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ORP demonstration of Udairaj model improved cookstove

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Abstract **:** An ORP demonstration was carried out in selected villages of Raichur district to evaluate and demonstrate the technical soundness of improved cookstoves of Udairaj model for adoption by the rural women. The performance of the improved cookstoves was evaluated in terms of thermal efficiency and power output rating. Also, to analyse the adoption behaviour, the attributes such as relative advantage and compatibility were considered for the study. The results indicated that, the thermal efficiency of double pot improved cookstove of Udairaj model varied from 24 – 26 per cent as compared to that of 10 - 12 per cent for traditional *chulha*, while the power output rating of these *chulhas* was 1.42 and 0.98 kW, respectively. After installation of these cookstoves in identified households, it was observed that the improved cookstoves scored high relative advantage and compatibility as compared to the traditional *chulhas*. The relative advantage and compatibility of Udairaj model cookstove were 89 and 87, respectively as compared to that of 61 and 78, respectively for traditional *chulha*. The beneficiaries opined that these cookstoves are smokeless and there was 30 to 40 per cent saving in fuel over traditional chulhas.

Key words **:** Compatibility, Improved cookstove, Power output rating, Relative advantage, Thermal efficiency

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In India, women generally cook under poorly ventilated conditions using biomass fuels, either in pits or in non-portable open U-shaped stoves, called *chulhas*. These stoves burn biomass inefficiently and release high volumes of air pollutants into indoor environments, resulting in elevated pollutant exposures, particularly among women and children. More than 72 per centof Indian households, as reported in the 2001 census, still use unprocessed biomass as their primary cooking fuel (ORG, 2003). In rural areas, this figure is approximately 90 per cent. As a result, India bears one of the largest burdans of disease due to the use of unclean household fuels (Smith, 2000). According to the world Health Organization Comparative Risk Study, exposure to smoke from household use of solid fuels is responsible for the premature deaths of approximate 4,00,000 women and in India every year, or 28 per centof all deaths caused by indoor air pollution (IAP) in developing countries (Smith, 2000). Poor households currently relying on biomass fuels in the near future due to lack of affordability. Although overall use of biomass fuel has been projected to decline over the coming years, reliance in biomass fuels as a major source of energy will remain substantial in the foreseeable future (Stern, 1996). To serve this need and address other associated concerns in rural development, the appropriate rural technology have to be developed through the application of science and technological knowledge.

Rathore and Jain (2001) developed improved single pot and double pot chulhas for rural and tribal people. They reported that the thermal efficiencies of these chulhas were found to in the range of 21.78 to 29.08 per cent and the cost of single pot was Rs. 175 and that of double pot chulha was Rs. 230. Rob Bailis *et al.* (2007) conducted field based kitchen performance tests for monitoring and evaluation of three improved cookstove dissemination projects implemented between 2004 and 2006 by non-goevrnmnetal organizations (NGOs) in India and Mexico. They reported that all improved cookstoves showed statistically significant reductions in average daily per capita fuel consumption ranging from 19 to 67 per cent.

The merits of an improved cookstove over traditional one, are utilization of wood / biomass more efficiently, thus saving in the fuel wood and reducing the smoke thus saving the household women from the ill-effects of the gases associated with the burning of wood / biomass etc. The chulhas constructed in the rural areas made up of mud and clay are not

long lasting their dimensions and are also frequently changed through finishing with dung slurry. Hence, there is a need to develop improved cookstoves which will last long and are portable.

METHODOLOGY

One unit of double pot Udairaj model was constructed at College of Agricultural Engineering, Raichur as per design specifications given by the CTAE, Udaipur (Fig. A) and its performance was evaluated at the centre.

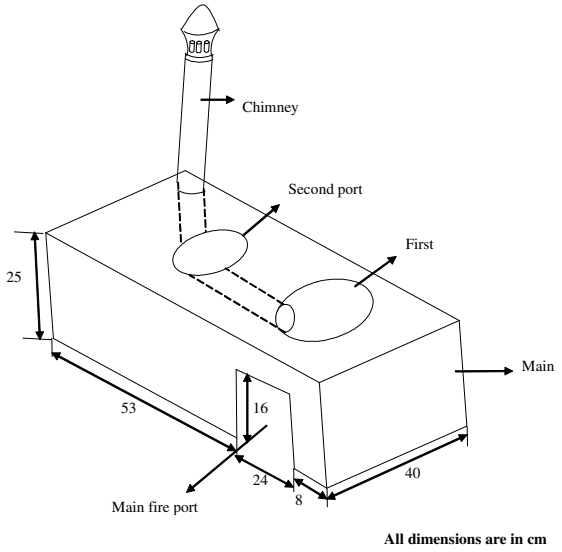

Fig. A : Line diagram of Udairaj model improved cookstove

The performance of husk cook stove was evaluated in terms of the thermal efficiency using water-boiling test as explained below :

$$\text{Thermal efficiency} = \frac{\text{Heat output}}{\text{Heat input}} \times 100 = \frac{Ho}{Hi} \times 100$$

