

# Historical Review Of Biomass Cook stove Development

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## Abstract

The domestic sector relies heavily on traditional sources of energy mainly for cooking for which traditional cook stoves are often used. These cook stoves are usually thermally as well as environmentally inefficient and hence create drudgery and health problems. Field evidences from many countries shows that the introduction of improved cook stoves has brought considerable benefit to rural masses. This paper is an attempt to address such a need and endeavors to improve on the technological development of cook stoves and review of what makes for success and failure for design of cook stoves.

Key words: Traditional cook stoves. Improved cook stoves .review, development, design

## 1. Introduction

In the past, traditional sources of energy such as fuel wood, charcoal, dung etc, were the only source of energy used for all type of applications. It is only during 250 years that fossil fuels such as coal, oil and gas and electricity have emerged as a major source of energy in most of the developed countries. However, nearly 75% of the world's population which in lives in the developing countries continues to depend on the traditional source of energy for most of their energy requirements.. The Asian countries the traditional source of energy accounted for about 60-90% of the total amount of energy consumed. In particular, the domestic sector relies on heavily on traditional source of energy, mainly for cooking for which traditional stoves are often used. These stoves are usually thermally as well as environmentally inefficient and hence create drudgery and problems for the users

## 2 Historical Review of cook stoves

### 2.1 Earlier History of Cook Stoves

During the earlier ages, cooking was presumably done over an open- fire with fuel arranged in a pyramid configuration. This mode of cooking primarily for roasting meat and heat during windy conditions, a lack of proper control over the fire exposure to heat and smoke

as well as fire hazards. However, at the same time, heat and smoke had also certain benefits such as food preservation and protection against large animals, insects. A major step

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towards the evolution of other cook stoves was the development of pots of various shapes and sizes. This necessitated the modification of the open-fire to create shielded- fire in order to balance the pot over the fire. The simplest form of the shielded-fire was a three-stone arrangement in which stones were arranged at approximately 120 degrees to one another on level ground. Besides, allowing a cooking pot to rest firmly on it, this arrangement also partly saved the fire from the vagaries of wind and slightly increased cooking efficiency. However by and large the three-stone fire still suffered similar drawbacks as the open-fire subsequently, the shielded –fire was changed to U shaped mud or mud/stone enclosure with opening in the front for fuel feeding and combustion air entry. Three small humps were positioned at the top rim of the enclosure and acted as a pot rest, induction point of secondary air needed for better combustion of volatile matter and for exhaust gas exit. In order to conserve heat from the flue gases and to enhance cooking productivity, additional pot holes enclosures were connected by a tunnel. All the above mentioned innovations in the cook stove design were made mainly by the users in light of their own experiences. These innovations did increase the efficiency of the stoves to some extent, but health and other hazards remained. Despite human evolution and the development which have taken place in stoves and fuel, it is to observe that currently most of the estimated 75% of the people who live in the developing world and still largely employing the three-stone or shielded-fire for cooking such as fuel wood an other biomass similar to their pre historic ancestors several year ago.

## 2.1 Resent Past History

In the early 1950's in India the first-phase of improved cook stoves (ICS) development started with technological attempts to improve the design of biomass fired stoves. Because of the appalling Smokey working environment of many Indian, kitchens in which women had to cook, improved multi pot stoves were introduced Raju (1953). These stoves which were of the high masses and shielded-fire type, had a chimney to remove smoke from the kitchen and had adjustable metal dampers to regulate the fire. Theodorolic (1954) was the first to conduct controlled laboratory tests on biomass burning ICS, in Egypt, although he did not measure the thermal efficiency of the stoves. Systematic studies on measuring cook stove efficiency were conducted by Singer (1961) in Indonesia on a high mass mud stone with similar design features to those introduced by Raju. During the second phase of ICS development extensive research and development studies were undertaken and a more sound technical base was laid as a result of detailed thermodynamic, heat transfer and aerodynamic studies. More systematic testing and design procedures were gradually established. A large number biomass burning improved cook stove models began to proliferate, especially from the laboratories in many developing and developed countries. For roughly 10 years, during the early 70s' and 80s various international donors had a very strong influence on improved cook stove development promotion and assistance all over the world, particularly in Asia, Africa and Latin America. Unfortunately, the impact of these aid programmes proved to be short lived. This was basically due to the inability of the programme to meet the expectations and actual requirements of the users, a lack of long-term development objectives, systematic institutional arrangements and

appropriate local man power development. During the third phase, which began as recently as the late 80's the emphasis shifted towards the needs of stove users based on lessons learned from the second phase? It was found that, in addition to the above mentioned criteria, factors such as cooking comfort, smoke free kitchens, convenience and safety in the use of the stove were considered by the users to be as important as fuel saving.

