STOVE FOR USE WITH LOOSE RESIDUES AS FUEL

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1. Background

Sri Lanka like many other South Asian Countries has a large rural population of about 80% in its 17.2 Million people. The land area is only 65000 sq. km.

Of the Sri Lanka's total land area, which was almost covered entirely by natural forest until the turn of the century has dwindled from about 80% to 24% in 1992. With 90% of the entire population depending on firewood and other agro residues for cooking, there is great emphasis of bio-energy supply in the country.

The Sri Lankan energy supply system is dominated by bio-energy and especially firewood. Of 6.44 MTOE (1 TOE=41.84 GJ), the total energy supply in the country in 1992, 62% or 4.0 MTOE is derived from bio-energy sources while the rest in supplied from oil and hydro resources. It is estimated that out of the total bio-energy supply only 7% come from natural forests while the rest come from other sources. (26% from home gardens, 19% from Coconut plantation & residues, 19% from Croplands etc.) Sri Lanka Forestry Sector Master Plan – July 1995. It has also been estimated that only 3% come from loose agro residues such as Saw dust and rice husk in 1993. This situation is not likely to change rapidly, but in 2020 it is estimated that loose residues, will account for approximately 6% of the bio-energy supply in the country.

2. Loose Agro Residues in Sri Lanka

Loose agro residues available in Sri Lanka can broadly be categorized into two. The loose dust forms and other loose forms Saw dust, rise husk and Coir dust fall in to the first category while, coconut husks, fronds and leaves, king coconut husks, wood shavings, tea bushes fall in to the latter category. While latter category of loose agro residues can be used in traditional domestic wool stoves, the former needs either re-processing or specially designed stoves to be used in the domestic sector.

Almost all the above mentioned residues have been in use in the households except the Coir dust which has an excessive moisture content of over 85% needs reprocessing often making it a very expensive fuel after re-processing. Until lately even the King coconut husk too was considered a difficult fuel even though the calorific content after drying is much higher than the normal coconut husk on a volumetric basis. King coconut husks are found to be a potential threat for the spread of Malaria and other mosquito borne diseases. King coconut husk is now being used extensively after few days of sun drying after splitting the husk in to pieces.

The total bio mass supply in the country in 1993 amounts to 9.17 MT (Million Tons) while it is expected to increase up to 0.64 MT in the year 2020. The overall loose agro residues supply is estimated at 3% of supply in 1993 amounting to 0.275 MT while it is expected to increase upto 6% of the total supply in 2020 amounting to 0.578 MT. These figures do not include the large quantities of baggage and other agro residue used mainly in the industrial sector. Which means out of total biomass supply of 8.15 MT loose agro residue will amount to 3.3 % in 1993 and will rise to 6.5 % in the year 2020 out of a total bio mass supply of 8.82 MT. This shows that there is an increasing importance of loose agro residue in the domestic energy supply system.

3. Saw dust domestic stove

Saw dust is produced in large quantities in the 4000 odd sawmills scattered in the country. In many cases saw dust is not utilized in any form and is allowed to pollute waterways or burnt and destroyed causing major health impacts in the people living in the immediate vicinity of the mills.
However in the medium to law income sub urban and urban households sawdust stoves are gaining popularity. The sawdust in these highly populated sub urban and urban areas is sold at the rate of about $1 for five bags containing about 50 kg. This price compares well with the current fuel wood prices.

The saw dust stove turned out in small workshops fetch a price of $2 for a large sized and $ 0.50 for a small one. The stove is shown in Fig. 1 and is a very simple device where the sawdust is compacted by pounding with a piece of firewood with a center hole and a single piece of firewood is inserted at the bottom to keep the flame alive. (Fig. 1-1 to 1V)

Once lit the stove will be burning the entire stock of sawdust until it is burnt out. A small domestic one would generally last 2-3 hours while the large ones used mostly in tea kiosks and eating-houses generally last for more than 6 hours.

There has been no attempt whatsoever to improve this design which has been in use for more than 50 years especially in areas where there is an abundance of sawdust.

