CHAPTER 5

Economic benefits and TIFICS promotion policy

5.1. Introduction

Irrespective of infiltration of efficient modern cooking devices, it is projected that there will still be 2.5 billion people by 2030 depending upon traditional biomass cook stove [1]. Realizing the importance of the issue, several efforts by international development agencies are being made to disseminate improved biomass cook stoves in developing countries. International organizations such as WHO, USAID and UK's Department for International Development (DfID) along with 350 other agencies have joined the United Nations' Global Alliance for Clean Cook stoves and pledged to improve the lives of 2.5 billion people depending on biomass cook stove by disseminating 100 million cook stoves by 2020 [2, 3].

Globally, a number of improved cook stoves are being developed and disseminated which are found to be fuel efficient and reduce indoor air pollution [4-8]. However, lower rate of adoption of improved cook stoves are reported [2, 7, 9, 10]. Design and performance studies mostly dominated the research on stove. But, economic analysis and investigation of reasons of barriers to extensive adoption of cook stoves are equally important. It is apparent that the success of stove dissemination programme depends on several factors related to stove design, performance, users' habit, cooking customs, fuel preference and finally the economics [11-14]. Overall, the initial cost of cook stove as well as operating cost of the stove is the most influencing factors of the adoption of cook stove particularly for economically disadvantageous section of the people. Additionally, availability of fuel and convenience of usage also governs the type of cook stove selection.

There are many commercialized TEG integrated cook stoves already available in the market with relative merits and demerits. All such stoves doesn't suit the local custom in addition to associated higher initial cost. The technology developed in this study have addressed these issues to make custom friendly stove as well as reducing the initial cost which can be afforded by the economically disadvantageous sections. However, a comprehensive economic analysis is important to understand any possible barrier against its mass adoption.

Keeping in view with this discussion, the Chapter presents the work on the economic analysis of using TIFICS and making a comparative analysis with other prevailing cooking technologies i.e. traditional biomass cook stove and LPG cook stove. Also, policy plays an important role. The prospect of promotion of TIFICS through the existing policy tools is also presented in the Chapter.

5.2. Economic analysis

A cook stove is successfully adopted if it provides benefits to every section of people of the family in terms of health and economy [15, 16]. A typical family of the study area have a clear division of works and responsibilities. Women are primarily involved in cooking along with kids or without kids whereas; the arrangement for procurement of the stove as well as fuel is either borne by men or women. In non-electrified conditions, cooking activity has to be conducted using kerosene lighting. The health benefits and the benefits of providing clean illumination have been clearly highlighted in the earlier chapters. It is already an established fact that dissemination of a technology becomes easier if the benefits are reflected for the entire section of the people in the family. TIFICS has a potential to provide benefits through reducing costs of fuel consumption and provide clean lighting and energy.

Levelized cost of cooking a meal (LCCM) is a parameter which accounts comprehensively all economic factors related to cooking activity and it is a useful parameter for comparison of competitive technologies used for cooking operation. The detailed methodology of LCCM is elaborated in Section 5.2.1.

Further, the other possible monetary benefits of TIFICS in terms of firewood and kerosene savings were investigated during deployment phase of TIFICS testing.

5.2.1. Levelized cost of cooking meal (LCCM)

Levelized cost of cooking a meal (LCCM) is an important parameter which determines the cost of cooking a meal based upon input parameters viz., cooking device cost, fuel cost, efficiency of stove, energy consumed in cooking a meal, lifespan of the cooking device, and interest rate on the purchased price [17]. LCCM is a useful tool to understand the best cooking technology in terms of cost associated in preparing a meal.

Traditional fixed clay biomass cook stoves (TBCS) are predominantly used with minor variations in the design which was discussed in Chapter 4. Certain section of the households in the selected rural area also uses LPG cook stove. In the present study, LCCM of TBCS, LPG and TIFICS was investigated.