## **2.2 The Present History**

The global survey (Ramkrishna 1991) conducted by the Energy and Policy Institute of the East-West centre, Hawaii for the Energy Sector Management Assistance Programme (ESMAP) of World Bank has shown that the goals for improved cook stoves programme have substantially expanded and are now diverse. The results show that there appears to be a distinct pattern of prioritizing improved cook stove programme objectives in different geographical regions. The greatest importance was placed on smoke reduction, increased fuel efficiency and increased environmental awareness. The regional expert consultation on ICS development held in Udaipur (FAO/RWEDP 1991) where the status of South-Asian ICS programme was reviewed, common problems and constraints identified and strategies and future directions discussed, resulted in four comprehensive sets of conclusions and recommendations on issues related to research and development programme management ,policy and Institutions ,and involvement of women. The general consensus of the meeting was that “Future Improved Cook Stoves Programme should follow a wider systems approach should look at not only the introduction of ICSs but also at improved kitchens, cooking practices, utensils and fuels” In addition, the role of improved stoves in reducing harmful emissions and green house gases through cleaner combustion was also highlighted. In short the major concern in the modern context has been focused on indoor air quality, the linkage between the functionality of stoves and kitchens and the elimination of cooking drudgery as well as the method of dissemination.

## **3 Principles of improved cook stove Design and Development**

### **3.1 Improved cook stove design perspective**

The thermal performance of an improved cook stove depends upon the efficiency of the heat conversion system e.g. conversion of chemical energy of fuels into thermal energy. It also depends upon the efficiency with which the thermal energy produced is transferred to the delivery system, especially the cooking vessel and its eventual transfer to the food being cooked.

### **3.1 Stove Classification**

A large number of ICS models based on different construction materials, fuel and end use applications, have been developed during the last 10-15 years, a proper ICS classification is essential for identifying a model suitable for a particular user, availability of construction materials and fuels, ICS can be classified in to various categories

- 1) Mono-function stove

## 2) Multi function stove

### 3.2 Design critical and principles

A cook stove is best considered as a consumer-specific device, the engineering parameters needs to be taken in to consideration in designing an appropriate ICS. The thermal performance programme of an improved cook stove depends on the efficiency of the heat conversion system, the efficiency with which the thermal energy produced is transferred to the cooking vessel.

## 4 Experience from other countries

In developing countries, many programmes that had potential for alleviating indoor air pollution and reducing women's labour met with limited success because of the lack of consideration for women's needs and preferences. The women's choice of continuing to use traditional biomass stoves in a fuel scarce region may be quite rational if the design is not user friendly.

### 4.1 Kenya

In Kenya, a custom –made improved cook stove failed because women had neither time for the patience to cut the wood to the small size required by the stoves restricted box. In fact, many of the women who adopted the stove ended up enlarging its firebox, knowingly sacrificing energy efficiency for convenience.

### 4.2 Indonesia

In Indonesia, women were not willing to accept stoves in which fireboxes were placed one behind the other. Women wanted these fireboxes to be adjacent to each others as it was more convenient to them during cooking

### 4.2 China

In China, improved cook stoves have been well accepted, partly because of the involvement of women of the programme. The subsidy was limited and stoves were created to suit local community. By and large local producers were aggressive for dissemination of the improved stoves.

### 4.3 Honduras

In Honduras, energy –efficient earthen stoves have become very popular because of women were introducing technology to other women. Also credit facilities through co-operatives made loans available for which the monthly payment for both the stove and kitchen shelter amounted to the same as the monthly saving on fuel.

#### 4.4 India

The Indian Government invested in a lot of promotion to disseminate the improved cook stove in rural India through NPIC. A key element of the dissemination policy was the provision of a government subsidy to all house holds purchasing an improved stove. However the primary draw back in this method gradually become evident as multiple levels of government, bureaucracy complicated the initiatives and the budget was insufficient for the level of supervision and assessment which the programme required. Problems were not noticed and rectified in good time; lastly the programme was soon scaled down.

#### 5 Future needs for R&D

The main emphasis of the earlier cook stove R&D was on product development, with less concern on other aspects related to the requirements of users in cooking, as presented. R&D attentions should be focused and built up on the development of subsystem so as to improve the performance of the total cooking system. Despite long and considerable developments efforts made on the improved cook stove development, both in scientific and social aspects, a number of gap still exist in critical areas of subject which needs attention are combustion, transient heat transfer studies, environmental studies, kitchen design, improved utensils, stove construction material and heat of chemical reaction.

#### 6 Conclusion.

Nonetheless, faced with aggravating population pressure and fuel shortage, developing countries have option but to look for improved cook stove which can play an important role in mitigating fire wood demand. An attempt to address such a need and endeavors to improve on the technological development of cook stoves and review of what makes for success and failure for design of cook stoves if the design is not user friendly.

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