraging this practice in the constructions by various government departments. It has been a matter of concern that in the last decade, this earthquake safe construction practice has lost its applicability in the housing sector owing to the emphasis on vertical expansion of the urban centres. However, the sub-urban and semi-urban areas still provide an opportunity for this construction practice as the best alternative for sustainable and earthquake resistant housing where adequate spaces are available for planning (Nath et al., 2010). This can be substantiated from the fact that more than 80 per cent of the population of Assam lives in the rural areas.

Assam Type House (ATH)-a brief review

The Assam Type House, a common housing typology, was introduced during the British rule. This construction type is in use for the last 200 years in Assam

(Kaushik and Babu, 2009). This type of house is a common feature in the north-eastern states of India. The Ekra type house (as in Figure 7.2) is also found in the Gangetic plains of Central India, Bangladesh, Myanmar, Thailand, Cambodia etc. (Kaushik and Babu, 2009). However, based on the local conditions and customs the houses may be a bit different in their planning and layout. The Ekra type house is no longer used in the urban areas, however, in some rural areas where Ekra is available it is still used but is not a preferred mode of housing.

The Challenges

While the rural households in Assam are generally made of locally available materials, such as bamboo, the recent trend for using the reinforced cement concrete has been growing among the middle class. This trend is evident both in the urban, semi urban and rural areas. This trend is due to the general belief that concrete structures are generally stronger and more durable as compared to the traditional Assam Type House. Further, the raw materials required for building the ATH are low in supply which also contributes marginally to the shifting trend to concrete structures. This probably is the first challenge to the traditional building industry of Assam.

The Assam Type House which is built on a raised plinth and is generally located in the plain areas of rural Assam where the area is highland and not subjected to floods. Das et al (2014) has identified four distinct types of houses which would be best to define the housing types as basically of two types, one on raised plinth and another on raised platform. The above two may be divided into various subcategories depending on the level of finishing given to the housing types. For example, a house owner may not choose to give a finishing of mud on the walls, while another may go for use of cement plaster on the walls. The walls themselves may be made either of ekra or bamboo, the two most preferred forms of wall materials for construction of wall panels in the rural area owing to their low cost and easy availability. The wall panels are then plastered with two/three layers in case of a mud house. First layer consists of wet mud-cow dung mixture, a second layer of mud-cow dung may be provided in case the first layer is not of sufficient thickness. The mud-cow dung layer is then topped with a wet mixture of mud-only to give a better finish and colour. The floors are also finished using the same mixture. However, in case of houses on elevated platforms, floors may be made of timber (depending on availability) or bamboo. This construction was done locally and by the house owner himself with the help of his family members. However, with the passage of time the rural masses have started building various modified types of the so-called Assam Type House. Figure 7.1 (a) to (f) provides a glimpse of a few types of the Assam type houses generally prevalent in the rural areas of Assam in the present time. With the change in the building typology the rural masses had to import skilled labour to build houses which earlier they had constructed themselves. This led to dependability on external agencies for house building. This is a big sustainability issue.



(a) Assam Type House (traditional)
(Source: igsss.org)



(b) Assam Type House (traditional)
(Source: earthquakeengineeringblog.worldpress.com)



(c) Assam Type House (modern)
(Source: thetelegraph.com)



(d) Assam Type House (traditional)
(Source: www.housing.com)



(e) Assam Type House (modern)
(Source: downtoearth.org.in)



(f) Assam Type House (traditional)
(Source: nelive.in)

Figure 7.1(a), (b), (c), (d), (e) & (f): Various forms of Assam Type house found presently

Conclusion

The above study essentially tries to submit that there is a challenge to the survival of the ATH industry and sufficient emphasis has to be given by all the stakeholders in the preservation of the Assam Type house considering the sustainability of the traditional materials and methods that has been used in the

construction of the house. Various other parameters including the cultural, social and religious aspects also have to be taken into consideration.

Acknowledgements

The support of the team members of Smart Villages Lab: The Assam Project- Growing capacity in rural construction and development is acknowledged. The help and support received from the faculty and staff of Melbourne School of Design, University of Melbourne is acknowledged. The support of Higher Education (Technical) Department, Government of Assam, Dispur, Guwahati, India is also acknowledged.

References

Das, N., Pal, S., Bora, S.S., & Walling, O. (2014), Study of Traditional Houses in Assam, *Journal of Civil Engineering and Environmental Technology*, 1(4), pp. 53-58.

Hemant Kaushik & K.S. Ravindra Babu (2009) Housing Report Assam-type House, Report 154, Earthquake Engineering Research Institute (EERI), World Housing Encyclopaedia

Patwari, N.N. (2017), Seismic Vulnerability Assessment and Prognostic Damage Scenario of Conventional and Traditional Housing around Urban centres of Assam, Phd. Thesis, Gauhati University, Guwahati, Assam, India.

.