Heat output is given by,

$Ho = m\ s\ \Delta t + L\ \Delta m$

where,

m = Mass of water taken

s = Specific heat of water, kcal / kg ^{0}C

Δt = Temperature difference, $(t_1 - t_2)\ ^0$C

L = Latent heat of water, kcal / kg

Δm = Loss in weight of water, kg

Heat input is given by,

$Hi = M \times CV$

where,

M = Mass of fuel, kg

CV = Calorific value of fuel, kcal / kg

The power output rating (PR) was calculated as given bellow

$$PR = \frac{f \times CV \times \eta}{860 \times 100}, \quad kW$$

where,

f = Quantity of fuel burnt, kg/hr

CV = Calorific value of fuel, kcal / kg

η = Thermal efficiency of stove, per cent

One hundred units of Udairaj model improved *chulhas* were constructed and demonstrated for their technical soundness in the selected villages of Raichur district. The performance of the improved *chulhas* was evaluated in terms of thermal efficiency and power output rating. To analyse the adoption behaviour, the attributes such as relative advantage and compatibility were considered for the study. A proforma was developed as given in Table A for colleting the users' opinion in terms of relative advantage and compatibility. The relative advantage is the degree to which the gadget is perceived as being better than the idea it supersedes. It indicates the strength of the reward or punishment resulting from the adoption. The other attribute compatibility is the degree to which the gadget is perceived as consistent with the existing values, past experience and needs of the adopters. The sub-dimensions of relative advantage and compatibility were selected on discussion with the farmers and scientists. Then the dimensions were ranked according to their importance. Based on the ranking, the raw scores for each dimension given by the users / adopters were collected and the average of scores were reported.

Table A : Proforma for collecting the users' opinion

Sr. No.	Dimensions	Rank
Relative advantage		
1.	Economic profitability	
2.	Low initial cost	
3.	Increase in comfort	
4.	Saving in time	
5.	Saving in labour	
6.	Less recurring cost	
7.	Less pollution	
8.	Preventive in nature	
Compatibility		
1.	Satisfaction	
2.	Less effort	
3.	Socially approved	
4.	Less uncertainty	
5.	Easy handling	
6.	Apt for the specific need	
7.	Immediacy of the reward	
8.	Reliability	

RESULTS AND DISCUSSION

The results of performance of the improved cookstoves are presented in the Table 1. It was observed that, the thermal efficiency of Udairaj model improved cookstove was 25 per cent as compared to that of 12 per cent for traditional chulha. While the power output rating of these *chulhas* were 1.42 and 0.98 kW, respectively.

Table 1 : Thermal efficiency and power output rating of improved *chulhas*

Sr. No.	Model	Thermal efficiency (%)	Power output rating (kW)
1.	Udairaj model improved cookstove	25	1.42
2.	Traditional *chulha*	12	0.98

The sub-dimensions of relative advantage and compatibility scores recorded are tabulated in Table 2. It was observed that the Udairaj model improved cookstove scored high relative advantage and compatibility as compared to the traditional *chulhas*. The relative advantage and compatibility of Udairaj model improved cookstove were 89 and 87, respectively as compared to that of 61 and 78, respectively for traditional *chulha*.

Table 2 : Relative advantage and compatibility of improved *chulhas*

Sr. No.	Model	Parameter	
		Relative advantage	Compatibility
1.	Udairaj model improved cookstove	89	87
2.	Traditional *chulha*	61	78

After installation of these cookstoves, the beneficiaries opined that there was 30 to 40 per cent saving in fuel over traditional *chulhas*. They also expressed that the improved cookstoves are smokeless. The smoke pipe got choked very often in some of the cookstoves as they used sunflower and cotton stalks as fuel. The cleaning of the cookstoves also as been demonstrated and they were asked to clean as and when the pipe got choked.

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