The advantage of this stove is its ready availability and cheap cost, easy operation and maintenance. These stoves generally last about 2-3 years. The main drawbacks are the difficulty in controlling the heat even though the flame can be brought down by pulling out the firewood that keep the flame alive. The other drawback seems to be that the stove will keep on burning until the entire charge is burnt. These stoves are generally smoky

and deposit a considerable amount of Soot and tar on the pots and pans. The housewives also complain about the uneven heat distribution of the stove having a concentrated flame at the center of the pot, which sometimes lead to cracks in earthenware pots.

4. Rice Husks availability in Sri Lanka

Total number of rice mills in the country is over 7000 and the annual production of rice husks is around 547,000 MT. Table I brings out the husks availability on the basis of utilized milling capacity. However, they do not include the recently developed Mahweli area paddy husks output. With the Mahweli area paddy husks output, total paddy hu8sks availability in Sri Lanka is much higher than the above amount.

Table 1

District	Rice Husk Availability in MT
Ampara	72135
Polonnaruwa	62829
Kurunegala	53591
Batticaloa	16228
Badulla	10475
Hambantota	67573
Anuradapura	72973
Kandy	7181
Matara	44250
Kalutara	1767
Gampaha	41164
Galle	24263
Kegalle	8068
Monaragala	6842
Colombo	24600
Puttalam	10737
	547403

5. Rice Husk Stove

Rice Husk is being used to a lesser extent than the similar sawdust stove. This is mainly because the rive husks is largely available in rural areas where firewood and other agro residues are available in abundance. However in small scale cottage industries such a coconut treacle and juggery industry etc. Large sized improved stove is being used which are more permanent in nature and covered with mud plaster more stability and structural reasons than heat conversion Fig 2 shows such an improved stove. These stoves generally last for 10 to 12 hours once lit.

Anuradapura rice processing research institute has developed an improved stove, which last one hr. duration and 1/2 hr duration. This has been developed about 2 years ago and each stove costs between 20-10 US$ each. So far only about 100 stoves have been marketed and there has been no serious attempt to popularize this. (See annexure 1)

In addition to that they have developed pedal operated husk blower and, Rice husk suspension burner. (See annexture 2, 3)

6. Other Use of Saw dust/ Paddy Husk

National Engineering Research and development center in Sri Lanka (NERD) had developed a Bakery oven fueled by sawdust or Paddy husk. Stoves have been developed to bake 65 loaves per batch during 1/2 an hour, Flue gas produced by the stoves moves upward heating metal structure in which bread or cake is located due to natural draught created by the chimney. In addition to above, an oven has been developed for baking 2 kg. of cake for domestic use.

7. Coir dust as a loose residue

Approximately 142,0 00 MT of Coir dust is produced in the country, in about 400 fibber mills. There is also a large quantity of Coir dust mountains collected over the past several decades. There have been in serious attempt to use this in the past even though it paused a very serious threat to the immediate environment by way of pollution of ground water and land usage.

There has been few attempt to dry this and briquette it for domestic and industrial usage. The production cost of these briquettes was found to be very high (twice as high as firewood) and it was not possible to popularize this as a fuel. Later several methods of compaction and cutting was attempted and before any success could be made several entrepreneurs began exporting this as an ideal soil conditioner specially to the Middle East. Now most of it is being exported in bails, brick and loose form as soil conditioners at a price far above the equivalent energy price. However not all the fiber dust available are suitable as soil conditioners. Therefore it would be futile to attempt any other alternate usage for this residue.

8. Efficiency Improvements and future directions

There has been very little attention to the stoves, which burns loose agro residues, no systematic study on improved design or any efficiency improvement has been undertaken except for the efforts by the Anuradhapura Rice Processing Research Institute. Much effort need to be devoted to bring down the cost of improved stoves. The main drawback seems to be the lack of proper marketing mechanism for these stoves. In as much as there has been an extensive effort on the development and dissemination of fuel-efficient wood stoves, the saw dust and rice husk stove should be designed for better efficiency.

As loose agro residues can easily be substituted for more valuable firewood, there should be a national policy to encourage and popularize these stoves.