

# Experiences in the first introduction of the new improved Agni Sakhi biomass stove to a rural community



Project completion report



Bengaluru

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## Executive Summary

The Census of 2011 informs that about 173 million Indian households – as high as 70% (88% in rural areas) still use traditional fuels such as firewood, agricultural residue and dung cakes as a primary energy source for domestic cooking. This resulting in hazardous levels of smoke and particulate emissions, avoidable burning of excess biomass which can be used for other applications. A recent report by Lancet<sup>1</sup>, the noted medical journal stated that Indoor air pollution caused 1.24 lakh premature deaths in India in 2015.

This report discusses field experiences and user specific actions carried out by TIDE, for a 200 stove dissemination pilot of a new advanced, forced draft two pan, agro residue fired cookstove Agni Sakhi in Chikkaballapur district of Karnataka India. Agni Sakhi, is a recent innovation from Energy Advanced Sustainable Technologies Foundation (FEAST) designed for use in households. It is fuelled by sun dried cut agro residue (around 5 cm long). The technology is an ejector based air supply system designed for intimate mixing between the volatiles and air. It ensures clean and complete combustion of biomass fuel and very good heat transfer. The technology is IP protected (Indian Patent pending) and the rights rest with FEAST. The stove has been developed by the same team that has earlier developed the Oorja stove. After successful user trials TIDE and FEAST would now initiate actions for testing version 2 the stove as per IWA standards in reputed, certified stove testing laboratories.

Considering that the Agni Sakhi stove was manufactured for the first time, several manufacturing processes had to be standardized and the cost of the stove was high. But the project team assessed that the first pilot would focus on ‘willingness to use’ rather than ‘willingness to buy’. So, cost reduction and manufacturing improvements were put off until the present study was completed. But with extensive presence in the field, the study also believed that it could propose an innovative payment option for the stove by paying through surplus or saved biomass.

Siddlaghatta was also chosen because of (i) abundant surplus of mulberry sticks (ii) proximity to Bangalore (iii) presence of a credible community based organization (iv) endorsement of the stove by farmers during pre project demos and (v) high percentage of electrified houses. A farmer survey confirmed that every land-owning household generates a about 8 to 9 tons of mulberry residue / acre / year. Baseline data collected showed that a traditional stove required 0.57 kg of agro residue for preparing 1 kg of cooked rice. Baseline data collected from 6 households that used LPG as a primary fuel for cooking showed that the average per capita LPG consumption is 80 grams / day. A walk through survey showed that biomass was extensively used for bath water heating, cooking for farm labour and for cooking non-veg food. The poorer households also used only the traditional stove for cooking.

This project also enabled learning on manufacturing and key manufacturing improvements to be explored during commercialization of stoves. The components that required more attention to detail in manufacturing were (i) power unit and its components (ii) air supply system and (iii) insulation. Stove users recommended that (i) the size of the fuel feeding hopper should be increased (ii) the stove should be made in a single piece without any detachable components except the power unit (iii) the

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<sup>1</sup> [http://www.huffingtonpost.in/2017/10/31/indoor-air-pollution-killed-1-24-lakh-people-in-india-in-2015-lancet-report\\_a\\_23261541/](http://www.huffingtonpost.in/2017/10/31/indoor-air-pollution-killed-1-24-lakh-people-in-india-in-2015-lancet-report_a_23261541/)

power unit should be smaller and lighter and it should not interfere with the cooking (iv) the charging slot should be fixed (immovable) (v) the length of the adapter wire should be longer to operate the power unit on mains and (vi) the ash box and power unit should be on the same side or ash box should be operated from the fuel feeding side for convenient operation. In addition to design and manufacturing recommendations, other conveniences that enabled user friendliness were identified and some of them implemented during the project period itself.

