

**DIFFUSION OF IMPROVED CHULHA
TECHNOLOGY: STRATEGIES AND POLICIES**

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ABSTRACT

The National Project on Improved Chulhas has been taken up by the Department of Non-Conventional Energy Sources with a view to reducing deforestation and meeting the cooking energy crisis particularly in the rural areas. The Project is designed as a programme for women for mitigating their drudgery and health hazards and also saving precious fuel in the bargain. The project also provides local employment opportunities for the persons who will be involved in construction and maintenance of the chulha.

India is known for unity in diversity. The diversity exists in every walk of life, right from cultural habits to languages. 'Food habits' are no exception. We find differences in tastes, foods, cooking habits etc. In this context, it is necessary to have different chulhas according to different needs. Various designs of chulhas have been approved by the DNES having thermal efficiency above 20%. Under the project, which has a multi-model and multi-agency approach, several models of improved chulhas, both fixed and portable type, which have been approved by the DNES, are being demonstrated and installed all over the country through the Nodal agencies/Departments identified by the State Governments.

The improved chula programme has established itself as a symbol of scientific and technological development reaching even the poorest household in the country.

1.0. INTRODUCTION

Technology development in improved chulhas was virtually absent till the 1950s. Thus, the history of organised improved chulhas movement is fairly recent. The early developments, spurred by Gandhian philosophy and practice, were primarily focussed on lowering smoke emissions. But, these attempts slowly petered out probably because of the relatively inadequate engineering inputs and dissemination efforts.

India is one of the developing countries where improved chulha programmes are being conducted. Department of Non-Conventional Energy Sources (DNES) became actively involved in Improved Chulha Programme. In 1983, National Project on Demonstration of Improved Chulhas (NPDIC) began. In 1986, this project was graduated into National Project on Improved models of Chulhas (NPIC) for mass scale diffusion all over the country. The project was designed as a programme for women, by women and was aimed at "helping solve the cooking energy crisis". In the Seventh Five Year Plan NPIC became the regular project of Department of Non-Conventional Energy Sources (DNES), with appropriate financial and infrastructural support. During the demonstration period of the National Programme on Improved Chulha (December 1983- March 1985) over 8 lakh chulhas were installed. In the first two years of the Seventh Five Year Plan, more than 20 lakh chulhas have been installed. The total number of chulhas installed by the end of 1988-89 was more than 40 lakhs.

1. Ministry of Energy - Department of Non-Conventional Energy Sources. Annual Report 1987-88.

1.1 Improved chulha is a nation-wide programme, being implemented by State Governments, State nodal agencies and Non-governmental organisations (NGOs). There are many back up units set up in different parts of the country. These technical back-up units work hand in hand with the implementing agencies. The Technical back-up units are involved in training, refresher training, technical services, evaluation analysis, field testing, feed-back and monitoring in addition to research and development work. There are many government and non-government organisations involved in this programme. Department of Non-Conventional Energy Sources (DNES) is the apex administrative body to implement and monitor National Project on Improved Chulhas (NPIC) at the Central Government level. However, at the State level, either a regular development department or a specially organised exclusive nodal agency is entrusted with the responsibility for implementing NPIC. It is interesting to note that from the very beginning of the programme, a policy decision was taken that NPIC implementation could best be achieved through NGOs. As a result, NGOs are largely responsible in implementing the programme in the field. Fixed chulhas are made in the beneficiaries kitchens by trained workers/craft persons. First the master craft-persons are trained by the technical back-up units set up in various parts of the country. These master craft-persons, in turn, go to the districts, blocks and villages, select and train local chulha workers for ten days and then these trained workers make chulhas.

1.2 The material for construction of chulhas, like mud, clay, straw, bricks etc. and labour are provided by the beneficiary

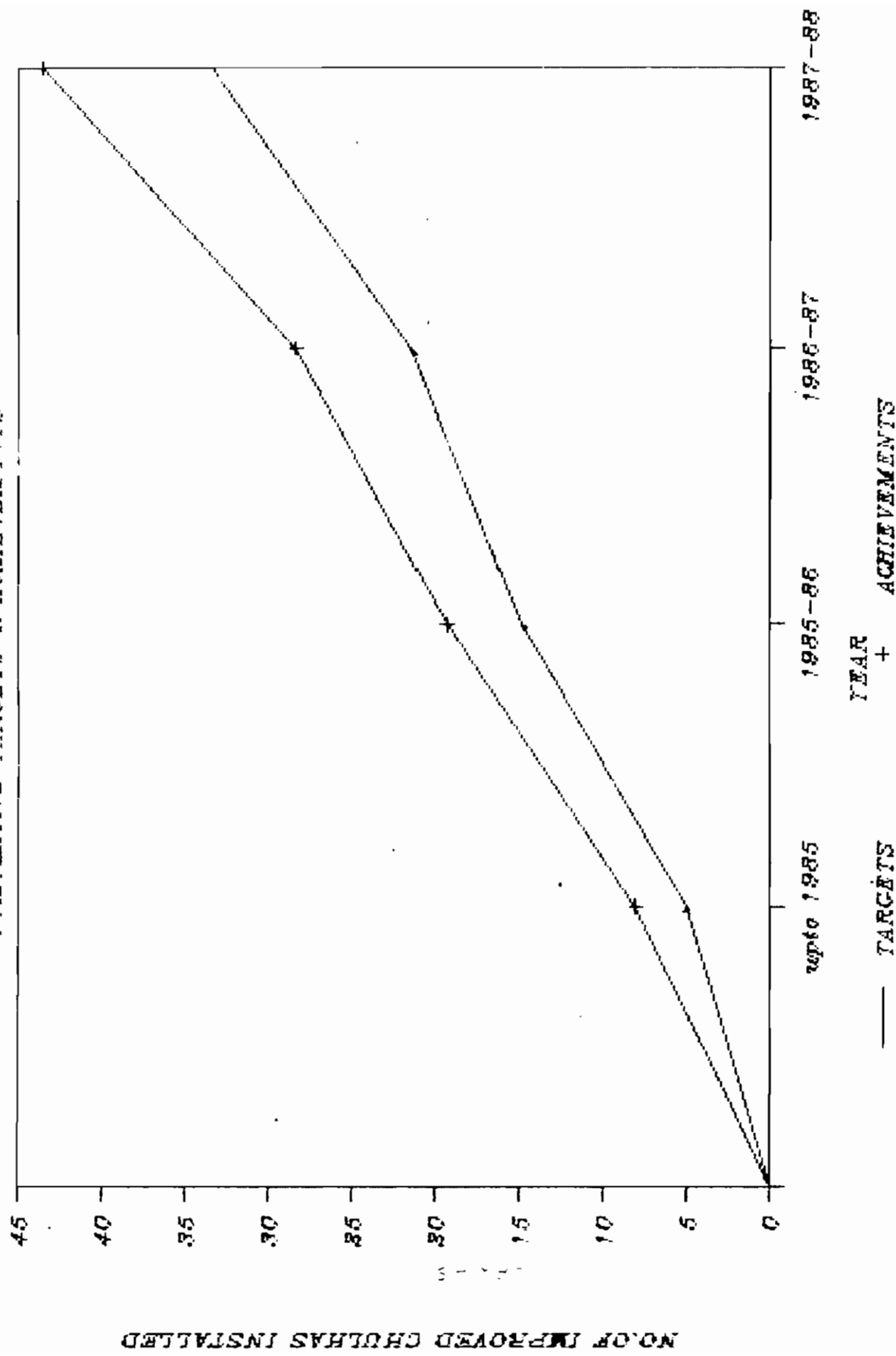
households. Chimney, coal and other accessories are arranged by the implementing agencies. Average per unit cost of fixed chulha is Rs. 40/- to Rs. 50/-. The beneficiary has to contribute Rs. 10/- (Rs. 5/- towards the hardware cost i.e. chimney, coal etc. + Rs.5/- for installation/supervision charges). There are also provisions for free chulha installation for poorer section of the rural population. Physical and financial targets are fixed for implementing agencies according to their area of operation and past performances. Achievements of each of the agencies are reviewed in the middle of the year by DNES and State level implementing agency and targets are re-adjusted according to performance and demand. Additional targets, if allocated after the review. Out of the total target minimum of 15 % and 7.5% are to be installed in the scheduled castes and scheduled tribes houses respectively. Hilly areas are also given priority for chulha installations. (See Table 1).

