

CAPACITY BUILDING FOR THE EFFECTIVE ADOPTION OF RENEWABLE ENERGY TECHNOLOGIES IN RURAL AREAS- EXPERIENCE OF INDIA NGOS¹

By

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I. PROLOGUE

- 1 The rapid industrialization and economic growth in several developing countries has placed a heavy demand on the use of energy. The rapid privatization in some of these countries is getting linked-with generation of more energy in an unsustainable manner, which is resulting in throwing up new problems related to environmental and social aspects. On the other hand there are 2 billion people (1/3rd of the world population) who presently have no access to electricity, majority of them are living in villages as well as remote and inaccessible regions of the world. Yet another very large group of people (especially in rural areas) have only limited quantity and lesser hours of supply of electrical power, to meet their entire energy requirements. Both these groups (unserved and under-served) not only require un-interrupted energy & power supply from environmentally friendly, renewable resources but also quality energy services at an affordable cost and sustainable basis to meet their regular energy needs. At the same time, additional power would also be required to meet the growing demand of those groups who are already being served well at the present level of consumption.
2. The experience of Indian NGOs involved in rural energy programme for over 2 decades has shown that the centralized generation of power from large power plants (whether Hydro, Thermal and even Renewable Energy based electrical power generation, e.g., from the large Wind Turbine farms in the coastal belts of India connected with large grids) has not been able to meet the needs of rural people, especially the rural poor.
3. The Renewable Energy (RE) promise for meeting the energy and electrical power needs in a decentralized manner, provides scope for meeting new and emerging challenges in respect of the people-centered, sustainable human development with distributive justice, while protecting the environment as well as the rich socio-cultural diversity of the large humanity living across the globe. In spite of this, the large-scale applications and adoption of RE options by local people has been very, very slow. At the same time, to meet the needs of unserved and underserved people, especially in the rural and far-flung areas of the developing countries, it is apparent that any future development strategy of such regions should be based on biomass, solar, wind, hydro, animate and other sources of renewable energy, to ensure sustainable growth and development of people in these regions.
4. The NGO networks involved in the rural energy based development programme for the last over 2 decades, now recognizes that when ever the issue of poverty alleviation and the improvement in the quality of life of the rural poor is addressed, the sustainable energy should be treated as one of the key inputs for promoting "Sustainable Human Development", provided its application is based on the "people

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centered development” and not just the growth center development- or at least there should be an appropriate combination/mix of both the approach.

II. EXISTING APPROACH FOR THE GENERATION OF ELECTRICAL POWER AND ITS IMPACT

5. Even though it is widely recognized that the human society requires continuous supply of energy, the solution found by the modern man has always been based on the consideration of growth-centered development. Some of the examples are- big hydroelectric and coal based power plants. Looking at the majority of developing countries, especially in India, it is evident from the energy development in the past that it has been based on the centralized energy/power generation, transmitted at great distances from the point of utilization, mainly to urban centres. The majority of power (electricity) generations (especially from the large power generation) units are located in rural areas, closer to where the major raw materials (inputs) for the operation of these plants are available. One of the main concerns of NGOs involved in the rural energy programmes is that, in spite of this the benefit of electricity power generation has mainly gone to the urban centres, whereas the people living around the power generation centres had to face and still face the negative impacts due to air, water and soil pollution, degradation of productive agricultural lands and health hazards as well as displacement & rehabilitation problems.

III. ENERGY AND POWER SUPPLY SITUATION IN THE RURAL AREAS OF THE COUNTRY

6. The centralized power generation in India transmitted through the high-tension power transmission lines going across the rural areas and several times through the farmers' field but most often the benefit never reaches the villagers, as it is used mainly for the benefit of urban centers and industries. Even if the electricity connections are given to the rural people, either the power supply is erratic or it is not available when it is required the most or the voltage is too low. Thus one can see that in terms of using commercial energy from centralized grids, there is a great disparity between urban and rural areas within the country itself.
7. The bio energy (cattle manure, crop wastes etc.) is the main source of cooking in the developing countries, including India. Those peasants, who have biogas plants, may also use it for lighting purposes (if electricity supply is not there or kerosene is not easily available). The locally generated biomass play very important role in meeting the cooking fuel need of the villagers- the biomass is usually collected (in the form of harvested crop stems and crop residues) and stored by the villagers at the time of harvesting of crops for personal use and also given to landless agricultural labourers used by them for harvesting and threshing of crop in the season. Thus it is clear that the major share of the rural energy demand are at present met by the natural renewable sources which would continue to play the important role in meeting their energy needs, therefore its efficient use has to be looked in very critically. Rural people who can't afford biogas plants depend upon kerosene for lighting, which apart from short supply and drain on the limited foreign currency, are also difficult to get in remote regions and are becoming expensive by the day as well contribute to GHGs, and hence not environmentally sound option.