LCCM of a cook stove is determined using the following equations [17].

$$LCCM = \frac{F_{cost} \times E_{meal}}{\eta_{stove}} + \frac{\sum_{t=1}^{n} \frac{I_{stove} + OM_{stove}}{(1+r)^t}}{\sum_{t=1}^{n} \frac{Meals_{total}}{(1+r)^t}} \quad (5.1)$$

where, F_{cost} is the cost of fuel per unit energy, US$/MJ, E_{meal} is the energy consumed in preparation of a meal, η_{stove} is the efficiency of cooking stove, %, I_{stove} is the cost of the cooking stave, US$. OM_{stove} is the operation and maintenance cost of stove, US$, r is the discounted rate, %, and $Meals_{total}$ is the total number of meals prepared with the cook stove.

E_{meal} was evaluated considering the preparation of a standard or basic meal (Rice, Lentil and fried mixed-vegetable) and was determined using the equation below,

$$E_{meal} = CV_{fuel} \times burn\ rate \times time\ to\ cook \times \eta_{stove} \quad (5.2)$$

Where, CV_{fuel} is the lower calorific value of fuel (firewood and LPG), MJ/kg, Burn rate is the fuel burning rate of stove, kg/min, Time to cook is the time taken to cook a basic meal and η_{stove} is the efficiency of cooking device;

All these parameters were considered from the standard review and data collected during the survey which is presented in Table 5.1.

During pre-deployment phase of TIFICS, TBCS users reported that an average family of 5 members require 60 min to prepare a standard meal whereas, about 30 min was required to cook in a LPG stove. Further, TIFICS required 45 min to prepare a standard meal. For LCCM comparison, these cooking times were considered for the three cooking devices.

The fuel cost for each scenario was considered to be the prevailing rate in the study area. Firewood was purchased at the rate of 0.07US$/kg (1US$=69.45 INR) which was inclusive of transportation costs as well. In case of LPG cook stove, the prevailing cost of an LPG cylinder with transportation was 13 US$ during the TIFICS deployment phase i.e. January 2018. The specific cost of fuel (firewood and LPG) energy (US$/MJ) was considered for the analysis as shown in Table 5.1.

The burn rates of TBCS was considered to be 0.037kg/min with thermal efficiency of 10% as reported for traditional three stone fired cook stove [18-20]. The burn rate of LPG cook stove operating at an efficiency of 53% was considered to be 0.0037kg/min [17, 21]. In case of TIFICS, the efficiency (25%) *Sukhad* stove obtained during laboratory at burn rate of 0.016kg/min was considered for the present study.

Both TBCS and TIFICS use firewood for cooking. During TIFICS field trial tests, firewood of calorific value in the range between 14.64 MJ/kg and 18.28 MJ/kg was observed. The average of the calorific values was considered for the analysis i.e. 16.26 MJ/kg. In case of LPG cylinder, the universal calorific value of LPG i.e. 46MJ/kg was considered for the analysis.

As discussed earlier, TIFICS comprised of TEG module, heat collector plate, fixtures, cooling tank, charging circuit and *Sukhad* cook stove. The details of the cost of the components are provided in Appendix C.

TBCS are fabricated by local households using locally available materials such as stone, clay and sand. The standard cost regarding the construction of TBCS is not available. However, for the present investigation, information pertaining to manufacturing (material and man hour) of such a cook stove is collected to estimate the cost. Details are provided in Appendix C.

LPG consumers get regular bottled LPG gas (cylinder) through a LPG distribution network which prevails in most of the regions. The supply of the LPG involves cost for registration to the consumer, bottled LPG cylinder, as well as the cost LPG cook stove. Details are provided in Appendix C.

In the present study a fraction of capital cost was considered as the operation and maintenance cost in all the cooking devices i.e. 3% of the capital cost.

TIFICS is an assembly of several components. Each of the component has its own lifespan. For instance, the TEG module can operate for 100000h as mentioned in previous literatures [22-24]. However, the lifespan of a clay cook stove is considered in the present study. The life of a clay cook stove is governed by the constructional method, standard constructional materials and users' behaviour. With regular maintenance and minor repairing, the useful life of clay cook stove could be enhanced up to 11 years. For LPG cook stove, the operational period was considered to be 10 years [25].

