ABSTRACT
The planner & developer of Improved Biomass stove technologies for cooking successfully came with more energy efficient stove & significant household pollution for human health. Some studies have, so far, been made towards the identification of barriers to dissemination of Improved Biomass stove technologies for cooking in developing countries. However, most of these studies are quite general and, simultaneously, deal with several end uses of energy. An end use oriented energy strategy is recently being advocated. In this, energy demand is disaggregated by energy end use activity, so as to highlight the technological, economic, socio-cultural and institutional issues that are relevant for each important end use.

The present study is a modest attempt towards identification of barriers in dissemination of Improved Biomass stove technologies used for one of the most important end uses of energy, i.e. cooking. An effort is made to provide some insight regarding the issues and factors that are likely to affect the adoption of Improved Biomass stove technologies for cooking.

Keywords - Biomass, Efficiency, Stove technologies

I. INTRODUCTION.

Biomass is the fourth largest source of energy worldwide and account for about 35% of consumption in developing countries [1]. Biomass provides a large share of world commercial energy consumption in sustainable energy [2]. These biomass sources of energy are considered as the renewable energy. Biomass is used as fuel mainly in developed country in rural area for domestic cooking [3]. This one not convenience to users due to higher emission of indoor pollution so required to clean combustion for human health Objective of biomass cooking devices force either draft or natural draft in the rural environment to assessing of clean combustion with biomass fuel with suitable design equipment for biomass heat needs to understand the performance characteristics of biomass in order to avoid possible problems and utilize the biomass effectively.

1.1 Characteristics of biomass, fuels and their usage
Biomass is defined as “The measurable organic matter include trees & shrubs, crops and grasses, algae aquatic plant agricultural and forest residues plus all form of human animal plant waste”

The chemical composition of biomass varies among species, but basically consists of high, but variable moisture content, a fibrous structure consisting of lignin, carbohydrates or sugars, and ash. Biomass is very heterogeneous in its natural state and possesses a heating value lower than that of coal. An effectively uses of biomass can be a source of liquid fuel (e.g., biodiesel) or gaseous fuel (e.g., “wood gas”), but the most common use is as a solid fuel (e.g., wood, biomass pellets).

In spite of economic development, traditional solid biofuel (such as wood, agricultural waste, and dried animal manure/dung cake) is still widely used for meeting cooking and space conditioning needs though per capita usage of cooking bio-fuels has declined[4],[5]. Dependence of the population on unprocessed solid biofuels is expected in continue in foreseeable future [6]. The use of firewood or agricultural residues for cooking is accompanied by two environmental problems. First, pollutants like suspended particles, carbon monoxide and unburnt hydrocarbons affect the indoor air quality [7]. Bio-fuel combustion in traditional mud stove for cooking in households is a common phenomenon [8], [9] after modifications to adjust for variance in diet and cooking styles as a complex web of social, economic, technical,
organizational, and individual factors interact to influence adoption decision of cooking technologies at household level [9].

1.2 Technology development
Combustion of biomass in a cook stove is a variable process because thermodynamic efficiency of a cook stove depends upon a large number of factors such as stove design, fuel composition, vessel design, culinary practice, meteorological conditions and operational variables, such as fire tending and rate of heat supply, etc. Most of these factors are variable in nature and hence the thermodynamic efficiency of a cook stove is not a unique property of the cook stove. Thus, it has a limited utility and cannot predict the actual fuel consumption. The efficiency is a design tool rather than a means of predicting field performance of ICS.

Gasification is the process of converting solid fuels, such as wood, agricultural residues and coal, into a combustible gas. A biomass gasifier consists primarily of a reactor or container into which fuel is fed along with a limited (less than stoichiometric, or amount required for complete combustion) supply of air. Heat for gasification is generated through partial combustion of the feed material. The resulting chemical breakdown of the fuel and internal reactions result in a combustible gas usually called producer gas. The heating value of this gas is in the range of 4-6 MJ/Nm, or about 10-15 % of the heating value of natural gas. Producer gas is a mixture of the combustible gases hydrogen (H), carbon monoxide (CO), and methane (CH) and the incombustible gases carbon dioxide (CO2) and nitrogen (N); the actual gas composition may vary considerably depending on fuel type and gasifier design.