8 Assessing the sustainability credentials of residential development projects in Australia

Professor Ray Green (BSc, MLArch, PhD) FASLA

Melbourne School of Design, Faculty of Architecture Building and Planning, The University of Melbourne, Victoria, Australia

Introduction

Land developers are increasingly recognising the need to show how their developments are environmentally sustainable. Seeking independent certification of the sustainability credentials of their projects to both meet market demand and to exhibit the types of environmentally responsible practices they are employing helps them to gain necessary planning approval and market acceptance (Alyami and Yacine Rezgui, 2012). There are various sustainability assessment tools and certification programs operating in various countries, which are focused on certification of both individual buildings and larger, master-planned developments of various types (Cole, 1998, 1999).

These sustainability certification programs, and associated assessment tools, are administered through a range of non-profit organisations and government bodies (Ding, 2008). These programs typically focus on a development's performance in terms of energy and water use, waste management, materials selection and use, ecology and how developments encourage social integration and fit with the environmental and social contexts of their sites. Most of these programs rely on assessments of a project's performance with respect to various sustainability factors and include procedures for weighting key variables within these factors (Chew & Das, 2008). Most of these assessments rely on the consensus of expert opinion (Haapio and Viitaniemi, 2008).

The emergence of such sustainability certification programs is testimony to the importance placed on making land development more sustainable. This is an acknowledgement that land development consumes an enormous amount of the earth's resources in the form of materials, energy and water, as well as negatively impacting the natural environment and the ecology of development sites. Buildings themselves, both their construction and operation, are responsible for a significant amount of greenhouse gas (GHG) emissions. In fact, buildings consume close to a third of the world's energy (Lucon, 2014). In the U.S., the use of energy for cooking, cleaning, lighting, heating and other household activities in homes accounts for some 20 per cent of the country's total energy consumption (Kaza, 2010).

The different sustainability certification programs that are operating around the world are administered at all levels from local through to national, primarily by non-profit and government bodies. Germany has been at the forefront of

developing procedures for assessing the sustainability credentials of development projects as a way of providing independent verification of their sustainability to inform both government regulatory bodies and home buyers (Rid et al, 2017). There are a range of other sustainability assessment programs operating in different countries including the BREEAM, LEED, SBTool, and CASBEE programs, all of which have their own assessment tools (Sev, 2011).

In Australia, the Building Sustainability Index (BASIX) is an example of a locally administered program developed by the New South Wales Department of Infrastructure, Planning and Natural Resources. This is a Web-based tool used primarily for assessing residential developments, with a focus on water and energy efficiency (Seo, et. al., 2006). At the national level, the GreenStar, NatHERS and EnviroDevelopment are the three dominant programs operating in Australia. The benefits of getting certification for a development under these programs, as reported the GreenStar program's website, is that it allows the developer to "...save money, create a healthy place for people, minimise environmental footprint and build a better future for us all."¹

The EnviroDevelopment (ED) program

The Urban Development Institute of Australia (UDIA), which is the peak property development industry body in Australia, and which has been operating for over 40 years administers the EnviroDevelopment (ED) program. UDIA provides policy and advocacy, industry intelligence, networking and business development opportunities for hundreds of companies across Australia and involves land developers, consultants, suppliers, government authorities, academics, utility companies and others who are trying to achieve more sustainable outcomes for land planning and design of buildings, infrastructure and open space.

The ED program was established in 2006. Each of UDIA's state offices operating in Australia, administer their own ED program using the same assessment process and criteria. To date, 130 mostly large-scale development projects have been granted ED certification nationally. Like other such programs, the overriding aim of ED certification is to provide independent verification of the sustainability credentials of development projects to assure consumers (e.g. home buyers) that the development embodies a greater level of sustainability performance than that which would be required to simply meet planning regulations. As stated on the UDIA website "EnviroDevelopment is a scientifically-based branding system designed to make it easier for purchasers to recognise and, thereby, select more environmentally sustainable homes and lifestyles" (UDIA, 2011).

Types of developments that are eligible for ED certification include:

- Residential Subdivision
- Multi-Unit Residential

¹ <http://new.gbca.org.au/green-star>

- Master-planned Communities
- Mixed use developments
- Retail
- Industrial
- Seniors Living
- Education
- Health and Aged Care Facilities

EnviroDevelopment Certification Benefits

There are several benefits associated with having ED certification, both internally (within development companies), and externally (to showcase to the public an image of their sustainability credentials).

Internal benefits include:

- Educating and informing developers, community members and local authorities about sustainable land development
- Reducing the delays to development approvals for sustainable developments
- Rewarding developers for employing sustainable practices and materials
- Hastening the implementation of sustainable development in general
- Providing Industry leadership with respect to sustainable land development
- Engaging the whole project team – developer in consultation with consultants, sub-contractors and builders
- Unified focus on sustainability goals
- Providing clear technical standards – flexible rather than prescriptive
- Providing a performance-based approach
- Consideration of the constraints and opportunities of each site
- Providing ongoing assistance to developers

External benefits include:

- Providing third party verification of a development's sustainability credentials
- Clearly communicating to consumers and tenants of the sustainability credentials of a development
- Overcoming perception of "green wash" lending greater integrity and clarity in marketing
- Using ED certification for promotion to gain marketing and advertising advantages
- Providing consumers with savings in terms of energy, water and material costs
- Profiling the value of sustainable land development through ED networks and national, state and local media.