IV. IMPORTANT FACTORS FOR THE WIDER ACCEPTABILITY OF RETS IN RURAL AREAS IN INDIA

8. The primary interest of people (End Users) in the rural India is the availability of sustainable energy which is affordable, efficient and backed by quality & reliable back-up service, which could be provided to them on-demand at their door step. The urban population is able to get these energy services, especially in the case of electricity, at comparatively affordable and more or less continuous basis. The large rural population

depending for centuries on the locally available traditional sources of fuels, though interested in convenient and efficient energy to improve their quality of life, would normally not like to be bothered from where and how these services are available to them, so long as they are affordable, of better quality, reliable and regular in supply. This would require innovative approach and change in strategy for the promotion of sustainable development & growth, keeping in mind the need for maintaining or improving the natural eco-system for future generation.

9. The renewable energy technological options such as biogas, smokeless biomass stoves and improved wood stoves, solar cookers, fuel wood and to a limited extent the solar PV system are being promoted for more than two decades now in India. Out of these, India took a big leap forward in the systematic promotion of two most appropriate rural based technologies, namely, biogas and smokeless biomass stoves etc.
10. However, several of these of RETs (e.g. Solar Cookers, PV systems etc.) had been/ are promoted in rural areas of India in the following manners, with out fully understanding the socio-economic aspects and with lots of promises:
 - a). The majority of RET programmes are being promoted using rural areas as a market without realizing that they are still too costly and the rural people have other priorities for using their limited earnings. Even if RET programmes (such as PV, biomass gasifiers etc.) are now getting linked to credit programmes; no systematic field level studies of implemented projects are conducted to ascertain their repaying capacity.
 - b). The RETs are often promoted in rural areas by manufactures telling them that these technologies are fool-proof, once they are bought no repair & maintenance are required for the life of the product- e.g. solar PV panels for pumping water and solar lighting.
 - c). Certain RET gadgets like Solar Cookers were initially promoted, backed by heavy subsidies with the promise to solve all the cooking problems with out much supervision, care and maintenance. After selling their RET products in rural areas, the manufacturers did not educate the people, could not provide back-up support and supply even simple spare parts and apart from operational problems due to quality resulting in to low efficiency, e.g. solar PV lamps; and in case of solar cooker, the promise of reaching the required temperature for cooking major meals all the year round cooking of all the meals, could not match the reality.
11. Some of the example mentioned above could easily demonstrate that instead of treating rural areas solely as market place for RETs, use the RE programmes to empower people and community, by village infrastructure development, creating employment and strengthening village economy by starting ancillaries units, capacity building of local people, training of unemployed rural youth for taking up maintenance, repairs & servicing, as well as integrating RE promotion with other development programmes so that it could become sustainable.
- V. EXPERIENCE OF AN NGO NETWORK IN CAPACITY BUILDING FOR PROMOTION & IMPLEMENTATION OF HOUSEHOLD BIOGAS PLANTS AND OTHER RENEWABLE ENERGY TECHNOLOGY IN INDIAN
12. The systematic development and promotion of biogas technology programme is over 60 years old in India. The first scientific development of family size (household) biogas units was initiated by IARI (Indian Agricultural Research Institute), New Delhi in 1939, and the first field worthy household (Hh) model with floating steel gas holder was developed by KVIC (Khadi and Village Industries Commission), Bombay in 1956. The

demonstration and limited extension phase of Hh biogas plants was first initiated in India by KVIC, using their floating steel gas holder model, in 1960. However, the implementation of Hh plant got impetus in India, only after the Ministry of Non-Conventional Sources of Energy (MNES- earlier known as DNES), Govt. of India, launched a centrally sponsored scheme, known as National Project on Biogas Development (NPBD), in 1981-82, to give a massive thrust for achieving a big target, country wise, using a decentralized implementation strategy and a Multi-Model and Multi-Agency approach adopted under the NPBD (National Project on Biogas Development), India has been able to achieve massive target of 3 million household (Hh) biogas plants, which has also ensured wider coverage throughout the country. Though it is still a drop in the ocean when considering the total potential of over 15 million Hh biogas plants (BGPs). The contribution of NGO network (since the inception of NPBD), who later on formed INSEDA in 1995, as their national registered association, played a very important role in the promotion, technology transfer, capacity building and systematic extension of Hh plants in the rural areas of the country, under the NPBD.