During the village survey, it was observed that 3 meals (breakfast, lunch and dinner) were always prepared by using either TBCS or LPG stove. The number of meals in Eq. (5.1) is determined by the product of annual number of meals and lifetime of cook stove.

Table 5.1 Cook stove assumption for LCCM analysis

Cook stove	Capital Cost, US$	Fuel cost (US$/MJ)	Burn rate, kg/min [Source]	Efficiency, % [Source]	Number of meals	Calorific value of fuel, MJ/kg
TBCS	7	0.006	0.037 [18]	10 [18-20]	12045	16.26
TIFICS	75	0.006	0.016	25	12045	16.26
LPG stove	57	0.02	0.0037 [17,21]	53 [17, 21]	10950	46

Fuel costs are highly volatile across the globe [26]. In India, cost of LPG cylinder has increased at an annual growth rate of 4% since 2010 till 2019. Whereas, the five year growth rate of LPG cost from 2010 is found to be 33% [27]. Similarly, the cost of firewood has also increased. A sensitivity analysis of LCCM on this key input parameter i.e. fuel cost is carried out considering increase in fuel cost at the rate of 5%, 10%, 30% and 50%, respectively.

5.2.2. Potential fuel savings through introduction of TIFICS

The potential saving of firewood due to the introduction of TIFICS was independently assessed. Based on the information collected during deployment of TIFICS and pre-deployment of TIFICS for the selected households, monetary savings of firewood was investigated. Along with this fuel, the saving of kerosene was also assessed based on the collected data from the households. These were used to assess the comprehensive merit of TIFICS and presented in Section 5.3.2.

5.2.3. Policy for TIFICS dissemination

The experience and benefits of TIFICS in the rural area as discussed in Chapter 4 indicated a prospect of dissemination of the technology. Addressing the issue of earlier cook stove dissemination policy, a comprehensive policy is suggested on the basis of the technical know-how generated from laboratory and field testing.

5.3. Results and Discussion

5.3.1. Levelized cost of cooking meal (LCCM)

We have compared use of TIFICS with two prevailing options of cooking. The realistic parameters required for comparison concerning the type of cook stoves, performance parameters of stove, cost and other relevant factors are considered to estimate a standard parameter of LCCM. We have discussed the details of parameters and its relevant assumptions.

LCCM of three cooking devices in the rural area was estimated to be in the range between 0.16US$ and 0.49US$. LCCM of TBCS was estimated to be highest (0.49US$) among the other scenarios whereas LCCM of TIFICS and LPG stove was calculated to be 0.23US$ and 0.16US$, respectively. It is observed from the Fig. 5.1 that improvement in mode of cooking can result in cost savings. In fact, a change from traditional mode of cooking to improve cooking i.e. from TBCS to TIFICS and LPG, results in decrease in cost of cooking a meal. LCCM of TIFICS was 53% lower compared to TBCS and higher by 30% compared to LPG cook stove. Conversion efficiency of TIFICS and TBCS is lower compared to LPG stove. This results in higher level of energy and hence fuel consumption in TIFICS and TBCS is higher compared to LPG stove. The higher LCCM of TIFICS and TBCS is attributed to these facts.

An important observation from Dikarijan village showed that 22 out of 93 households owning LPG stove cook also used TBCS in order to prevent frequent refilling cost of the LPG cylinder. Fuel stacking was maintained in these households and two out of three meals in a day was prepared using TBCS. Similar cases can be identified in different regions of India. Thus, with lower LCCM compared to TBCS, TIFICS can be used in conjunction with LPG stove considering the cost savings associated with it. However, TIFICS can be used as a replacement in other households where entire cooking was performed using TBCS.

