Live-In-Labs
AN INITIATIVE BY AMRITA UNIVERSITY
Experiential Learning in Rural India

Research Areas & Projects
Live-in-Labs Mission

The Live-in-Labs program aims to expose international youth to problems faced by rural communities in India through experiential learning opportunities that put theory into practice by generating innovative solutions and facilitating critical and collaborative problem solving abilities of participants.

Program:

Live-in-Labs is a multidisciplinary, theory-into-practice program that facilitates research, development, and deployment of sustainable solutions for current challenges faced by rural communities in India.

The program provides international students and researchers an experiential learning opportunity in which they can directly interact, observe, and study, while living in rural communities to gain a better understanding of problems.

The program supports and facilitates students from multiple disciplines to delineate projects that address problems, and subsequently, to implement, test, and eventually demonstrate innovative, affordable, and comprehensive solutions.

Thematic Areas:

1. Environment and Farming
2. Education and Technology
3. Infrastructure and Facilities
4. Energy
5. Health and Livelihood

Proposed Deployment:

- 101 villages adopted by the parent organization
- Though challenges look similar for two villages, the influence of economic, social and political factors will influence the projects at large.
Key Challenges in Thematic Areas

**Education:**

Student dropout rates are very high in the village for higher grades and literacy standards are very low. This is due to a lack of motivation, awareness, and impact of social factors like education awareness, alcoholism, etc. We intend to reduce the dropout rate and increase social engagement among students.

**Health & Livelihood:**

There is a dearth of information regarding proper health and sanitation in many villages in India. Open defecation is practiced among all. The government-built toilets are used as storage houses and some are abandoned. No proper research has been done on toilet designs that are sustainable and rational for villagers to use. Waste water management barely exists and hardly any drainage systems are in place.

**Energy:**

Approximately one third of India’s 600,000 villages do not have access to electricity and villages that do, receive power intermittently and with constant disruption, making the supply of electricity unreliable. Furthermore, a lack of locally qualified electricians and maintenance follow-ups leaves much to be desired in the endeavor to bring electricity to rural India.
Infrastructure:

The community belongs the native tribes of the western Ghats live on traditional huts for years. The Government of India built them one room kitchen homes free of cost for all. These homes gave them a shelter; they rarely meet their minimum demands. These 200 sq.ft house is home to 17 to 20 people in a family. Also the extreme weather conditions and sloppy tertian has created constructions defects in the house.

Farming:

In many states, villages are spread across two hills and do not have planned designs to materialize the available land for extra income generation through, agriculture, live–stock, home based industries, toilets, drainage, water systems etc. Furthermore, distribution of drinking water and water for irrigation is a big challenge due to rocky surfaces. In many cases, a single village depends upon only two streams, which dry off the during summer. There is no distribution model currently available for water and villages currently rely on independent PVC pipes to draw water from streams. The same stream water is used for irrigation, washing, and bathing.

"Everyone in the world should be able to sleep without fear, at least for one night. Everyone least one day when hospitals see no one admitted due to violence. By doing selfless service for at least one day, everyone should help the poor and needy. It is Amma's prayer that at least this small dream be realized."

AMMA
Environment & Farming

Objective: Analyze the environmental impact of current farming methods; effectively use waste through various recycling methods; introduce organic gardening, perm culture, and forestation; and cultivate high-value crops.

Education

Objective: Empower rural communities with basic education through the use of tablets, vocational training, and communication systems.

Infrastructure & Basic Facilities

Objective: Provide rural communities with safe homes, roads, dams, canals, bridges, as well as drainage and sanitation facilities such as biodegradable toilets.

Energy

Objective: Provide electricity to rural communities via solar power, aid in the development and utilization of smart energy technology, and encourage the efficient management of energy resources.

Health & Livelihood

Objective: Develop innovative strategies to provide access to safe drinking water, affordable and advanced healthcare, and counseling for substance-abuse.
Proposed Projects

Civil Engineering

Area 1: Water

Challenge: In hot climates, the daily demand for water by those who can afford to regard it as a desirable luxury is invariably many times that of poor people who can only use piped water for basic purposes i.e. to drink and stay healthy. The water resources available for distribution in such a climate are rarely sufficient to satisfy the combined basic and discretionary/luxury demands of all the people within a given service area. Under these circumstances, the water supply pipes are bound to empty every day and the supply organization usually tries to manage these ‘down times’ by isolating sections (or zones) of the distribution network on a rotation basis. With an intermittent supply, the system is exposed to dangerous contamination every day. It is also inequitable since those that can afford to install large storage tanks and pumps take an abundance during the supply periods whilst their poorer neighbours suffer a shortage.