13. This NGOs network of over 60 INSEDA members operating across the length and breadth of the country, has built over 125,000 biogas units and till date and trained a large number of field functionaries, rural artisans and end users been providing regular back-up services to plant owners. In the process of implementation of biogas programme, the members of INSEDA Network have also built-up and strengthen infrastructure at the grassroots level to implement other low cost RETs, like smokeless cook stoves, and now gearing-up to provide services and capacity buildings in other appropriate RETs (e.g. simple PV systems, micro-hydro and small scale biomass briquettes and gasifiers, as well as small scale decentralized electrical generation from biogas units) for rural applications.
14. In the backdrop of above, the development and promotion of low cost, household biogas plant by an NGO network in India and the lessons learned to empower the rural people and the community is of great significance. The role played by the NGOs in the capacity building in appropriate rural energy technologies, with specific reference to household biogas plants and the lessons learned are summarised below:

VI. CAPACITY BUILDING FOR THE PROMOTION OF HOUSEHOLD BIOGAS PROGRAMME IN INDIA

15. The NGO network of INSEDA which had been involved in the extension of household biogas plant for over 2 decade, apart from building of demonstration plants in new areas, under took systematic capacity building programme as part of the implementation strategy, which paid richly, and now have built over 125,000 units, under the national project on biogas development (NPBD) of the Ministry of Non-conventional Energy Sources (MNES), Govt. of India. The NGO network have been the active partners in the NPBD since its inception in 1981-82, and played an important role in the capacity building activities of all the possible actors involved in Hh biogas units.
16. Based on the two decades of experience of INSEDA members in biogas promotion, the various actors involved in this programme could be categorised three groups. They are- (1) ENERGY PRODUCERS, (2) ENERGY SERVICE PROVIDERS and the (3) ENERGY END USERS. In some cases the (1) and (2) could be the same and in some cases (1) and (3) could be the same. All these groups required appropriate capacity building in order to ensure effective coverage of and success of biogas energy programme. The capacity building programme undertaken by NGO network for the key actors during the last two decades are described in the subsequent paragraphs:

17. BIOGAS ENERGY SERVICE PROVIDERSa). NGOs Functionaries and Local Artisans:

- (i) For the systematic promotion and extension of biogas units, depending on the number of district covered with in the States, type of services and the size of operations, some of the key personnel appointed by the NGOs members of the network were Project Directors, Extension Managers, Technical Officers/Junior Engineers, Supervisors/Motivators, Technicians/Master Masons.
- (ii) Majority of these NGOs operated in one district for biogas implementation, and had bi and large a combination of at least three staff on their regular roll- namely (1) Biogas Extension Manager, (2) Biogas Supervisor and (3) Biogas Master Mason. Funds for appointing a team of these three staff came form a common programme of the biogas network, funded by an overseas funding agency for 10 years (divided in to two project phases of approximately 5 years each), through a nodal national NGO. The Chief Functionary of the respective NGOs normally performed the role of Hon. Project Director. As the biogas programme got evolved, gradually, some of the NGOs pushed the programme at a very faster pace, making it as one of their major activities. Such NGOs with much wider spread prepared separate projects to secure additional funds for keeping additional staff for efficient operation of large area coverage.
- (iii) Apart from this, there was a provision in the NPBD to give service charges to the recognized biogas service providers on pro rata basis (commonly referred as turn key fees). In the initial years the turnkey fees was 250 Indian Rupee (IRP)/Biogas plants (BGP) constructed and commissioned, which has now been increased to 500 IRP/BGP. The recognised NGOs who qualify to get this turn-key fees under NPBD, are also supposed to give guarantee to plant owners for three years period against defective construction and provide free post-plant installation services repair & service and free construction of a new BGP in the event of major structural and construction defects.
- (iv) Brief description of capacity building programme for different levels of functionaries of NGOs involved in the implementation of household biogas programmes in rural India under the NPBD are given as under:

