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MELBOURNE

Smart Villages Program

Faculty of Architecture,
Building and Planning

Government of Assam Policy Framework for Smart Villages

Summary of the results of the research project conducted at the Smart Villages Lab (SVL)
at the University of Melbourne, Victoria, Australia in collaboration with the Assam
Engineering College (AEC), Jalukbari Guwahati, Assam

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Smart Villages Lab
Culture • Construction • Capacity • Community



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GOVERNMENT OF ASSAM

Policy Framework for Smart Villages is the summary of the results of the research project conducted at the Smart Villages Lab (SVL) at the University of Melbourne, Victoria, Australia in collaboration with the Assam Engineering College (AEC), Jalukbari Guwahati, Assam.

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FOREWORD

Shri Sarbananda Sonowal
Honourable Chief Minister
Government of Assam



Sarbananda Sonowal



**Chief Minister, Assam
Guwahati**

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14.11.2019

MESSAGE

It gives me immense pleasure to learn that a collaborative research project ‘Cross Cultural Analysis and Capacity Building in construction management practices focussing on housing and infrastructure sectors in Assam and Australia’ between the University of Melbourne and the Department of Education, Government of Assam has resulted in a unique set of policy recommendations that support the uplift of rural populace in Assam. The collaborative research conducted by the Smart Villages Lab at the University of Melbourne and Assam Engineering College under the auspices of Smart Villages informed us not only about some of the world’s best practices in developing rural communities but also contextualised knowledge for improving the living condition of several crores of people living in more than 26 thousand villages in Assam.

The policy document presented, thus gives a clear reference to 10 key areas namely Employment and Income, Education, Agriculture, Housing, Energy, Waste Management, Water and Sanitation, Transport, Health and Environment. All these areas are equally important for empowering rural communities and building Smart Villages. Over the coming days, the concerning departments of our government will look into the document including the recommendations and make every effort to implement it at the earliest possible time.

I appreciate the initiative of Dr. Hemanta Doloi, an Assamese diaspora in Australia and an academic at the University of Melbourne and Dr. Atul Bora, Principal Assam Engineering College for leading the collaboration and culminating into a successful venture. I hope the benefits of such collaboration will flow into the state of Assam for lending capacity building and skill development including enhancement of technical proficiency across the engineering institutions.

I convey my best wishes to all who contributed to this important project.

(SARBANANDA SONOWAL)

FOREWORD

Dr Himanta Biswa Sarma
Honourable Minister
Government of Assam



DR. HIMANTA BISWA SARMA, Ph.D., LLB
Minister, Assam



**Finance, Transformation & Development,
Health & Family Welfare and
Public Works Department.**

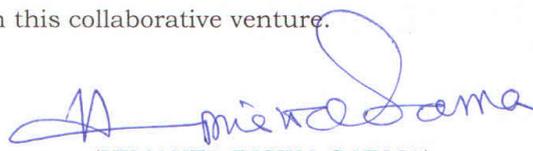
Forward

It is my utmost privilege to state that the collaborative research project “Cross-cultural analysis and capacity building in construction management practices focusing on housing and infrastructure sectors in Assam and Australia” between the University of Melbourne in Australia and the Government of Assam was one of the unprecedented opportunities for the State of Assam. Through this project, we have been able to stand shoulder to shoulder with the prestigious international institution such as the University of Melbourne where the challenges and opportunities in our current development effort have been shared and discussed. With a collaborative venture between the Assam Engineering College and the University of Melbourne, the research undertaken has resulted in a rich and relevant set of policy recommendations that support the upliftment of rural communities in Assam. The research conducted by a group of world experts at the Smart Villages Lab (SVL) under the leadership of an Assamese diaspora Dr Hemanta Doloï informed us not only about some of the world’s best practices in developing rural communities but also contextualised knowledge for improving the living conditions of over 2.8 crores people living in 26,000 Assamese villages.

Focusing on ten key interrelated areas, the policy document highlighted the key challenges and opportunities including time-bound interventions required for a seamless and sustained development of the massive rural population in Assam. The areas comprise *Employment and Income, Education, Agriculture, Housing, Energy, Waste Management, Water and Sanitation, Transport, Health and Environment*. Addressing all these areas with equal priorities is highly important for empowering rural communities and building Smart Villages. Over the coming days, the concerning departments of our government should look into the document, scrutinise the priorities and enact the recommendations for implementation as appropriate.

I sincerely appreciate the leadership of the team from the University of Melbourne for extending hands and developing shared capacity for benefitting the state from a cross-cultural perspective.

I wish every success in this collaborative venture.


(HIMANTA BISWA SARMA)

FOREWORD



Shri Siddhartha Bhattacharya
Honourable Minister for Education
Government of Assam

With immense pleasure, I wish to state that the collaborative research project “Cross-cultural analysis and capacity building in construction management practices focusing on housing and infrastructure sectors in Assam and Australia” between the University of Melbourne in Australia and the Government of Assam has seeded a fantastic foundation for the state of Assam to build shared capacities and address some of the key challenges in the housing and infrastructure sectors across the state. Building capacity for upliftment of the massive rural population in the state is the need of the hour for all involved. The research conducted by the Smart Villages Lab at the University of Melbourne in collaboration with Assam Engineering College under the auspice of Smart Villages has resulted in a set of policy recommendations which could potentially benefit the concerning agencies to derive appropriate plans and strategies for implementation on the ground. Through this project, the application of global knowledge has been adequately contextualised for building required capacities and improving the living conditions of over 2.8 crores people living across 26,000 villages in Assam.

As a firsthand witness of the research being carried out at the Smart Villages Lab, I can boldly state that the research team, under the leadership of Dr Hemanta Doloi, made a fine and sincere attempt to develop relevant knowledge for holistic rural development in Assam. The fieldwork conducted in Majuli district to demonstrate the proof of concept on the development modalities was highly novel. The research based policy document currently being presented to us makes a clear reference to ten key areas namely *Employment and Income, Education, Agriculture, Housing, Energy, Waste Management, Water and Sanitation, Transport, Health and Environment*. All these areas are highly significant for empowering rural communities and building Smart Villages in the state. I sincerely hope that this unprecedented collaborative cross-cultural effort and the underlying benefits will enhance the necessary capacity and skills across every sector and contribute to the growth of the economy in the state of Assam.

Best wishes to all.

A handwritten signature in blue ink that reads "Siddhartha Bhattacharya". The signature is fluid and cursive.

(Siddhartha Bhattacharya)

Date:13/11/2019

PREFACE

As a native Assamese who has spent almost three decades outside Assam, a slow fire has been burning in my heart to do something meaningful for my fellow citizens living in beautiful villages in Assam. As the saying goes, ‘if there is a will, there is a way’, this has been my exact situation where almighty God created an opportunity for me to contribute my professional knowledge and expertise to grow capacity in the state.

Despite the desire to do many things on the ground to uplift the poor villagers, due to various regulatory or logistical constraints, the nature of activities needed to be attuned. As ‘knowledge is power’ and power is what is needed to move the immovable, my focus has instead been the creation of new knowledge with the potential to frame policies and develop effective strategies to ensure sustained growth and development.

Having trained as a Civil Engineer and currently being an academic in one of the fine Australian universities, my knowledge creation was hugely supplemented by the opportunity of an unprecedented collaborative research project generously funded by the State Government of Assam. The project “Cross cultural analysis and capacity building in construction management practices focusing on housing and infrastructure sectors in Assam and Australia” conducted in the Faculty of Architecture, Building and Planning at the University of Melbourne in collaboration with Assam Engineering College (AEC) provided significant new opportunities to explore ideas, gather evidence and create knowledge for addressing some of key issues around rural development in Assam.

While focusing on Assam, the evidence-based research could not be conducted without appropriate reference to global issues and the underlying body of knowledge. With over 40 per cent of the world’s population living in rural areas, there is a global interest in research associated with the creation of “Smart Villages” to address the ever growing urban-rural divide. The concerted effort of practitioners, academia, and policy-makers including social workers for ensuring sustained transition of the rural population into smart communities is the need of the hour. The focus of the research conducted at the Smart Villages Lab (SVL) is exploring solutions for rural community development, improving practices and policies with a focus on community-centric planning of affordable housing, infrastructure, sustainable development and growth, community empowerment and other issues related to the creation of Smart Villages.

The spirit of public funded research is that the findings should support public policies for potential improvement of the lives in the community. A detailed field study was undertaken in the district of Majuli in Assam to demonstrate the Smart Villages concept. Over 2,000 households in 37 villages were surveyed using a smart phone-based custom-built App. The data, containing every aspect of the lives of the individual community members including socio-economic conditions, were analysed using a purpose-built data management system. The visual functionality of the data management system allows accurate understanding of the community’s

needs and priorities at various levels of abstractions such as individual, household, village or district. Such scanning of the community eventually assists in formulating comprehensive policies and devise effective strategies for direct action planning and developing communities in specific contexts.

Over the past three years, the research effort of a large team from the University of Melbourne, Indian Institute of Technology Guwahati and Assam Engineering College has resulted in a unique set of outputs supporting the creation of Smart Villages. The outputs are now compiled as a policy recommendation document for Assam. The document comprises ten broad areas namely, Employment and Income, Education, Agriculture, Housing, Energy, Waste Management, Water and Sanitation, Transport, Health and Environment. As all these areas are equally important for empowering rural communities and building Smart Villages, the document clearly lays out some of the important and time-bound recommendations for supporting the State Government of Assam in their ongoing effort to upgrade the over 2.8 crores people living in over 26,000 villages in the state.

Having developed a critical mass in Smart Villages research at the University of Melbourne, we aim to extend our research by creating awareness of this area of critical need among the broader international community by expanding engagements with potential future partnerships from other parts of the world, especially developing economies and harnessing funding opportunities for conducting sustained research and expanding disciplinary knowledge. SVL will strive to disseminate this research by building collaborative teaching activities such as specialised classes and international travelling studios broadening the interdisciplinary education curriculum at the University of Melbourne and beyond.

Last but not least, I sincerely appreciate the support, dedication and commitment of the visionary leaders within the Government of Assam for providing us with this unique opportunity to build intellectual capacity on Smart Villages and enhance the global body of knowledge. Without their selfless support and good wishes, Smart Villages research would not have materialised. I sincerely expect this collaboration to continue developing our shared capacities for empowering the poor rural communities in the state.

With warm regards

Dr Hemanta Doloï

Lead Investigator (Assam Project)

Director (Smart Villages Lab)

PREFACE

Our collaborative research project “Cross cultural analysis and capacity building in construction management practices focusing on housing and infrastructure sectors in Assam and Australia” between the University of Melbourne and the Government of Assam through Assam Engineering College has created an unprecedented impact in enhancing and benchmarking the technical education across the state. Standing shoulder to shoulder with a fine Australian university, the University of Melbourne, we have had the opportunity to not only validating our academic excellence at a global stage but also impact in practice with appropriate knowledge and skill with local relevance. For the first time, we have had the intensive academic training and development program undertaken as part of this collaborative project. We have sent eight academic scholars for receiving training and mentorship at Melbourne for eight weeks each who upon returning are able to disseminate knowledge and experience to many others for building shared capacities across a number of fronts. Construction being one of the critical areas for the development of the state of Assam, we have now started imparting professional knowledge in Construction Management across a number of practicing departments in the state.

The research program undertaken in the Smart Villages Lab at the University of Melbourne demonstrated some of the unique methodologies for connecting with the rural community and developing participatory capacity keeping the community at the core of policy making and implementations. The fieldwork carried out in Majuli across 37 villages demonstrated the processes for improving the efficiency in public works and ensuring benefits in societal context. Resulting from the research on Smart Villages, we have collectively founded

an “International Conference on Smart Villages and Rural Development (COSVARD)” for providing a platform for experts, academia and policy makers to come together and enhance the body of knowledge required for upliftment of over 40% rural community globally. Assam Engineering College, being the local organising partner, is involved in collaboration with University of Melbourne for organising the 2nd COSVARD 2019 on 2-4 December 2019. This conference truly is one of the most significant outcomes of the ongoing collaborative research project geared towards upgradation of skills in construction sector of the state. The construction sector has a strong multiplier effect on all other sectors of economy and therefore attempt has been made to engage all stakeholders to make the collaborative venture a grand success.

As Skills in Construction, Information Communication and Technology (ICT), Smart and Sustainable Village and Cities, Sustainable human settlements are embedded to each other, the theme of this annual conference is chosen to continue a healthy debate among the participating experts and stakeholders of diverse background. Our message is clear. ‘Smart Village’ will never happen without ‘Sustainable Construction Practices’. Therefore, improvement of capacity in this sector is taken up to create smart and sustainable villages, cities and towns in the state as well as in the world.

I hope the policy framework on Smart Villages will herald a new dawn for enhancing capacities across multiple departments within the government of Assam.