Table 1 : Year-wise Targets and Achievements

Period/Year	No. in Lakhs ('00000)	
	Target	Achievement
December, 1983 to March, 1985 (Demonstration Period)	5.00	8.12
1985-86	10.00	11.22
1986-87	6.50	9.05
1987-88	12.00	15.17

NATIONAL PROGRAMME ON IMPROVED CHULHAS

CUMULATIVE TARGETS & ACHIEVEMENTS



2.0 STAGES IN THE ADOPTION PROCESS :

The adoption process is characterised by five well-known stages: awareness, interest, evaluation, trial and adoption. NPIC aims to promote more energy efficient cooking chulhas in the domestic front in India to economise fuelwood use. It is noted that individual or group users usually have the following stages of acceptance:

Awareness : Information delivery system (mass-media, extension agents, demonstration trials etc.) play important role in making the prospective user aware of the new technology. But it should be noted that the awareness created due to exposure to these media do not necessarily lead to active interest.

Interest : Most of the improved chulha adopters were found to be really interested in the technology through personal contacts. This personal contact could be Mukhya Sevika, Social Worker, Govt. officials, local NGOs etc. This person-to-person contact plays a major role in creating an awareness and arouses active interest in village people to adopt improved chulha. Once the active interest is aroused, most of the adopters were found to actively seek detailed information from various credible sources concerned government agencies/officials and NGOs at the local level. Seeing the neighbours using improved chulas also helps considerably. At this point demonstration and trial plays an important role in the adoption stages.

Evaluation and Trial : Once the potential adopter has obtained all the relevant information, he usually passes through a stage of evaluation and trial, in which all the important information observed or obtained is critically examined. Food habits, cooking

habits, types of fuelwood used, utensils used, and various social and cultural differences determine the choice of model to be adopted and whether or not minor changes are required to meet local needs.

Adoption : It was observed that 80 % of the people who passed through the evaluation and trial stages, ultimately adopted the technology. The reasons for adopting chulhas varied from person to person. The main factors for adopting an improved chulha are 'quick cooking', less fuel consumption, and inbuilt smoke chamber, keeping the kitchen smokeless. Due to various reasons, about 30 % to 40 % of the initial adopters were found to discontinue the use of chulha either full time or part time. The reasons being excessive fuel consumption, major repairs required like chulhas broken due to leakage of rain water , badly built and incomplete chulhas and sometimes the large diameter of the chimney gave out sparks frightening people. This means that of the total number of potential adopters, who pass through the stages of trial and evaluation, only 50% were found to adopt chulha for continued use.

2.1 Factors Influencing the Diffusion Process

There are generally three main factor influencing the diffusion process. These are as follows :

2.1.1 Individual differences

People's penchant for trying out new technologies differ markedly irrespective of socio - economic differences. Based on the data of some evaluation studies, the adopters could be broadly classified into the following categories depending on the time gap

between awareness and decision to adopt on the one hand and continued full time chulha use on the other.

Table 2 : Improved Chulha Adopter Categories

Categories	% of adopters
Innovators	0.4
Early adopters	15.0
Early majority	25.0
Late majority	30.0
Laggard	29.6

2.1.2. Role of Personal Influence

Personal Influence is person-to-person communication between a potential beneficiary and a communicator of the new technology. It plays a crucially important role in the adoption of any new technologies. In all the evaluation studies, it was consistently observed that friends/relatives, the local development officials, the field supervisors, the trained mistries and the local NGOs were the most influential personal sources of information. However, during evaluation/trial and adoption stages, contact with the local implementing agencies (local NGOs) and seeing a neighbour using chulha is extremely important information inputs.

