A Critical Evaluation of the Improved Cooking Stove Programme in Nepal

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ABSTRACT

This paper examines the development of the Improved Cooking Stove (ICS) programme, which was instituted in Nepal in 1950, and highlights the programme's existing efforts. It also examines the technical and economic parameters which have influenced the development of this technology. Furthermore, it evaluates the economics of the ICS programme with respect to users (financial) and programme (economic) perspectives. In the case of the users perspective, the benefit-cost ratio is tested against the percentage of time the ICS is used and the price of the fuelwood consumed. With regard to the programme perspective, the evaluation is based on the value of fuelwood, the rate of subsidy, and the use-factor. Furthermore, the programme evaluation is based on several general assumptions such as the annual fuelwood consumption per capita, average household size, saving of fuelwood, discount rate and life of the ICS. Policy considerations and recommendations are made based on the evaluation as well as on other social and technical factors.

BACKGROUND

The history of the dissemination of the Improved Cooking Stove (hereafter referred to as the ICS) in Nepal dates back to 1950 with the creation of the Village Development Service or "Gramin Vikash Sewa". This was a joint venture of His Majesty's Government of Nepal (HMG/N) and the Government of the United States of America. Originally, this organization was responsible for the execution of programmes related to education, health, and agriculture in rural areas and the distribution of the ICS came under the agriculture programme. The design and model of the ICS were brought to Nepal from Hyderabad, India. The promotion and dissemination of these stoves were concentrated in a few areas such as Ilam, Biratnagar, Birgunj, Kathmandu, and Bhairahawa. Training for the manufacture of ICS was the responsibility of the Engineering Section, Department of Agriculture, and the Women's Training Centre.

In 1960, the Village Development Service was abolished and its staff was transferred to a number of different organizations. As the scope of the Women's Training Centre was confined to training women only, the dissemination of these stoves slackened. Moreover, the manufacture, promotion, and dissemination of the stoves were not very effective as fuelwood was readily available at a nominal cost. At this time too, the attention of HMG/N was geared more towards the development of other infrastructure and it did not realize what the long-time effect of ICS promotion might be.[1-2]

However, the 1980 rural energy crisis, which was the aftermath of the 1973 oil embargo, and the country's fast depleting forests revived the government's interest in conserving forest resources. This interest was also expressed by a number of foreign aid agencies. In 1979, the Research Centre for Applied Science and Technology (RECAST) involved itself in the research and development of the ICS and organized a workshop/seminar on "Developing Fuelwood Efficient Stoves in Nepal". This made the people very aware of the usefulness of the ICS programme and RECAST can be considered a pioneer for the second phase of ICS development. Various designs have been developed, but till now only one type of stove design, i.e., insert-type stove, is popularly used. At present, about 10 organizations are involved in the dissemination and promotion of the ICS and in adapting different design types according to their own experience.[3]

Realizing the benefits of ICS promotion and dissemination, the National Planning Commission (NPC) has set the target of disseminating 160,000 ICSs during the Seventh Five Year Plan (1985-1990).[4] But unfortunately, not a single organization seems committed to the promotion and dissemination of the ICS on such a massive scale. Furthermore, the scope of research needs to be broadened as variations in climatic conditions, eating habits, cooking practices, ethnicity, level of income, size of household, etc. make it quite difficult to develop a standard model which will be acceptable to all.[5-10] Nevertheless, about 20,000 ICSs have been disseminated among villagers, and feedback from the users is being carried out to improve the design so as to suit the local conditions and increase the rate of adaptability.[3]

EXISTING PROGRAMME

Table 1 provides performance indicators for the ICS programme for the last 5 years and for the next 5 years. During the last 5 years, ICSs were bought by some of the organizations and distributed to the local people for free or with only nominal charges. The present capability to distribute ICSs is about 50,000 units only[3,11] and therefore in order to meet the target of the