The idea is that ED certified projects can be shown to perform better in terms of sustainability than comparable developments that do not incorporate the same types of sustainability features. From an operational perspective, houses in ED certified "sustainable developments" are generally less expensive to operate in terms of household costs for energy and water, compared to similar houses in non-ED certified developments. This gives developers a marketing advantage in terms of advertising. Home buyers can also be more confident in buying houses into certified ED developments because the developer's sustainability claims are backed up by a trusted industry body that rigorously assesses each development with respect to six dimensions of sustainable development, represented by the six ED assessment "leaves". Recent research by Green et al. (in-press) suggest that developers tend to select ED leaves to meet certification criteria based on factors that will please buyers the most, such as the energy and water leaves, both of which can help reduce household operation costs. Developers also frequently select the ecology leaf, particularly when their development sites contain significant existing indigenous vegetation and undisturbed geological conditions.

The six ED assessment "leaves" pertain to the sustainable use of water and energy, handling of waste, selection of materials, conservation and enhancement of ecology, and building a sense of community. Developers seeking ED certification must demonstrate how their project meets the assessment criteria for at least four out of six of these "leaves", however, many developers try to acquire all six.

Developers use ED certification and the ED logos for promoting their developments, which is typically motivated by the prospect of gaining a market advantage in terms of lot and home sales. The ED logo signifies that a development has been assessed as more sustainable than similar non-ED certified developments. There is some evidence to suggest this can translate into potentially both more rapid sales of lots and/or houses and/or higher property

values (WGBC, 2013). However, with some innovative thinking there is no reason that more affordable housing cannot adopt the same or similar sustainability features. Significant saving on water and energy costs can also often be made, making the operation of houses less costly.

Foundation and Process Principles

The ED program is based on a set of foundation and process principles. The foundation principles include:

- Seeking long-term environmental, social and economic health
- Seeking equity and respecting human rights
- Maintaining and enhancing biodiversity and ecological integrity
- Improving quality of life
- Focusing on communities, regions and conserving their heritage and 'sense of place'
- Insuring a net environmental, social and economic benefit from development
- Achieving the common good

The process principles include:

- Accountability, transparency and public engagement
- Guided by the precautionary principle
- Balancing environmental, social and economic performance
- Working through iterative changes to achieve optimum results

Technical Standards

Every three years the ED technical assessment standards are updated to reflect new initiatives gleaned from the industry, government authorities, developers, consultants, academic research and model development projects worldwide that embody a high degree of sustainability.

The ED technical standards are used to assess development projects nominated for ED certification. They are aimed at raising the minimum requirements for planning, design and regulatory requirements by at least 20 per cent.

All developments nominated for ED certification must:

- Establish a community education program
- Conduct thorough site analysis prior to planning and design phase - identify areas of prime significance for conservation
- Install effective sediment and erosion control measures
- Where relevant, recycle and reuse all vegetative debris on site
- Demonstrate assessment of solar orientation options to provide best practice solar access opportunities
- Demonstrate how the project will reduce GHG emissions beyond regulatory requirements

- Demonstrate how the project will reduce potable water consumption for irrigation
- Demonstrate how community consultation and feedback has been incorporated

The Six EnviroDevelopment Leaves

As previously mentioned, each development nominated for ED certification must demonstrate that it has met the assessment criteria for at least four of the six ED leaves (See also Appendix A for details of the assessment criteria for each leaf). Below is an overview of the standards associated with each of these six leaves representing ecology, materials, energy, water, waste and community.



Figure 8.1 EnviroDevelopment logos representing ED leaves

Ecology

The aim of this leaf is to protect and enhance native ecosystems by minimising degradation caused by the development and humans and encouraging species to live in a more harmonious and balanced environment. The overarching aim of this leaf is to create places that protect and enhance existing indigenous ecosystems or encourage natural systems and biodiversity where degraded sites are rehabilitated.

Achieving this leaf involves:

- Conservation and/or establishment of healthy, biodiverse ecosystems
- Encourage and/or create high biodiversity
- Encourage resilient natural ecological communities and protect natural connectivity
- Encourage protection and rehabilitation of riparian vegetation and wetlands
- Avoid pollution in waterways and natural systems and remediate any water quality problems occurring on-site or in neighbouring areas
- Minimise disruption to landforms and natural ecosystems
- Encourage development on previously developed or degraded sites
- Encourage protection (during and after construction) of existing habitats for native animals and restore places where they are not already in a healthy state

- Maintain and enhance habitat size and corridors to improve connectivity and reduce fragmentation
- Promote biodiversity conservation awareness in residents
- Establish programs to monitor and maintain ongoing ecosystem performance and functions



Figure 8.2 Conservation of wildlife habitat – Tiger habitat

Materials

The aim of this leaf is to encourage recycling, minimise pollution, and promote re-use of existing materials. Achieving this leaf can also involve using materials that are recycled, renewable, non-toxic, locally sourced and that have low lifecycle energy requirements.

