One Pot, Two Pot...Jackpot: Some Suggestions for Future Directions for Woodburning Stoves in Sri Lanka

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Some Suggestions for Future Directions for Woodburning Stoves in Sri Lanka

1. Introduction

This report is the result of a two-week visit by the writer to Sri Lanka in August 1985. The purpose of the trip was to evaluate the rural stoves programme and to offer suggestions on how that programme, now rapidly entering its dissemination phase, could be strengthened.

The second purpose of the trip was to review progress on the urban stoves programme, to investigate possible directions for that programme and to lay the groundwork for the start of the urban stoves programme at the beginning of 1986.

The writer would like to thank all those people who helped him tremendously during his stay in Sri Lanka for this report, and most especially Mr. Amarasekere and Mr. Abeyratne of the CEB, Harshini and Sisira Navaratne of Sarvodaya, Per Bertilson of the NHDA, Harry Sivanadian of the Ceylon Ceramics Corporation and Mr. Jayasiri of the State Timber Corporation.

2. Conclusions and Recommendations

2.1 Rural Stoves

The Sarvodaya two-piece pottery liner is now being widely disseminated in Hambantota and dissemination programmes are under way in Kandy and Ratnapura. Other districts will be following shortly. While the progress made is very encouraging it is felt that a number of initiatives could be taken to improve the effectiveness of the programme :

1. Marketing of stoves needs to be improved in terms of increasing the awareness of the benefits of the new stoves, not only in terms of fuel-saving, but also in terms of investment in hime improvements and of the potential for cooking products for sale.

2. Centralised production is not a feasible option for the rural areas. Efforts should be concentrated on upgrading the skills of rural potters. These efforts should be aimed at women as well as men. To date, very few women have been given these new skills.

3. Alternative commercial methods of stove distribution should be investigated to improve the chances of price reductions to consumers. The dangers of using the government structure need to be recognised.

4. A one-piece two-pot liner should be field tested as a possible alternative to the Sarvodaya stove. This stove could have several advantages :

- it should remove the need for an installer going into the householder's kitchen.

- it should reduce the price to the consumer.

- it should improve quality control.

5. The dissemination process should be properly monitored so that changes to the stoves programme can be made in reaction to consumer and producer needs.

2.2 Urban Stoves

The programme is in very early days currently, and a number of aspects of the programme need to be examined and problems resolved before a dissemination programme can get under way :

1. There are still serious doubts about the CISIR one-pot stove. Its life and efficiency both need to be improved, and its price reduced. Further design work and development of good cheap refractory clay bodies are needed. A range of sizes also needs to be developed.

2. A portable two-pot stove appears to meet more consumer requirements and this should be actively developed at the same time as the CISIR stove.

3. Production should be encouraged both through the formal and informal sector. The market is big enough for both and using both sectors should ensure that an affordable stove is available to a large proportion of the population. This has substantial implications for training.

4. The needs of urban populations outside Colombo must be examined to see whether their demand can best be met by the urban or rural stove programme.

5. Great attention needs to be paid to developing an effective marketing system :

- public awareness needs to be raised
- distribution networks of retailers and wholesaler need to be established
- a rapid effective complaints service needs to be established

3. The Ceramics Industry in Sri Lanka

The ceramics industry in Sri Lanka operates in three main product sectors: utility pottery, tiles and bricks. Utility pottery includes hand-crafted cooking pots and flower pots and also the modern sector production of high quality porcelain products. A small amount of artwork is also produced in this sector. Tiles and bricks are both divided into rural informal low-capital operations and (usually) urban formal higher-capital (though not capital-intensive) operations. The rural sector of both these operations is declining, as is rural craft pottery.

As can be seen from Table 3.1 these sectors provide substantial employment for both men and women. In 1981 at least 16,800 people claimed one of these sectors as their main source of employment, of which 5,483 were potters. Let us briefly examine each of these sectors in turn.

Pottery is a caste industry and, as such, tends to be concentrated within particular families and villages. Non-caste people are interested in becoming involved in "ceramics" rather

than "pottery": working with white clay is not considered low caste, while red clay is.

Potters are sometimes based in pottery villages as is the case in Hambantota, or they are distributed more widely in the community as in Kandy for example. This appears to be at least partly linked to the availability of clay. In the south, there are many tanks which are government owned and the potters have the right to remove the clay from the base of the drained tank. It makes sense, therefore, for the potters to cluster near tanks. In other parts of Sri Lanka, however, where there are no tanks, potters either have to buy their clay from landowners or dig it from their own land. There is not, therefore, the same financial motive for potters to concentrate in one place.