Dr Atul Bora

Principal, Assam Engineering College
Partner Investigator (Assam Project)

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A Chang Ghar in Flood-prone areas in Majuli, Assam



Modernisation of a Chang Ghar in Flood-prone areas in Majuli, Assam

1. INTRODUCTION

Most governments consist of a complex structure with different aspects of society being managed at national, regional and local levels. Within each of these levels responsibilities are divided into various departments working independently to develop policies relating to their specific category. While having a dedicated department catering to each component of society can seem beneficial, there is often an overlap between the impacts of different policies. The failure of different departments to coordinate their policies can lead to ineffective implementation and thus failure over the ultimate policy goal.

This has been found to be particularly problematic when attempting to implement developmental improvements to those living in poverty conditions as their status is the result of a multitude of factors. Implementing a policy that improves one aspect of their life may not lead to any change in their development status as the other components will continue to prevent them from achieving true improvements.

To illustrate this point, consider an example where the labour department provides incentive for a large company to establish a factory in a poor rural area. The goal of this policy is to bring many employment opportunities to the region, providing families with steady income and ultimately improving their developmental status. Various assumptions are implicit in this policy, which in the past have failed to come to fruition:

Firstly, the most obvious assumption is that the company will employ people living locally to their new factory, creating many long-term employment opportunities. In reality, these companies need staff with a specific skill set, and have often shown they prefer to pay someone with relevant expertise to move to the area and take up a position rather than spending money on training an inexperienced local person.

Secondly, there is the assumption that such employment opportunities will grow over time. In reality, as the advent of technology leads to increased sophistication of factory production systems, increased company production rates generally lead to a decrease in employment positions. Most large companies are publicly traded, and their priority is generating profits for their shareholders, therefore increasing the use of technology at the loss of human staff is the general trend. Another issue in countries with underdeveloped labour laws is unrestricted employment hours. This leads to companies employing one person to work for far above the 40-hour week, meaning work that should be employing 2 or even 3 people is being done by only one person, minimising employment opportunities.

Thirdly, this policy fails to consider the availability of essential resources in the local area such as water and electricity. These large companies usually end up taking priority over residential properties and where these resources are scarce, they are often diverted to the factory and away from the local community. Therefore, instead of leading to developmental improvements, the provision of a large company base has been found to leave residents worse off than they had been previously.

Even with some coordination issues can still arise. Due to the lack of employment opportunities many men have migrated to urban areas, leaving behind a wife and children to fend for themselves. A new employment opportunity could potentially provide the women with a steady source of income, but who will care for the children while she is at work. In many instances an older child may be given this task, however, this means that child will miss out on school and the potential to attain an education, limiting their future employment potential and trapping them in the poverty cycle.

Another hindrance may be the location of the family's house. The most common mode of transport among developing rural communities are walking and cycling. If employment opportunities are not located within a reasonable walking or cycling distance people may struggle to access places of work. Where public transport services are available, they are often unreliable, and may result in residents spending a large portion of their day commuting. In many places these services are also unsafe, especially for women and children.

Alongside government there are many NGOs providing support to rural communities. Unfortunately, the lack of coordination between these organisations and the government means the services they provide can sometimes duplicate existing services or be only temporary improvements. A large amount of resources often ends up being wasted and the developmental status of rural communities remains unaffected by their efforts.

The only way to effectively improve developmental status is a coordinated effort across all relevant departments. The activities of NGOs must also be part of a coordinated effort to ensure these precious resources are not wasted. The use of technology is likely to be the most appropriate way to move on from traditional government structure and provide a more coordinated approach to policy formation.

For the past three years the Smart Villages Lab at the University of Melbourne, with the help of generous funding from the Government of Assam, India have been researching effective development policy. The target of the research is to provide a way forward for the government to attempt to bring the rural communities of Assam out of poverty. This overwhelming task has many factors to incorporate including the fact that there are more than 100 different ethnic groups and tribes in the region

with strong cultural habits. The document is arranged by departments with suggestions of potential policy approaches that have been successful elsewhere. Within each of these overlap with other departments is alluded, and the final section of the document will bring together the most effective of these highlighting their overlap and the necessity for a coordinated approach to future policy-making. We emphasise the potential for technology to provide an effective long-term solution to policies intent on alleviating poverty.

Figure 1.1 depicts the overall scope and three key dimensions of the Assam project funded through the Education department of the Government of Assam. The three dimensions are, 1-build knowledge base in smart villages, 2-develop construction management capacity and 3-provide recommendations for creation of smart villages. Construction being one of core and enabling disciplines for developmental work in any country, building capacity in workforce for producing high quality construction projects requires relevant scientific knowledge in both educational and vocational contexts. As part of the project, a major initiative was undertaken to develop a professional Construction Management course in Assam Engineering College (AEC). With active participations of eight selected academic colleagues and under the leadership of the Principal of Assam Engineering College, a new Construction Management course is being developed for imparting relevant education and closing the gap in both academia and industry. The scope of the Construction Management related activities undertaken in the Assam project is not within the scope of the current policy framework. Focusing on the two other dimensions (Dimensions 1 and 3 in Figure 1.1), this report entails the findings and observations resulted from the research in rural development leading to the creation of Smart Villages in Assam.

Figure 1.1: Overall Scope and three key dimensions of the Assam Project

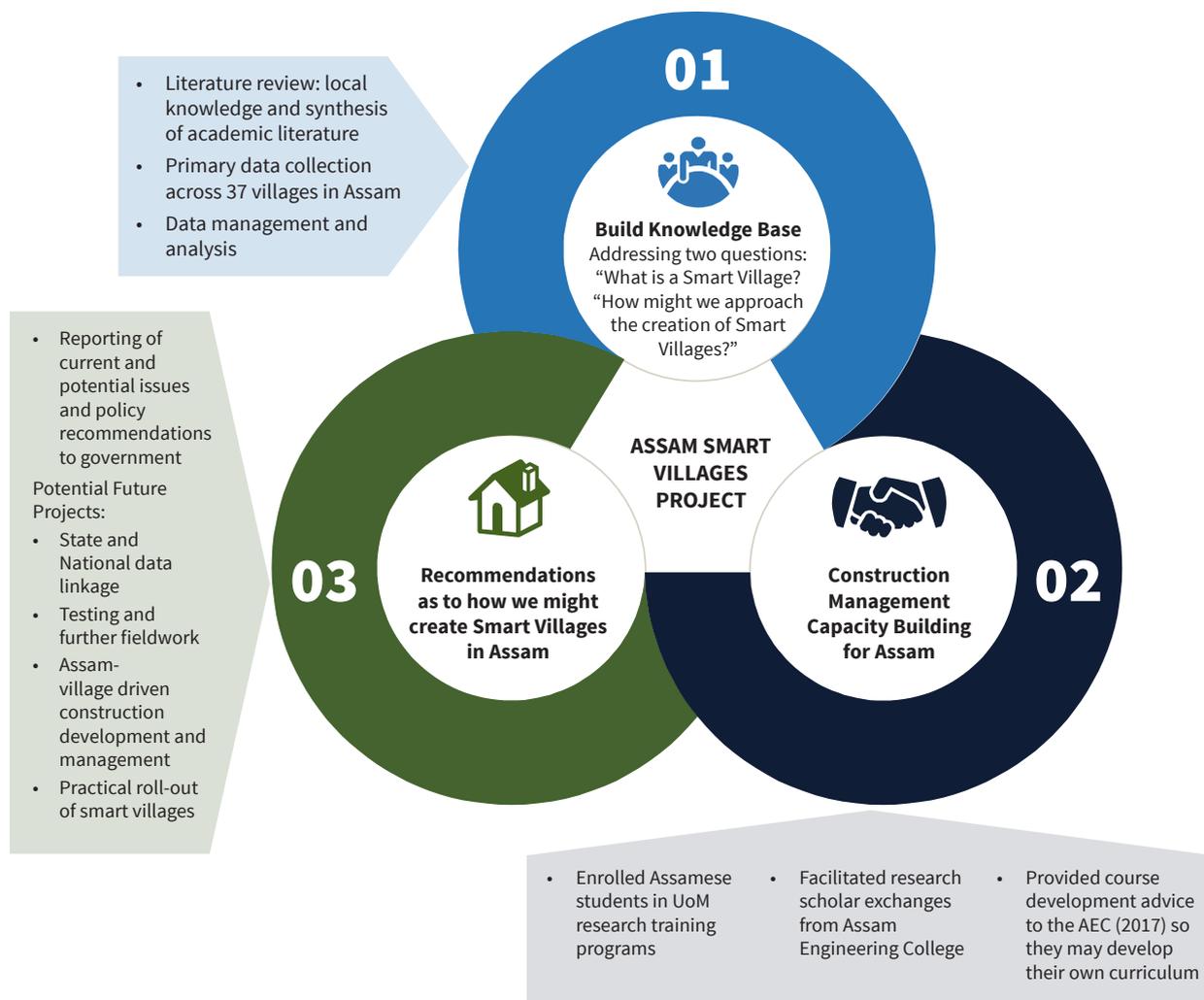
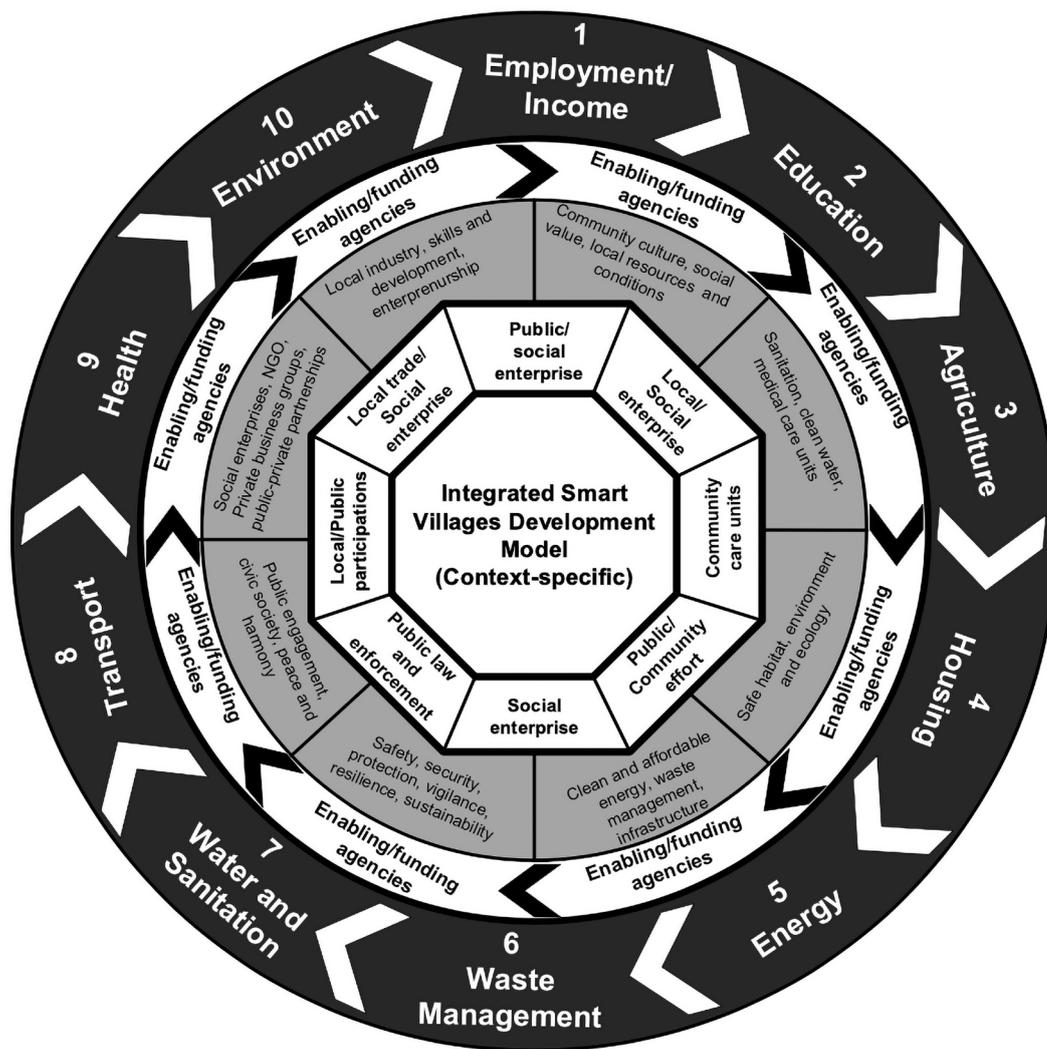


Figure 1.2 shows an integrated model for empowering rural communities through Smart Villages. As seen, an idealised Smart Village in the context of Assam comprises ten key areas: 1. Employment and income 2. Education, 3. Agriculture, 4. Housing, 5. Energy, 6. Waste Management 7. Water and sanitation, 8. Transport, 9. Health and 10. Environment.

There are significant overlaps in all these areas. Thus, the development effort needs to be integrated across all these areas. The premise of a Smart Village is context-specific planning and intervention predominately based on the community needs, requirements and priorities. Effectiveness in planning and development in each of these areas at a macro level relies on the collective effort within the community at a grass-roots level. In the Smart Villages development process, community-driven bottom-up effort prevails over the traditional top-down policy-based interventions and the process starts with the community at the core of the development (refer to Figure 1). In the process however, the effort needs to be concerted and shared across multitude of actors ranging from individuals, community groups, social enterprises, and Non-Governmental Organisations (NGO) to government agencies, policy makers and financiers etc. Each of these areas is expanded in the subsequent sections of this document.