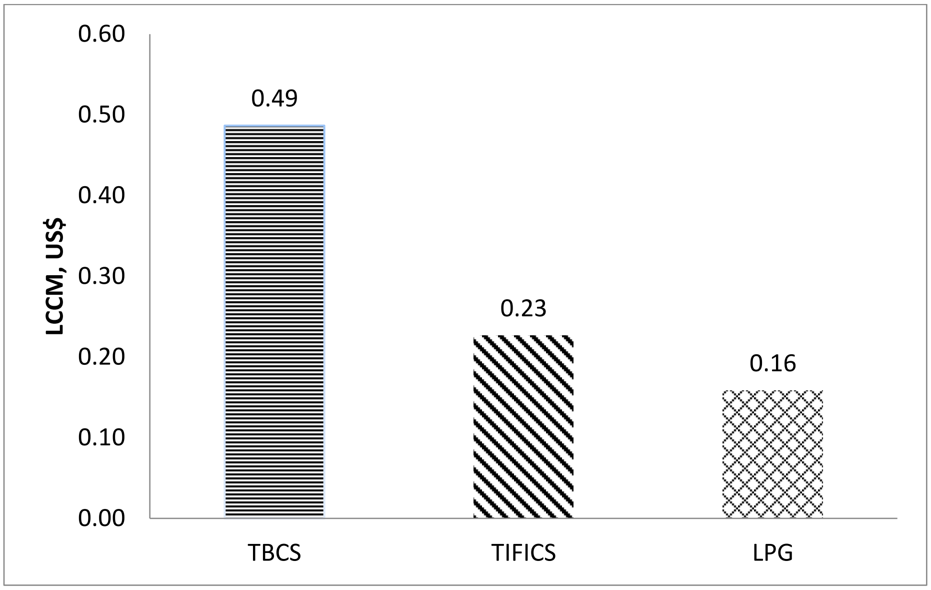

Fig. 5.1 LCCM of cooking devices

Table 5.2 Favourable features of cooking devices

Factors influencing adoption	TBCS	LPG stove	TIFICS
LCCM	×	√	×
Illumination	×	×	√
Battery charging	×	×	√
Clean cooking	×	√	√
Thermal energy storage as hot water	×	×	√

A sensitivity analysis of LCCM was carried out considering the increasing rate in fuel costs and shown in Fig. 5.2. Increase in fuel cost is expected to affect all the three cooking devices. LCCM of TBCS at existing fuel cost is 0.49US$, but as rate of fuel cost increases from 5-50%, LCCM of TBCS increases considerably from 0.5US$ to 0.73US$ which is the highest for any of the cooking devices and thus will never be favourable compared to the other cooking devices. However, with increasing rate of fuel price, LCCM of TIFICS increases at a slower rate i.e. from 0.23US$ (5%) to 0.24US$ (50%). Interestingly, LCCM of LPG cooking stove at 50% increase in fuel cost is similar to LCCM of TIFICS.