2.1.3 Influence of Technology Characteristics on the Rate of Adoption

Every technology has its own inherent characteristics which affect the rate of adoption. Five characteristics seem to have

an especially important influence in the adoption rate.

a) Relative advantage of Improved Chulhas

- In India, about 200-300 mandays are spent by an average rural family in gathering wood. The improved chulhas means less time spent (25 % to 50 %) on gathering wood or less money spent on fuel.
- The chimney system will mean less smoke in the kitchen, lessening of respiratory problems associated with smoke inhalation.
- The savings in firewood (reported to range from 0 % to 50 %) will mean less cowdung diverted and used as fuel, releasing more available for agriculture.
- The use of local and cheaper materials of construction means little initial costs compared to most other modern kinds of cooking appliances.
- The closed hearth models will mean improved hygiene and safety in the kitchen.
- The securely set pots into the stove means less chances of accidents.
- The multi-pot seats, hence, multi-meal chulha means reduction in cooking time (about 25% to 65%) and more time available for other productive purposes.
- Removal of smoke means cleaner operation and less blackening of the utensils and thus less time and energy spent in cleaning them.
- Larger mass and size of the cooking chulha means that heat retained after cooking may be available for other purposes like baking, or keeping the cooked food warm for a longer period.

- Fire controls mean better cooking operations and convenience. Also the fire requires less attention.
- Use of local skills means potential for new job opportunities to the local people, artisans and women.
- Lastly, but not the least important is the fact that the improved chulha can help overworked and exploited rural women gain a new consciousness. It will make them want to improve their lives and status in society.

b) Compatibility

The compatibility of improved chulha depends on careful matching of the design and specific situational needs or conditions. As mentioned earlier, there are significant variations in India between different regions in cooking and food habits, in types of biomass fuel used and in cooking utensils used. Thus, the compatibility can be achieved only by matching the design with these varying situational factors. This also means that there cannot be any single standardized design of improved chulha for India and therefore the programme cannot aim for mass manufacture of improved chulhas. Given this inherent technological limitations, India's Chulha programme has to evolve and promote of necessity, a number of chulha designs catering broadly to the varying needs of the beneficiaries.

c) Complexity

Compared to the traditional chulha in practice, the improved chulha is certainly more complex. However, except for the difference in cooking procedure recommended by implementing agencies, the technology is very simple in both construction and usage. It should be noted that trained workers like mistris are

required for construction of improved chulha. Improved Chulha technology also requires adopters' proper understanding of its operation i.e., how to use the chimney, fire dampers and the firebox door for space heating. In certain places it is found that users mud wash their chulhas frequently. This results in cooking holes becoming smaller over time which increases fuel consumption.

d) Divisibility

In improved chulha, divisibility is not possible. All the parts of improved chulhas are important as a package so that optimum efficiency can be achieved. However, certain things like length of chimney can vary according to the suitability of the user. Similarly, size of pot holes or number of pot holes can be reduced or increased according to the user needs. In certain areas, there is demand for one holed chulha as people are very poor to cook two items for each meal.

e) Communicability

Some advantages of improved chulhas are clear, the most obvious being the smokelessness. In addition, reduced fuelwood consumption and therefore reduction of gathering time of fuelwood, and reduced cooking time are other advantages. However, except for the advantage of smokelessness, other advantages can be achieved only when the chulhas are properly and optimally used. However, due to negligence or lack of knowledge about optimal operating principles, it is found that the users are often not able to achieve all the advantages to the fullest extent. The operation of improved chulha requires some departures from traditional practices in order to obtain the rated efficiency.

It is necessary, for example, to keep the firebox lid closed and to complete the cooking with the heat stored in the chulhas. The communication of these operational details to the households has been receiving increasing attention. Thus, the actual savings in fuel consumption realised by users do not compare with what is achievable, and the main benefit referred to by most users is the smokelessness of these stoves.

As far as construction of improved chulha is concerned the design has enabled local artisans (usually potters and masons) to fabricate chulhas quite easily. However, the necessity of adhering quite strictly to some crucial dimensions in the fabrication (such as the pan clearances) have yet to be grasped by all the stove builders.

3.0 DIFFUSION APPROACHES

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There are basically three diffusion strategies :

- 1) The 'top-down' strategy in which centralised agencies are entrusted with the task.
- 2) The 'bottom-up' strategy where individual and voluntary initiative is harnessed for the effort, and
- 3) The 'franchising' strategy where the advantages of centralised agencies are coupled to the strengths of entrepreneurship. Indian improved chulha programme, like all other technologies, is a mix of all the three strategies. Improved chulha diffusion strategies use a mix of the five education approaches with varying degrees of emphasis.

3.1 Motivation Approach

In all the big fairs and exhibitions in India, a mobile van with renewable technologies are in show. There are also attempts to include these technologies in primary and secondary education. In certain areas promise of free chulhas is also given. So the motivation naturally becomes high. At the national level, an annual competition is organised among all states and a National Prize is awarded every year after considering both qualitative and quantitative achievements under the project.

This approach has been increasingly used in this programme. The programme is implemented through self-employed workers. These workers are responsible for construction/distribution, maintenance, feed-back, monitoring follow-up and repairs. These trained workers also provide education and training to the beneficiaries by organising user's training camps. Each self-employed worker is engaged on a contract basis and is paid Rs. 10 per fixed chulha. However, for notified far-flung hilly and remote dispersed and north - eastern areas the amount is fixed at Rs. 15/- per fixed chulha. In addition, to the contract amounts, self-employed workers also collect Rs. 5/- per fixed chulha as the supervisory fee from the beneficiary after issuing proper receipt. In case of community chulhas Rs.25/- is charged for this purpose. For repair /modification of chulhas installed prior to April 1988, the self-employed workers are entitled to get Rs. 4.50 per chulha out of which Rs. 4/- is recovered from the beneficiaries directly and Rs. 0.50 from the nodal agencies.

The nodal/implementing agencies organise user's training camps through self-employed workers to educate the beneficiaries

in the proper use of chulhas, its maintenance and repairs. They prepare posters, audio-visual-aids and other publicity materials for this purpose. For this purpose amount not exceeding 4% of the cost of chulhas subject to a maximum of Rs. 1.50 lakhs is provided by the DNES, 3/4th of this amount is utilised for bringing out publicity material, operation and maintenance manuals, preparation of folk songs and puppet shows etc. in respective regional languages.