Table 1
ICS implementing agency performance indicators

Organization	Stoves Installed 1980-1985	5-Year Target 1986-1990	Financing	User Input	Comments
CFDTP	10,000	30,000	World Bank	Minimal	70% still in use after 1 year. Disuse due to breakage, lack of maintenance
ADBN	4,100	10,000	UNICEF	Minimal	80% still in use after 1 year
RCUP	1,109	2,000	USAID	Minimal	70-75% still in use after 1 year. Fuel savings 20-25%. Use cast iron rings and grid
UMN		Minimal	UMN	NRs. 30 Investment	40% still in use after 3 years
SATA	1,000	3,000	SATA		
UNICEF		5,000		Minimal	
OTHERS	4,000				
TOTAL:	20,209	50,000			

Seventh Five Year Plan this capability has to be doubled. However, the second year of this plan period has already passed and nothing has been done.

TECHNICAL AND ECONOMIC CONSIDERATIONS

Technology

There are a number of different designs available at present. The insert-type ICS was designed and developed by RECAST as shown in Fig. 1. This two-pot stove is made from three separate pottery pieces and a pottery chimney. It is surrounded by a mud mix. The three pieces are: a fire box with the first tunnel attached, a separate second pot hole with a baffle attached, and a rear tunnel attached to the chimney base. There are no doors, dampers, or grates. The cooking pots rest on the mud surround rather than the pottery stove. Insert-type ICSs with a few modifications such as a system for improved cleaning of the ICS chimney, pots of different size and improvements to match the cooking habits of users of different regions are being disseminated by the Community Forestry Development and Training Project (CFDTP), UNICEF, Resource Conservation and Utilization Project (RCUP), etc. Other types of stoves developed by RECAST are the Terri Stove, the Double Walled Stove, the Mud and Sand Stove, and the Single Pot Stove. Other large stoves for food processing and small scale industrial purposes are also being developed by RECAST.[12–17]

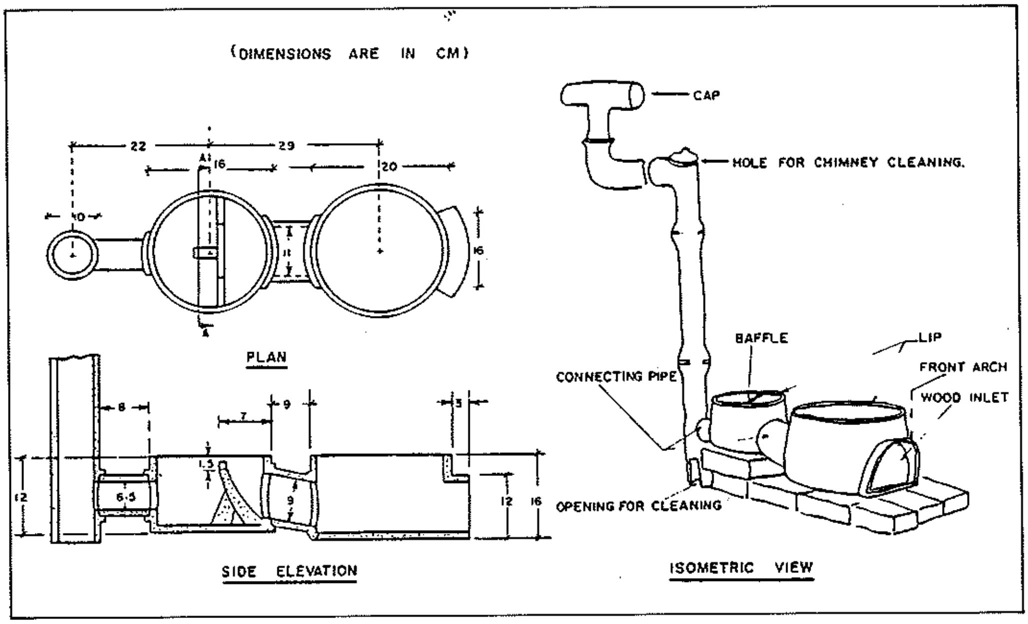

Fig. 1 Improved cooking stove (insert type).