Within potter families, most tasks are shared between the sexes and there does not appear to be any differentiation between the sexes, although within families it is not uncommon for family members to specialize on particular items. Sometimes labour is hired for the unskilled jobs or one member of the family will mix the clay, while another makes the stoves and another loads and unloads the kiln. Production units are usually of very low capital-intensity. The simplest potteries are lean-to additions to houses while the brick kiln is in a thatched building nearby. Other potters have invested in corrugated iron for rooves and timber planks for shelving to avoid the inevitable risks of damage when drying pottery on the ground. Most potters have a simple kick wheel and a stone and paddle for finishing the bases of their cooking pots. Techniques used are mainly coil and wheel-work. Slab techniques have not developed in Sri Lanka. Firing is in wood-fired brick kilns - open-topped in traditional potteries, but with a range of kiln designs in the formal sector. The main products of this sector are cooking pots, curd pots and flower pots. Cooking pots are being replaced by aluminium pots and the flower pot market is threatened by cheap cast cement pots.

Pottery production is seasonal. During the rainy season, production will fall for two reasons : firstly, clay drying becomes much more difficult and secondly, most potters dig their clay from the base of drained tanks, which fill in the rainy season. Most potters do not own land and there is thus little conflict between potting and planting/harvesting. Where potters do own land, the seasons can have an added constraint on production.

Production reaches a peak in the months before the New Year in April when all families purchase a new rice pot every year. Prices are very buoyant at this time and production of other items (such as flower pots or curd pots - and of course, stoves!)

will virtually cease. After April, most potters produce little for the next month as their financial resources are healthily bloated. If we look at the map, we can see that the greatest concentration of potters is in Hambantota, Kurunegala and Puttalam, with Gampaha and Matara not far behind.

A number of potters now work within larger tile factories producing mainly flower pots. They are paid piecework and can earn substantial incomes of up to R 1,000 per week for potters around Colombo, and more usually R600-800 (Sivanadian, pers. comm., 1985).