3.2 Creative Approach

Apart from training camps, workshops and seminars can be organized where free sharing of ideas and experiences occur. Out of five approaches, it is probably the lowest in rank in terms of planned emphasis. Large number of NGOs involved in improved chulha diffusion programme do often use this approach in small discussion groups of the beneficiaries in identifying felt needs within the framework of existing socio-economic condition and development efforts. The control and decision mechanisms remain foreign to the local people. At best local people's interest and needs are intellectualised by the planner and plans that supposedly embrace people's needs are assumed to be "appropriate".

3.3 Analytical Approach

Implementing agencies are holding ten days demonstration camps to motivate and involve the villagers, government functionaries and students etc. This camp helps villagers and potential adopter to understand the technological aspects and real benefits of improved chulha which they can understand more rationally and analytically.

3.4 Planning Approach

A multi-agency approach is adopted for implementation of the National Programme on Improved Chulha. The programme is executed by State Govt./Union Territories (UTs)/State Government Agencies/Housing Bodies/Recognised Autonomous Bodies, Voluntary Organisations etc. The nodal department utilizes the voluntary agencies as much as possible. Presently, about one-fourth of the targets is implemented through voluntary agencies.

This is one of the most important educational approaches used in diffusion strategies. "To see is to believe" is the dictum highly emphasized in this programme. Villagers are encouraged to go to the demonstration/training camps which helps potential adopter to know about all the steps that must be taken to reach a desired goal. Posters, blow-ups and video cassettes of before and after effects of improved chulhas are shown. Because of low literacy level of villagers, planning approach is the best approach.

3.5 Didactic Approach

As a traditional approach, it is close to the version of a 'shot gun approach'. This approach considers that the technology is given and means of inducing users acceptance should be devised. The delivery system as developed in India in terms of implementing organisations, physical and manpower infrastructure is clear indication of the predominance of this approach. For successful implementation of the programme it is considered essential to raise a dependable trained force of workers, named as, "self-employed-workers". The self-employed-workers chulha

(SEW-chulha) work as a direct link between beneficiaries and implementing agencies and are selected as trainees who had successfully undergone the training programme/course. At least one training course is conducted in each district. Trainees are drawn from local potters, masons, artisans, trained persons of Industrial Training Institution (ITI), mahila mandals, local voluntary agencies/ welfare societies, krishak mandals, women's welfare organisations, adult education centres and other interested individual/organisations. Due weightage is given to local potters, masons, ITI trained persons and artisans in the selection. The selection of the trainees is such that 75% are from amongst the categories mentioned above for carrying out implementation, maintenance, repair, monitoring, feed back etc. and 25% trainees are from implementing agencies, like village level workers, gram sevikas, mukhya sevikas, primary health centres, multi-purpose health workers, bharat scouts & guides, etc. The selected trainees go from village to village. As far as possible training courses are organised under supervision of technical back-up units. On successful completion of the training the best workers are selected in accordance with the target in consultation with technical back-up units and they work as self-employed-workers (SEW).

4.0 SOCIO-ECONOMIC CONSTRAINTS

A close examination of Improved Chulha Diffusion Programme clearly reveals that it is subject to a host of socio-economic constraints operating both at micro and macro levels.

4.1 Micro-Aspects

Various factors influence successful diffusion of improved chulha technology. In broader terms, these factors include a) technical, b) economic, c) social and d) cultural. These constraints may come in terms of user constraints, economic constraints and technical constraints.

4.1.1 User Constraints

These constraints refer to hindrances for improved chulha diffusion programme and adoption, to reasons within the user or person itself as manifested in the following issues :

- Lack of motivation

In spite of mass diffusion programme of improved chulhas, a large number of rural households in India are far away from active consideration for adoption. It is often reported that mass media and extension agents tend to favour the economically and socially privileged households; village level agricultural extension workers, and government officials are found to contact the richer land-owning farmers. This affects the motivation level of other potential adopters.

While selecting villages, due importance is given to the areas already experiencing serious deforestation, having high fuel supply/demand deficit. Due importance is also given to hilly areas where mostly wood is used for cooking and other domestic heat requirements.

There are two main benefits of improved chulha : first, conservation of fuel, which is only possible if chulha is technically sound and user-education is not neglected; secondly, smokelessness is the major benefit to all adopters irrespective of

cooking is often done outside in the open, while the improved chulha is built inside the house in a room or a kitchen (if the house has one). Thus, for those households (richer sections) where fuel-saving is not a priority need as fuel-wood supply is regular, motivation to adopt improved chulha is at a low ebb. On the other hand, 'smokelessness' even though desired by all types of households may often act as an 'undesirable' factor for those households (tribals mostly) who need smoke for preserving seeds/or as disinfectant for termites/insects. It is also difficult to motivate the villagers who are afraid of the cost involved. In some areas people use leaves and straw as fuel. Ash quickly accumulates in the chulha blocking the passage to the chimney which reduces the motivation level of potential adopter.

- Lack of Information

In 1983, National Project on Demonstration of Improved Chulhas (NPDIC) began. During the last 5-6 years in spite of vastly improved information campaign and enlarged organisational network there are many villages and villagers who are unaware of the details of the programme. To a certain extent this is inevitable due to the large area to be covered in a country like India. On the other hand, the level of training of chulha builders and users is often inadequate. This has a serious effect on this programme. Some of the users are unaware about which organisation is building chulhas; whom to contact; who will construct and who will repair in case of breakdown etc. The national programme on improved chulhas is still in its infancy. However, the information gap has decreased since 1983 when NPDIC began.

Lack of Time

Chulha is an essential element in any household. In fact in certain areas, it is a matter of pride for women. Traditionally, Indian women are used to tending chulhas regularly, even decorating it. A technology like chulha which is used almost daily in a household, requires by its nature regular day-to-day attendance and care. Thus, the constraint of lack of time does not operate as far as the user is concerned.