To achieve this leaf a development must show how it:

- Encourages recycling of construction and demolition materials
- Reduces the amount of waste going to landfills
- Minimises on-site pollution during construction
- Promotes the re-use of existing buildings and materials
- Reduces demand for resources
- Promotes resident awareness and encourages engagement in recycling, composting and waste reduction
- Provides appropriate recycling facilities
- Makes efficient use of resources
- Uses resources more efficiently



Figure 8.3 Local materials used in vernacular architecture in Majuli Island, Assam, India

Energy

The aim of this leaf is to encourage measures to achieve energy reduction and reach a minimum of a 20 percent reduction in GHG emissions.

To achieve this leaf, the development must:

Reduce GHG emissions through:

- Energy efficient appliances and fixtures
- Passive cooling and heating designs
- Use of renewable energy sources (e.g. solar, wind, biomass, gas, hydro)
- Reduce energy usage through design
- Reduce energy demand
- Encourage resident behavioural changes
- Use energy saving devices



Figure 8.4 Old mud house in rural India with wind turbines background



Figure 8.5 Solar panels in Turtuk village north India

Water

The aim of this leaf is to improve water use efficiency, conserve potable water and encourage the use of alternative water sources to result in reductions of potable water use. This includes using low water needing plants for landscapes, water saving fixtures and fittings within the dwellings and common areas of developments, and the use of recycled water wherever possible.

To achieve this leaf the development must:

- Reduce potable water use by at least 20 per cent
- Employ water efficiency devices and mechanisms
- Use non-potable water for irrigation requirements for landscapes
- Utilise alternative water sources where possible - e.g. rainwater, stormwater, dual reticulation
- Meet irrigation demand for public open space and common areas through use of drought tolerant plant species irrigated with recycled or non-potable water



Figure 8.6 Community well in Indian village in Amravati, Maharashtra, India, with women carrying water in traditional pots



Figure 8.7 Hydroelectric Dam in Tehri Garhwali, Chamba, India

Waste

The aim of this leaf is to reduce the amount of waste going to landfills and minimise on-site pollution during construction. This is achieved by encouraging recycling, including of construction and demolition materials, promoting the re-use of existing materials, and discouraging demand for resources in general. Promoting awareness of the need to reduce, and efficiently use resources, and encouraging recycling and composting, by providing appropriate recycling facilities.

To achieve this leaf a development/developer must demonstrate:

- Facilities for recycling have been installed
- Residents are encouraged to recycle and re-use materials
- Encourage the use of renewable materials
- Avoid the use of toxic materials
- Where possible use locally sourced materials and with low embodied lifecycle energy.



Figure 8.8 Indian women separating materials to sell for recycling of waste - Tamil Nadu, India

Community

It is assumed that a sense of community is a key to the success of any development. Each developer has the capacity to offer an active and healthy lifestyle by offering local facilities and services, which in turn encourages people to change their attitudes and behaviours to be more sustainable in their daily lives. Achieving this leaf involves engaging in community consultation, community governance, more sustainable transport options, community prosperity, locally sited facilities and employment, safety and accessibility and inclusiveness. The aim is to create places that are vibrant, socially cohesive, healthy and happy, adaptable, and prosperous.

To achieve this leaf the development/developer must:

- Consult with surrounding community and traditional owners
- Encourage community cohesiveness and interactions through provision of facilities, social interaction and community organizations
- Encourage use of public transport and walking/cycling
- Provide accessible local employment, education and services to encourage cohesive community
- Reduce the need for regular travel beyond the local area
- Encourage safe, accessible, comfortable housing, facilities and workplaces
- Protect heritage, both tangible and intangible
- Maintain and enhance community assets



Figure 8.9 Rural village street market in Nagpur, Maharashtra, India, with street vendor selling items for Hindu festivals



Figure 8.10 Local Indian cottage industry – Silk weaving, Badnera, Maharashtra, India

Conclusion

The assessment standards and criteria embodied in the ED program, as outlined above, can potentially be applied to any type of development, at any scale, and in both urban and rural environmental and social contexts. The suggestion here is that development associated with the Assam Smart Villages project can be assessed using the sustainability criteria associated with the six ED leaves as described above. Of course, the geographic context in which a development is proposed will dictate to some extent which leaves, and associated assessment criteria will be most applicable. For example, in much of Australia water conservation is a salient issue. However, Assam, given it receives an abundance of water, in many instances too much water resulting in flooding, this leaf would not seem to be as applicable in that context. The energy leaf, however, would be applicable to any development and in any geographic setting as the aim is to reduce GHG emissions, which is the cause of climate change globally. However, how this is achieved may vary depending on local environmental conditions. For example, production of energy through solar panels is well suited to Australian conditions whereas in Assam wind or some forms of hydro-electric energy generation may be more applicable.

In conclusion, the sustainability objectives embodied in the ED program could be incorporated into a set of sustainability assessment procedures and related criteria specifically designed to optimally service the development industry and the public in the context of Assam villages.