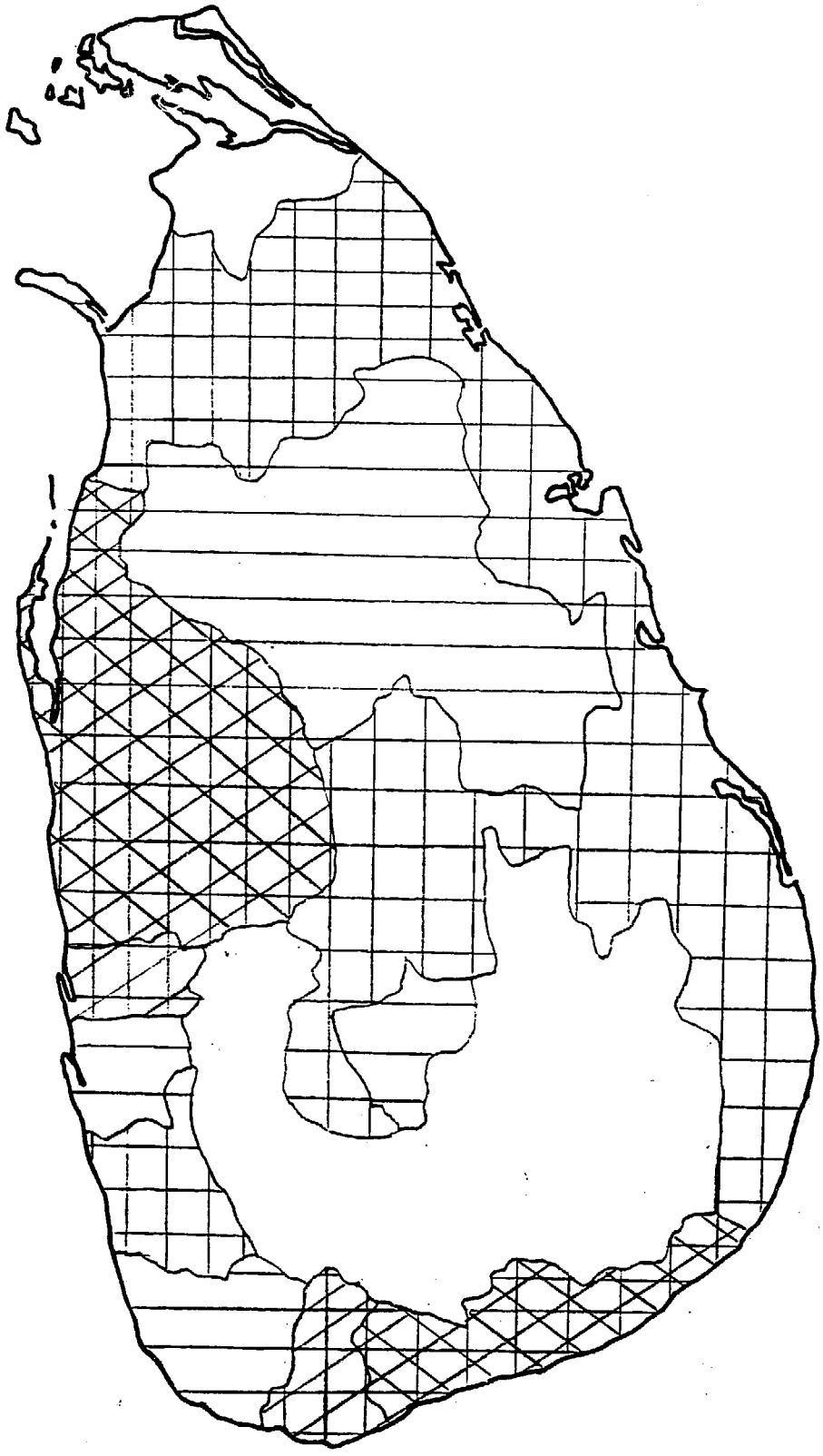
Tile factories are largely based in the coastal districts north of Colombo. Colombo, Gampaha, Kurunegala and Puttalam account for 86% of all employment in tile-making. The small traditional tile-makers, manufacturing the old U-shaped tile have largely ceased production, and tile-manufacture is now concentrated in large factories employing up to 150 people using more or less machinery to produce moulded tiles. Employment practices vary greatly : at the Sumagi Tile factory in Negombo, the majority of the workforce are women, while the Ceylon Ceramics Corporation will not employ women in its factories. Overall, employment is approximately 3:1 in favour of men. Tile-making has been largely de-skilled and tile-makers could not easily make stoves without the use of moulds.

Bricks are still manufactured throughout much of Sri Lanka on a small scale basis using traditional clamping techniques. Some potters also build their kilns out of green bricks earning some extra money from these bricks when fired. Some bricks are now produced in the tile factories to the north of Colombo but what proportion of the total this represents is not known. Interestingly, the Sumagi Tile Factory is exporting hand-made bricks to Bedford, England, the centre of the UK brick industry.

The main concentration of brick-making employment is down the western coastal districts from Puttalam to Matara, which account for 81% of employment. Employment is very largely male, men outnumbering women more than 13:1. The skills of brickmaking rest largely in the construction of an effective clamp. These skills have little relevance to stove making and therefore, brick-makers would probably have to use moulds, and learn appropriate firing techniques.

Apart from this private/public sector commercial activity, the Department of Small Industries operates 16 pottery centres which provide training for potters. Potters are paid R5 per day during their training which lasts six months and then piecework for the next six months. After that the potters have to leave the centre but they can still buy their clay and market their products -

mostly tourist goods - through the centres. It is not clear how many potters have been successfully trained through these centres and since most of the work is art-work rather than utilitarian, it is not clear to what extent these people could become involved in the stoves programme.



KEY:

Potters per 100,000 Population

- Unknown
- 0-9
- 10-49
- 50-99
- 100+

Distribution of Informal Sector Potters in Sri Lanka, 1981

Source: Dept. Census and Statistics (1985)