Biomass energy pathway (Table-1) contain mainly Combustion & Gasification for cooking, in accent days people also using Combustion Technology for cooking & lighting, cooking with combustion Technology having efficiency 6-9% as way 94% of energy waste due to Lack Of high performance devices. So we can say that combustion technologies are “Immature Technology” or inappropriate technology. Now Days improved combustion Technology has been developed which are costly due using of expensive raw material & these technology efficiency having 15-25%, still 60%to 75% Energy going to wastage, for further improved technology are biomass gasification which having efficiency more than 40-55%, Due to lack governmental support, Unavailability of adequate Poor technology transfer Difficulty in integration manpower to develop, with the social structure installation, operate and maintains.

<table>
<thead>
<tr>
<th>S.N</th>
<th>Combustion</th>
<th>Gasification</th>
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<tbody>
<tr>
<td>1</td>
<td>Natural convection (without blower)</td>
<td>Natural or Forced convection (blower) provided good mixing of air &amp; gas for cooking</td>
</tr>
<tr>
<td>2</td>
<td>Inefficiently without clean combustion</td>
<td>Clean combustion &amp; efficiently</td>
</tr>
<tr>
<td>3</td>
<td>4 Stage i.e-1 Heating and Drying, -II Pyrolysis, -III Gas Phase Reactions, -IV Oxidation reactions</td>
<td>Stage - I. Heading, Drying &amp; Pyrolysis Stage - II. Thermal Cracking of Tar and Clean Combustion.</td>
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</table>

1.3 Natural draft Vs force draft cook Stove.
In traditional mud stove combustion, combustion happens almost as soon as volatilization around the solid fuel zone; this can lead to significant emissions of products of incomplete combustion. In contrast, force draft (FD) stoves and natural draft (ND) stoves tested were designed on the basis of principles of micro-gasification to improve combustion efficiency [10]. In micro-gasification stoves, air supply [from either fans (FD) or free convection (ND)] is partially supplied into the combustion chamber from primary small openings located at the bottom of the stove [11]. The remaining air supply is channelled to the top of the combustion chamber (and preheated) through secondary small openings [12]. Originally stage micro- gasifier based cook stove developed by Reed and co-workers developed a free convection-based gasifier stove and have subsequently discussed the development of forced convection-based gasifier stove force draft stove reduces smoke by up to 80-90%, significantly optimizes
fuel consumption, can cook faster and is portable while the force draft runs on battery power pack [13].

II. BARRIERS AND POTENTIAL OF VARIOUS TECHNOLOGIES

All fuel-device combinations face economic, cultural, environmental, social/political and technological barriers: even the three-stone firewood stove. Beyond these barriers are the potential benefits of each combination [14]. The potential benefits and barriers of force, natural draft improved stoves, traditional discussed here. Summarized below are the primary benefits of and barriers to various biomass stoves in Table-2, 3, 4. Stoves commonalities are increased efficiency and a need for changes in operator behaviours. Durability and portability are also important design features of cook-stoves [15].

<table>
<thead>
<tr>
<th>Potential</th>
<th>Barriers</th>
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<tbody>
<tr>
<td>Quick</td>
<td>Unreliable supply, especially in rural and remote areas, lack of local market</td>
</tr>
<tr>
<td>Pan</td>
<td>Cooking pots of limited shapes and sizes</td>
</tr>
<tr>
<td>Biomass fuel</td>
<td>Small hardwood, other crop residue and bio-dung applicable</td>
</tr>
<tr>
<td>Repairer and maintains</td>
<td>Need to develop Service networks in rural area.</td>
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Table 3 Primary benefits and barriers to the Natural draft stove

<table>
<thead>
<tr>
<th>Potential</th>
<th>Barriers</th>
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<tbody>
<tr>
<td>Quick</td>
<td>Unreachable to reaching capacity to end user, lack of local market, some financial outlay needed.</td>
</tr>
<tr>
<td>Pan</td>
<td>Cooking pots of limited shapes and sizes</td>
</tr>
<tr>
<td>Biomass fuel</td>
<td>Small hardwood, other crop residue and bio-dung applicable</td>
</tr>
<tr>
<td>Repairer and maintains</td>
<td>Need to develop service networks in rural area.</td>
</tr>
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Table 4 Primary benefits and barriers to the traditional stove