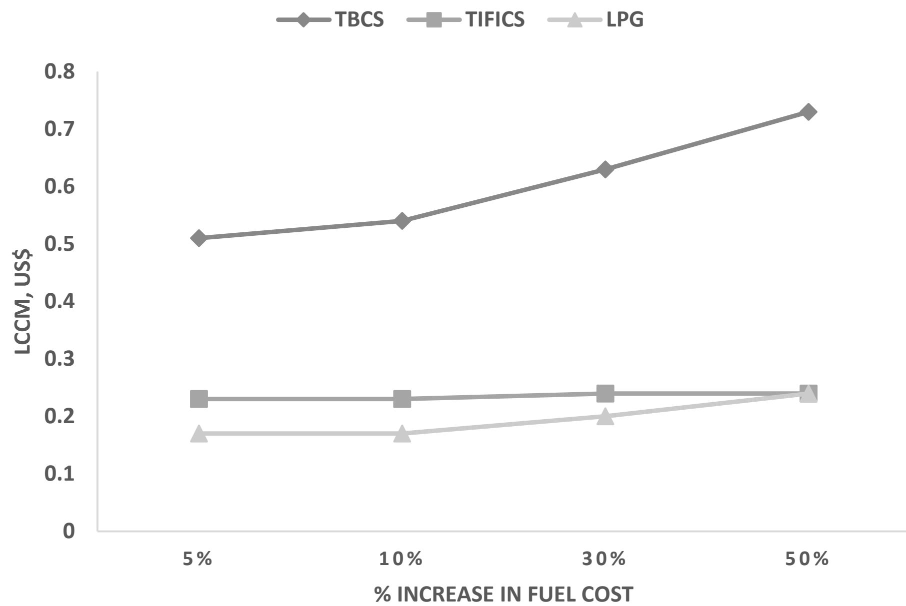

Fig. 5.2 Sensitivity analysis LCCM with respect to increase in fuel cost

Although, LPG cook stove is observed to be a favourable cooking option compared to TIFICS and TBCS, there are additional factors such as, electricity generation (illumination and battery charging), clean cooking and thermal energy storage in the form of hot water that favours TIFICS over LPG as well as TBCS (Table 5.2). The multi-functionality of TIFICS was capable of reducing the hardships of the section of people facing indoor air pollution, hazardous kerosene, in addition to unreliable electricity. The multi-fold advantages of TIFICS over LPG and TBCS makes it a prospective solution to be disseminated in energy deprived regions in spite of its low LCCM as compared to LPG mode of cooking.

5.3.2. Potential savings due to introduction of TIFICS

The material savings was estimated and considered for the current year and presented in Table 5.3 and Table 5.4. An average firewood savings of 4-5.5 kg/day was observed among the households during the usage of TIFICS. More than 100US$ of costs was estimated to be saved through firewood savings among all the households with H2 saving the highest (145 US$).

Table 5.3 Firewood savings

Household	Firewood consumption kg/day Pre-deployment	Deployment [a]	Savings, kg/day	Annual monetary savings (US$)
H1	11.0	7.0	4.0	105
H2	13.5	8.0	5.5	145
H3	15.0	10.0	5.0	131
H4	13.0	8.5	4.5	118

[a] *Average of 90 days is used for estimating firewood consumption during deployment using TIFICS*

As discussed in Chapter 4, households in the study area used predominantly two types of kerosene lighting options viz., (i) hurricane kerosene lamp (HKL), and (ii) exposed kerosene wick can lamp (EWL). Both of these lighting options were available in different capacities i.e. 350ml (HKL) and 50ml (EWL). Average value of 3 months (90 days) field test kerosene consumption was recorded. Kerosene savings was obtained by deducting monthly kerosene consumption during pre-deployment phase and deployment phase.

Every household received 3L of subsidized kerosene (0.36US$/L) per month and in times of excess requirement beyond 3L, they have to pay 0.57US$/L for every extra litre of purchase which is the unsubsidized rate.

Night time illumination from TIFICS in the cooking space brought down kerosene consumption in the range of 50 to 75ml/day thus saving around 65 to 110ml/day (Table 5.4). Around 3h of night time illumination was reported by users of H1, H2, H3 and H4. Majority of kerosene savings was recorded at H4 i.e. 110ml/day contributing to monetary kerosene savings of 20US$ annually. The variation in kerosene savings was mostly due to subsidized and unsubsidized rates of kerosene. Annual kerosene savings in the range between 24-40L was expected which translated to savings between 10 and 20 US$ annually.

Table 5.4 Kerosene savings

Household	Kerosene consumption, ml/day		Savings in kerosene, ml/day	Annual monetary savings (US$/y)
	Pre-deployment	Deployment [a]		
H1	165	75	90	10
H2	115	50	65	10
H3	165	60	105	19
H4	165	55	110	20

[a] *Average of 90 days kerosene consumption is estimated*

The monetary savings obtained from firewood and kerosene could be utilized in other activities for the livelihood improvement of the users.