There are also individuals who have developed their own design but these are not as popular as the insert-type stoves. Insert-type stoves are widely disseminated as they are cheap and easy to transport from one place to another. They are also as efficient as other improved stoves with their efficiency lying between 23 and 25%. The efficiency of the open fire stove and the traditional mud stove (see Fig. 2) is 3 and 13%, respectively.[15]

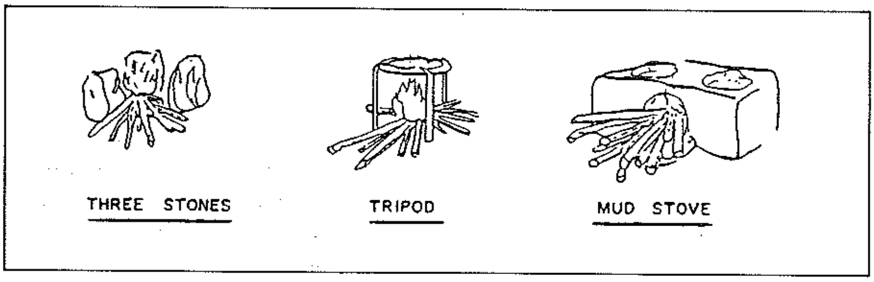

Fig. 2 Traditional stoves.

Production, Promotion and Dissemination System

At present, the production of the ICS is mainly concentrated in the Kathmandu Valley. These stoves are manufactured by traditional potters and by about 10 families of potters who have received training organized separately by UNICEF, CFDTP, and RCUP. The potters use their own traditional method of firing and use the traditional potter wheel. Most of the organizations involved in disseminating ICSs buy from them. Organizations like CFDTP and UNICEF provide training to local potters in different districts and have already trained 1 or 2 families in about 15 districts. A CFDTP report indicated that a family of skilled potters in Kathmandu Valley can produce up to 800 stoves per year working on a full-time basis. The potters, however, feel that there is still too much uncertainty and risk involved in abandoning the production of traditional pottery ware, in which case the production capability per family would be only 200 ICS units per year.[3,9] Based on the above mentioned factors, the maximum production capability of ICSs is only 12,000 units per year in the Kathmandu Valley and the minimum capability may be as low as 3,000 units per year. Outside the valley the maximum production capability is about 5,500 units per year whereas the minimum may be as low as 1,500 units per year. Considering the existing situation of ICS production and dissemination, the maximum production capability in a 5 year period will be 87,500 units, while the minimum would be 22,500 units. These figures correlate with the maximum 5 year target of different organizations which is about 50,000 units.

Even though it is possible to produce ICSs outside the valley, the production cost of locally produced ICS is about 15% higher than the ICSs produced in Kathmandu valley (which includes the production cost and truck transport cost of 4-5 hrs. drive). This is due mainly to the limited number of stove manufacturers outside the valley.

Furthermore, there are other constraints on the sustainable production of ICSs. These are: the low demand for them, the non-availability of trained potters, the quality of soil, etc. A major reason for the low demand of ICSs is that the ICSs which are distributed are of rather small size whereas most of the time villagers have to cook for their families as well as for others who work for them in accordance with the prevailing exchange labour system. Other reasons are: time spent on cooking when using the stove is greater than when using traditional methods, the stove does not provide heating, it is difficult to prepare "dhindo" on the stove which is a common food in the hills, the cultural practices of some of the ethnic groups are such that the location of the ICSs is not acceptable, there is little knowledge of how to maintain and operate the ICS, etc. Also there is no direct linkage between the producers and users. Most of the time, the organizations involved in distributing the ICSs are motivated by a better economic return to the nation, rather than by the expressed needs of the villagers.

An important aspect of stove production is the quality of soil from which the stoves are made. This usually differs from place to place. According to the CFDTP office, the soil of Kathmandu Valley, especially the Thimi and Bhaktapur areas, is good for making pottery stoves, and in the past stoves manufactured in the Thimi area were popular. But nowadays, considering the fact that the production capability has to be developed in many areas, the CFDTP office is encouraging potters in those districts which fall under their jurisdiction and also providing basic training to them.