- Lack of Staff or Skilled Manpower

Construction of improved chulha is not a technically difficult task. So it doesn't require a highly skilled person. Implementing organisations take care of construction part. Therefore, it is not necessary to have skilled manpower within the adopter's family. Still it helps if end-user can understand the technical aspects and functions of chulha so that he/she can get optimum benefit from improved chulha. It is in this regard, that follow up of the users is most essential, which is often found to be neglected by the implementing organisations.

- Inadequate Incentives

The advantages of improved chulhas are only present when the chulha is implemented in technologically and socially sound way; but in practice many construction faults occur due to ineffective training, wrong materials used, larger than required diameter of the chimney and faulty installation of chimney causing fire hazards. Also, in case there is no proper user education, there is an increase in fuel consumption. Poor families can ill-afford double or trebled fuel consumption as it increases their labour and cost. Traditional chulha can burn fuel of any size, shape or

type. It can be located anywhere and can be built free of cost. Against this, a beneficiary has to pay Rs. 10 for the improved chulha, which often is an extra-burden for poor rural households with a very low or almost no cash-income flow. On the other hand, smoke has its use in preserving seeds for food crops and it can keep termites and other insects out of thatched roofs and walls. These factors do not appear to be providing sufficient incentive for some people to adopt improved chulha.

- Social and Cultural Unacceptability

Sometimes this technology diffusion comes across 'irrational' and 'conservative' attitudes of rural people. Such type of attitude is very misleading because the problem is located in the potential adopter's particular economic and social position within the community. To an outsider, it may appear irrational but it may be perfectly logical within the potential adopter's cultural context. In certain parts of the country people who use open fire believe that the 'family spirit' resides in it and their reluctance to switch to the improved chulha could be attributed to superstition. In certain communities, people brew their own liquor for which wide open fire is more useful than the narrowed improved chulhas. The most serious cultural and social constraint is the role and status of women in decision making in male dominated society. It is men who usually decide on how money is to be spent. Hence when men make the decisions, the purchase of an improved chulha may not get priority, especially where the only advantage perceived is greater leisure or convenience in cooking for the women. Rural women usually have no direct access to institutional credit or have independently disposable cash income

to purchase new innovations/technologies This has been found to constrain dissemination in several improved chulha diffusion programmes.

- Reluctance to Innovation/Change

The potential adopter's attitudes towards particular innovations would also be governed by the person's past experience with innovations; and equally important, the person's experience with past promoters of innovations. This is because the adoption of any new innovation contains an element of risk for user. It is in this regard, the status of women within the household could be a significant factor in improved chulha adoption. Women are the potential users of the innovation. But in a male-dominated society like India, improved chulha is often likely to be relegated to be a low priority need because it mainly benefits women. This often creates resistance to change.

Also, rich people who have easy and free access to firewood are less prone to change because they don't care if more firewood is used. Secondly, they normally have servants for cooking purpose and they are in position to substitute firewood with alternative fuels (e.g. LPG, Kerosene, Coal, etc.) that require cash expenditure. On the other hand, poor people are likely to be more prone to change because conservation of firewood means saving of firewood collection time which can be used for other gainful purposes. Similarly, smokelessness is not always an attractive feature for many rural Indian people (particularly tribals) because, as mentioned earlier, smoke often has its use as disinfectant or for preserving seeds of food crops.

Lack of Funds to Acquire the System

In India, 45% of rural people live below poverty line with extremely low purchasing power. Even at a very low cost, it is very difficult for some households to buy a chulha. Average per unit cost of fixed chulha is Rs. 40 to Rs. 50. The beneficiary has to contribute Rs. 10 in addition to labour, mud, straw etc., remaining cost of the chulha is provided by DNES. Cost of portable chulha is Rs. 78 to 120. The beneficiary of the SC/ST category has to contribute 25% of the cost whereas 50% contribution is required by other categories. Many households cannot even afford improved chulha at such a low cost.

- Educational Level

This programme is designed for women and by women. In rural India, illiteracy level is very high - about 70% to 80% , which act as a constraint for diffusion of improved chulha technology. Education makes it easier for the person to understand various technical parameters and direct or indirect advantages of improved chulha. It is observed that user's education has direct relation with working efficiency and maintenance of improved chulha. It is necessary that users fully understand the operation of improved chulha, can maintain it by doing minor repairs themselves and continue to use it.

- Lack of Information System Among Users

In rural areas, there is no systematic formal information network among the users of improved chulha. There is a long tradition of informal network of information sharing among the villagers, particularly among women, which play a very important role in communication. It is observed that most of the people come to

know about improved chulha through gram sevika and mukhya sevikas. In some parts of the country, gram panchayat and panchayat meetings act as formal information system. When the traditional informal network is so strong in rural India, lack of formal information system does not seem to be a serious constraint.

- Labour Scarcity

Labour scarcity has never posed as a constraint in improved chulha diffusion programme. There is always abundance of labour in rural areas except during busy agricultural seasons. However, there is high drop out rate among the mistries and skilled labourers. These mistries join the improved chulha training programme with great enthusiasm and they learn the construction techniques very fast. However, they are engaged to construct chulhas only for 2 to 4 months in a year and rest of the year they remain idle. So when the next chulha programme comes there are very few skilled people available and often therefore, the implementing agencies have to start afresh. Irregular payment and remaining idle for almost 6-8 months in a year is the main reason for high mistri drop out rate.

4.1.2 Alternative Competing Factors

The traditional cooking technology is a three-stone open fire or a traditional chulha. The traditional chulha and open fire use more firewood than improved chulha. It may be drudgery to collect firewood, but this is not always in short supply in rural areas, because in the villages the competing fuels like agricultural wastes/firewood and dung cakes are available through collection or gathering almost at a zero private cost. Traditional chulhas are highly energy inefficient, but are home made and

with local materials without any cost at all. Therefore, improved chulhas have to compete with traditional one in certain respects.

There is another method of cooking - solar cookers which are also being promoted in India. But this cooker is expensive and process of cooking is also quite time-consuming and highly dependent on the availability of intensity of sunshine. So solar cooker is not in direct competition with improved chulha except the fact that it does not require any fuel except solar heat.