References

- Alyami, S.H. and Yacine Rezgui, Y. (2012). Sustainable building assessment tool development approach. *Sustainable Cities and Society*, 5:52-62
- Chew, M.Y.L. and Das, S. (2008). Building Grading Systems: A Review of the State-of-the-Art. *Architectural Science Review* 51(1):3-13
- Cole, R.J. (1998). Emerging trends in building environmental assessment methods. *Building Research and Information*, 26 (Sustainability: An international perspective): 3-16
- Cole, R.J. (1999). Building environmental assessment methods: clarifying intentions. *Building Research and Information*, 27 (4/5):230-246
- Ding, G. K.C. (2008). Sustainable construction—The role of environmental assessment tools *Journal of Environmental Management*, 86(3): 451-464
- Doan, D.T., Ghaffarianhoseini, A., Naismith, N., Zhang, T., Ghaffarianhoseini, A. and Tookey, J. (2017). A critical comparison of green building rating systems. *Building and Environment*, 123: 243-260
- Green, R., Tiwari, P., Rao, J. and Hershburgh, R. (in-press). Strategies used by developers in seeking EnviroDevelopment certification for “sustainable” master planned residential developments in Victoria, Australia. *International Journal of Housing Market and Analysis*
- Haapio, A. and Viitaniemi, P. (2008). A critical review of building environmental assessment tools. *Environmental Impact Assessment Review* 28: 469–482
- Kaza, N. (2010). Understanding the spectrum of residential energy consumption: A quantile regression approach. *Energy Policy*, 38:6574–6585.
- Lucon O., D. Ürge-Vorsatz, A. Zain Ahmed, H. Akbari, P. Bertoldi, L. F. Cabeza, N. Eyre, A. Gadgil, L. D. D. Harvey, Y. Jiang, E. Liphoto, S. Mirasgedis, S. Murakami, J. Parikh, C. Pyke, and M. V. Vilariño, (2014). *Buildings*. In Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)). Cambridge University Press, Cambridge, United Kingdom and New York.
- Rid, W., Lammers, J. and Zimmermann, S. (2017). Analysing sustainability certification systems in the German housing sector from a theory of social institutions. *Ecological Indicators*, 76: 97-110
- Seo, S., Tucker, S., Ambrose, M., Mitchell, P., Wang, C.H. (2006). *Technical Evaluation of Environmental Assessment Rating Tools*, Research and Development Corporation, Project No. PN05.1019.

Sev, A. (2011). A comparative analysis of building environmental assessment tools and suggestions for regional adaptations. *Engineering and Environmental Systems*, 123:243-260.

Urban Development Institute of Australia (2011). Enviro-Development National Technical Standards - Version 2:

http://www.envirodevelopment.com.au/01_cms/details.asp?ID=200). (Accessed 16 February, 2018).

WGBC (2013) The Business Case for Green Building: A Review of the Costs and Benefits for Developers, Investors and Occupants. (Online), Available at:

<http://www.worldgbc.org/news-media/business-case-green-building-review-costs-and-benefits-developers-investors-and-occupants> (Accessed 10 January 2017).

Appendix 8.A – EnviroDevelopment Leaves and Assessment Criteria

- **Energy:** The aim this leaf is to reduce the use of fossil fuel generated energy. This can be achieved through incorporating various climate responsive design features; the use of alternative sources of energy (solar panels on houses) and orientating houses so they will have optimal solar exposure; encouraging the use of energy efficient appliances, lighting and heating and cooling systems and promoting behaviour among residents that will help to conserve the use of energy.
- **Water:** The aim this leaf is to reduce the use of potable water across the entire development and this must go beyond government requirements. This leaf can be achieved through promoting the use of alternative water sources; use of water saving fixtures and fittings; use of water sensitive design (WSD) methods; use of drought tolerant plant species in landscape designs, both in private and public spaces. and minimizing the need for irrigation.
- **Ecosystems:** The aim of this leaf is to conserve and enhance indigenous flora and fauna, ecosystems and ecological functioning, and rehabilitate ecologically degraded sites. This can be achieved through protecting and enhancing connectivity of existing habitats; protecting, and where necessary rehabilitating indigenous vegetation, particularly riparian and wetland habitats; protecting native fauna through conservation and/or enhancements of their habitat requirements; avoiding polluting water ways and bodies and mitigating any water quality issues on-site and in surrounding areas.
- **Materials:** The aim of this leaf is to use environmentally responsible materials and construction methods that will lower negative environmental impacts from the selection of materials and their use. This can be achieved through using environmentally responsible construction materials for civil works and landscaping and the use of materials (e.g. paints) and finishes that will help to increase indoor air quality.
- **Waste:** The aim of this leaf is to implement waste management practices that will reduce the amount of waste that goes to landfills and facilitate recycling of waste products. This can be achieved through encouraging recycling of construction materials and limit waste going to landfills; minimising on-site pollution during construction and providing recycling facilities and encouraging resident use of these facilities.
- **Community:** The aim of this leaf is to encourage healthy, active lifestyles, a sense of community, and inclusion of a diversity of people and be responsive to changes in communities' composition over time. This can be achieved through encouraging greater engagement and understanding of surrounding communities; encouraging community cohesiveness and social interaction by

providing appropriate facilities and programs that will support community building and a sense of community; promoting the use of public transport; providing facilities that support active transport (e.g. bicycle and walking paths) and providing access to local employment, education and services to help reduce the need for travel beyond the local area.