At present, although vitally important, the promotional activities of CFDTP are rather limited. The promotion and dissemination of ICSs are being hampered due to the fact that there are few local potters who can manufacture and sell these units. It is clearly necessary for more local potters to be trained and credit to be made available to them so as to encourage them to produce ICSs. At present, the potters being trained are mostly from Kathmandu Valley and the level of training is low. It is preferable that trainees should be selected from each district, with a higher priority given to districts with serious fuelwood problems. Moreover, the level of training should be higher.[15,18] After completing their training potters should be able to apply new ideas, or to make improvements in ICSs according to local conditions. If an ICS programme is launched on a massive scale then some funds should be kept aside for this activity. A number of trained promoters may be required in each district to make the programme successful. Women would be ideal promoters as they are involved in cooking and are the main users of the stoves.

Installation, Repair and Maintenance

At present the most popular type of ICS is the insert-type stove. But only trained personnel can install these units. It seems that 2-3 installers per village "Panchayat" are required and they must undergo training for about a week.

One of the major reasons for the non-use of the ICSs after installation is the inability of the villagers to repair and maintain them. In some instances it has been observed that although the repair and maintenance technique has been explained to the male member of the family, when requested by the housewife to repair the stove he has refused and has asked her to use the traditional stove. This refusal seems to be due to a feeling that such work is women's work. Given this situation, it is important to make available repair and maintenance training to female members of the house.

ECONOMIC EVALUATION AND ASSUMPTIONS

General

The economic evaluation of the ICS programme is based on a users (financial) and a programme (economic) perspective. The general assumptions which are valid in both cases are as follows: the average annual fuelwood consumption per capita is 642 kg; average household size is 6; saving of fuelwood using an ICS is 30% when compared to the traditional stove; discount rate is 12%; life of the device is 3 years.[15-22]

Cost Streams

The typical production cost of the ICS is shown in Table 2. The total ex-factory price of a 20 cm. size ICS is NRs. 75.00. About 48% of the ex-factory price is in the form of labour cost, while the cost of material accounts for about 2%. The energy cost during the manufacturing process of the ICS is about 21%. It is also noteworthy that the cost of the pottery chimney and pipes is about 57%, while the cost of the pottery stove accounts for about 13% only. The transport cost is assumed to be NRs. 10.00 per unit. As far as the local transport cost is concerned, in most cases the users themselves carry the ICS and it is not valued in this analysis. The installation charge is about NRs. 20.00 per unit. This amounts to 25-30% of the total unit cost. The overhead cost incorporates the training and administrative cost. The training cost includes the cost of training the potters, installers, and promoters. The administrative cost includes the cost of appointing promoters in each district. In general, it is assumed that 1 promoter and 2 installers are required for every 600 stoves to be distributed. Based on these assumptions, the training cost per unit is NRs. 23.50 and the administrative cost per unit is NRs. 85.00 (per. comm., Mr. K. Shrestha, CFDTP, Nepal).

Table 2
Typical production cost of a 20 cms ICS

Description	Production Cost (NRs.)		
	Stove	Pipes & Chimney	Total
1. Labour Cost	7.50	28.20	35.70
2. Material Cost	0.10	0.90	1.00
3. Energy Cost	2.14	13.66	15.80
Sub-Total	9.74	42.76	52.50
4. Supervision Cost†			5.25
5. Damage and Breakage†			5.25
6. Seller's Margin			12.00
Ex-factory Price			75.00

† 10% of Sub-Total.