Figure 1.2: Integrated model for empowering rural community through Smart Villages



2. EMPLOYMENT AND INCOME GENERATING OPPORTUNITIES

The ability to generate an income sufficient to cover basic needs is the key to poverty alleviation. As stated in the introduction providing employment opportunities is unlikely to be successful without provision of training in relevant skills. Therefore, the first step to improving a community's employment prospects is ascertaining the current skills people have. The next step will then be either providing relevant skills training opportunities or finding relevant employment opportunities for the existing skillset.

There is an assumption that rural communities have no ability to establish their own employment opportunities. However, in our research we found many people may have ideas for a potentially profitable business but are hindered by lack of access to finance products such as loans and saving accounts. Low literacy levels also stop many potential entrepreneurs from obtaining financing due to the inability to fill out long, complicated application forms.

Financing is essential to help businesses become established and grow. The Grameen bank microfinancing model can provide the basis for this by offering small loans that require no collateral, with low interest rates and long payback periods. The charitable nature of these institutions meant assistance was also available in filling out paperwork, overcoming illiteracy issues. Until now, the success of these loans has hinged on the fact they were offered by NGOs with no desire to generate profits but as demand for loans increases and NGO microfinancing programs are forced to transition to commercial enterprises, the risk that the desire to generate profit will outweigh the desire to alleviate poverty is concerning. Staffing the enterprise with a mix of experienced financiers and social workers was not found to be the most successful approach, compared to staffing the company with inexperienced recent graduates. Finding entrepreneurs with balanced goals seems to be the key to ensuring the program management is committed to both goals of alleviating poverty and maximising profits. These types of entrepreneurs are most likely to evolve traditional microfinancing models into their most effective form, rather than relying on emulating current models.

Making loans available is only part of the solution, ensuring they are used to generate businesses, and not just to cover expenses is also a challenge. Loaning money to groups rather than individuals appears to be more successful, similarly requiring loan recipients to participate in sustainable development improvements, such as attending health clinics or sending children to school could also make microfinancing schemes more effective at driving communities towards attaining sustainable development goals.

It is important that any new business ventures are conducted in a way that preserves the natural resources the community is relying on for survival, to ensure that rural communities will be self-sustaining in the long-term, not just temporarily.

Some examples of the potential for increasing income generation in rural communities include: extraction of forest products that do not lead to destruction and loss of biodiversity; and Ecotourism ventures are another good opportunity to provide income while preserving resources. To be able to take advantage of these approaches, communities will need to be provided with training programs to develop new skills, not just in the activities described, but general business skills, such as marketing, that will be essential to making any business venture a success.

Recommended Policy Approach

Short Term Goals

- Establish the existing skill level and identify areas essential for improvement
- Identify the potential for harnessing local trade and culture and showcase for outside community for potential income generation.

Intermediate Goals

- Implement a coordinated effort for skill improvement in the region
- Improve access to financing instruments for potential small businesses
- Capitalise on local culture and heritage and promote eco-tourism.

Long Term Goals

- Ensure mandatory educational courses, especially primary and secondary schooling, incorporate practical skills development. This should include sustainable approaches to the use of resources.
- Universal access to banking products, especially savings accounts.
- Establish nature, culture and heritage based eco-tourism hubs.

3. EDUCATION

Where income generation is the key to poverty alleviation, education is the key to income generation. The benefits of providing children with an education have been shown to not only benefit the individual, but society as a whole by increasing productivity and reducing crime. The survey of Majuli Island residents showed that in India this is already well underway to being implemented as there is a clear increase in the proportion of residents with higher education level with decrease in age.

It is often the case that primary school children from rural areas under perform compared to children from more urban locations. Addressing this will be important to ensure education standards are universal and rural children are not disadvantaged. Difficulty in attracting teachers to move to rural areas is one issue contributing to this and the Government of Assam has already taken steps to address this issue with improved teacher training programmes. A knock-on effect of low numbers of teachers can mean teachers need to teach multiple grades simultaneously, impacting on their ability to effectively impart knowledge to all students.

Another common hindrance to children's education in rural communities, particularly those from agricultural families, is the necessity for these children to assist with the family business during peak periods such as the harvest. These children may miss a week or even a month of school and will return to class lagging behind the other children. Poor transport facilities coupled with long distances to the nearest school in rural areas has also been shown to cause many children to miss significant amounts of school. With no way to catch up these children often end up dropping out of school. Incorporating more flexible courses, such as the Nueva Escuelas (NE) system used in South America could help. In NE system, students are guided by the teachers to learn among the peers promoting task-based progress rather than class-room based regular activities.

Technology could also provide a solution by giving children access to a virtual classroom experience via the internet. In this way they can spend part of their day in educational activities, while remaining at home and assisting their families with duties. In the classroom it could also aid teachers with large numbers of students, or students at mixed levels.

This flexible education system could also allow for more targeted programmes that teach children skills that will not only improve their prospects, but also their current situation. Children could be learning relevant things like sustainable ways to increase agricultural yields, marketing and business management. Incorporating an interactive agricultural experience into the curriculum can have multiple benefits. It provides relevant hands on experience for the children. It also provides a source of food that can be used to prepare school lunches. Many poor families are unable to provide their children with three meals a day and these children may show up to school hungry. Hunger impacts concentration and may inhibit these children's ability to attain education despite being in class. Thus, a school garden can provide a free meal to the children to incentivise both the children and their parents to attend school and maximising their learning ability during attendance. The preparation of meals from the self-grown food can also provide a hands-on learning experience and provides an opportunity to teach about hygiene practises that could potentially improve public health.

Children learning these practical skills at school can share them with their families and the wider community helping them to improve their livelihoods.

Courses targeting adults could also go a long way to improving quality of life. These may not necessarily need to teach new skills but also teaching people how to exploit their existing skill sets. For example, many residents may have agricultural skills, producing much high-quality produce; however, they may not have complementary skills on how to profit from these skills. Marketing their products is one component of this, along with money management skills.

It is strongly recommended that schooling begins earlier than primary school age. This does not necessarily need to take the form of providing a school room experience but could be intervention with parents to ensure they are aiding their children's cognitive development during the formative early years of life.

Recommended Policy Approach

Short Term Goals

- A review of the current education curriculum as well as an investigation into underperforming schools to begin addressing why children from schools are more advanced than others. In particular, schools in rural areas have been found to perform poorly compared to urban areas. The extent of this needs to be clearly understood so that it can be addressed effectively.

Intermediate Goals

- Developing a more flexible curriculum for rural areas can help relieve some of the common problems associated with these schools, such as poor attendance. It can prevent children from falling behind and ease the burden on teachers where schools are understaffed or have small numbers of children in many different age groups.

- During the development of this new curriculum, courses targeted to rural communities, such as incorporating agricultural skills, as well as expanding courses to cover hygiene and other health and safety measures. Courses in business management would also assist in children of agricultural families improve their family’s income by increasing their understanding of how to profit from their wares.
- To implement a context specific curriculum with local relevance, teachers training should be provided for developing relevant professional competencies among the teaching staff. The training could be administrated effectively by engaging private or public providers with specific skills and track records. For instance, Assam Agriculture University located in Jorhat may be engaged to provide necessary training to selected teachers in rural villages in Majuli to develop competencies on organic farming at the school yards.

Long Term Goals

- Currently, the various forms of the “education for all” initiative have targeted universal primary school level education, and this has been very successful. While this has been a positive start, in the long run it is simply “moving the goal posts” rather than providing genuine breaking from the poverty cycle. Expanding universal education programmes to incorporate early childhood and secondary education should be on the longer-term agenda.



Sequence of building a shed by Construction Management students at the University of Melbourne for demonstrating one of structural solutions for low cost housing in Assam

4. AGRICULTURE

Agriculture remains a core component of the rural economy, however, many families engaged in agricultural activities are struggling. There are multiple factors impacting the ability to generate a significant income from agriculture:

Unsustainable methods are depleting natural resources leading to decreased yields; increasing incidents of extreme weather events have had a devastating effect on many communities; some of those that are successfully growing bountiful harvests have trouble selling it for profit due to lack of access to markets; in the market place traditional small-holder farms are competing with large industrial farming operations that can afford to sell their produce at lower prices.

The goal of smart agriculture is sustainable intensification: intensifying agricultural production, without increasing damage to the environment. Secondary to this is supporting families to diversify their sources of income to increase resilience against harvest failures.

In developing economies of Asia, arable agriculture has been intensified by using inefficient irrigation that wastes water, and excessive fertiliser and pesticides application leading to serious health implications for farm workers and causing severe environmental damage. In Africa many farmers are not using irrigation, fertilisers or pest management strategies at all, and failing to yield enough from each harvest to support themselves and their families. This keeps them in a “poverty trap”. The solution to both problems is better education for farmers. Many governments are subsidising farmers in some way, for example through heavily subsidizing fertilisers. These funds could be diverted to providing education for farmers on better management practices.

Incorporating sustainable agriculture in school curricula in rural areas can potentially help to improve farming practises in these settlements. This will also prepare farmers of tomorrow for successful agricultural management that they can pass down to future generations. The pillars of this educational program would be knowledge about managing soil moisture content, soil nutrient content and pests.

Relying on rainfall to manage soil moisture is becoming increasingly difficult as periods of drought are becoming longer and more frequent in some parts of the world. Farmers should be encouraged to employ underground or drip irrigation techniques. Especially in poorer communities, the use of perforated clay pots or even plastic drinking bottles placed strategically throughout the crop field and periodically filled to provide water during drier periods is an inexpensive (though labour intensive) way of ensuring plants have adequate water, without being wasteful of water. Wastewater can also be used if it is treated beforehand to minimise the risk of toxicity.

Farmers need an understanding of soil nutrient requirements for optimum plant growth. Where nutrient levels are found to be inadequate the use of manure and composted food and garden waste can be used for optimum results. The use of synthetic or mineral fertilisers should only be employed where compost is unavailable, or where the soil nutrient content is still deficient even after compost application. The timing of fertiliser application should coincide with the most appropriate point in the growth cycle and targeted to the root of the plant to avoid runoff into nearby waterways. For example, mixing fertiliser with water and applying it through a drip irrigation system is ideal. Where timed application of fertilisers is not feasible, the use of slow release fertilisers, or inhibitors can be used.

Farmers should be supported in the use of an integrated pest management system. Where chemical pesticide use is seen to be still necessary, farmers should be taught about the health risks associated with pesticides and encouraged to properly use personal protective equipment. Teaching farmers to keep detailed records of their activities will help them to recognise patterns in pest emergence and plant response to fertiliser use. This can help them build up a better understanding of when to apply chemicals and how much to use.

Farmers should also be encouraged to employ techniques of crop rotations, cover crops, and intercropping where possible to naturally support soil nutrient management, discourage pest invasions and produce more diversity of crops and often for more money.

For farmers raising livestock, the key to sustainable management is integrated manure management. The first step to achieving this is to encourage the use of manure for fertilisation. Where possible this can be linked to energy production derived from manure through anaerobic digestion, with subsequent application to land to improve soil nutrient content. Animals should be given adequate space to naturally support their growth and reduce the risk of disease and the use of vaccinations should be encouraged. However, the use of antibiotics should be responsive rather than preventative to prevent the evolution of disease resilient superbugs.

Recommended Policy Approach

Short Term Goals

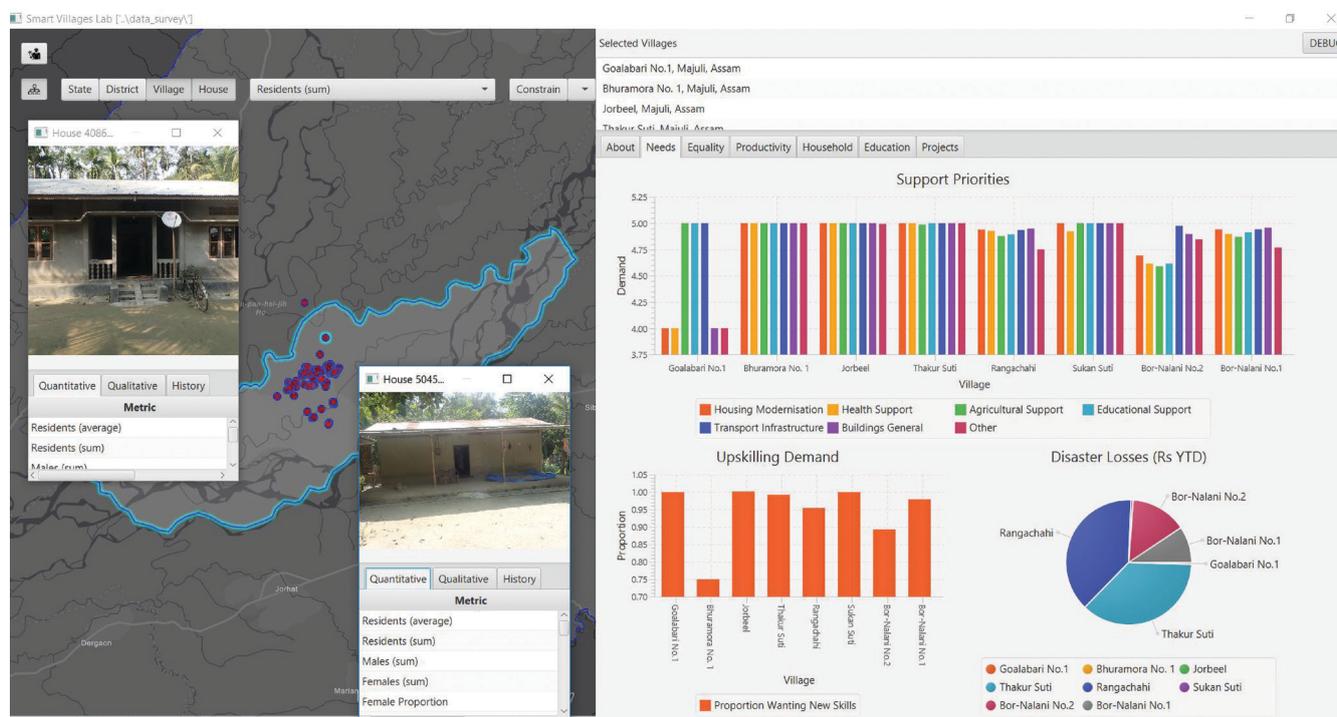
- The recent flooding events in Assam destroyed an estimated 87,000 hectares of agricultural land. Therefore, the immediate goal must be to increase flood resilience through better management of waterways, especially the Brahmaputra River. This will be described in the water management section below as well. However, there is little point in investing in agricultural improvements while the lands are vulnerable to devastation.