Workshop/Seminar for Chief Functionaries (CF)/Project Directors (PD):

- Three days duration annual workshops/seminars were organized for CFs/PDs during the programme period. The period was utilized for in-house discussions on the achievements against the annual target of each NGO set by them self in the last annual workshop and agreed by the network as a group. The workshops were held in a participatory manner, with the objective of learning from the field experience of each other. The group also addressed to some of the individual problems, which were location specific, as well as discussions on some of the common problems, e.g. subsidies, turnkey fees, bank loans, and their timely release, relationship with the state level Nodal Agencies and networking with other biogas service providers in the block, district, states and regions (2-3 states) etc. During this period some of the technical matters were also discussed and clarified by the specialists /experts and some of the new RETS (or new ideas for new

RETs, including new biogas plant designs or improvements in existing designs). The participants also got the opportunity to discuss the new policy directives of the National Nodal Ministry about the biogas development programme, and its negative and positive impact and decide on the appropriate strategy(ies) for dialogue with the state level Nodal Agency(ies) based on local realities. The most important aspect of these workshops was the field visits to the BGPs constructed by the NGO hosting the workshop, where apart from participatory critical appraisal & monitoring of the host NGO's programme, the participants also learnt new things by interacting with the plant owners. These workshops contributed a lot to the capacity building process of the participants (senior and top management staff of NGOs) by enabling them to learn new and practical ideas for them to implement in their own situations as well as to give practical tips to the CF/PD of the host NGO from their own experience, thus helping each other for making qualitative improvements in their biogas extension programme, by keeping abreast with the latest information. The last part of the programme of these workshops had been to draw-up and present the Action Plan by each NGO for the coming year for discussions and endorsement by the house as well as, deciding on the venue of the next annual workshop. With the MNES recognizing many other national, regional and state level competent NGOs as biogas Nodal agencies; this role is being performed by them.

Capacity Building of Biogas Extension Managers (BEM)/Coordinators:

- Normally those NGOs who operate Biogas Extensions Centers (BECs) in more than one district in a state and have larger targets, appoint a regular Biogas Extension Managers (BEM) for the effective management of their biogas implementation programme. If they operate only in one district and have comparatively lesser targets then they employ one Biogas Coordinator (BC). The Biogas Extension Managers (BEM)/ Biogas Coordinators (BC) are one of the key personnel for the success of NGOs household biogas programme in rural areas.
- A one-week duration training programme was designed for especially up grading the knowledge of this group (BEM/BC) of functionaries. In the initial years of biogas implementations, one such programme was conducted each year. This one-week programme was meant for upgrading the basic knowledge about the low cost biogas technology for rural applications. Where ever possible exposure was given to the practical construction techniques and the explaining of finer and key points for building biogas plants, selection of appropriate beneficiaries, plant size and plant site, building materials, evaluation of capabilities of biogas technicians and master masons, testing of new biogas plants for leakage, initial and regular feeding of plants, commissioning of gas, utilization of biogas gas and biogas digested slurry (manure) and it's composting as well as general care, maintenance and repair aspects. The training also covered different designs and models of household biogas plants, their merits and demerits, and simple design of biogas projects, management, financial and reporting aspects, collection and monitoring of socio-technical information about the plant owners as per designed format for reporting to nodal government agencies as well as donors, filling of applications for bank loans, forms for government subsidies etc.

Capacity Building of Technical Officers (TO)/Junior Engineers (JE):

- As the biogas started becoming popular in rural areas of the country, more demand started getting created; due to this several NGOs expanded their programme to meet the growing demand. Thus the need was felt by NGOs to attend to more technical issues, independently, rather than depending on a single national level technical service NGO. Thus these NGOs started hiring technically qualified staff. Based on the need for the capacity building of these technical people, a special training programme of one-week duration was designed and launched. This programme covered the designs of popular Indian household models, design principles, design calculations key factors in designs, design for different agro-climatic conditions, merits & demerits of different designs, and how to design different types of simple digesters. They were also taught about the correct selection of building materials, plant sites, plant capacity (for size of families and availability of quantity of feed materials), quantity required to be fed when the plant (which were essentially designed for operating on bovine manure) was to be used for other domestic animal manures and human wastes (excreta) for biogas production. The curriculum also included, reading of and correct interpretation of dimensional drawings, correct construction techniques, identifications of technical in biogas plants (design and construction), testing of plants, different methods of repairs and sealing of gas leakages from the plants, initial loading of plants, and testing and commissioning of gas, emptying, cleaning, checking and reloading of plants. In addition they were also taught about how to build these household plants under special field conditions, e.g. high water table and black cotton soil etc. and precautions in construction and operations.