Benefit Streams

In this analysis, only the tangible benefit is taken into consideration, i.e., the fuelwood saved due to the use of the ICS compared to the traditional stoves. The amount of fuel saved depends upon the comparative efficiency of the ICS versus the traditional cooking stove. The efficiency of the stove depends primarily on the burning rate and the heat loss from the stove. The burning rate of the cooking stove is a function of the size and dimensions of the combustion chamber, size of the fuelwood, and availability of oxygen in the combustion chamber. In the case of the ICS, the dimensions of the combustion chamber are properly maintained as per the design. The size of fuelwood should be small because the ICS has a small mouth. Further, the cooking pot is so placed that there is no flame coming out through the side of the pot. All these factors help to increase the efficiency of the ICS, which in turn results in fuelwood being saved when compared with the traditional stove. Laboratory tests show a 50% saving in fuelwood when the ICS is compared to the traditional stove, while field studies show a 25 to 35% fuelwood saving.[15,17-19] In the rural areas the value of fuelwood is not realized due to the fact that fuelwood is collected by household members in their free time, or by the children, or by the women. In these cases no opportunity cost is assigned. Furthermore, in many instances villagers augment their fuelwood collection with twigs and branches from their own farms. On the other hand, among high income groups and in urban areas fuelwood is generally purchased. In this analysis fuelwood is therefore valued from zero to its current market price in the urban centre, i.e., Kathmandu.

Users Perspective

Assumptions

The costs from the users (financial) perspective are production, transport, installation, operation and maintenance. In this analysis, all of the above costs are assumed to be borne by the users without any subsidy. The monetary benefits perceived by the users primarily depend upon the price of fuelwood which varies widely from region to region.

Furthermore, the economic parameters will also vary greatly with the percentage of time the ICS is used by an individual or family. The percentage of time the ICS is used depends upon many factors such as: the stove being damaged, the stove being incorrectly installed, pipes being blocked, pots not fitting, the users moving house, users wanting more smoke, more time required for cooking, the ICS being considered inconvenient, etc.[3]

In this analysis the benefit-cost ratio (B/C Ratio) will be tested with different prices of fuelwood and different percentages of time the ICS is used.

Results and Discussions

Figure 3 shows the circumstances under which an ICS would be economic from the users perspective without subsidy. A curve in Fig. 3 shows the relationship between the price of fuelwood and the percentage of time the ICS is used when the benefit-cost ratio is 1. Intersections of the price of fuelwood and percentage of time the ICS is used falling above the line indicate a B/C Ratio of more than 1 and intersections falling below the line indicate that the purchase of an ICS is not economical from the users perspective. For example, when the price of fuelwood per kg is NRs. 0.3 and the percentage of time the ICS is used is 40% then from Fig. 3 it is obvious that the intersection falls in the cost effective zone and it would make sense for the potential user to purchase a stove. If the ICS is used 10% of time then this point falls in the zone where the use of ICS is not cost effective. It can be seen from Fig. 3, that if the price of fuelwood is less than NRs. 0.05 per kg, an ICS is not economical, no matter how often it is used. If users have to pay NRs. 0.3 per kg of fuelwood (Fuelwood Corporation of Nepal's lowest price) then the percentage of time an ICS is used must exceed 15% to be financially viable to users. Furthermore, an ICS is not financially viable if the price of fuelwood perceived by the user is zero, even with 100% subsidy.

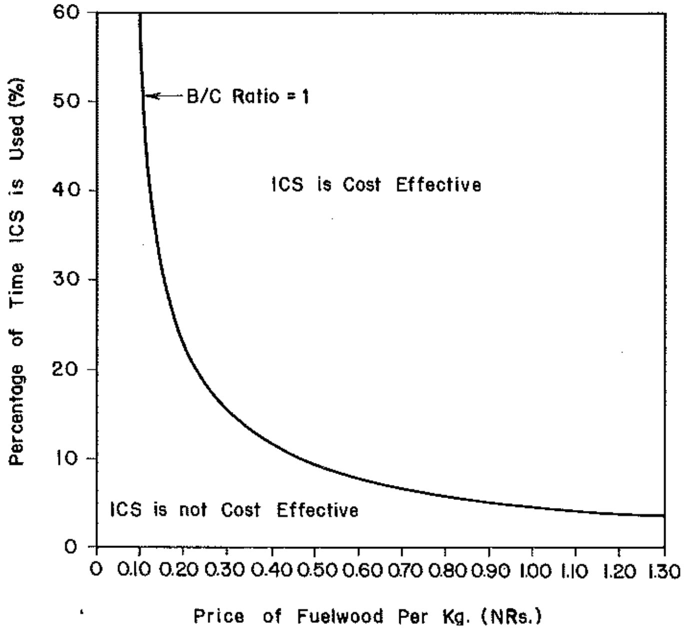

Fig. 3 Economic benefits of an ICS to its user with no subsidy.