Intermediate Goals

- As described in the education section, improving the next generation's understanding of agricultural activities and how these can be managed sustainably is essential to the longevity of agricultural lifestyles in the region. This should include basic skills in business management.
- Crop diversification and potential for multiple harvesting should be included in the school curriculum targeting mature-age students from the community. Again, Assam Agriculture University in Jorhat may be engaged to provide necessary training to empower the community in such practice.

Long Term Goals

- The long-term goal should be to establish thriving and sustainable agricultural communities, that attract people to their lifestyles, reducing the wave of urban migration and possibly enticing urbanites into rural areas.
- As agriculture is one of the most profitable trades for income generation and employment, appropriate marketing support including supply-chain should be established among the community to promote trade and commerce encompassing broader market-base.



A snapshot of the smart data platform showing the comparison of the needs of the community across eight villages in Majuli, Assam

5. HOUSING

Like most parts of the world Assam's rural communities suffer from chronic housing shortages. Past schemes such as the Pradhan Mantri Awas Yojana – Gramin (PMAYG) have attempted to rectify this situation, however, the provided housing was found to fail to meet end-user expectations.

Three considerations form the basis of housing policy: affordability – most people are on low incomes. In the PMAYG scheme the government foots the bill for the entire build, however, this is not a feasible long-term solution as funding will inevitably run out at some point. Most households can pay something for their housing, and there is no reason why they shouldn't. However, having the money to purchase an entire house upfront is also unrealistic. Increasing access to mortgages is the best way to overcome this problem. Households can obtain a loan appropriate to their income that is paid off in manageable instalments overtime.

The second issue availability. There are fewer houses than families in the region. To increase the housing stock, it is essential to find more land for building on and to simplify the process of land ownership. At the same time, it will be essential to ascertain flood plain areas and ensure housing is not built at these locations.

The third issue is adequacy. For rural families, many of whom are self-employed, a house is not just a roof and four walls, it is also a work place, for families with children it is a place to study and play. On top of this, many ethnic and religious cultures involve houses having a specific arrangement. Some require segregated areas for different genders, others require space to practise religious rites. The location of a bathroom can also form part of many cultural traditions. On top of this, seismic activity and frequent flooding plague the region. In this past year alone many thousands of families lost their homes to flooding and its associated landslides. The design of buildings in this region must integrate measures to make them resilient to these types of natural disasters.

One of the main problems with the design of previous housing projects was the failure to consider the traditional vernacular housing that once dominated the different parts of Assam. These houses were designed in response to the local climate and geographical conditions, and used locally available, often renewable building materials making them affordable and sustainable. Incorporating some of the elements of these vernacular designs into modern housing could provide appropriate, affordable, and adequate housing. Of course, new housing should have the capacity for electricity, and connectivity to keep it in the modern world, therefore elements of both vernacular and modern design will need to be combined.

Another issue is the failure to understand the existing skill level in rural communities in relation to housing construction. Previously, these traditional vernacular houses were designed and built by locals, with no formal architectural or construction training. In some places these traditional skills may still exist and exploiting these may reduce the cost of housing compared to bringing in labour from other places.

While owning a house, operation and maintenance requirements and possible financial obligation should also be considered. Proper maintenance of houses is essential from both health and hygienic and retention of financial value perspectives.

Recommended Policy Approach

Short Term Goals

- Our research indicated that the biggest hindrance to housing attainment was lack of land availability. The ability to purchase land was complicated by the necessity to obtain permits, the cost of which often exceeded the cost of the land itself, and the inability of some applicants to fill in necessary forms due to illiteracy. On the other hand, parcels of land that are in flood prone locations have been developed, leading to devastation when disaster strikes. Another issue was that rural land was sold at large farm scales, where as many poor families just wish for a small parcel of land and cannot afford anything bigger, allowing large land titles to be split into several smaller titles could significantly increase housing without having to develop in nature reserves.
- Therefore, in the short term we recommend that identifying land available for development ensuring it is not in a flood plain, creating parcels of land appropriate in size for poor rural families and simplifying the land acquisition process including provision of assistance for illiterate people.

6. ENERGY

Access to energy is an essential component to good quality of life. The ability to cook food and boil water is essential in developing regions where water supplies are often contaminated with pathogens and lack of refrigeration means food cannot be stored hygienically. In cold climates indoor heating can be essential to survival. Further to this, electricity access is considered a necessity by the United Nations. There are many potential advantages to providing energy to a village, from improving process efficiencies allowing small businesses to increase their output, to improving cooking facilities. And of course, it is essential for providing the technology that is simplifying daily life.

Fuel for cooking and heating is largely from biomass burning and this is a good option where fuel is in abundant, accessible supply. However, in many locations, resources are scarce due to competing uses for biomass products, and the collection of fuels can be a physically demanding and time-consuming task. Plantations dedicated to biomass fuel can be a good option where space and soil quality permit. It can provide a potential business opportunity for a family, selling their harvested biomass to locals or exchanging for other produce. Where this is not feasible, the use of anaerobic digestion can provide a superior way to generate methane gas. However, Anaerobic Digestion (AD) technology is complex and would require some level of expertise to be managed successfully.

Cooking and heating can also be provided by electricity, along with many other beneficial uses. Broadly speaking there are two ways to provide electricity access – connecting communities to the national grid or providing microgrid systems locally. Economically, the decision will be a question of distance from the national grid – the further away from the system the less efficient providing electricity and so will make microgrid systems more attractive.

Unfortunately, however, many areas that are connected to the national grid suffer frequent black outs and brown outs. Therefore, even connected areas should be considered for microgrid systems. In many cases, these systems provide energy in excess of the local need and can be fed into the national grid system, diversifying the electricity supply and reducing the risk of black or brown outs.

Previously, the financial burden of establishing microgrid systems has fallen on governments or the charity of NGOs. This is clearly not a viable solution for Assam with 26,000 rural villages to cater for. Fortunately, there is now a strong body of evidence showing that electricity access effectively increases incomes, giving households the means to pay electricity bills. This potential for profit paves the way for private investment in microgrid electricity systems. There are several potential hindrances to the success of private microgrid schemes. Firstly, income increases will only come after connection, thus accessing to funding for the connection will be a challenge for many households. Microfinancing may be necessary to bridge this gap. Secondly, residents will need to understand the ways in which they can use electricity to increase incomes, thus the installation of the system must be accompanied by some form of education programme to raise awareness. Finally, it is well known that there have previously been many failed microgrid schemes, therefore assuring residents that this scheme will be reliable and successful will be essential.

Other important considerations are the type of microgrid system, and maintenance of microgrid systems. The choice of microgrid technology will be location specific and careful assessment must be carried out to establish the energy generating potential of each option. Diesel generators are common; however, the use of fossil fuels has negative environmental impacts and the unpredictable cost of these fuels can make their profitability concerning. If the electricity companies agree to set tariffs for their customers, they will have to bear the costs of sudden spikes in fuel prices while if customers are on variable plans, they will have to pay these costs and it may affect the affordability of the system. There are many well-established renewable energy technologies available, the appropriate choice will be dependent on the local climate and geography. Management and maintenance of microgrid systems must come from members of the local community. To aid communities to true self-sufficiency any development of microgrid systems must be accompanied with training of members of the local community in system management and maintenance. This could also provide a much-needed employment opportunity for a local community member.

It is recommended that microgrids are established at the village level rather than household level, to decrease the number of people required to understand operation and maintenance of the system.

To ensure the reliability of electrical energy, storage should be operated with a predictive control strategy, where the charge level is somewhere between zero and 100 percent, optimising the system and minimising energy losses.

As incomes improve through access to electricity, households will more than likely to purchase more electrical appliances, increasing electricity demand. Therefore, systems should have the capacity to expand overtime. This continued increase in income generation and increase in electricity demand is an important path towards alleviating poverty and achieving equality for remote rural communities. Thus, to be sustainable the system must be able to grow in response to this demand.

Recommended Policy Approach

Short Term Goals

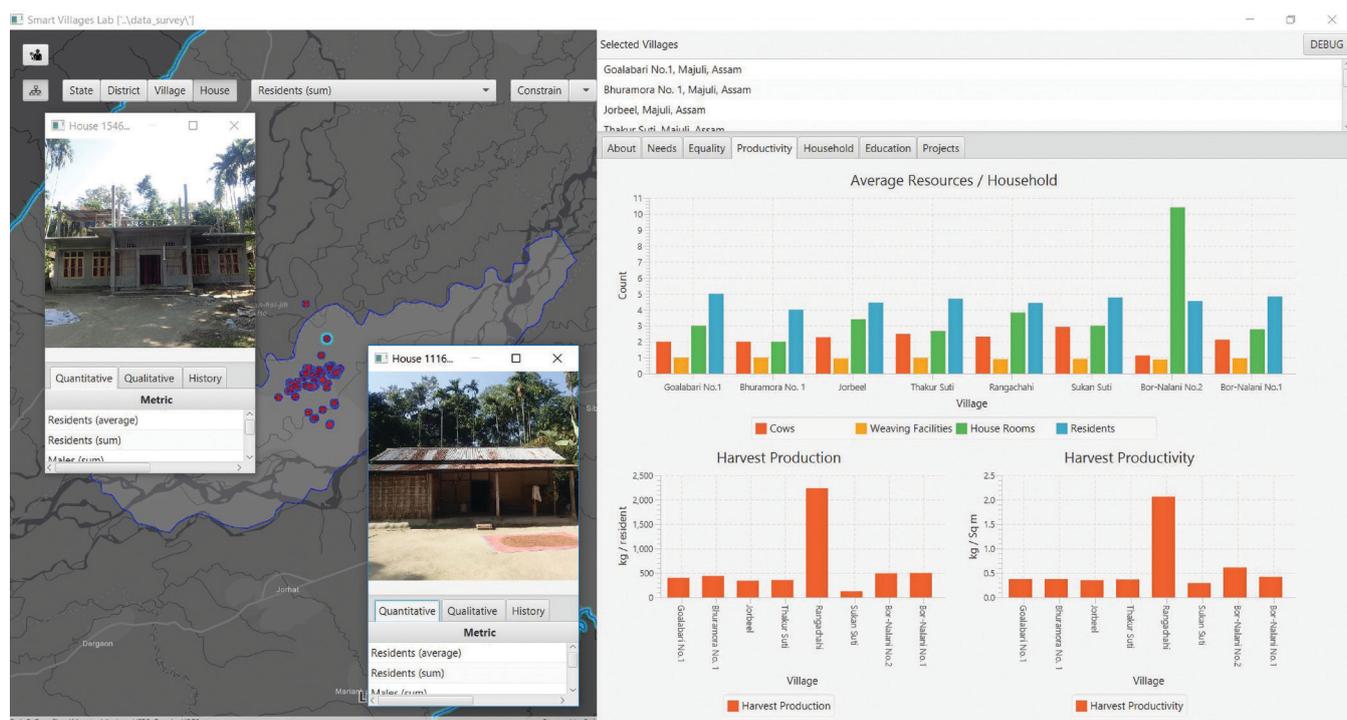
- In the short term, the universal provision of access to electricity through a combination of national grid connection and microgrid structures should be a goal. Encouraging private investment into the development of microgrid systems will take some of the cost burden off the government increasing the feasibility of this goal.

Intermediate Goals

- The intermediate goal should be to tackle the frequent black and brown outs in national grid electricity supply. Diversifying the electricity supply system is likely to provide the key to this.