Laboratory and field testing results were analyzed and based on the analysis TIFICS was found to be technically perfect for capturing waste heat from traditional fixed clay cook stoves which are prevalent in the study area. Further, from the responses of the user, the technology was found suitable. However, there are certain areas which needs to be addressed for further dissemination and acceptability of TIFICS. Additionally, there could be barriers of TIFICS dissemination considering the society and economics of the stove. , The present study also analyses the different policy for improved cook stoves in India as well as in other parts of the country. Based on such review, it is anticipated that some specific policy guidelines will be useful to assist for further dissemination of TIFICS. The following section discuss the various policy driver that can be incorporated or introduced to prevent the barriers.

5.4. Policy support desired for dissemination of TIFICS

Success of any new technology depends upon the ability to address its barriers appropriately. Improvement of the cook stove has been a universal attempt for most period of the time along with support from government and research organizations. There are several financial supports through policies to mitigate the adverse impact of traditional cook stoves particularly the indoor air pollution and excessive firewood consumption. However, there have been mixed degree of success as per as improved cook stove is concerned. The identification of regional factors and planning policy which pose as a barrier and running the policy tools to address these barriers are required for the introduction of TIFICS in rural Indian context. The Government of India has existing policy support for introduction of improved cook stove. TIFICS could also be included as an appropriate improved cook stove particularly in regions where affinity of traditional cook stove is very strong and where there is inadequate supply of grid electricity. For that matter, some new guidelines could be formulated in the existing policy as highlighted below. In this section, we have identified five specific policy driver for TIFICS promotion and dissemination as shown in Table 5.5.

Table 5.5 Policy for TIFICS promotion

SN	Policy	Proposed deliverables
1	Electricity generating cook stove	Promote cook stove with features of waste heat recovery and conversion into electricity in regions with biomass cooking and inadequate access to electricity in addition to regions where cost of supplying grid electricity is high
2	Business plan	Promote TIFICS in existing business plan and schemes
3	Custom compatibility	Promote TIFICS as user friendly electricity generating cook stove with negligible changes in existing cooking habits
4	Users' participation	Promote TIFICS dissemination with an aim to train users
5	Integration of TIFICS with national schemes	Promote TIFICS to fulfil partially or fully the objectives of national schemes of clean cooking and electricity access

5.4.1. Promotion of cook stove with provision of waste heat recovery and generation of electricity

In India, government has agreed to meet the UN SDG7 by 2030 by providing universal clean and affordable electricity for all [28-30]. Continuous efforts has been made to make 100% household electrification throughout the country [29]. However, there is a delay in covering the entire population and though in some regions there is electricity, the supply is intermittent and unreliable. For such conditions during the transition period, TIFICS is a potential solution. As observed from the experience of this research work, introduction of TIFICS can generate electricity without additional resource and without disturbing the tradition of cooking customs. Conservation of energy of the cook stove, provision of a clean environment in cooking through chimney, and generation of electricity for illumination and phone charging appears to be attractive options for the cases discussed above. However, organisational support is required from the research and development sectors as well as the government to promote TIFICS further. As similar support is done for other improved cook stoves, TIFICS can also be included in the list of approved cook stoves. Additionally if waste heat recovery for generation of electricity to illuminate and charge battery powered devices is included as a desired feature for improved cook stove which is found feasible in this study, TIFICS could get an extra lift for recommendation and promotion.

Further, the concept of promotion of TIFICS will also have the relevance to other regions. For instance, African governments have been prioritizing electrification for all round human development [31-33]. African leaders adopted Agenda 2063 to provide universal energy access while mitigating climate change by 2063 for the socio-economic transformation of the continent [34]. In majority of Sub Saharan African countries, the power sector is challenged with high prices, low efficiency, unreliable electricity supply and low generation capacity. For such countries to be economically developed with expected rise in population, it will be difficult to meet the electricity demand. A significant scale up of the power sector including generation capacity and transmission and distribution network is required to provide 100% access of electricity. Thus in African countries, where issues of lack of electricity access and dominancy of traditional cook stove prevail, TIFICS appears to be a prospective technology for dissemination.