Programme Perspective

The second evaluation conducted concerns the impact of subsidy on making the ICS cost effective as a forest conservation mechanism. Therefore, in a cost-benefit analysis, cost is the subsidy provided by the programme on each stove unit, and benefit is the value attributed, from a programme (economic) perspective, to fuelwood as a resource.

Assumptions

Costs for the analysis include the subsidies provided on each ICS unit. The cost of an ICS unit in this instance will include the normal costs as considered in the users perspective, plus the additional costs of administration and training provided by the programme as mentioned in the section "Cost Streams" above. The analysis assumes four costs by considering subsidies on the capital cost of the stove of 10%, 33%, 67%, and 100%.

The economic benefit of the programme lies in the use of the ICS resulting in a saving of fuelwood as a resource. The benefits perceived by the programme therefore can be given a value relating to fuelwood. This will vary with factors such as the resource availability of fuelwood in the region, other energy options, and the perspective of the programme developer or policy maker. The value of fuelwood is therefore given a floating value from zero to current market price in Kathmandu.

The main variable which controls the net benefit is the use-factor of the ICS programme. Use-factor is a ratio designating the effectiveness of a stove programme and is a compound of two variables: the percentage of stoves in use from time of distribution, and percentage of time an ICS is used each year. Socio-cultural and environmental aspects of the community also affect the use-factor. These include climatic conditions, cooking habits, ethnicity, easy access to fuelwood, literacy rate, household size, income level, livestock holding, fodder availability, perception of fuelwood crisis, nearness of market centres, hesitancy to adopt new technology and so on.[3-7] In this analysis the benefit-cost ratio will be tested with different values of fuelwood, rates of subsidy, and the use-factor.

Results and Discussions

The set of curves in Fig. 4 shows a relationship between the value of fuelwood perceived by the potential promoter of an ICS programme and the use-factor when the benefit-cost ratio is 1 for different rates of subsidy on the total cost of ICS units in a programme (including administration and training cost per unit). Fig. 4 differs from Fig. 3 in several ways: the zone above the curve shows cost effective ICS programmes, rather than a cost effective ICS unit; cost streams also include programme overheads; and the use-factor is the Y-axis rather than percentage of time the ICS is used. It can be deduced from Fig. 4 that with the use-factor as low as 15% and a value attributed to fuelwood of NRs. 0.55 per kg (Fuelwood Corporation of Nepal's highest price) a 100% subsidy could be given on a stove and still provide an economic payback to a programme.

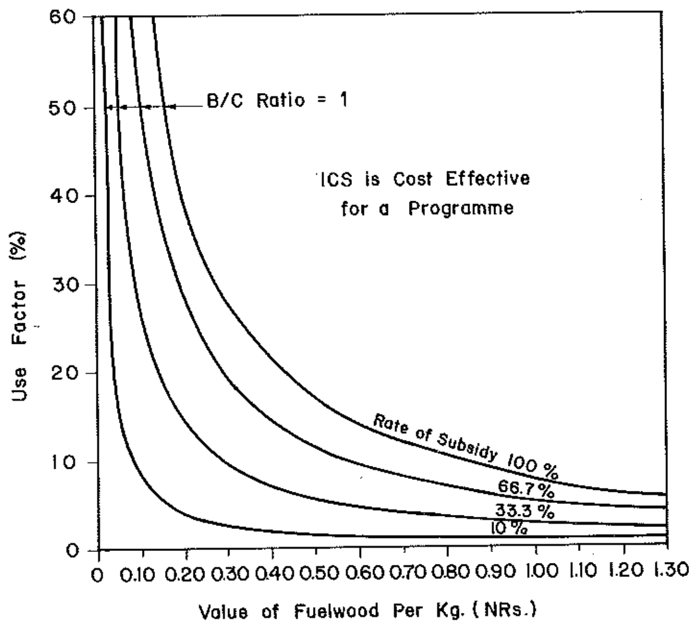

Fig. 4 The effect of an ICS subsidy on programme effectiveness.