Long Term Goals

- The long-term goal should be to have rural villages with their own self-managed microgrid electricity systems, working in complement with the national grid. Components of this will include educating members of the community in the management of the microgrid technology ensuring local ability to perform essential repairs and maintenance on the equipment.



A snapshot of the smart data platform showing the comparison of the productivity across eight villages in Majuli, Assam

7. WASTE MANAGEMENT

Waste is an ever-growing problem worldwide. Throughout India, litter lines the streets and clogs waterways. Exceptions to this situation exist such as Mawlynnong, dubbed the cleanest village in India. The lack of litter is down to one simple factor, the people living there clean up after themselves. Working together as a community they ensure that there is no visible waste and go to great lengths to ensure any waste generated is repurposed, recycled, or exploited for energy potential. It is this type of community spirit, without any government intervention that could help rural communities thrive.

In many regions different types of waste are collected together and dumped. This is an inefficient use of resources as many things considered waste have the potential to be transformed into other products, that could save money and reduce the negative environmental impact. For example, the transformation of plastic wastes into raw building materials for housing has been shown to provide resilient, durable building materials. The recycling of metals is cheaper and more environmentally beneficial than the extraction of metals from mining, to name a few.

In rural areas, the largest sources of waste are organic materials which have the potential to be repurposed in a way that is beneficial to the community. One option is to compost the waste, turning it into a nutrient rich soil additive, reducing the use of synthetic and mineral fertilisers.

Composting can be carried out at small or large scale depending on the willingness of residents to participate, the level of suitable waste generated, and the potential end users.

Small scale composting at the farm or even household level can work, if there is a demand for the soil conditioning. The use of on-farm composting should be encouraged for all small-holder farmers. Subsidies for a composting drum or barrel and training materials on how to manage and use compost would be essential to maximise the benefits of this initiative.

In a village where many households are not growing their own produce, a large-scale compost facility may be more appropriate. A farmer could take advantage of this situation and set up a composting system on part of their land. The council department currently collecting the waste could subsidise the farmer to help establish the system, using money they would save in no longer having to facilitate the collection themselves. The farmer can then also charge money for the product to sell to other farms in the area. The process should be kept as simple to manage as possible. Training into maintaining aeration and ensuring temperatures reach appropriate levels to destroy pathogens will be an essential component of ensuring the safe operation of the system and use of the resulting composting material.

Another option for managing organic wastes is anaerobic digestion (AD). In this process the waste is sealed in an air tight environment, forcing the production of methane during the decomposition process. The methane can then be siphoned off and used for energy generation. After processing, there is still a nutrient rich humus substance that can provide fertilising benefits to soils. would be a superior option to composting for treating organic waste, due to the generation of a fuel for energy, the complexity of maintaining the system means there is a high risk of failure. Therefore, we would generally recommend implementing a composting system unless there are local experts who can aid maintenance problems associated with AD to ensure the long-term success of these systems.

Recommended Policy Approach

Short Term Goals

- Evidently, the overwhelming amount of litter has been a huge obvious burden on the local environment. The short-term goal should be establishing more effective waste collection and disposal systems. The use of incineration is likely to be more realistic than expanding landfills due to limited land availability and desire to prevent degradation of the existing land. Supporting people to take pride in the appearance of their village and start removing litter from the streets and waterways should also be implemented. A successful approach could be to run a cleanest village competition, where villages have a set time to clean up, before judges from the council visit. The winning village will receive funding towards development in their village. Running the competition annual could support maintenance of cleanliness in participating villages.

Intermediate Goals

- The intermediate goal will be to improve recycling facilities and support the use of composting.
- Making provisions and incentivising community for collecting and separating wastes from remote public places such as picnic spots along the bank of rivers and composting.

Long Term Goals

- The long-term goal will be a reduction in waste generation through improving the quality of products and replacing the disposable products with reusable ones as far as possible. Developing closed loop economies where one industry's waste is another industry's raw material should also form part of this goal.

8. WATER AND SANITATION

Water is a precious resource with many competing uses. Access to clean drinking water is essential to human survival, and yet many are supplied with water contaminated with potentially harmful bacteria. Water can be purified by boiling, therefore households with access to energy can safely drink it after treatment. For areas that lack energy access other low-tech solutions exist. For example, in warm climates, placing the water in a black plastic bottle and placing in the sun can effectively heat the water to high enough temperatures for purification.

Access to sanitation facilities can also go a long way to the prevention of disease, yet many still practice open defecation. While flushing toilets are often perceived as the most hygienic solution, pit latrines, or composting toilets can be equally hygienic if managed properly. These can be a more appropriate solution in regions where water sources are scarce. The use of double pit latrines, with a platform should be satisfactory except in regions that have high groundwater, are prone to flooding or are located near tidal areas. In this case the use of a sealed composting toilet system, that prevents penetration of water is recommended.

In areas with no current wastewater treatment systems, implementation of a “natural” wastewater treatment system such as a constructed wetland is recommended, especially where the surrounding waterways are supporting a fishing industry that could be negatively impacted by the discharge wastewater.

While water gives life, it can also cause devastation in the form of floods that plague the riparian areas of Assam. Just this year over 2 million people were displaced, thousands of hectares of agricultural crops were damaged and 86 killed. The rivers that make Assam’s landscape, especially the mighty Brahmaputra have many human interventions for hydroelectricity production. These massive dams could provide a way to regulate water flow and prevent disastrous flooding that occurs regularly. Instead they exacerbate the problem. Consultation with dam construction expert Tarun Borgohain reinforced the high potential for managing river flows with dams. He highlights the failures in existing flood prevention measures, and the need to develop a master plan coordinating management throughout the river system.

He proposes a combination of hard measures such as reinforcing riverbeds with concrete, and soft measures such as restoration of wetlands. He notes the importance of engaging with the target communities throughout the process to ensure they understand the purpose of the measures as they will take on some of the responsibility of maintaining the measures. For example, restoring flood plain areas to their natural state through planting with native flora, will absorb more water when the river water breaks the bank, preventing it from reaching areas further away. These restored areas will also naturally raise ground level over time. It is essential that the local community is aware that these areas are there for their protection otherwise they may remove the plants and attempt to build leading to inevitable disaster.

The management of water resources needs to be a cooperative effort between all water users and the government, rather than a competitive situation. The management must ensure that annual water consumption does not exceed the water replenishment rate, so that freshwater resources will still be available for future generations.

Recommended Policy Approach

Short Term Goals

- The immediate goal must be to address flooding in the region. Developing a multi-layered strategic plan incorporating the following elements: altering the existing network of dams in the river system to prioritise water flow regulation over profit from hydroelectricity generation; Setting aside flood plain areas to ensure they are not developed for housing or agricultural activities; reinforcing riverbanks through a mix of natural (restoring native vegetation) and artificial structures such as concrete pillars.

Intermediate Goals

- The quality of water for many rural communities is poor. The water is contaminated with harmful bacteria that can cause serious or even fatal illness. We have found that many residents are unaware of the dangers of this water, often attributing disease symptoms to eating spicy food. Increasing awareness of water quality and encouraging people to purify water before drinking, especially through boiling where this is possible, or if energy sources are insufficient other solutions such as black plastic containers placed in direct sunlight can reach high enough temperatures to kill bacteria in warm areas.
- Sanitation practises are also a leading cause of disease in many developing regions, thus increasing awareness of good hygiene will go a long way to improving public health.

Long Term Goals

- The long-term goal of water management would be to treat water prior to distribution to the community ensuring it is potable. Providing universal access to improved sanitation facilities that prevent contact with faecal matter is essential.
- Relocation of the flood prone community in planned resettlement centers (or areas) with necessary access and other essential services for promoting sustained growth and empowerment.

9. TRANSPORT

Poor transport infrastructure is a huge hindrance to the lives of rural communities. The ability to access schools and work places, the ability to transport produce from farm to market are all things that can stop rural citizens from fulfilling their potential. Being able to visit friends and relatives is also an important part of social development and can be an important source of news for people in regions with poor media access.

The decision-making process for transport infrastructure development should aim to impact as many people as possible, while adhering to sustainability objectives. The process should incorporate consultation with potential future road users as these are the only people who know where they need to go and what means of transport they will use to get there. These are the key considerations which should inform the design and development of new road infrastructure.

Regular road maintenance is essential to provide long-term transport connections to villages and to ensure money spent implementing road infrastructure is not wasted. Thus, budgeting for maintenance should form part of the road design phase. This could include setting funds aside from the outset or implementing a tax on road users. Localising road maintenance has also been shown to be an effective way to prevent roads falling into disrepair. Training people who use the road every day to identify the need for maintenance and perform basic repairs ensures roads do not fall into disrepair and minimises the costs of road maintenance. If locals can perform the maintenance with locally available materials this will be even better as it will ensure maintenance is performed as early as possible.

Our research found that walking and cycling are the most common forms of transport in many developing rural communities. Motorised vehicles are often a small proportion of users of rural roads. Yet, transport infrastructure is provided for motorised vehicles, and often dangerous for these other forms of transport. Therefore, roads infrastructure should include features that cater for non-motorised forms of transport such as pedestrians and cyclists. This will be essential for reducing the high number of road collision related deaths and injuries that are currently occurring in many developing regions.

While walking and cycling provide a good transport option over short distances, residents rely on public transport services to reach places that are further away. For many this can mean frequent things like accessing a school or place of work. It may also be less frequent but essential things like visiting medical centres. Buses are the most common form of public transport. These can often be unreliable, overcrowded and unsafe for some people. Motorcycle taxis are the second most common form, but these can often be expensive making them unfeasible for many. Improving the reliability and safety of these services needs to be prioritised to effect real change in rural communities. Public transport provision must form a part of the design phase of transport infrastructure to ensure it is adequately budgeted for.

Recommended Policy Approach

Short Term Goals

- Consult with rural communities to understand their current transport use and identify gaps in transport services.
- Train, engage and incentivise local community for supporting basic maintenance of the local roads including patching-up potholes on a regular basis.

Intermediate Goals

- Once the main uses of roads are established, providing roads suitable to the transportation types can help reduce maintenance costs. For example, a simple gravel road will suit regions with pedestrian and cycling rather than car use. When potholes appear, these can be repaired by anyone with a shovel. Therefore, the interim goal will be to upgrade roads to suit the local use and provide training within the local community on road maintenance so repairs can be carried out instantly without having to wait for a response from the government.
- Any road development plan must incorporate provision for regular maintenance to ensure longevity of the usefulness of the project.

Long Term Goals

- As we have mentioned, very few rural residents have access to a motorised vehicle. Despite this, many areas suffer from significant traffic congestion and pollution, thus increasing road traffic is not a good option. Rather, provision of clean, safe and efficient public transport services must be the long-term goal. Taxing car users and using this to fund the public transport system will help provide this essential service while discouraging drivers and thus reducing pollution and potential accidents.
- Taking advantage of the extensive river system in the region by providing more public ferry services has the potential to further reduce traffic congestion and increase the reliability of public transit.

10. HEALTH

The top ten causes of death reported by the World Health Organisation show that in developing economies many diseases remain a significant public health issue despite being largely eradicated in other parts of the world. These include diarrhoeal diseases, HIV, malaria and tuberculosis. Road collisions and complications during pregnancy and birth also persist as leading causes of death.

While there will be many challenges to reducing incidents from these, better education could have a significant impact. In previous sections of this document we touched on some of the leading causes of diarrhoeal diseases such as contaminated water, poor hygiene in food handling, and lack of access to sanitary toilets. Better knowledge of safe food storage and handling could prevent many foodborne illnesses; increased knowledge of improved sanitation practises and increased awareness of the need to purify water prior to drinking could all prevent bacterial infections that are the leading cause of this disease.

Better understanding the mechanisms for infectious disease transmission, especially malaria, HIV and tuberculosis, could see a significant reduction in incidence of these diseases;

Better knowledge of the use of treatment for those infected with these diseases will help improve the seeking of treatment and adherence to treatment regimes. Tackling the social determinants of these diseases, alongside medical treatment will also be essential to eradication of these preventable and treatable illnesses. The provision of financial incentives could potentially be a good way to increase the willingness of young adults to seek and adhere to treatments, especially if financing allows them to develop a small business, giving them hope for the future.

To achieve the above goals, the increased presence of healthcare professionals is a possible solution. This does not necessarily need to be a fully qualified doctor. Pharmacists, nurses etc. can have increased training allowing them to provide hygiene classes to the local community as well as acting as a first port of call for consulting about illnesses to determine whether visiting a doctor is essential. The presence of a healthcare professional during childbirth can also prevent many of the deaths occurring during this process. Telecommunications is also likely to be an important way of increasing access to health care through virtual appointments.

Finally, many deaths are a result of traffic collisions. In transport we highlighted the necessity to provide transport infrastructure that caters to pedestrians and cyclists, as well as motorised vehicles for increasing the safety of roads. Another issue is the lack of medical assistance at the scene of an accident that could go a long way to preventing the death of accident victims. Increased first aid training for members of remote communities, especially those most likely to be present on the scene of a traumatic incident is recommended to reduce the number of

deaths and disabilities due to trauma. Improved safety regimes are also recommended; however, these are likely to be more of a long-term goal due to the need to change people's attitudes to safety, especially employers. Implementing increased first aid training is a more immediate solution to reducing trauma related mortality.