Day 3 – Round table discussions Morning session Nature Conservation and Development chaired by Prof Ray Green, Dr Sasanka Borah; Afternoon session Housing chaired by Prof Mark Burry and Prof Bipul Talukdar.

Day 4 – Round table discussions morning session Sustainable Infrastructure chaired by A/Prof Robert Crawford and Dr Sally Donovan; Afternoon session on Governance chaired by Geoff Kimm, Dr Hemanta Doloi and Dr Sasanka Borah.

9 Round Table 1: Nature Conservation and Development

Facilitators:

Professor Ray Green, Dr Sasanka Borah

Round Table 2: Housing

Facilitators:

Professor Mark Burry, Professor Bipul Talukdar

10 Round Table 3: Sustainable Infrastructure

Facilitators:

Dr. Robert Crawford, Dr. Sally Donovan, Dr. Bipul Talukdar

The dictionary defines infrastructure as “the basic physical and organisational structures and facilities needed for the operation of a society or enterprise”. We opened our workshop by asking the participants to give us examples of infrastructure and together produced the following list:

Roads

Civic amenities

Power/energy systems

Water systems

Sanitation

Waste management

Schools

Hospitals

Railways

Airports

Public amenities (playgrounds, stadiums etc.)

Banking

Bridges

We then went on to define sustainability as “the ability to be maintained at a certain rate or level”; “avoidance of the depletion of natural resources to maintain an ecological balance.” And sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

By combining these two sets of definitions we came up with the definition of sustainable infrastructure “basic physical and organisational structures and facilities needed for the operation of a society or enterprise, that meet the needs of the present without compromising the ability of future generations to meet their own needs”.

We then expanded this definition, to include environmental, social and economic issues, as shown in Figure 10.1.



Figure 10.1 Sustainability diagram

We then distributed ten images that showed infrastructure that was not entirely sustainable and asked the participants to discuss in groups of 3 or 4 what they could identify as unsustainable in each image. We specifically asked them to consider how the things were unsustainable in relation to the three tiers of sustainability shown in Figure 10.1.

Our aim was to use the discussion around the images to generate thinking about what would need to change to make the images sustainable. For the final part of the session we again split the participants into groups of three or four and tasked each group with devising a sustainable solution a particular component of infrastructure. We asked each group to list the ways in which their solution was sustainable for each of the three levels of sustainability shown in Figure 9.1.

The first group was discussing waste management systems. The results of their discussion are shown in Table 10.1.

Table 10.1 The ways in which each waste management solution is sustainable

SUSTAINABLE WASTE MANAGEMENT SOLUTIONS			
Idea	Environmental	Social	Economic

Composting	Prevents methane generation from breakdown in landfill Improves soil fertility Offsets energy intensive production of synthetic/mineral fertiliser	Methane gas, generated from compostable wastes in landfill, is explosive, and can be dangerous for people exposed to the area. The breakdown of waste in landfills can also lead to other health impacts, as chemicals enter waterways.	Offsets the use of expensive synthetic and mineral fertilisers. Reduces costs of landfill management. Small business opportunities – collecting compostable material on a large scale taking to large plant or selling home composting bins.
EFW	If carefully managed avoids greenhouse gas emissions compared to landfill Reduces space required for landfill Offsets the use of fossil fuels for energy generation	Reduces space required for landfill, and the associated health hazards that arise in the surrounding areas. Leaves more public amenity space. Landfills can attract stray animals, inversely affecting their health as they eat from it. Can bring energy to small villages, without having to connect to the national grid.	Offsets the use of expensive fossil fuels for energy generation. Small scale energy production facilities reduce pressure on national grid. Once established operational costs cheaper than landfill. Creates jobs.
Increased collection in public spaces	Reduces litter preventing it from being ingested by animals, entering waterways and leading to hazards	Litter can also have negative health impacts, as toxic chemicals can be released as waste breaks down. Provides better public amenity space.	Less litter increases property values and avoids expensive clean-up later when the litter becomes hazardous. Create jobs through added collections - opportunity for small business, especially if segregated into

		Aesthetically improves landscape improving quality of mental health.	recyclables
Plastic recycling	Reduces landfill requirements. Can have lower impact on environment than production of virgin materials (depending on type of plastic etc.) Plastic litter can lead to animals choking.	Plastic waste can be a choking hazard.	Can be cheaper than producing virgin materials. Avoids expensive clean-up of plastics in the environment. Creates jobs/ business opportunities.

The second group was discussing Energy systems.