5.4.2. Business plan for promotion of TIFICS

Considering the facts discussed, the ability of TIFICS to provide illumination and charge mobile phone could be a solution to regions till reliable electricity is ensured. In order to channelize the benefits of the know-how generated in the present research work, an appropriate business plan will be required. This work provides the basic technical information regarding the potential market of TIFICS concerning a specific rural region in Assam (India). Similar markets also exist in other parts of the world including in South East Asia and Africa. A detail market survey might be useful before such a business plan in the respective countries. In the context of India, there have been many drivers like Startup India and MUDRA (Micro Units Development and Refinancing Agency) for getting policy benefits to open and establish such socially relevant enterprise [35]. With more than 2.5

billion depending upon traditional biomass cook stoves globally, and with the multi-dimensional supports including the mission of clean cooking, energy conservation and rural development, it is expected that TIFICS could be disseminated to the needy section of the rural population. Existing mechanisms or missions TIFICS can also be considered or incorporated under these schemes prevailing in India.

5.4.3. Technology compatibility with prevailing customs

Integration of technical and existing cooking customs is important consideration towards disseminating a technology in rural areas. Most ICS programmes are technology oriented with special focus on improving engineering stove design and manufacturing process for large scale dissemination [2, 10, 13]. There are evidences of ICS dissemination failure where input from target users regarding design specific to user requirement were not considered. Issues such as, passage block inside chimneys, structural cracks, pot hole mismatch with local pots and choice of fuels were reported from stove programmes from India, Nepal, Peru and Guatemala [11, 36-39]. In a study carried out in West Bengal, India stove users adjust the pot hole (to accommodate vessels) and fire wood mouth of ICS according to their need [36]. The factors or aspect desired or required by the local community were addressed while designing the *Sukhad* stove. It appears that TIFICS will be compatible with existing customs.

TIFICS is a multi-utility device with provision of simultaneous space heating, warming of food, and multiple pot cooking. Apart from this, type of fuel is also an important factor for deciding the preference of a cook stove. Most of the ICS fails to consider the predominantly available cooking fuel in a particular region. Most users face the issue of regulating or controlling the flame in natural draft type ICS whereas in forced draft ICS, users find the processing of fire wood in smaller pieces tiresome. In absence of market for processed fire wood in rural regions, the adoption of forced draft is restricted [40-42]. Further, a study in Karech village, India, reported that users found ICS i) easily tip over wasting both time and food; ii) difficult to light; iii) over and under cooked food and iv) high cost in repair and maintenance [2]. It is evident that adopting new stoves, users have to abandon their cooking customs and recipes, learn new cooking techniques, adjust to alteration in food taste and finally indulge in laborious activities such as cutting firewood into desired sizes. Most of ICS designed are not versatile in terms of fuel use. It is observed that ICS do not meet the wide applicability of a traditional cook stove. However, in the present study, TIFICS attempted to address these aspects. The multifunctional requirements of users are addressed and also the fuels available in the regions were usable in TIFICS. Thus it appears that promotion and dissemination of TIFICS would be easier.

5.4.4. User participation for TIFICS promotion

One of the major barriers of previous ICS dissemination is the higher (non-affordable) cost associated with the stove. ICS are targeted for rural regions where affordability is an issue [13, 43, 44]. The cost of TIFICS has been estimated as 75US$ per unit which may come down if manufactured through a mass production scheme up to 29US$ per unit whereas the average income of such regions are in the range under 1.9-4.3 US$/day [45, 46]. This was based on the experience of manufacturing TIFICS during the research work. However, despite of the several benefits as discussed earlier, the cost appears to be a barrier for TIFICS dissemination. There have been many examples of addressing this affordability issue through policies by the governments. Experience of two government sponsored schemes, viz., National Programme on Improved Chulha (NPIC) by Ministry of Non-Conventional Energy Sources (now MNRE) and China's National Improved Stove Programme (NISP) could be to guiding tool for promoting TIFICS through appropriate financial support [47-49].