Recommended Policy Approach

Short Term Goals

- Increasing awareness of health and hygiene practises through incorporation in school curriculum and adult education courses could go a long way to preventing or better managing the diseases that remain a leading cause of death in developing regions.
- First aid training courses and increased emergency response services could also prevent deaths during emergency situations such as birth complications or road traffic accidents.
- A road safety campaign including training and educational materials for every section of the community should be developed. People in schools, colleges, government and non-government organisations should be trained on road safety to improve the safety bottom line across the state.

Intermediate Goals

- The intermediate goal would be to increase access to healthcare services by exploiting technology to provide virtual consultations with doctors for people in remote villages.
- Increasing training of other health care professionals living in proximity to these regions, such as pharmacists, could also give people a first port of call to ascertain whether their symptoms are a sign of something serious requiring a more specialised consultation or if they are simple treatable conditions.
- Mandatory road safety campaign including training and educational materials for every section of the community.

Long Term Goals

- Long-term the goal should be to eradicate tuberculosis, HIV and malaria, and significantly reduce diarrhoeal disease through provision of clean water, improved sanitation facilities and increased awareness of hygiene.
- Taking advantage of ICT to establish rural health centres that incorporate remote support from medical specialists, providing real-time care in rural communities.
- Set up a road safety commission or something similar to provide regular training and building capacity across all sections of the community.

11. ENVIRONMENT

The environment contains all the resources we require for survival. The quality of our environment therefore has a direct impact on the quality of our life. Yet the way we conduct our daily activities often negatively impacts on the environment, depleting these precious resources and damaging our health. Our attitude to the environment in the way we practise agriculture, and the way we develop infrastructure and housing is that it is something to be conquered. This attitude needs to change. We must start attempting live in harmony with our environment to ensure not just our survival but that of future generations. As such, the environmental impacts of all the policies we develop must be given careful consideration.

When it comes to environmental regulation there is a huge emphasis on minimising greenhouse gas (GHG) emissions. While this is extremely important, the loss of biodiversity could have equally detrimental impacts on our quality of life and so should be given equal weighting. Therefore, developing rural communities in an environmentally friendly way should incorporate strategies that both reduce GHG emissions and preserve biodiversity.

Developmental goals often aspire to emulate countries with the highest incomes. However, these countries are often high polluting and extremely wasteful. There are countries that have achieved widespread developmental improvements in terms of well-being and life expectancy without significantly increasing GHG emissions and these should be providing the model for future development.

Forests are extremely important in terms of both storing GHGs and biodiversity conservation. The preservation of the remaining forests should thus be a priority. Some consider this to be a contradiction to development goals for poor communities that reside in and around forest areas. However, there are ways to exploit forests for income generation without destroying them, such as ecotourism ventures. However, this must be sensitive to the rights of indigenous communities that reside in and around these areas. Careful fragmentation of forests may be an appropriate way to allow rural communities to develop while preserving biodiversity, however, the long-term impacts of this practise are not well-understood, and further research will be essential to ensure the sustainability of this approach.

Where biodiversity loss has already occurred the reintroduction of species has been shown to help maintain biodiversity in a relatively sustainable way. Although this has only been trialled where an extirpated species was returned to its once natural habitat. Where a species has become extinct, the introduction of a substitute species should be tested before it is carried out on a large scale.

Native vegetation including native timber logging must be protected. Rather, timber plantation should be enforced and facilitated to support the building industry with necessary timber and timber products.

Agricultural practises should be encouraged to be performed in a way that supports biodiversity by adhering to the principles of permaculture as far as possible. It should not be difficult to encourage this practise as it is a way to improve yields naturally through better water retention and soil nutrition.

The provision of energy should aim to use renewable sources with low carbon emissions; however, these should be developed in a way that is sensitive to local fauna and flora to ensure that it does not lead to the loss of biodiversity.

Recommended Policy Approach

Short Term Goals

- Developing rural communities such as those in Assam are usually low emitters of greenhouse gases. Maintaining this aspect of their lifestyles must be at the core of any new development goals implemented in the region.

Intermediate Goals

- Protecting biodiversity, especially remaining forests is an important environmental goal that affects rural communities that live close to these nature reserves. The success of the rhinoceros protection in the Kaziranga national park highlights the ability of rural communities to support biodiversity in their local surroundings. The tourist attraction created by these creatures has also brought income generation to the region, where increased requirements for accommodation, restaurants and souvenirs have all been exploited by the local community.
- Botanical diversity is also important and should be supported for agricultural communities, by encouraging them to plant alongside their crops – improving their understanding of agricultural practises can highlight to them how diverse crops can provide natural resilience to supports while supporting soil fertility, minimising the use of environmentally harmful pesticides and fertilizers. Supporting the use of composting organic waste and using this to complement the use of synthetic fertilisers.

Long Term Goals

- Living in harmony with the natural environment that exists around rural communities, ensuring they are thriving today and long into the future.
- Preserving local forests and native timber logging practices, including timber plantation management to support the building industry.
- By implementing the research-based Smart Villages principles developed in the Smart Villages Lab, the development of the rural communities without significantly increasing greenhouse gas emissions will contribute the current global effort of combating climate change.

12. A COORDINATED APPROACH TO POLICY-MAKING

Throughout this document we have highlighted how the different aspects of rural village life are dependent on each other, emphasising the importance of developing coordinated multi-dimensional policies for alleviating poverty.

The basic building block of overcoming poverty is creating income generating opportunities, while the basic building block of creating income generating opportunities is education. Providing educational opportunities that target skills training in not just income generating activities but also in business management, marketing and all the components that go along with making an activity profitable.

The other components of a rural village, housing and infrastructure are essential to facilitate these activities. People need a house that provides not just a room to sleep in but adequate and appropriate space to work and study. The house should also provide thermal comfort and sanitation to prevent illness, a significant inhibitor to the ability to perform income generating activities or to attaining education. Electricity can also provide many advantages, especially time-saving activities such as electrically milling rice, has been shown to free up many hours over a year allowing more time to spend in other income generating activities or pursuing education.

Access to telecommunications, especially the internet, can provide citizens with access to important information on what is happening in the world around them. It can be an important way for people to find out about new policy development, or warnings about impending disaster, allowing ample time for people to move to safety.

The home may also need to come with adequate arable land to provide the household with a key source of sustenance and potential income generating opportunity for these largely agriculture-based communities. The use of this land should be managed with long-term thinking allowing provision of sustenance and income for not only the current residents but future generations. The management of agricultural land will again require appropriate education in land management techniques to ensure the longevity of this precious resource.

Outside of the home people need a means of transport allowing them to connect with educational facilities and work places. Access to reliable telecommunications equipment can substitute poor transport links in the interim and maybe an efficient interim solution.

It is important to acknowledge that different villages have differing needs, and the only way to understand these needs is by consulting with the residents of the village. Thus, the first step to improving the effectiveness of policy formation will be giving citizens a meaningful voice. The abilities and skills in developing rural communities are often overlooked, with many people taking the attitude that people are poor because they are inherently inferior and failing to acknowledge the hindrance that the disadvantages of their circumstances can have on allowing people to reach their full potential. Local communities can be given more responsibility to participate in the policy decision-making process appropriate to their unique circumstances.

People can lack a voice in two ways: socially, in places where citizens have never been given the chance to voice their concerns. In some cases, this can be the perception that the government does not care about their needs, in others, this can be a very real danger where voicing an opinion that disagrees with the government could lead to imprisonment or endanger their personal safety. Physically, lack of access to media such as internet, television, even newspapers makes it difficult for many people to find out what is happening in the world around them. Lack of transport infrastructure and time constraints make it difficult for people to access community meetings and other forums often employed to engage citizens in policy-making process.

Increasing the use of technology to enhance Citizen-Government communication could be an appropriate solution. Mobile phone penetration is growing rapidly, and operating community forums as live webcasts can be far more practical for many people in remote communities. While sending a community representative can be a solution, a webinar forum would be even more engaging. We have demonstrated in our Smart Villages Lab how the use of technology can gather data at the household level in an efficient way. This demonstration survey focused on gathering data from all households in a single region. However, the similarity of responses by demographic groups demonstrates that surveying a representative selection of residents in a larger number of communities has the potential to give equally valid results. The important thing is to ensure that the surveyed households from a given community are representative of the demographic distribution in that community.

Another important communication potential demonstrated by our project was establishing a two-way online interface where the government can post information about upcoming policy developments, while also allowing citizens to upload information to government representatives. Thus, citizens keen to participate in the policy-making process have a platform for doing so.

Even if the state or panchayat level government gathered detailed information on each village in the way described, how can a central government develop a scheme that would be suitable for implementation in hundreds or even thousands of villages with differing needs? While the central government can set targets for developmental improvement, the implementation of these improvements must be done at a more localised level, that is appropriate to a village's specific needs. A potential way to do this is through Government-Community partnerships. In some regions, small rural communities already have informal local leaders, either through

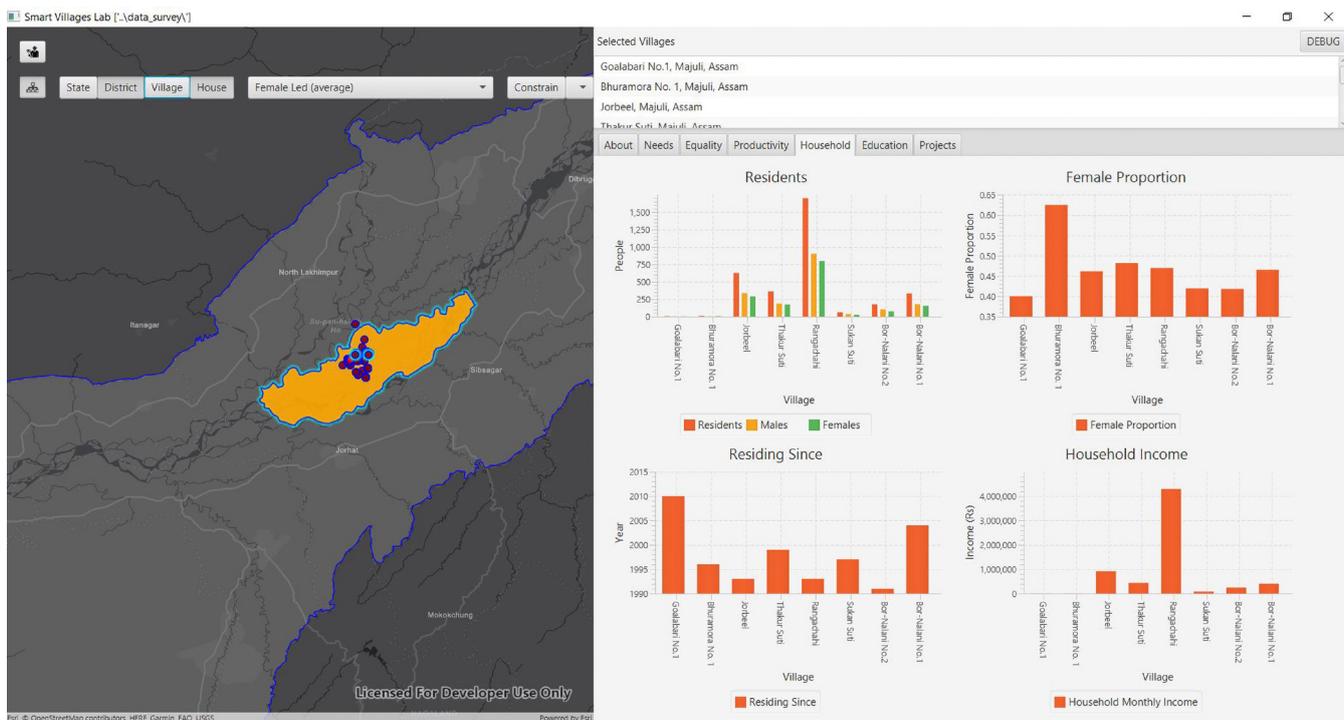
religion or other methods. Exploiting this existing situation, where locals already have a leader in their community that they trust to represent their needs can provide a simplified and successful transition, as was the case in Indonesia. Another approach can be appointing local community members to form a committee.

There are two potential negative outcomes from these local committees. Firstly, they may be commandeered by local elites, who will use the platform to further their own agenda ignoring the needs of the broader community. To the other extreme, these can lead to policy targeted solely the poorest members of the community. Ideally policies should impact all levels of the community in a fair way. To ensure this, committees need to include representatives from the different segments of the community, including wealthy elites, poor and those in between. It's also important that different ethnicities, religions and genders are represented as far as possible.

These local committee members will work together to put forward proposals for local needs or will review policies proposed from the state or panchayat level government and give feedback as to whether the policy will work for their community or suggest changes to make the policy more relevant and effective for their unique situation.