Capacity Building of Technical Supervisors (TS)/ Sr. Technicians (ST):

- Normally NGOs employ one technical supervisor (TS)/sr. technician (ST) per block, to effectively cover 40-50 KM radius from the base- a block may have 80-100 villages. A person appointed as TS had to have at least 1 year of formal training in technical certificate course. Where as an ST would normally selected by NGOs out of the systematically trained Master Masons having long practical experience of constructing and supervising biogas plant construction, who had some informal training in reading and writing with strong technical aptitude and supervisory quality. The capacity of Technical Supervisor (TS)/Senior Technician (ST) were strengthened and periodically upgraded through these programme. After participating in these trainings the TS/ST would be able to effectively conduct village level surveys to ascertain the potential of household biogas plants, undertake motivation and awareness programme for the prospective plant owners (on one to one basis) and also conduct periodic motivational and awareness camps for group of rural people, explaining the benefits of biogas plants. They would also assist the prospective plant owners in correct filling of application forms for plant construction and also assisting them in filling loan applications (if they want to finance the plant through banks) and submitting the application either directly to the local branch of the bank or alternatively sending to the Biogas Extension Managers (BEM) at the NGO's Biogas Extension Center (BEC) for checking and submitting to the banks. Except the design related aspects of the biogas plants (which are part of the training programme of only the Technical Officers/Junior Engineers), the TSs/STs were also given training on all the other technical aspects of household plants (but to a lesser degrees, as compared to TOs/JEs). The first training of TSs/STs would normally be of 3-4 weeks duration on the constructional aspects

of household biogas plants along with the master masons. During this period they were exposed to hands-on experience of building plants from scratch along with the master masons (MMs). This helped them to build their confidence in supervising construction of plants by local master masons. During this period they were also taught about reading the drawings, the locating faults in the plants if any, testing for digester slurry and biogas leakage and rectifying the fault or repair the plants. They were also trained in appropriate selection of pipes and correct laying of biogas pipelines, accessories and biogas appliances, construction of compost pits attached with biogas plants, feeding and commissioning of plants as well as utilization of biogas for different applications and the digested manure for crop production. Later on they were normally given one-week durations once in a year or in two years in groups as well as provided in-house periodic training for up-gradation of their skills and knowledge.

Capacity Building of Master Masons/Artisans (MM/As):

- The NGOs network had been mainly promoting and building fixed dome household plants, constructed from bricks and cement mortars. Therefore the master masons (MMs) played a very important role in the success of this technology. The rural masons in India normally come from the families of bricklayers whose ancestral profession is masonry for generations and live in villages. They can do the construction of traditional rural houses and simple building structures, but lack the necessary skills to build a civil structure that would be gas-leak-proof. Since the fixed dome biogas technology requires special skills for either making a cylindrical structure with an air-tight dome cover or an ellipsoidal shaped plant without form-work and build air-tight, therefore require special kinds of skills training. For this purpose a three-week duration, brick-by-brick construction training was designed for this group of rural artisans. The construction trainings by NGOs were conducted (at the farmers' sites) by the technical expert with the assistance of an experienced Technical Supervisor or a Senior Technician. During each training 10-15 masons were trained by them constructing 2-4 biogas plants of different capacities for the cooperating farmers (who contribute for family labour and the material cost), who would use them, therefore had to be foolproof construction. The NGO network trained over 6,000 rural masons during the initial period of the programme; out of this about 30% were categorised as MASTER MASONS, who could build fixed dome plants independently. The balance of trained masons were expected to work under the guidance and supervision of master masons for some time, till they developed enough skills & confidence to build plants independently. Most of the NGOs involved in the biogas extension programme kept at least one master mason on their regular rolls, and hired the trained local masons as and when the need arose. Several of the trained master masons who could not be provided regular appointment by the NGOs and other agencies also motivated rural people on their own and directly contacted the prospective plant owners to build plants for them.