Table 10.2 The ways in which each energy system solution is sustainable

SUSTAINABLE ENERGY SYSTEMS SOLUTIONS			
Idea	Environmental	Social	Economic
Solar, wind, hydro on national grid	No pollution generated during operational phase. Offsets the use of fossil fuels which emit greenhouse gases, and other air pollutants.	Reduces dependence on purchasing fossil fuels from other, politically unstable countries.	Reduced reliance on variably priced fossil fuels.
Solar, wind, hydro - microscale		Gives households' independence from unreliable national grid. Can bring energy to households in remote locations, not able to connect to the grid.	Access to power can increase income generating opportunities for households not connected to the grid. For households connected to the grid, reduces energy bills, and can sell

			excess energy back to the grid.
--	--	--	---------------------------------

The third group was discussing water

Table 10.3 The ways in which each water system solution is sustainable

SUSTAINABLE WATER SYSTEMS SOLUTIONS			
Idea	Environmental	Social	Economic
Sewage treatment plant	Cleans pollutants from water before release into the environment. Sludge can provide a soil fertiliser, offsetting use of synthetic/ mineral fertilisers.	Reduces release of pollution into waterways, increasing public health and minimising odour nuisance.	Use of sludge to offset use of expensive synthetic and mineral fertilisers. Creates jobs.
Water recycling system	Keeps fresh water in circulation, avoiding problems related to droughts, or when fresh water sources become contaminated due to flooding. Reduce need for plastic for bottled water.	Maintains a constant supply of potable water, essential for drinking and cleaning.	Provision of potable water at household, reduces necessity for bottled water, or water purification.
Subsurface extraction	Can integrate a PV cell to make the process zero emissions.	Can be community level project, creating water independence.	

The fourth group was discussing transport.

Table 10.4 The ways in which each transport systems solution is sustainable

SUSTAINABLE TRANSPORT SYSTEMS SOLUTIONS			
Idea	Environmental	Social	Economic
Paver blocks for roads	Can be made from renewable/recyclable material	Easily repairable, so maintenance can be performed more readily. Roads will be safer.	Long lasting Easily repairable.
Build and maintain footpaths for pedestrians	Promotes walking and cycling, reducing road traffic. Keeps pedestrians away from roads, reducing congestion	Safer travel for pedestrians. Increase safety for market stalls found at roadside	Increase trade for roadside market stalls. Reduce traffic delays.
Electric cars	No pollution during operation. Reduction in air pollution, and its associated environmental impacts	Reduces impacts on human health from air pollution. Reduction in traffic noise.	The diversity of fuel options for electricity generation offers more chance of making charging economical, over combustion engines which rely solely on petrol.
Road bridges	Could potentially be made from renewable or recycled materials.	Relieve congestion on major roads. Increased road safety	Saving on travel times due to relieved traffic congestions.

11 Round Table 4: Governance

Facilitators:

Dr Hemanta Doloi, Geoff Kimm, Dr Sasanka Borah

Figure 11.1 shows the broad architecture of the smart governance system that has been used as a “Use-Case” for developing the digital Smart Data platform proof-of-concept in the project.

The interface of the system including the dynamic interaction capability of the system was presented to the audience to demonstrate the purpose, functionality, significance and benefits in the context of supporting smart governance.