Project: Affordable Low Cost Water Distribution System

The project aims to build customized water distributions systems which will be able to source water, be distributed equally, train local villagers to use and maintain the system, and develop a sustainable ecosystem around the network. The research focus will be on the piping system, valves, pumping system, creating awareness programs, and empowering villagers. The key areas addressed under this project are:

- Requirement estimation
- Identification of water sources
- Surveying
- System design
- Sustainability study

Collaborating Departments: Amrita School of Engineering, School of Biotechnology, Amrita Center for Environmental Studies, and the Amrita School of Business

Area 2: Water Purification System

Challenge: Most of the Indian villages are agriculture based, so most of the available land will be farm land. For profitable and easy farming, villagers depend upon chemical fertilizers and pesticides which will finally run into the water systems. Pesticides have penetrated deep into the water table and common pond and rivers. Along with this, open sanitation poses challenges during monsoon seasons as epidemics spread due to the consumption of contaminated water and most of market available filters are too expensive for the villagers to buy.

Project 1: Home Based Purification System

- Create awareness programs
- Construct water quality surveys
- Develop community low cost filter for drinking water
- Develop home based low cost filter for drinking water using locally available resources
Project 2: Village Water Quality Management

- Develop flood water management systems
- Develop village level drainage management systems
- Develop strategies for water quality management of local water bodies
- Create aquatic ecosystems

Collaborating Departments: School of Biotechnology, Center for Wireless Networks and Applications, Department of Social Work, and the Department of Environmental Engineering.

Area 3: Infrastructure

Challenge: Construct low cost buildings using locally available materials.

Project 1: Build houses and cattle sheds with locally available materials

Project 2: Design Micro Processing Units

This addresses issues related to the problems in existing houses. Another major area of research is on how to make use of the available water for day to day activities and optimizing solutions for roofing related problems. This is because existing methods of addressing issues related to roofing could either be too costly or inappropriate for the area (taking into consideration the availability of material and skilled labor).

Collaborating Departments: Departments of Environmental Engineering and Mechanical Engineering

Area 3: Waste Disposal System

Challenge: Villagers were known for their zero waste culture. They used to consume all locally made products which do not require any packaging or preservatives. With the introduction of new products and services, villagers were forced to deal with the waste associated with it. Most of the debris from the villages either get dumped in the water bodies or get mixed during rainy season thus polluting the water bodies.

Project: Rural Waste Management

The solutions to this should be one that would be sustainable. Appropriate changes should be made to the conventional methods of disposal and should be redesigned to meet the requirements. Some of the methods such as the development of biogas plants could be beneficial as the benefits could be twofold. The first being the disposal of waste and the other being a path towards sustainable development. This is because the biogas plant could be used to generate electricity from the gas and the slurry obtained could be used as manure for agriculture.

Collaborating Departments: Department of Mechanical Engineering and Center for Environmental Studies
Mechanical Engineering

Area: Rural Automation

Challenges: Most of the rural villages are agricultural based with manual farming as the norm. From field preparation to harvesting, involvement of new machineries or equipment are very little. The reasons may be affordability in terms of buying power, poor maintenance services, lack of skilled technicians and adaptability in terms of culture, gender bias and processes. Inefficient farming practices result in poor farming ergonomics. Since large part of farming labor is shared by females, this imposes health risks. The tradeoff between automation cost and low productivity is still remaining as a pulse among Indian farmers. Moreover economic conditions, exploitations from money lenders cause of concern for poor farmers in large investments for machinery and equipments.

Possible Project Topics: With the introduction of uninterrupted power supply, the agric machinery and tools and equipment, the projects can be:

- Solar dryer
- Sorting machine
- Heater
- Low power cooling solutions
- Powdering machines
- Kinetic turbine for electric power generation
- Micro- thermal and hydro turbine design

Project 1: Traction Systems
Villages which are located at higher altitudes and roads are not there. Women have to carry these things to the villages and they have to adjust the systems.