In the initial stage and during stove manufacture, it is important that the technology developer, the manufacturer and the dissemination agency be in constant contact with each other, cross checking the product under development and sharing information. Quality assurance parameters must also be introduced and verified at the level of manufacturer and the distribution partners to ensure that defective pieces are not introduced into the sales channel. The project acquired an understanding of the facilities that a manufacturing unit should have and the level of detailing that must go into the purchase orders.

This project has not explored the stove financing issues. The payment option by paying in kind through abundant surplus biomass available locally did not appeal to the community. They said that the same was not workable. But the potential for sustained positive triple bottom line impact would be compromised if the MRP of the stove was unaffordable. FEAST the technology developer has already initiated efforts to reduce the ex factory cost of the stove to around Rs 3500 assuming high production levels.

The fuel security and low or no recurring cost of cooking that the Agni Sakhi stove offers to its users addresses a major concern regarding availability and recurring cost of fuel. But even a relatively simple requirement of local availability of sized biomass is a challenge in villages. Local initiatives for making the same available are a major challenge and require more work. An important lesson is that the same should not be trivialized. When agro residue of the recommended size is used, it is immediately translated into significantly lower emissions and less tending of the stove.

A survey on agro residue availability at the taluk level is important and the stove must be launched from these agro residue rich but otherwise poor regions. Latest information on generation of agro residues are available with the department of agriculture of the state governments. Data collected from Agriculture dept. Government of sources for Karnataka for the year 2015 shows agro residue generation of 7.2 million tons. Data from <http://biomasspower.gov.in/biomass-info-asa-fuel-resources.php>) estimates the residue to be 9 million tons from Karnataka. Maize stalks, coconut fronds and cotton stalks top the list. Belgaum and Haveri districts generate the maximum agro residues.

But a major data gap is the existing usage patterns of the agro residues. TIDE has generated this information locally for mulberry cluster in Karnataka. The mulberry crop generates about 9 tons / acre / year of agro residues. The project estimates show that each household burns 2.5 tons of agro waste every year for their cooking, bath water heating and other needs. But the villagers estimate that this number is 3.5 tons / year. Other fuel related data measured in the field are:

Bulk density of mulberry sticks (kaddi)	44 kg / cu. m
Bulk density of mulberry stems (dumpe)	70 kg / cu. m.
Gross calorific value of the same	3960 kcals / kg

Ash content

2.4%.

A major contributor to the success of the project was its ability to forge relationships with many and credible local institutions. The project developed working relationships with SHGs, fuel aggregators, local dealers and technicians and a farmer producer company (FPO). The latter has recently signed a tripartite agreement with a biomass pelleting unit and a progressive local farmer for supply and processing of 10 tons / day of mulberry waste. Contact was also established with another FPO in Kolar that was active in the mango cluster - the Holur Horticulture Farmer Producer Company Holur. These farmers have offered biomass resulting from the annual mango prunings which is available in surplus.

For stove sales, the project worked with local women from self help groups for carrying out awareness meetings. In early stove demonstration meetings, there was very positive response from women. They said that they were now aware of the value of the biomass around them. They said that they could save fuel and earn money by selling the saved biomass after switching to the Agni Sakhi stove. But the project progress met with an unexpected hurdle. The PMUY programme of LPG supply by the Govt. had recently penetrated into the villages in Siddlaghatta in a big way. Most households now had LPG connections and many of them discovered that they could not afford the recurring cost of LPG. The practice of paying for cooking fuel was also alien to them. But families were enthused about LPG because it was a clean fuel that cooked fast; it was also a status symbol. The awareness creation strategy had to be reworked. The pitch was fuel security, no recurring cost of cooking and time saving, an LPG quality flame and with free fuel.

The project focussed on 'willingness to use' Agni Sakhi as the primary goal of stove sales. The course correction carried after the entry of LPG in the villages was (i) to reduce the MRP of the stove to Rs 1000 (ii) awareness creation done by TIDE by deploying women from the community and stove sales through local entrepreneurs / dealers with attractive commissions. Response from the awareness meetings were mixed. Long time users of LPG were not enthused – they said size reducing biomass was a drudgery. Households wanting to migrate to Agni Sakhi from traditional stoves and recent adopters of LPG who were feeling the financial stress of recurring payment for cooking fuel did not mind using sized biomass in an advanced stove. There was equal interest among men and women.