We also need to consider the fact that the proposed policies will overlap different sectors within the government. So how can an effective policy be created and implemented when the government structure is made of divided components working independently? For effective implementation of poverty upliftment policy, it is essential for intergovernmental communication to improve. In a hierarchical way where national, state and local level governance needs to be coordinated, as well as within each of the tiers where interdepartmental communication needs to improve to facilitate the successful implementation of the multidimensional policies essential to the effective improvement of quality of life of poor rural communities. Technology is also the recommended solution. If a department is developing a policy that they can see will overlap with another departments area of responsibility, there can be a forum where they post the proposed policy and flag it for the attention of the overlapping department. This will allow the other department to review the policy and either agree to it or suggest any amendments.

While the government is working hard to develop effective long-term solutions to rural poverty with a limited scope and budget, on the ground there are many NGOs working to bring improvements to rural areas. These sometimes take the form of large companies fulfilling their social corporate responsibility, and other times are volunteers from charitable organisations. The resources utilised by these projects often ends up wasted, as the improvements turn out to only provide a temporary solution or duplicate existing services. The government could take advantage of this source of potential resources to help focus on targeting areas of greatest need. While it is important that total control of these activities is not commandeered by the government, they can facilitate a system where applications for NGO based activities are made, and the government can ensure they are not overlapping with existing services, but rather providing a complement to these.



A snapshot of the smart data platform showing the demographic distribution of people across eight villages in Majuli, Assam

Practical implementation of Smart Villages strategies in Assam

Bringing sustained growth and empowerment to the rural communities of Assam is a challenging task as 86 per cent of the population reside in 26,000 rural villages. Successful implementation will involve a concerted effort between communities, governments and nongovernment agencies.

Figure 12.1 shows the key processes and requirements for transforming rural communities into Smart Villages. As seen, a bottom up approach keeping the community at the centre of the development is required. Once a community is identified, appropriate demarcation of its geographical boundary along with collection of the underlying demographic characteristics is important for understanding the needs, requirements, priorities, ongoing schemes, and interventions including involvement of any agencies on the ground. The Smart Villages approach characterises location-specific and need-based interventions at a grass-roots level. This information forms a solid basis in planning and implementing policies and actions required to meet the target development outcomes.

Figure 12.1 Key processes and requirements for transforming rural communities in Smart Villages

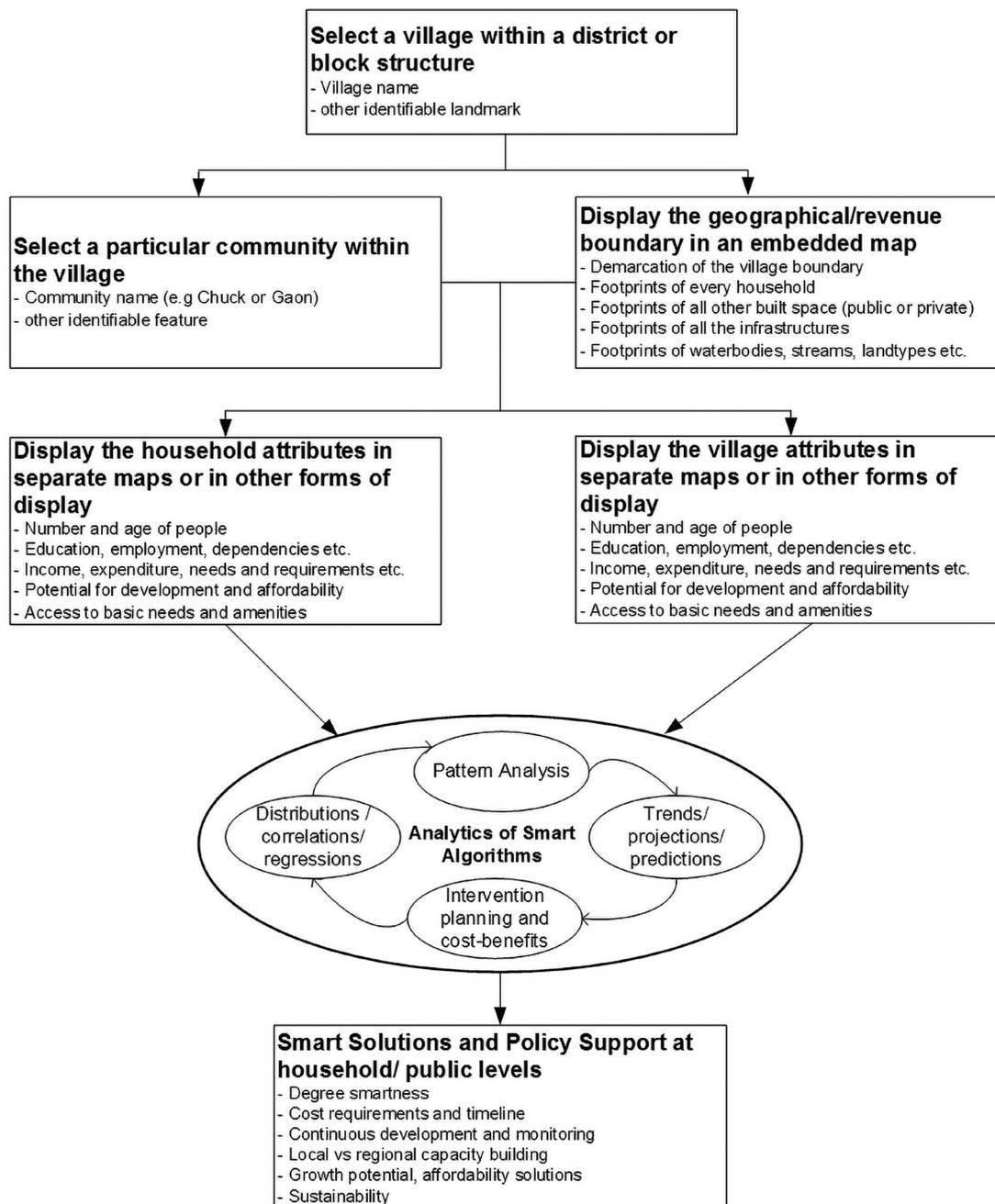


Figure 12.2 shows the transformation of a community through data analytics encompassing multiple dimensions within the development environment. Data must be collected across all the interrelated dimensions within the community. Information Technology (IT) enabled data collection with advanced computational algorithm provides a clear understanding of family compositions, current and past living conditions, health, work and skill requirements including culture, history etc. The outcome of the computational assessment provides necessary input for formulation of the Smart Villages policies across every facet of development within the stated community.

Figure 12.2 Transformation of community through data analytics

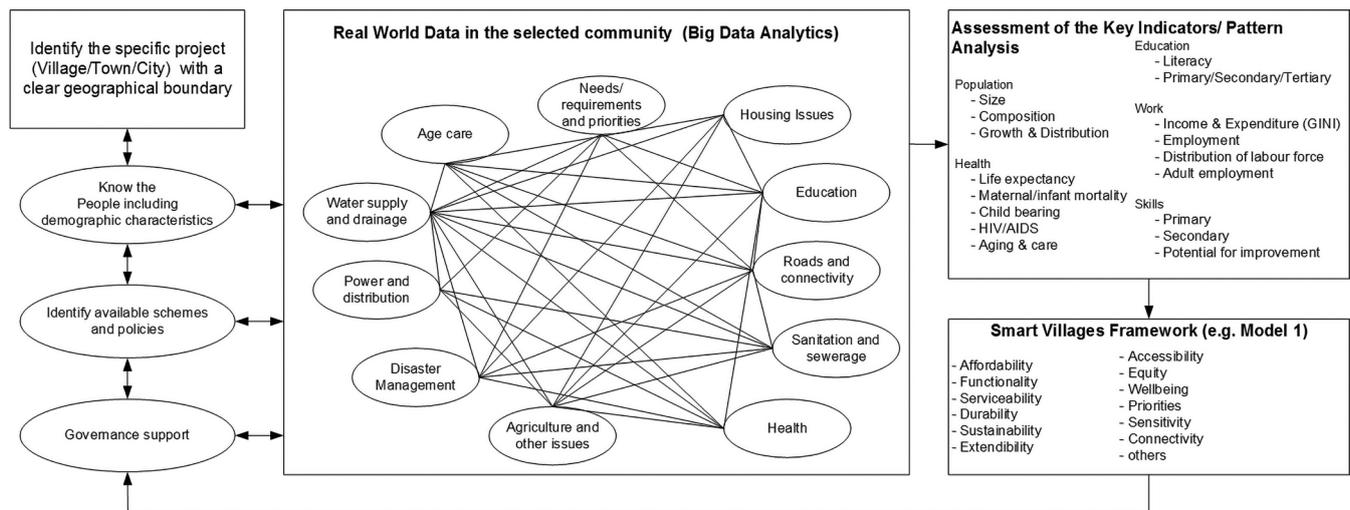
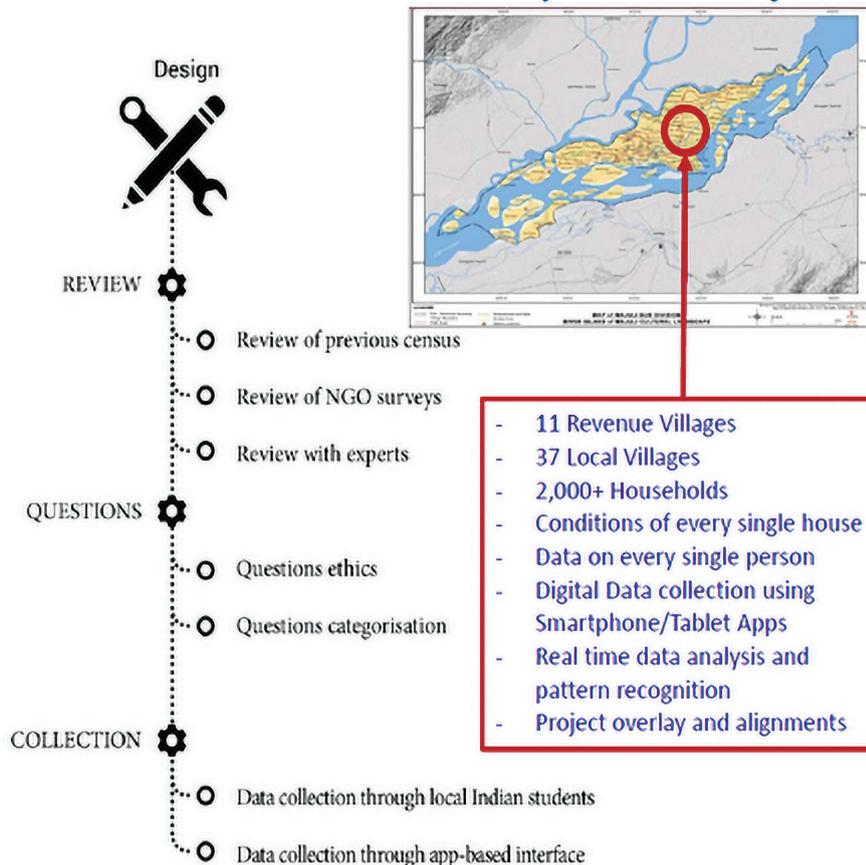


Figure 12.3 The Majuli Survey in the Smart Villages project in Assam

Fieldwork -The Majuli Survey



While the premise of Smart Villages development is empowerment of individual communities, the benefits will have an impact at regional and national levels.

To demonstrate the use of ICT for studying rural communities, the Smart Villages research project surveyed more than 2000 households in 37 villages in Majuli, Assam. Figure 12.3 shows the scope of this field work which was conducted in Majuli in 2017.

Data were collected at both household and individual levels using a purpose-built smart phone App. The App comprised a detailed questionnaire containing more than 600 questions covering the six broad categories:

- Housing – materials, size, no. occupants, age of house etc.
- Household demographics – income, education, occupation, age, gender, potential
- Energy use – electricity availability, appliances used, cooking fuels
- Agriculture – size of land, livestock, crops, income generated
- Skill level – current skills, desire to gain new skills, willingness to pay for skills development
- Infrastructure priorities – road infrastructure and maintenance

Figure 12.4 The Majuli Survey in the Smart Villages project in Assam

Figure 12.4 shows the interface of the App. Members of the local community collected the data after being trained in the data collection process. The collected data was instantly uploaded to cloud storage when a reasonable network signal was available in the field. In locations where the network was unavailable, the accumulated data was uploaded at a later time when the network connectivity was established. The survey data were collected over 4 months.

Figure 12.5 shows the smart data platform built for integrating the field survey data of each household including the photo of the house and the geographical location. A wider range of data analytics algorithms were developed to analyse the dataset at various levels of abstractions such as individual, local (Chuk), village, block and district.