4.1.3 Channel Factors

The total success of improved chulha diffusion programme highly depends on the 'diffuser' or 'promoter'. In various stages of adoption we have already mentioned about the credibility and efficiency of various communication sources. For effective diffusion there are following channel factors.

- Inappropriate Entry Options

The main work of the promoters is to identify the potential target group in a certain area and make them conscious of their 'need'. In rural areas, there is no systematic formal information network among the users of improved chulha. There is a long tradition of informal network of information sharing among the villagers, particularly among women, which play a very important role in communication. It is observed that most of the people come to know about improved chulha through gram sevika and mukhya sevikas. Conservation of firewood, on the other hand, is an advantage to be achieved to the fullest extent if the chulha construction is technically sound and the user operates it optimally. This means that the promoter needs to assess the needs of

the beneficiaries and make deliberate educational efforts to make them conscious of the desired benefits of the chulhas. Also, in the process it is possible to assess the required level of post-installation follow-up services. It may be desirable, given the available infrastructural facilities to choose those areas first where post-installation service requirements would be minimum.

- Credibility of Technology Promoters

One of the important channel factors is the credibility of the promoters to the potential target group. The potential adopter's attitudes towards particular technology would also be governed by the person's past experience with innovations and equally important the person's experience with past promoters or innovations. Promoters' social relations, interaction with villagers and other personality factors are important only technical knowledge is not enough.

- Technical Familiarity of the System

Promoters should be thorough with all technical aspects of improved chulha so that it can be promoted as a new cooking process instead of a piece of equipment. The basic parameters of improved chulha technology should also be made known to users. User education programme and participation in training camps are important factors. Observing the construction of improved chulha and demonstration effect of operating chulhas among the neighbours helps the potential user. Construction of an improved chulha is not a very complicated task. However, construction of the chulha should be controlled carefully to obtain the rated efficiency and the design matching the local situational factors.

Another factor which is very important is the size of the pan used, diameter of chimney. All these technical matters have to be taken care of. This means the promoter should not only be familiar with the technical aspects of the improved chulha construction, but also about the local socio-economic cultural aspects of life.

- Inadequate Promotional Strategy and Lack of Timing

It is clear that appropriate promotional strategy depends on socio-economic conditions, and it should have relevant mix of approaches so that target group can have optimum benefits. Improved chulha technology is relevant for all groups/classes of households. In order to achieve the target in number of installed chulhas, promoters are often found to hurry through the diffusion programme, without proper selection and extension work in the villages. Also, the important element of follow-up user education is often totally neglected. As a result, there is either straight-away rejection of the introduction of technology or disinterested acceptance of technology under official force.

- Lack of Post-Installation Services and Lack of Follow-up Activities

In any successful technology diffusion programme, it is very important to have post-installation services and follow up. In recent years, it has been increasingly realised and given due attention. It is sometimes observed that relationship between trainers and trainees ends with a training course. Trainees are expected to have acquired perfect skills during the training period. Once a chulha is constructed in a household, responsibility of the mistri is not over. He should remain responsible for

how the chulhas perform after being built. The follow up programme of improved chulha is found to be inadequate.

In recent years, however, importance of the post- installation services and follow-up element in the diffusion programme is increasingly realised and given due attention. The National Programme on Improved Chulha is covered under the new 20 point programme and the Minimum Needs Programme of the Government of India. The monthly and quarterly progress of the implementation of this programme is reviewed by the Cabinet Secretariat, Planning Commission and Ministry of Programme Implementation. The implementing agencies are advised to fix monthly targets under intimation to DNES together with setting up of coordination committees at State and District levels to review and monitor the monthly progress under the chairmanship of the Head of the Administrative Departments and District Magistrates, respective representatives from various developmental agencies/departments and other institutions concerned with different aspects of the programme.

Physical progress reports in respect of monthly achievements are reported to DNES telegraphically so as to reach by the 4th of the following month. Detailed physical and financial reports in the prescribed formats are required to be furnished invariably by the 10th of the following month by each of the implementing agencies. The implementing agencies make arrangements for regular follow-up inspection and monitoring of the programme and submit a quarterly report to DNES. Repair, upgradation and corrective action in respect of the chulhas already installed under the National Programme is taken up through the self-employed-workers.

For these chulhas are divided into the following categories :

a) Chulhas having Hardware Materials

The chulhas installed before April 1988 which are having hardware materials and are not properly used are repaired, reconstructed, converted into damperless designs. For carrying out the above operations the self-employment - workers charge Rs. 4-50 out of which Rs. 4 is recovered from the beneficiary directly and Rs. 0.50 from the nodal agencies and submit reports of such chulhas to the implementing agencies.

b) Chulhas with Broken Pipes, Cowl etc.

These type of chulhas are repaired by the self-employed- workers as per entitlement mentioned above in (a) in most of the places. There can be many reasons for it. In certain hilly areas, monitoring and follow up programme is expensive. Implementing agencies do not have infrastructural facilities for follow up. After installation of chulha , officials do not visit the household.

4.2 Macro-Aspects

Macro-level socio-economic constraints refer to the "high level" concerns which may be referred to also as "off-the village" constraints. These are relatively extraneous and referred to information deficiency, institutional problems, and policy matters.

4.2.1 Information

There are two interconnected aspects of information which are important in regard to the introduction and use of improved chulha technology. First, research must be conducted on the suitability of the technology for the intended purpose. Second,

there must be general knowledge of the availability of the technology including its technical and economic utility. Many useful results of this research programme are put to widescale use and applications in India. However, these efforts are not enough because of the wide diversity of situational factors prevailing in a large country like India. There is therefore, a necessity for continuous research to develop suitable designs for different sets of people differing in socio-economic needs, food habits/cooking habits and types of fuel used. Technical back-up units like IIT Delhi, Universities in Chandigarh, Udaipur, Baroda and Polytechnic of Patiala and a few Engineering Colleges are helping in research work as well as assisting local NGOs in implementation of the programme.

Historically, attempts to improve the chulhas began in the late 1940s, for a mixture of reasons : fuel efficiency, health and modernization. Because of diversity of food habits, type of fuel used, it was necessary to develop the different design suiting local needs.