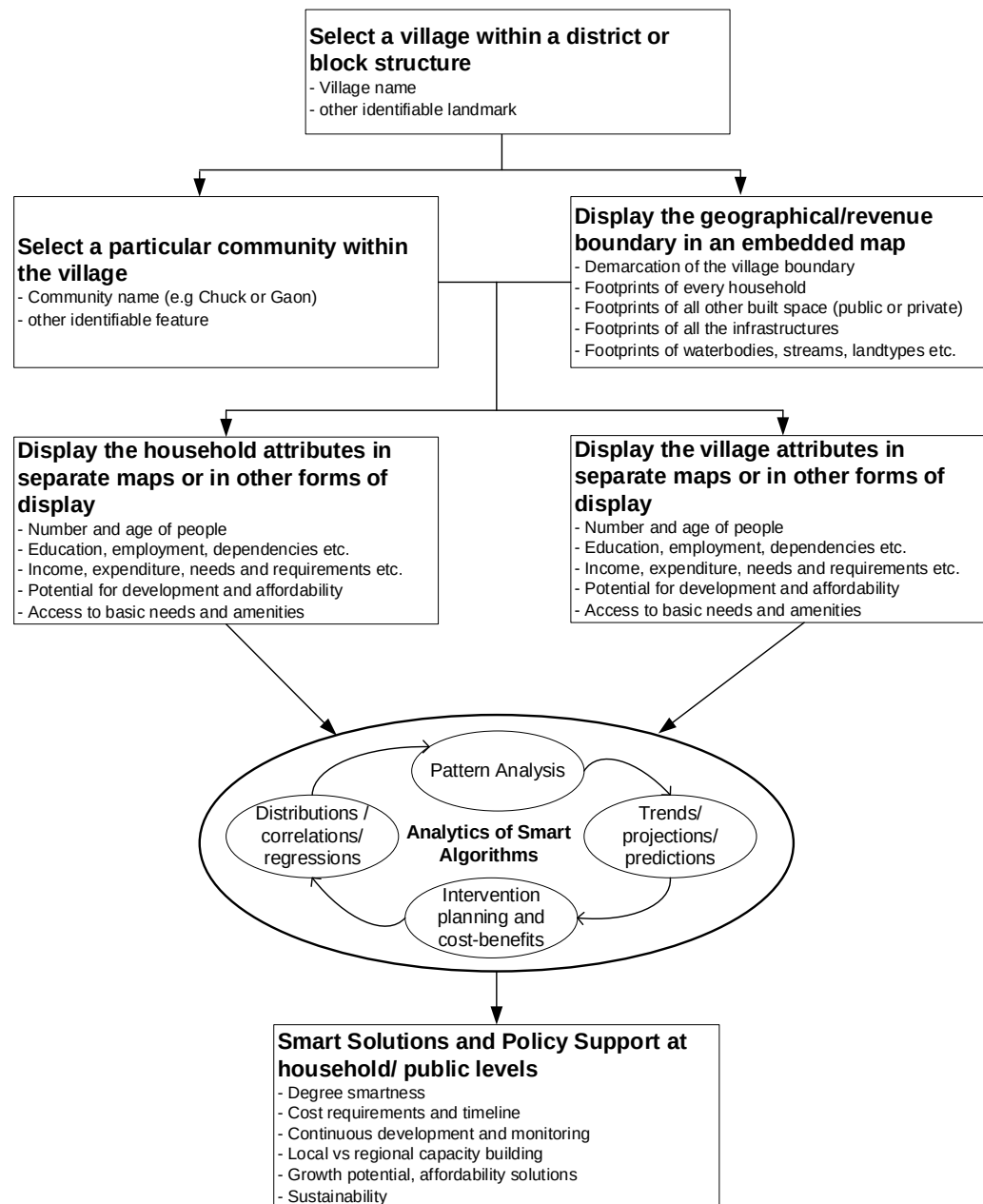


Figure 11.1 Broad Architecture of the Smart Governance System

Scope of the roundtable session

In this round table session, the smart data platform that is currently being developed in the research project was presented to the group of stakeholders with two clear purposes, first, to introduce the aims, objectives and nature of the development, and second, to receive the input on the functionalities from a useability perspective.

After presentation of the prototype and the underlying functionality, there were some useful feedback received. Various aspects of the feedback are listed below:

Communication

How can villagers communicate issues in the survey?

- As the survey is quite comprehensive and it requires great deal of knowledge and time for the house owners to answer every question accurately, the concern was raised about the understanding and ability of the community to respond to the questions.

Response: Five local surveyors have been trained for collecting the data using the tablets who assist the house owners to accurately furnish the required information in the survey.

Reporting

How can villagers report on the issues?

- As the reporting requires some technical knowledge, how the villages could send the relevant concerns for reporting.

Response: Local council or someone from local representative could act on the community behalf for necessary moderation and reporting.

Access

How every member in the community can afford a smart phone to enter data and the issues on equity?

- As the access to survey app requires smart phone with Internet, every house owner may not be able to afford a smart phone for furnishing the household data or to participate digitally. In the absence of the smart phone, how does the equity for accessibility to the data platform and community participation work?

Response: While ownership of the smart phone is an absolute requirement for accessing the data platform for entering household data and digital participation, inability for owning such a device by every house owner is a genuine issue. However, given the smart phone is getting quite cheap and accessibility to the Mobile Internet is also free (Jio network being rolled out rapidly), this issue should not be a major one over time. Moreover, local government offices (e.g. Gaon Panchayat) equipped with an Internet enabled device may provide access to all the villagers using their unique identity (such as Adhaar card) and participate.

Incentive

What would be the benefits to the community and what would be the rewards?

- Questions were raised about the benefits that the community would perceive for furnishing the correct data and the underlying benefits to do so.

Response: The key benefits that the community would perceive be the government-based schemes for supporting the community as per their needs and requirements which will then bring the direct benefit to the community at large. The direct actions and relevant plans will empower the community in long run. In regard to the reward, at the moment the reward is attached to the field surveyors only where about Rs.75 is paid per completed survey. Such a financial incentive may be required for the third party to collect data until the time where community would develop the self-realisation and furnish the data voluntarily.

Local Administration – Moderation (Validating reports)

Would there be any role of the local government in the management of the data platform?

- Questions were raised about the role of local government and their ability to managing the data platform

Response: The role of local government will be absolutely crucial not only to facilitate access to house owners who do not have access to smartphones but also to moderate the issues with local knowledge for setting the priorities and overall management. Different level of access may be generated for accessing the data platform by various authorities as per their needs and power of authority.

12 End of Workshop meeting

At the end of the final day a meeting took place between the visitors from the University of Melbourne and key partners at AEC to discuss:

Reflection of short course and workshop

Planning for next short course and roadmap for rolling out the new CM course at AEC

Planning for next year workshop and inheritance of the Sustainability in Civil Engineering bi-annual conference

Majuli project and action plans including getting RGVN onboard for field support

Academic scholars for 2018

AOB