Project 2: Processing Units
Most of the villages are centuries old and therefore will have a traditional occupation which is very unique to the place and depend on the availability of resources like herb and flora and fauna etc. Villagers are also dependent upon traditional energy sources like charcoal, fire wood, and biomass which make it difficult to collect, store and use for processing the traditional products out of herbs or vegetables. With the introduction of our intervention, villagers will able to restart their traditional business with new energy options. These systems have to be redesigned to work with the new energy sources. The idea is to design units so that maximum productivity is achieved with minimal investment for the units.

Few processing units identified:

- Lemon grass distillation units for few houses
- Corn powdering units
- Jack fruit peeling units
- Palm leaf pressing units
- Treatment Plant and ancillary product design
- Drinking water treatment plant
- Valve design for water distributions
- Bio gas plant design

Collaborating Departments:
Departments of Chemical Engineering and Electrical Engineering
Electrical Engineering

Area: Rural Electrification

Challenges: One of the main challenges for rural India is the quality of power supply. Although most of India’s villages are connected through a grid, the quality and availability is very low. Furthermore, the remoteness of the village does not facilitate the possibility of grid maintenance. Thus villagers are forced to live in darkness. There is also not enough electricity to run irrigation pump sets and lights at night. Also financial conditions do not permit villagers to switch to renewable energy sources although there is a huge potential for it.

Project 1: Audit
- Energy Audit of the Village/Pre-Survey of Energy usages
- Awareness Programs

Project 2: Energy Generation
To identify the potential Renewable energy sources and feasibility of study of the same. To model the potential generation from the sources and devise a project plan which includes designing the generators and test and implementation of Hydro, solar, wind and solar Generation units.

Project 3: Distribution
Selection, design and implementation of Distribution network includes development of smart nano and micro Grids, interconnectivity of Grids, Algorithm to achieve stability.

Project 4: Utilities Development
Depending on the Source and Distribution type we need to develop which utilities which will supplement which grid:
- Smart Energy Meter
- DC irrigation pumps
- Dc furnaces

Collaborating Departments: Mechanical Engineering, Center for Wireless networks, Amrita School of Business, Department of Civil Engineering

Business & Management

Area 1: Energy & Water

Challenges: To provide minimum assured Energy and water to rural communities at an affordable price.

Projects:
- Study the energy economics of the proposed energy solutions
- Develop a income model on the installed grid
- Develop a income model for water distribution

Collaborating Departments: Electrical Engineering, Civil Engineering, and Social Work

Area 2: Health

Challenges: To provide Affordable and quality healthcare in rural communities;

Projects:
- Study the health economics of the village community pre and post intervention
- Develop strategy for community healthcare initiatives

Collaborating Departments: School of Medicine, School of Pharmacy, and School of Social Work
Area 3: Entrepreneurship

Challenges: Currently most rural communities are agriculture based. With the change in climate, most farmers are at high risk. There are no skills acquired, Poor Market knowledge, and exploitation from middle men.

Projects:
- Develop a product development plan for locally made c.
- Develop Market study for locally made products.
- Develop the business model for the Self Reliant Groups under different Skill.
- Develop community based service industries

Collaborating Departments:
Computer Engineering, School of Social Work, and Communication Engineering

Biotechnology

Overall Challenges:
India’s diverse culture has its indents in prevention and care using local available flora and fauna which was lost due to the globalization of western medicine. Also the use of chemical fertilizers over three decades made pesticides and chemicals run into the water supply, polluting the drinking water. Also large amounts of human and livestock waste accumulate in the field and contaminate the drinking water.

Area 1: Local Herbs
Project: Study of medicines prepared from local herbs

Area 2: Pesticides in Drinking Water
Project: Develop a Low Cost Pesticide for Community Wells and Pipes

Area 3: Sanitation
Project: Disinfect Toilet Waste Using Bacteria Phages

Area 4: Energy
Project: Microbial Fuel Cell Based Lighting Technology

Collaborating Departments: Electrical Engineering, Civil Engineering, Electronics Engineering

Area 5: Low Cost Diagnostics Tools
Project: Develop a standalone community based diagnostic device which will monitor the Key health parameters.

Collaborating Departments: Amrita Institute of Medical Sciences, Electronics and Communication Engineering, Computer Science Engineering, and School of Social work.