4.2.2 Institutional Support

Since 1983 when NPDIC began, there has been a conscious attempt for development and promotion of improved chulha technology in a mass scale covering the entire rural areas. The financial support from government of India for the programme was Rs. 87.4 million for the year 1987-88. This budgeted amount is meant for incentive payment to the mistries, cost of training programme, R&D and monitoring, cost of core staff for the implementing organisations, cost of publicity and technical back up units. To illustrate, until now the DNES has sanctioned the core organisational

support unit to implementing agencies at specified outlays. From 1988 onwards the organisation/implementation infrastructural support to the implementing agencies is sanctioned at an outlay not exceeding 10% of the cost of chulhas installed subject to the minimum limit of Rs. 10,000/- and maximum limit of Rs. 5,00,000/- . An indicative pattern for the creation of posts at the state headquarters is given below :

a) For State Level Implementating Agencies

Senior Scientific Officer	-	One
Supervisor/Coordinator	-	One
Assistant Accountant	-	One
Clerk-cum Typist	-	One

b) For Agencies Operating at other levels or in Spec Regions :

Supervisor/Coordinator	-	One
Technical Assistant	-	One
Clerk-cum Typist	-	One

The supervisory staff at the State and District levels is appropriately strengthened so that purchase and distribution of materials and management of the programme is augmented suitably to match the targets. While recruiting staff for the core-organisational support units, the implementing agencies and nodal agencies select personnel having aptitude for rural/women development programmes.

The DNES has already established 11 technical back-up units in different areas as mentioned earlier. The DNES has one technical back-up unit in specified areas spread in most of the States so that regional problems concerning the improved chulha programme is taken up at local levels. The technical back-up units carry out R&D, testing, training and extension, technical survey, evaluation and analysis, monitoring and feed-back, inves-

tigation, extending awareness and publicity, field-testing and evaluation and other related activities are assigned to them. Initially the new units in unrepresentative areas is opened as extension-technical back-up units and attached to the existing technical back-up units. The outlay for an extension technical back-up unit is Rs. 1.00 lakh per annum which covers salary, TA/DA of the staff, contingencies. The implementing agencies identify suitable institutions for this purpose and specific proposals are sent to DNES.

4.2.3 Policy Directives

The improved chulha programme has been combined with the policy objective for not only providing people with new modes of cooking technology but for conservation and optimisation of use of fuel-wood, improvement in environment, employment generation, by making kitchen smokeless, upgrading the health and hygiene standard in rural areas. Thus, the broad policy goal of the programme has been to improve the quality of life as an integral part of general development programmes.

The policy of Government of India in favour of improved chulha came in the wake of a realisation that for years to come a large part of rural India will remain utterly dependent on fuel-wood/agricultural wastes as cooking fuel. On the other hand, there has been a deep concern about the environmental degradation in the form of increasing rate of deforestation/soil erosion as well as drudgery/health of women. A large part of these ills are caused by the inefficient cooking technologies, traditionally used. It is well known that fifty to seventy per cent of all wood

used on earth ends up under some one's cooking pot. In India, it is said that 90% of households in rural areas, 75% in the semi-urban areas, and 25% in urban areas use firewood chulhas. More than half the world's kitchen use simple wood-burning chulhas for cooking. The traditional methods of cooking which have been used for centuries with little modifications, involve burning wood in an open fire, sometimes enclosed by a horse-shoe shaped alcove made of clay or bricks to act as windshield. In some cases, three stones are placed around the fire to act as support for the cooking vessel. The method is very inefficient and only 5% to 10% of the potential energy in the wood fuel is utilized in the cooking process. This is unhealthy too. Emissions in the house, especially the women who handle the cooking, are exposed to the constant emission of smoke and soot. It is hazardous. Burns can result from sparks from burning logs or from unstable pots. Also, the combustible structures are exposed to fire damage. The soot may come in contact with the cooked food and thus make preparation unsanitary. Generally, only one food item can be prepared at a time.

4.3 Economic Constraints

It is noted that private financial benefits of investing in an improved chulha are likely to be small or nil where wood is still not generally purchased. The private financial cost of the investment would depend on what materials are used to build it. If it is built from material available locally, such as local mud or clay, the expense may be negligible. If the material is difficult to procure and needs purchasing, some financial expend-

iture would have to be incurred. On an average per unit cost of fixed chulha is Rs. 40 to Rs. 50. The beneficiary has to contribute Rs. 10 (Rs. 5 towards the hardware cost i.e. chimney, cole etc. + Rs. 5 for installation charges) in addition to labour, mud, straw etc., the remaining cost of the chulha is provided by the Department. Cost of portable chulha ranges between Rs. 75 to Rs. 120 depending on various types of materials and sizes, for which SC/ST have to contribute 25% of the cost and the general category 50% of the cost. In certain areas for specific poorer groups, full subsidy is given. Since the traditional cooking technology is obtained and maintained at zero private cost, subsidy seems to be the only way to motivate people to adopt the technology. Given the long-run social benefits in relation to women's health, saving of forests/agricultural wastes etc. the subsidy is well justified. Most of the potential benefits from improved chulhas are non-monetary. The extent of non-financial benefits is in many ways dependent on the economic class of the household, i.e. the saving of cattle dung for manure would only be important to land-cultivating household and not to a landless one. At the same time, the effects on nutrition levels would essentially be felt by these households who are on the margin of subsistence, who cannot afford to buy alternative fuels and who therefore have to economize it, and in this case, it becomes a difficulty for the household to buy a stove, even at a very low cost. Considering the target group's financial condition, govt. has given 50% to some cases for subsidy.