Capacity Building of Technical Supervisors (TS)/Sr. Technicians (STs) and Master Masons (MM) on for Repairs of Household Biogas Plants:

- During the earlier stages of implementation of National Project on Biogas Development (NPBD) of MNES (earlier DNES), Govt. of India, which was launched in 1981-82, a large number of plants failed (about 20%) due to faulty implementation, as due to meeting the annual plant targets and too much emphasis on achieving/chasing the targets, without employing

systematically trained personnel, as adequate number of appropriately trained technicians and Master masons were still not available every where, with the field and extension organisations. However, after the initial period of five years when a large number of technicians, supervisors, engineers and technical officers were trained, backed by the qualitative inputs provided by NGOs in the systematic implementation of this programme, using developmental oriented extension approach, things started improving. During this period the need was first felt by NGO Network to design a special training programme for training of TS, STs and MM on the repairing of the faulty fixed dome biogas plants.

- Thus one-week duration programme was designed to give hands-on training to Technical Supervisors, Sr. Technicians and experienced Master Masons on identification of design as well as construction faults, testing for checking leakages of slurry and biogas from the plant and then undertaking appropriate repairs to rectify the faults. The faulty plants were selected in advance by the experienced trainer, close to the venue of the training. The plant selected for repair trainings had to be constructed more or less as per the standard design by a trained master mason, to ensure that there are no major design and structural defects/faults, other wise the entire plant would have to be dismantled and new plants would have to be built, which would require 3-4 weeks, which could normally be done by a team of very skilled and experienced trained supervisor and master masons.

Refreshers Training for Different Energy Service Provider Groups:

- The experience of biogas implementation showed that each group of ENERGY SERVICE PROVIDER FUNCTIONARIES required to upgrade and update their skills and knowledge to remain relevant and effective, therefore, when ever required, either they were invited for refreshing their existing skills or need based training was designed to meet the requirement of a particular group. This made the qualitative improvement in the biogas implementation programme.

Capacity building of Biogas Technicians/Master Masons as Trainers:

- With the increase in demand for biogas, the pressure on the existing master masons grew several folds, both from the local government agencies as well as the other biogas service providers. Most of the technicians and masons were good in constructing or supervising construction of biogas plants, but lacked the skill in training other masons. Thus several Technicians and Master Masons Training programmes were launched by NGOs. The duration of these training programmes were of two-three week duration, where apart from they getting involved in the construction of biogas plants, were also taught to conduct classes, first in the class-room then at the plant site of the farmers. Each evening they would also review the day's training with the facilitator/trainer and also learn to use construction slides, construction manual and cut model of plants to train other masons. They were also told about some of the finer points, which they would have to explain to their trainee masons, while conducting programmes in their respective projects.

Training of Trainers (TOTs)

- After the biogas programme picked up then need was felt by the members of the NGO network to take up capacity building programme of other NGOs in their respective regions. Thus a special Training of Trainers (TOTs) programme was launched. The duration of these trainings were of one week, meant for Biogas Extension Managers and

Technical Officers. Apart from review of their knowledge (theoretical and practical) in a participatory manner, under the guidance of a team of experienced training facilitators, they learnt to use the various teaching aids and slides on the constructional & operational aspects of biogas plants and how to conduct effective training. After the training they were given the appropriate training materials to be used by them for training in their respective programmes.

Special Training Programmes for NGO Functionaries:

- Apart from the above-mentioned regular capacity building programmes of the different biogas Energy Service Provider, a few special training programmes were designed and conducted, based on the need to upgrade skills and knowledge to effectively implement and manage the biogas programmes. Some of the trainings planned, designed and organized for NGO functionaries were- all aspects of (i) Night soil biogas plants, and (ii) Community biogas plants, as well as (iii) Management programmes for Chief Functionaries/Project Directors.

b). BIOGAS ENERGY PRODUCERS-CUM-END USERS (PRODUCERS-CUM-CONSUMERS)