Early awareness raising by self help groups did not result in the desired sales, it provided valuable insights to stimulate sales. Actual stove demonstrations created a very positive impression about the stove in people's minds. The quality of the flame caught their attention and they said that the stove performance was on par with LPG. Men, more than women were keen on buying the stove. They controlled the household finances and felt the pinch of recurring payment for LPG. It is important to attract both men and women from a household to a stove demonstration for easy and quick purchase decision making. But in the market place, women were seen rejecting every cooking option that required them to move away from LPG.

The project sold stoves through the FPO, through a Siddlaghatta based agricultural and cycle repair shop and through a travelling dealer. Stove were sold by the FPO largely to rich farmers who had LPG connections but purchased the stove for bath water heating and other needs. The dealers sold to the poorer communities and were supported by the vehicle campaigns conducted by the project. The vehicle campaigns travelled to poor villages and targeted communities that could not afford LPG. The

features of the stove that caught immediate public attention were (i) the stove body was not hot to touch, (ii) water was boiling really quickly (iii) The speed and the sound of the flame was reassuring and people started comparing the stove with LPG.

Vehicle campaigns also provided varied learnings and interesting user interactions. (i) Many households were using traditional stoves in spite of availing the free LPG connection (ii) complete shift to LPG was not affordable (iii) stove demos with mixed fuels were more appreciated (iv) when mobile stove campaigns were held in weekly markets rich discussions with a cross section of people were possible.

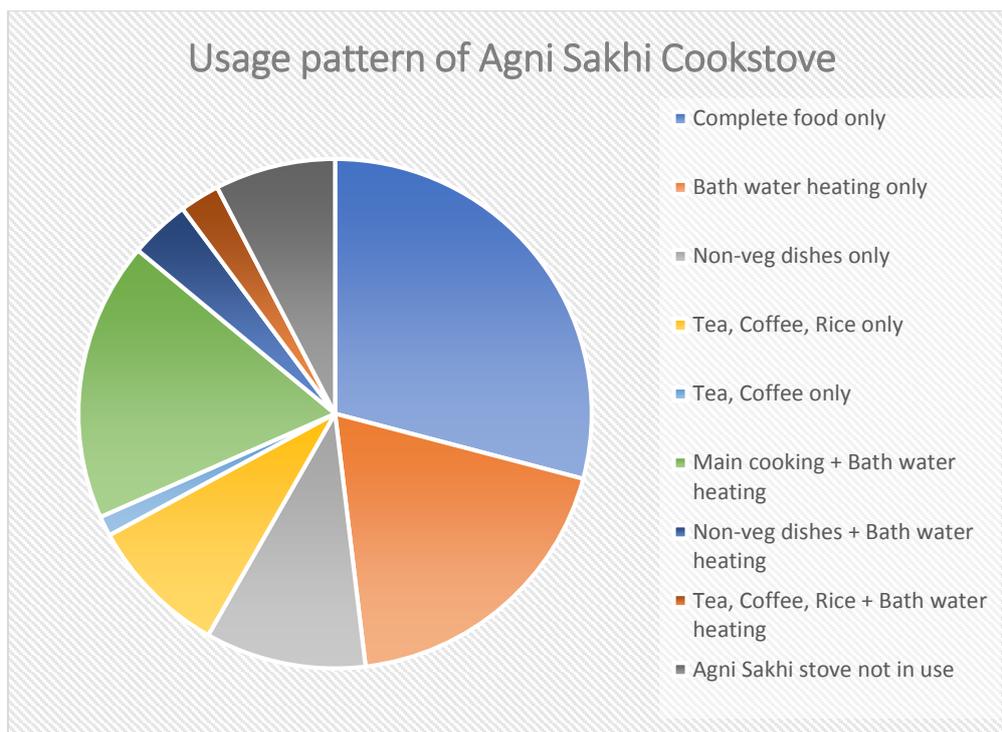
Richer households that could afford LPG were using Agni Sakhi for other uses like bath water heating, cooking non veg food outside the kitchen, cooking for farm labour and for fodder preparation. Poorer households were using the stove for primary cooking. Variety in use of the stove was a very valuable and positive feedback. It implied that the stoves were useful and accepted by both rich and poor households and for multiple uses