Various studies[3-6] reveal that a 20% use-factor is not unreasonable. Assuming the value of fuelwood to be NRs. 0.3 per kg (Fuelwood Corporation of Nepal's lowest price) with more than a 20% use-factor, the ICS programme promoters will be in an economically feasible zone even though they provide a 70% subsidy on the total cost. If the value of fuelwood perceived by the programme promoter is zero, then the ICS programme cannot be judged economic no matter how low the subsidy.

POLICY CONSIDERATIONS AND RECOMMENDATIONS

The conclusion of the users and programme evaluation along with certain technical and social factors are now used to form the basis of a number of policy considerations and recommendations.

Policy Considerations

In areas where fuelwood is not traded and/or no opportunity cost is assigned for the time spent on the collection of fuelwood, no amount of subsidy can make the ICS financially attractive. In almost all of the rural areas of Nepal, fuelwood is perceived as being freely available. Only in semi-urban and urban areas is fuelwood being sold. This is one of the reasons for the past lack of success of the ICS in Nepal.

Many programmes of HMG/N offices and/or funding agencies buy ICSs and distribute them providing a 100% subsidy to the users. This has disrupted the market interaction of the producers and users, and has failed to provide enough incentive to the user to maintain the equipment properly.

There are a number of reasons for a low percentage of time the ICS is used including: an ICS does not provide for heating needs, it is not flexible to the extent that it can be used for cooking for large gatherings, animal feed, or liquor; women, the primary users of an ICS, are often not trained in its maintenance.

At least six agencies are actively promoting the use of the ICS in Nepal. The work of these agencies is uncoordinated and no specific national guidelines exist for the implementation of the ICS programmes. The targets set by the National Planning Commission in its Seventh Five Year Plan for ICS dissemination will likely fall short by almost 70%. Moreover although the second year of the plan has already passed, HMG/N has not yet budgeted any money for the stove programme.

It must also be concluded, however, that there are many unknown and unquantified costs and benefits in ICS use so that a strict econometric approach is not adequate for projecting the attractiveness either of an ICS to a potential user or of a subsidy programme to a potential funding agency.

Recommendations

For the present, the dissemination of ICSs should be concentrated in areas where fuelwood has a real cost or in areas where there is a scarcity of fuelwood. The usefulness of the ICSs should be propagated and demonstrated in areas where the rural populace do not perceive fuelwood to have a price.

Subsidies should be applied to ICS programmes only for an initial period, to encourage market forces to develop. It is likely that a 70% subsidy on the capital cost is sufficient to include the use of an ICS while providing an incentive to entrepreneurs to expand their markets. Subsidies should be as follows:

- 40% on the production costs of an ICS;
- 100% on the transport costs from production centres, as well as on programme components such as administration and training.

On the theory that demand should be present before stoves are introduced, and that subsidies should be used to "push" rather than "pull" the market, the creation of production centres rather than installing a "quota" of ICSs should be the purpose of the ICS programmes.

An ICS programme should encourage the development and sale of local models to meet local needs. This may mean training local potters as stove makers and developers.

Methods should be devised by a programme to test and monitor different models for their fuelwood savings and their durability; hence their eligibility for subsidy.

Emphasis should be given to women as stove users by, for example, appointing women as stove promoters and by training women in stove maintenance.

The Water and Energy Commission Secretariat's (WECS) position as the national coordinator of energy programmes should be emphasized and strengthened through the following measures: the creation by WECS of national guidelines for the conduct of ICS programmes; the Finance Ministry referring all new ICS programmes to WECS for their evaluation and approval; WECS responsibility for the regular monitoring of all ICS programmes in Nepal and for coordination with the implementation agencies.

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