- (i) The NGOs recognised that the Energy Producers-cum-End Users were the primary stakeholders of the household biogas programme. As apart from being the END USERS, they were also the producers of biogas energy. The prospective PLANT OWNERS, as the ENERGY PRODUCERS-CUM-END USERS had to invest certain amount of their own capital for building plants and after that to operate them on regular basis.
- (ii) Because of their long developmental experience, the NGOs, instead of treating the biogas as a consumer product, recognized it as one of the important tools, which if implemented properly, could contribute to their empowerment, more especially the rural women. Due to this, the NGOs followed an extension approach (rather than market oriented approach) backed by awareness, motivation and educational programme with patience, which lead to its successful dissemination, acceptance and adoption by the rural masses.
- (iii) Accordingly the following capacity building programmes were planned, designed and undertaken by the NGOs for the BIOGAS ENERGY PRODUCER-CUM-END USERS:

Awareness-cum-Motivational Camps:

- A number of such camps were organized by NGOs in villages for explaining about the benefits of biogas technologies, supported with slide shows and distribution of simple leaflets on household biogas plants. During these camps the villagers were told about the comparative advantages of recycling their bovine manure through a biogas plants. They also got the opportunity to clarify their doubts and got information about the various financial incentives under the National Project on Biogas development (NPBD), as well as the availability of technical assistance from NGOs to build their plants.

Special Capacity Building programmes for Women Users:

- Rural women are the main beneficiaries of the energy from the biogas plants. They are the ones who collect the bovine manure daily and after mixing it with equal quantity of water, feed the manure slurry in the plants, and use the biogas for cooking. If the plant doesn't work properly or stop working at all, even due to minor problems either in the pipeline

or accessories or the biogas stoves, it is the women end users who are affected the most. In view of this, regular training camps of one-day duration each were organised for them by NGOs. During these camps the WOMEN END USERS were first given practical demonstration on- proper adjustment of flames to give maximum energy, how to cook to conserve the biogas, cleaning of burners of the biogas stove to enhance its efficiency, checking of gate valves on the plant's dome for leakage of gas, proper adjustment of biogas stove valves to get the right mixture of air and biogas to get blue flame while burning, removing the condensed water from the pipe line when the biogas flames would flutter, and the efficient way of cooking of different types/kinds of meals on biogas stoves. In the next step, the women end users were asked to practice what was demonstrated so that they could get the feel of it. By having periodic camps for this group, the women end users eventually developed confidence to perform this minor yet important task themselves.

Operational-cum-Care and Maintenance Camps for End Users:

- Normally after the commissioning of each biogas plants, the owners were given training on the proper feeding, biogas & slurry utilization, and the care & maintenance aspects of their plants, accessories and appliances. But after a number of biogas plants were built in a given area, regular one-day duration operational-cum-care and maintenance camps were organised by NGOs.

Camps for Demonstrations on Utilisation of Biogas Digested:

- Even though all the plant owners were told about the benefits of biogas digested slurry, and need for proper composting to get maximum advantages of the biogas system, yet during the follow-up visits and post-plant installation survey, it was discovered that the farmers were not able to make best use of the digested slurry. In view of this the NGOs decided to organize demonstration-cum-training camps, twice in a year, once in each season, to teach them the correct use of digested slurry either directly or by using it for composting along with other biomass available from local seasonal crops during the different seasons. The new plants owners were also shown the comparative growth of standing crops of existing plant owners who had been using their biogas manure for crop production. This created good impact.

VII. LESSONS LEARNED FROM THE TWO DECADE OF CAPACITY BUILDING AND IMPLEMENTATION OF RENEWABLE ENERGY PROGRAMME BY NGO NETWORK IN RURAL AREAS OF INDIA

18. Following are some of the lessons learned, based on the experience of NGO network INSEDA members in the promotion of biogas and other renewable energy technologies (RETs), for over two decades in rural areas, in which the capacity building of Energy Service providers and the Energy End Users, which could be useful in the promotion and implementation of any RETs in rural and far-flung and areas of the developing countries:

- a). The RETs are new & aliens to the rural people, as they are developed outside the rural environment, therefore would be first viewed with skepticism by the villagers.
- b). Any new RE technology selected for promotion should be fully matured before it is transferred, demonstration, and promoted for rural applications.
- c). In the initial stages of demonstration of RETs in rural areas of the developing countries, failure of even one unit could create negative impact in villages, within a radius of 20-30 KMs and its short-comings would be spread like a