<table>
<thead>
<tr>
<th>Potential</th>
<th>Barriers</th>
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<tbody>
<tr>
<td>Efficient</td>
<td>Local repairer and maintains skills.</td>
</tr>
<tr>
<td>Construction materials</td>
<td>Construction materials largely local at least zero cost</td>
</tr>
<tr>
<td>Easy to use</td>
<td>Loving nature to ancient age</td>
</tr>
<tr>
<td>Biomass fuel</td>
<td>Hardwood, Crop residue, Bio-dung</td>
</tr>
<tr>
<td>Drudgery</td>
<td>Leading to causes health injury</td>
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III. MULTIPLE ENVIRONMENT CONNIVANCE PERSPECTIVE WITH BIOMASS COOKING STOVE

A questionnaire based feedback on biomass cooking stove direct user of three type of ND,FD,and TC stove, with sample 25 village households selected for our study to getting judgment for sustainable habit practice of biomass cook stove uses as: cooking pot, device technology, biomass fuel choice in cooking and user prior with time fuel and smokeless
87% households wanted double pot biomass cooking stove based on FD (Pankhewala or Fan wala chulha) reason behind it they using double pot TC stove since ancient history, also single pot FD size the minimum power requirement to cook food for a meal for a family of 4 persons [17].

50% using bio dung and 25% crop residue as main fuel in our study sample households due to least zero cost of fuel. Only 5% households using uniform hardwood in cooking and remaining 20% households using gathering fuel as multi fuel in cooking. User prior with 25% fuel saving 12% time saving and 63% smokeless.
IV. BIOMASS BASED COOKING SUSTAINABILITY

Meeting the needs of society in ways that can continue indefinitely into the future without damaging or depleting natural resources. In short, meeting present needs without compromising the ability of future generations to meet their own needs. Sustainability is the capacity to endure. For humans, sustainability is the long-term maintenance of responsibility, which has environmental, economic, and social dimensions, and encompasses the concept of stewardship; the responsible management of resource use for next generation. Sustainability depends on The Triple bottom line made up of People, planet and profit. Biomass cook stove also enclose on universal sustainability pillar in corporate as Social as poverty of household income& cooking fuel, Economics as high cost and long payback period of device [18 ] and Environment as emission reduction.

"Cradle to cradle" design - ending the "cradle to grave" cycle of manufactured products, by creating products that can be fully reclaimed or re-used. And also optimization by experimental and modeling of biomass cook stoves.

Source reduction - reducing emissions and high thermal efficiency by changing patterns of production and consumption.

Innovation - developing alternatives to technologies as Natural Draft to Force draft for better performances.

Viability - creating a center of economic activity around technologies and products that benefit the environment, speeding their implementation and creating new careers that truly protect the planet.

4.1 Sustainability Model for Improved Biomass cooking devices

Economical- High cost The main Barriers to dissemination of Improved Biomass stove technologies for cooking high investment cost & long payback period, biomass cook stove generally use in rural area, mostly rural people poor reliability so Lack of purchasing power uncertainty about benefits of dives, in improved stove required slightly modified fuel for these fuel are costly. Already alternated fuels available at zero private cost. & operating of improved stove Requirement of skilled manpower

Technological- Lack of high performance devices locally, Training /Education

Institutional - Subsidy for fossil fuel or Electricity, Lack of Co-ordinate among government agencies, Lack of product standards or performance

Socio-Cultural – Poverty Household income & cooking fuels

V. CONCLUSION

The majority of households in developing countries belong to the category of low income fuel gatherers. Thus, identification of potential users of the technologies is quite crucial in rural area. Many times, the cook stove designs are found to be incompatible with traditional ways of cooking. For example, any change required in the position of the cook while cooking may not be accepted. The paper conclusively proves the role biomass fuel applicability with improved stoves can play towards improving the design and it sustainability. There are important parameters like user acceptance and operational issues which are critical for widespread acceptance of any alternate cooking technologies.

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REFERENCES