The project worked in a partnership mode with a cross section of partners - a community based organization, self help groups, a farmer producer company, stove dealers, a fuel aggregator and local technicians. None of them had worked on a stove dissemination project before Sustaining these partnerships required tact, working towards good inter personal relationships and mutual trust. The fact that the project team comprised men and women helped in relationship management. But TIDE also tried to categorise these partners as (i) partnerships for a limited, time bound intervention without much investment from the project team (ii) partnerships without a commercial angle requiring capacity building investment by the project (iii) partnerships with a commercial angle and (iv) long term relationships based on trust. Different methods of nurturing these partnerships were developed but usually the project gave more than what it asked of the partner.

The project encountered many challenges and had to evolve and implement a course correction that was time consuming. The project primarily tracked users and user behaviour. It was able to reach out to 40-45% of the users for qualitative information. It also captured field level information on fuel saving for shift from traditional to Agni Sakhi and cost saving when shifting from LPG to Agni Sakhi.

Baseline data shows that the traditional stove in the region was very similar to a two pan improved natural draft stove with chimney (efficiency not measured but estimated to be around 20%). So the fuel saving data below should be understood as saving by shift from an improved natural draft stove to a forced draft stove. Cost saving data is also reported for shift from LPG to Agni Sakhi

Usage	Fuel saved /stove / year (kgs)	Usage	Cost saving / stove / year (Rs)
Complete meal shift from traditional to Agni Sakhi	426	Complete meal shift from LPG to Agni Sakhi	5762
Bath water heating shift from 3 stone to Agni Sakhi	455	Tea/coffee/rice shift from LPG to Agni Sakhi	2004
Non veg cooking shift from three stone to Agni Sakhi	71		



The user feedback from the stoves has been consistently positive. They say they liked the stove because it offered (i) reduction in cooking time of 40 mins / day which is a significant time saving for them (ii) a high temperature and high velocity flame which gives a cooking experience similar to LPG without the recurring cost (iii) the stove could cook two dishes simultaneously and also offered the flexibility to use as a single pan with large vessels if required (iv) the highest acceptance for the stove was coming from users who had recently migrated to LPG (about 6 months to one year) but discovered that they had not planned for anticipated the high cost of cooking with LPG.

The consistently high usage of the Agni Sakhi stove has been very encouraging. The high acceptance is extremely visible when households are adopting the stove for non family cooking needs like bath water heating, cooking for farm labour etc. If Agni Sakhi stoves can be made affordable, they would feature prominently into the household energy stack. Agni Sakhi stoves are now in use in 55 villages.

Some problems however do remain, especially size reduction of fuel prior to usage. The temptation to use larger pieces of fuel is extremely high. Efforts have been made to support electric fuel cutters in two villages but sizing the fuel is an issue that must be addressed for better stove performance.

#### ***Learning and course corrections***

The 200 stove experiment was a success with all buyers of the stove using it for different cooking and heating needs. This gave good insights into stove stacking, 'willingness to use' and 'willingness to buy'. It highlighted to need for reducing the MRP of the stove, increasing the life of the stove and need for a reliable service infrastructure equipped with tools and spares locally. Development of a version 2 of the stove is in progress. This would mainly introduce user friendly features and operational convenience.

The course correction that the project introduced was effective in stimulating sales of 200 stoves to a cross section of users. Some lessons like working in a partnership mode, awareness through women's networks and sale through dealers, effective awareness content and sales pitch can be universally adopted during scaling.