5.0 TECHNICAL CONSTRAINTS

Improved chulha technology for rural/urban households has some specific technology constraints which are as follows :

5.1 Difficulty of Operating and Maintaining the Technology System

The success of improved chulha programme largely depends on the users full understanding of the operation of improved chulha so that she/he can maintain it by doing minor repairs independently and continue to use it . As such improved chulha is not a technically complicated product. But there are few things like how to use the chimney damper, cleaning of chimney periodically, not to remove the firebox door for space heating etc. Neglect of these parameters reduce the efficiency of the chulha. It is found that an adopter often removes the fire dampers. It is done due to inadequate understanding of the functions of the damper in controlling and directing heat flows inside the chulha. The proper maintenance is required for improved chulha. Most chulhas currently available have a useful life of only six months to two years. To increase the life of improved chulha maintenance is necessary.

5.2 Debuging Problems

Improved chulha technology cannot have any debugging problems if it is constructed properly by a trained person.

5.3 Inadequate Raw Materials

As we mentioned earlier the beneficiary has to contribute Rs. 10/- in addition to labour, mud and straw. Recent improvement efforts have focussed on two classes of chulhas, namely, fixed

and portable. Fixed chulhas are typically constructed from clay, straw and sand mixtures and are provided with chimney duct system for smoke removal. Portable stoves usually have metal as fire clay structures and are without a chimney duct system. Inadequate raw materials is not a constraint as far as improved chulha is concerned because clay, straw and sand are mostly locally available.

5.4 Poor or Inadequate After Sales Service

There is sufficient scope for improvement in follow-up and post-installation services, specifically in the areas where government bureaucratic agencies are active in diffusion programmes. The local NGOs have been more successful in this regard.

5.5 Lack of Technical Know-How :

The relationship between trainers and trainees often ends with a training course. Trainees are expected to have acquired perfect skills not only in chulha construction but also in training others after effectively 8 days of training. So most often improved chulhas are constructed by untrained or ill-trained persons without proper understanding of the technical know-how, which results in failure of improved chulha.

There is also a high rate of mistri-drop-out because they are engaged only for 2 to 4 months and rest of the year they have to remain idle or till the next budget is approved. Low literacy rate and neglect in user-education in terms of understanding basic minimum technical know-how by the beneficiaries is another constraint for successful diffusion of improved chulha programme.

5.6 Technical Inefficiencies Relative to other Competing Systems

The direct competing system is traditional chulhas in rural areas as far as cooking/heating is concerned. Improved chulha is far superior in efficiency in comparison to traditional chulha.

5.7 Tedious and Cumbersome to handle Agro-Livestock Wastes

Since improved chulha requires no additional or different mode of handling agro-livestock wastes as practised in using traditional cooking system, it hardly puts extra burden on the users.

5.8 Technical Inefficiency of Improved Chulha Technology

The physics of designing and fabricating more energy efficient cooking chulha is complex, combining processes of conduction, several modes of heat transfer and fluid flow. This requires stringent technical know-how. However, the improved chulhas work suffers from serious data gaps. Such uncertainty may challenge stove technologists, policy makers and field practitioners, but unfortunately for the improved chulhas 'cause', it does not affect the millions of potential users who can always rely on the traditional chulhas.

6.0 CONCLUSIONS

The success of improved chulha programme lies very much in the eyes of the beholder. From the point of view of the organisations involved, success is usually measured by the number of chulhas built, But the original aims were to save the forests and mitigate the drudgery of women. From the view point of the user, success could be measured by a number of factors such as smokelessness, fuel saving, cleanliness, convenience, safety, house-heating functions and so on. Some of these benefits like smokelessness, convenience, and cleanliness are easily and immediately achieved, while others require optimal operations. The difference between users' view point and organisations view points can perhaps be measured by the proportion of chulhas built that are abandoned by their adopters after some time, which reflects that diffusion of improved chulhas in India has not been one hundred per cent. However, any new technology to replace a traditional technology is a time-consuming process, given the various socio-economic constraints operating in field conditions. While various improvements in the policy and programme implementation are necessary in overcoming the constraints, the success achieved so far in India is quite commendable indicating the potentialities and relevance of improved chulha technology.

6.1 Improved chulha diffusion has experienced two main types of problems: Firstly, technical, socio-cultural, and economic difficulties inherent to the chulha technology itself ; and secondly inadequacies in programme formulation and implementation. However, even if improved chulha diffusion programme was better conceived and carried out, fundamental constraints and competition

with the open fire or traditional chulha limit rapid, widespread adoption by the potential users.

6.2 The intrinsic difficulties on which R&D efforts and programme design need to be addressed to in future are as follows :

Technical :

- a) disagreement on the concept and measurement of efficiency;
- b) large discrepancy between laboratory and field performance;
- c) potentially superior performance of a well-tended open fire;
- d) declining fuel performance due to rapid deterioration and breakage (short chulha life);
- e) complexity of the design process matching varying cooking/food habits, types of fuelwood traditionally used etc.;
- f) availability and low durability of materials; and
- g) given the wide diversity in the socio-economic conditions as mentioned in (a) it is near impossible to have one standardized design of improving chulha for a country like India.

Economic :

- a) direct relationship between chulha with excellent fuel performance and much higher costs;
- b) chulha benefits not perceived where fuelwood is non commercial; and
- c) unclear role of subsidies.

Socio-Cultural

- a) strong competition from the open fire;
- b) unknown determinants of user acceptance; and
- c) improper chulha use.

The study indicates that the importance of R&D efforts and R&D institutions, the techno-socio-economic constraints indicate major areas for research. The currently prevalent question is; "Can Improved Chulha Programme ever bring about widespread dissemination upon the millions?" Based on important advances, and the data of field evaluation studies and technical knowledge required for improved chulha design, it appears that most of the

demands required for success are in place. The major technical back-up units are also making valuable efforts to link laboratory and field workers in order to achieve greater consensus on the most promising diffusion strategies. The urgency of the fuelwood crisis dictates that financial and technical assistance, local trained staff and official policy support be stepped up in order to advance existing improved chulha programme towards the dissemination stage where the potential for successful diffusion can be clearly demonstrated.

The nodal implementing agencies are concentrating their efforts on the most promising improved chulha models (presently 25 models are certified for promotion meeting the varying habits in different regions) and promotion opportunities and increasing local support for them. It is in this regard the official policy decision to involve the local NGOs in a significant scale in implementing and monitoring the programme in the field has been extremely crucial for the success of the programme.