Health Care & Medicine

Overall Challenges: The Indian government has invested a great deal of money and time to develop the rural health care sector through the community health centers and other different health worker programs. But nothing can complement the shortage of doctors and or diagnostics centers, supply of medicines or cost of health care. Even large subsidies were allocated for rural health care sector; the large Health care miles and quality of Health care still pose health care a burden to rural communities. Timely dissemination of information is also a major reason that controlling the epidemics and seasonal diseases is possible.
Area 1: Training Health Care Workers

Projects:
- Course development
- Collaborative internship for trainees
- Design of training program
- Development of post training activities/ follow ups

Collaborating Departments: School of Social Work, School of Biotechnology, and Department of Computer Science.

Area 2: Awareness Programs

Projects:
- Develop awareness programs for anti alcohol abuse, anti smoking, anti tobacco chewing, and good hygiene practices
- Develop program evaluation methodologies

Collaborating Departments: Department of Social work

Area 3: Rare Disease Research

Projects:
- Study low life span of the community and factors contributing to the same
- Study the impact of life style diseases on diagnosis and treatment of other diseases in the rural environment

Collaborating Departments: Department of Social Work and Center for Wireless Networks and Applications

Area 4: Infant Health Care

Projects:
- Study on the effectiveness of the current interventions.
- Study on the effectiveness with the introduction of technologies on infant and pregnancy care of the rural communities

Collaborating Departments: Center for Wireless Networks and Applications

Area 5: Digital Health & Telemedicine

Projects:
- Develop information systems to maintain the health information of villagers
- Analyze the data pattern to develop the healthcare model of the village
- Install telemedicine unit in villages

Collaborating Departments: Department of Computer Science;

Area 6: Affordable Diagnostic Units

Project: Develop affordable low health care diagnostics tool and kits.

Collaborating Departments: Department of Social Work, Department of Educational Technologies, Department of Biotechnology, Department of Nano Technology.
Social Work

Area 1: Effectiveness of Intervention

Challenges: Continues evaluation of social impact

Projects:
- Study the effectiveness of interventions in the areas of health, energy, infrastructure and education, and skill development
- Study the impact of interventions on the well being of the society under study

Collaborating Departments:

Area 2: Awareness Programs

Project: Develop awareness programs in the areas of health, infant care, pregnancy, anti alcohol abuse, anti smoking, anti tobacco chewing, etc

Collaborating Departments: Center for Educational Research, School of Pharmacy, and School of Community Medicine.

Electronics & Communication Engineering

Area 1: Technology Enabled Rural Transformation

Challenges: Continuous data collection using effective technologies

Projects:
- Wireless Sensor Network System for Improving Crop Production
- Real-time Embedded System Development for Monitoring and Control of Machines
- Integrated Sensor Systems for Environmental Monitoring
- Wearable Wireless Device for Remote Patient Monitoring
- Portable Devices for Primary Health Center
- Deployment of Communication Network for Rural Villages
- Communication Technologies for Community Based Social Media Management in Rural India

Collaborating Departments: Center for Wireless Networks and Applications, Center for Educational Research, Center for Cyber Security, Department of Electronics and Communication Engineering, Department of Electrical Engineering, and Department of Instrumental Engineering

Computer Science

Area 1: Big data collection and analysis for rural management

Challenges: Continuous data collection and information processing for effective rural development

Projects:
- Big Data Platform Development for Rural Management
- Mobile Based Health Information System for Rural Villages
- Mobile App for an Effective Real-time Auction System for Crops and Other Products
- Context Aware Barter System App for Effective Trading
- Counseling System for Higher Education and Job Opportunities
- Personalized Skill Development Platform to Increase Rural Job Opportunities
- E-learning and M-learning Systems for Neo Literates
• School Management Software for Rural Schools
• Natural Language Processing System for Effective Disaster Management
• Crowd Sourcing Techniques for Effective Data Gathering and Information Processing
• A Framework to Disseminate Messages, Policies, Regulations etc., from Government Offices to Individuals
• Crop Management Software
• Biogas Plant Monitoring System
• Renewable Energy Monitoring and Control System
• Career Development Management Software
• Speech Recognition System for an Effective Tutoring Mechanism
• Online Teaching Systems
• Real-time Traffic Information System
• Computer Human Interaction System for Skill Development
• Water Management System

Collaborating Departments: Center for Wireless Networks and Applications, Center for Computer Human Interactions and Applications, Center for Educational Research, Center for Cyber Security, Department of Electronics and Communication Engineering, Department of Electrical Engineering, and Department of Instrumental Engineering