In India, dissemination of about 35 million cook stoves from 1985-2002 under NPIC has been reported [47, 50]. However the scheme was also through a subsidy given to stove manufacturers [51]. The inability to connect the users in the subsidy programme has resulted several shortcomings in the manufacturing of the stoves such as, i) failure to accommodate household cooking pot, ii) failure to withstand the heat required for cooking, iii) failure to provide savings in fuel wood consumption [2, 36]. As a result, the expected level of success could not be achieved. Alternatively, in NISP, the user participation were made compulsory to get the benefit of the subsidy for the dissemination of the cook stove and therefore the features required by the user and the perfection in manufacturing were achieved and thus the higher degree of success compared to India's NPIC. In light of the above it is desired that TIFICS manufacturing could be considered through users' participation. The development of rural entrepreneurship taking the benefit of several rural development schemes and national mission in India like Make in India, and Start-up India appears to be appropriate to ensure benefit of TIFICS to the user community. On behalf of TIFICS dissemination, it is suggested that majority of subsidy should be provided to the beneficiaries rather than the manufacturers so that much attention can be provided to the design aspect.

5.4.5. Prospect to include TIFICS with schemes of rural development

Government of India has realized the issue of ineffective cooking devices, electricity and unreliability electricity access and laid out certain schemes for the benefit of users in such regions. The experience of users during field testing highlighted the potential of TIFICS in supporting national schemes of clean cooking and universal electricity access. Any provisions to benefit the disadvantageous rural people, the schemes should be channelized to promote TIFICS as it is potential to fulfil partially or fully the objectives of the schemes as shown in Table 5.6.

Table 5.6 TIFICS and government schemes

Schemes	Important feature	Options for TEGIS
Power for All [52]	Provide reliable and quality electricity supply at affordable price across all non-electrified households, strengthen transmission, improve energy efficiency, employ RE, adequate power supply to agricultural consumers	TIFICS could play a part in providing electricity during load shedding hours, power cut resulting from natural calamities such as storm and flood
Pradhan Mantri Har Ghar Bijli Yojana (SAUBHAGYA) [53]	Free electricity to all households in EWS group., provide Solar PV based standalone system in areas without grid connectivity, Households not in EWS should pay INR 500 for new connection	TIFICS could be distributed in regions without grid connection. Provision of payment in installments can be done
Deen Dayal Upadhyaya Gram Jyoti Yojana [54]	Provide grid electricity to rural and remote areas without grid connectivity.	TIFICS could play a part in providing electricity during load shedding hours, power cut resulting from natural calamities such as storm and flood

MNRE's Solar Study lamp scheme [55]	Distribute solar study lamp to 70 lakh students from Class 1 to 11 in regions without electricity access	The results from field study showed that school going children are benefited from the 3 W LED lighting from TIFICS. In this regard, the technology can play its part
Pradhan Mantri Ujjwala Yojana [56]	Launched on May 1st 2016, the scheme will distribute 50 million clean LPG cook stove connections to below poverty line (BPL) families	TIFICS can be integrated under Ujjwala Yojana as clean cooking is ensured with it
UJALA (Unnati Jyoti by Affordable LEDs for All) [57]	Launched on January 5th, 2015, the scheme was aimed to replace 770 million incandescent light bulb with LED bulbs in the country	TIFICS with provision of LED lighting during night supports UJALA scheme

5.5. Summary

In this Chapter, we have presented a comprehensive analysis of TIFICS in terms of economic benefits and policy support desired for dissemination of TIFICS. The analysis is carried out on the information generated from field testing in a selected rural area.

Economic benefits in terms of firewood and kerosene savings with additional features of electricity generation, clean cooking and thermal output in the form of hot water favours TIFICS over existing cooking devices in the selected area.

The benefits of TIFICS are potential to infuse itself into existing government schemes on clean cooking and electricity access with appropriated financial institutions.

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