Figure 12.5 The Majuli Survey in the Smart Villages project in Assam

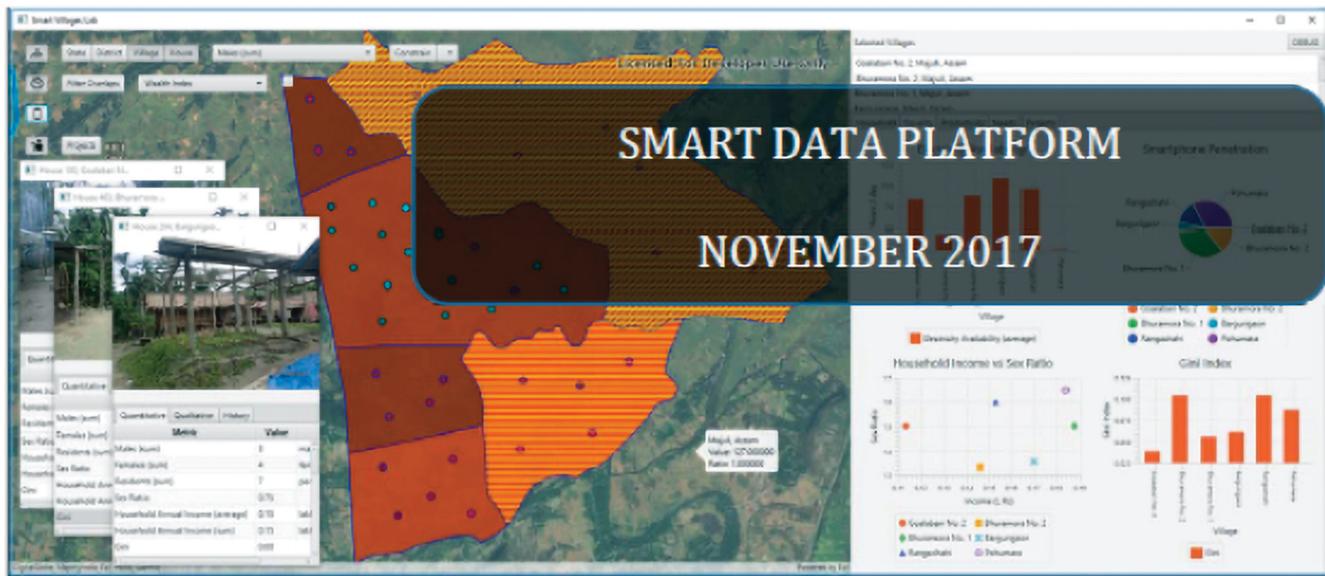


Figure 12.6 demonstrates how the collected data was used to understand the education disparity between male and female within the community. This result could potentially support the development of education policies for the selected community.

Similarly, Table 12.1 shows an example of the relationship between roofing materials and housing conditions. The data clearly shows that many households have poor roofing conditions and need intervention. A public scheme to address this need will instantly improve the lives of these people.

Figure 12.6 Highest education level based on gender

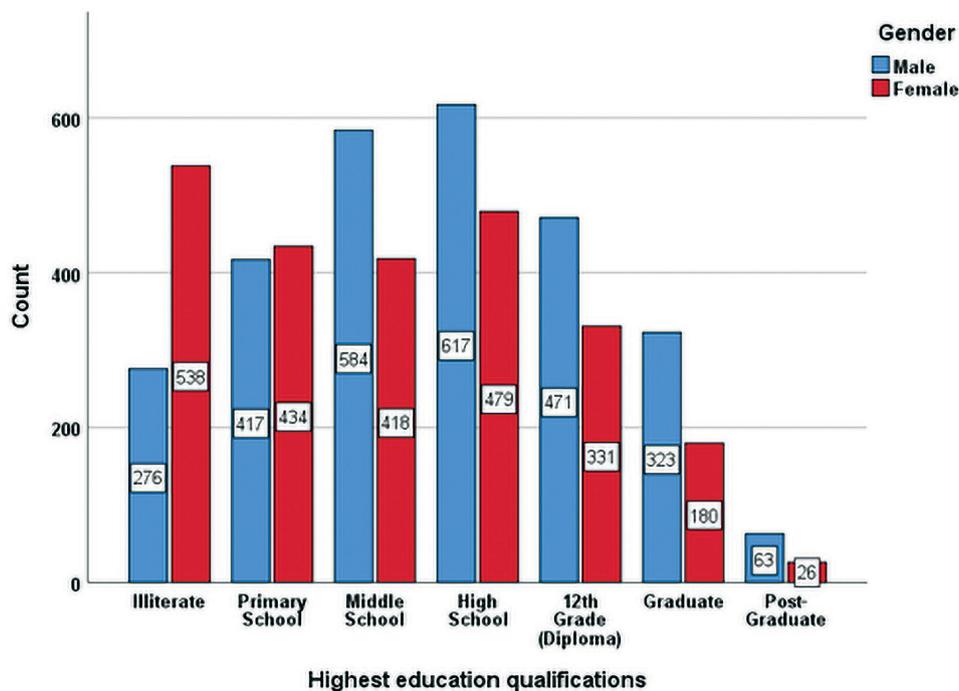


Table 12.1 Roofing materials and existing conditions of the houses

Roof material	The existing condition of the house	Count	The existing condition of the house		Total
			Dilapidated (Poor)	Liveable	
Bamboo Tarja	Count	20	49	69	
		4%	3.8%	3.8%	
Thatch	Count	8	61	69	
		1.6%	4.7%	3.8%	
Tin Single Ek Sali	Count	29	27	56	
		5.8%	2.1%	3.1%	
Tin Dui Sali	Count	438	1119	1557	
		87.1%	86.7%	86.8%	
Concrete (RCC)	Count	8	35	43	
		1.6%	2.7%	2.4%	
Total	Count	503	1291	1794	
		100.0%	100.0%	100.0%	

In regard to energy usage, Figure 12.7 shows pattern of the cooking energy being used within the respondents' community. The data clearly shows that LPG, Firewood and Kerosene are the three main source of energy being used for cooking in the villages. Based on the pattern seen, the health hazard for CO2 emission from the use of Firewood and Kerosene can be easily estimated. Using such data clearly supports evidence-based planning of the public schemes for tackling health-related hazards and promoting healthy living within the community.

Figure 12.7 Energy usage for cooking within the community

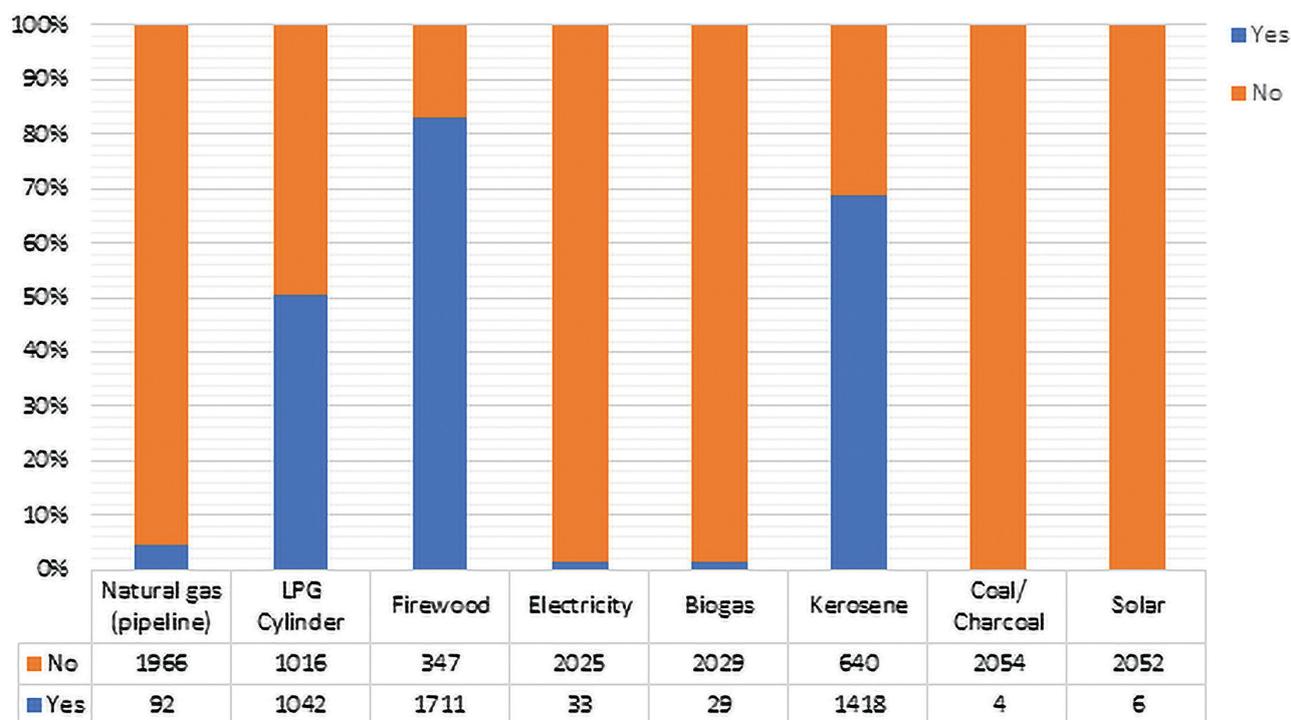
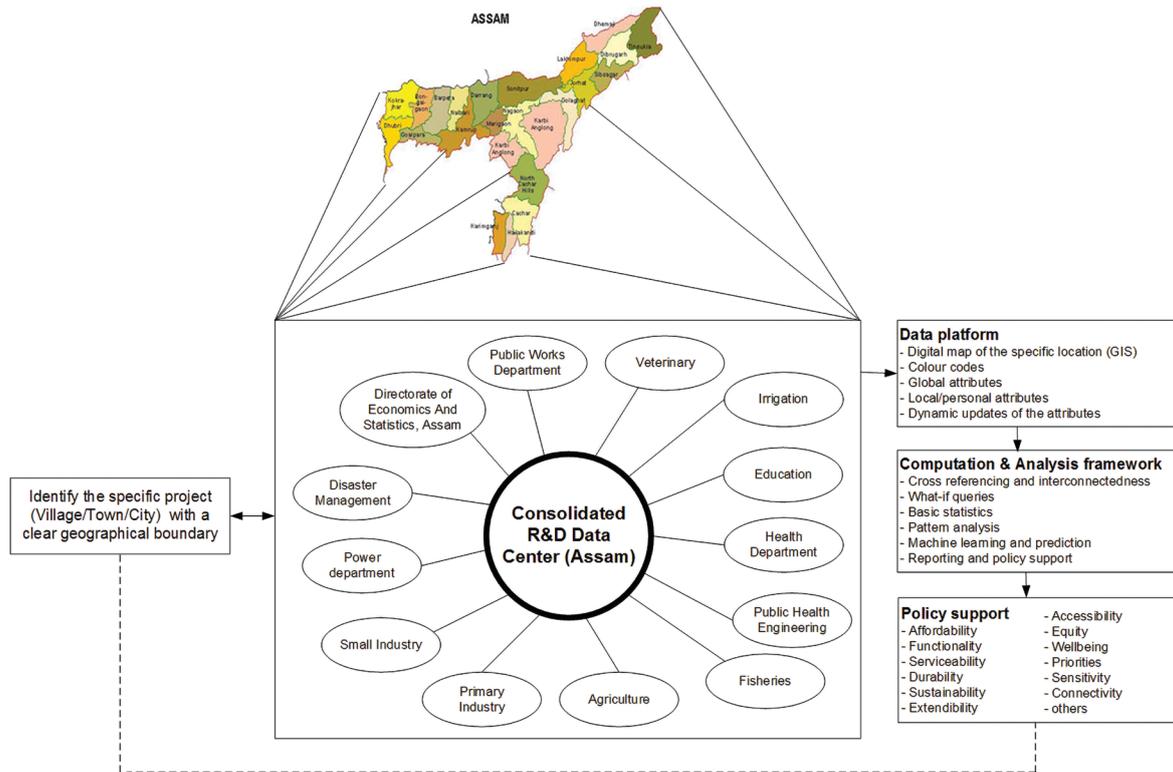


Figure 12.8 Consolidated Data Analytics and Management Center (CDAMC) for developing Smart Villages in Assam



The above examples clearly demonstrate the purpose and usefulness of real-time demographic data for location-based planning and implementation of strategies for development of community in specific contexts. Scaling up the demonstrated survey process to encompass the entire rural population of Assam will require a much bigger facility given the volume of data and the complexity of the computational analysis. This facility will need to work alongside government agencies, to enable realisation of the true-benefit of data-driven support in rolling out the Smart Villages program across the state.

Figure 12.8 depicts a Consolidated Data Analytics and Management Center (CDAMC) for developing Smart Villages in Assam. As seen, CDAMC comprises multiple agencies responsible to making policies and implementing development strategies within the Government of Assam. Unlike the traditional practices, these agencies under the CDAMC umbrella not only need to support data-standardisation but also share and utilise data for making relevant policies and implementation strategies following an integrated development approach.

Based on our understanding of the current governance structure, a new commission may be formed for effective facilitation and operation of CDAMC for the state of Assam. Utilising the ICT platform, data-sharing facilities may need to be developed for all the concerning agencies to work collaboratively and oversee the seamless development and empowerment of rural communities across the state.

As demonstrated in our Smart Villages research project, a purpose-built smart phone App can be used for collecting real-time data from the community located in any part of the state. With reasonable network connectivity even in the remote locations in India, a smart phone-based data collection process enables citizens' active participation which results in effective development of the government's policies aligning community's needs and priorities. Such practice not only promotes accountability and transparency in implementing public policies but also increases the efficiency of scarce public funds and supports smart governance.

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Smart data, smart governance and empowered community



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