#### *Recommended good practices*

- Good accounting practices to be followed by dealers
- Train every user in stove usage until there are a critical number of stoves in a village with opportunity for experience sharing and peer learning.
- Share stove user training with users through social media.
- Sensitize every user on fuel preparation. Going forward include 10-15 kg of sized fuel as a free gift with the stove purchase. This would set the bench mark for good stove performance.
- Track every complaint by the user. Equip the local technician with spares especially of the power unit and its components.

#### *Cookstove financing issues identified but not addressed*

Consumer financing options are extremely important for scaling. Regions where the stove has been accepted and 'willing to use' has been established would require consumer financing to transition to 'willing to buy'. This vast but unexplored issue must be addressed perhaps through another dedicated project in the same project area.

#### *Fuel management*

- This needs to be done at the local and the ecosystem level. Secondary data shows that the annual generation of agro residues in India is 145 million tons. There is presently no information available on the usage of this agro residue and an assessment of the true surplus after its use for meeting local cooking and heating needs.
- Studies on utility and efficacy of different farm and transportation equipment and recommendations for best practices in farm level loading / unloading, compaction, shredding, sieving and transportation of agro residues are required and must be available in public domain
- Studies in size reducing and sieving of biomass obtained from different types of agro residues, and with different size reduction equipment operating at different capacities are required and the information available in public domain.
- Development of standard operating procedures for procurement of sized agro residues, quality assurance parameters and procurement level testing of for the same.
- The focus of fuel management should be agro residues collected exclusively for fuel trade and not fuels that are incidentally accumulated because they are by product of value addition to agri produce.

#### *Social exclusion and gender issues*

There was a clear divide between the upper and lower caste, between the rich and the poor, the landlords and the landless who were working on rich farmer lands. Communication between the haves and the have nots and between men and women was difficult. The project conceptualization had failed to anticipate this reality to the extent that was experienced. The project had to work with the

richer landlords for fuel trade and sell the stoves to the poorer households who could not afford the recurring cost of LPG without interfering or influencing the current social construct.

Gender issues were encountered when the project was trying to implement the payment option for the stove by paying in kind (through fuel). Traditionally very few women have decision making power regarding sale of farm produce. The self help groups that associated with the project were from relatively rich and upper caste families. The awareness carried out by them was directed only at their peers and not at other women or men; the same did not stimulate sales but brought the attention to cooking energy issues. Vehicle campaigns had participation from men and women from the same family and were able to stimulate sales. After a stove demo, men were keener to buy the stove. The family finances were largely controlled by men and through this stove, they could see an opportunity to reduce the monthly fuel expenses and also offer to women a quality cooking experience.

The next tasks for TIDE are (i) piloting the low cost version 2 of the Agni Sakhi stove followed by certification of the performance of the stove and establishing its position in the IWA tiers. There is a lot of work to be done around fuel preparation, technician and user training and enterprise and end user financing. A scaling strategy can emerge only after the above ecosystem issues are addressed and an enabling atmosphere for stove dissemination created.

This project enabled TIDE to understand dissemination of a forced draft stove. TIDE could get an intimate insight into the decision making process of the different user segments. It is now in a position to take the stove to other regions with good understanding of the messaging, the different methods of community engagement, the correct stove pricing, the design modifications for version 2 of the stove many more such learning. The project could not explore the problem of making the stove affordable through financing innovations. The most positive message from this experience is that the community is looking for a change in their cooking behaviour. When the rich, LPG using landlords started buying the stove for different domestic applications, the economically backward people developed the confidence to buy. This risk taking behaviour needs to be further understood and triggers needed to be created for stove purchase (as the drop in the price of the stove provided).

In conclusion, the work done in the project would contribute to building conviction that with a little more additional work to address the identified gaps, very pertinent and path breaking options for clean cooking can be created wherever there is generation and availability of agro residues. For this it is important that the verified results and outcomes be disseminated widely for larger public good and universal