TABLE 3.1: NUMBER OF POTTERS, BRICKMAKERS AND TILEMAKERS BY DISTRICT AND SEX, 1981

	Potters		Brickmakers		Tilemakers		Total		
	M	F	M	F	M	F	M	F	Total
Anuradhapura	39	12	218	6	15	1	272	19	291
Puttalam	282	232	1,849	237	527	301	2,658	770	3,428
Kandy	154	60	589	109	8	3	751	172	923
Colombo	92	11	798	41	189	24	1,079	76	1,155
Kurunegala	839	730	856	32	139	20	1,834	782	2,616
Polonnaruwa	21	3	217	3	0	0	238	6	244
Trincomalee	27	7	123	5	1	0	151	12	163
Ampari	38	29	153	1	7	1	198	31	229
Kalutara	146	104	285	51	49	3	480	158	638
Gampaha	507	428	2,840	95	300	119	3,647	642	4,289
Mannar	22	0	1	0	0	0	23	0	23
Hambantota	517	546	143	14	12	19	672	579	1,251
Mullaitivu	0	0	7	0	0	0	7	0	7
Matara	205	152	243	22	85	25	533	199	732
Batticaloa	16	76	7	0	7	0	30	76	106
Galle	36	15	336	4	9	0	381	19	400
Matale	55	18	114	33	7	1	176	52	228
Nuwara Eliya	35	2	5	0	1	0	41	2	43
Vavuniya	21	6	7	0	0	0	28	6	34
TOTAL:	3,052	2,431	8,791	653	1,356	517	13,199	3,601	16,800

Source: National Census, 1981

N.B. Five districts have not yet been processed:- Jaffna, Moneragela, Ratnapura, Kegalla, Badulla.

4. The Rural Areas

4.1 Progress to Date

4.1.1 The Sarvodaya Stove

Work on developing a suitable wood-burning stove for the rural areas began in earnest in August, 1979, when the Sarvodaya Shramadana Movement based in Kandy started looking into the problem of providing a stove affordable by the mass of the rural population which reduced fuel consumption and improved working conditions in the kitchen.

The Sarvodaya two-pot liner stove emerged out of numerous tests in 1982 and has evolved since into its present design. It is currently a two-piece liner made out of sandy fired clay. The firebox is usually made using a coiling technique and the second pot-rest is usually made on the wheel. The two pieces are assembled in the kitchen and encased in a mud mixture (in Hambantota, the mix is : 2 buckets cowdung, 2 buckets ash, 4 buckets anthill clay and 4 buckets sand). This stove has proved popular with users both because of its low price of R30 installed, its wood-saving (in tests it saves between 25 and 50%) and its ability to cook two pots with one fire.

As the woodfuel energy crisis in Sri Lanka became more apparent, so other organisations have become interested in the mass dissemination of the Sarvodaya stove. While Sarvodaya used the stove as part of its community development activities, the recognition by the Government of the long-term dangers to Sri Lanka of not reacting quickly to reduce fuel wood consumption led the Ceylon Electricity Board (CEB) to examine ways of rapidly disseminating the stove throughout the island.

4.1.2 Production Methods

Before examining the chosen methods of distribution, let us look at how the stoves are manufactured and installed. The stove liners are currently all manufactured by rural craft potters, using traditional coil and wheel methods and firing in open-topped brick kilns.

There are inevitable consequences of this production strategy. Firstly, stove production will tend to be erratic, affected by the seasonal nature of demand for other products and the seasonal nature of clay availability in some areas. Secondly, large numbers of potters will need to be trained to provide sufficient production levels. While this has positive employment generation aspects, it does entail substantial training costs and the risks of poor quality control are greatly increased. Thirdly, areas

where pottery is not widely produced, whether because of historical reasons or because of a lack of clay, may prove difficult to introduce to the new stoves and even harder to maintain an adequate supply.

The stoves are installed in people's kitchens by a trained specialist. The two pieces of the liner are set into a mud mixture by the installer in the kitchen. This leads to obvious problems of co-ordinating the activities of potter, installer and householder and increases the overall cost of a stove to the end-user.

4.1.3 Disseminating Rural Stoves

Sarvodaya are currently disseminating some 50 stoves per month, mostly in Kandy. Some 3 - 5000 have been disseminated in total. Their method of dissemination is through the Sarvodaya district centres. Orders are taken by the Sarvodaya volunteer working in a particular village. The worker then collects the liners from the district centre and installs them in the kitchen. The worker gets paid R15 for installation which is meant to be returned to Sarvodaya, although this does not always appear to happen. The households thus pay R15 for the liner and R15 for installation. There are no mark-ups between the potter, who is paid R15 per liner, and the installer.

This separation of skills and business activity between potter and installer has been adopted by the CEB in its chosen method of dissemination. However, a new element in the dissemination process has been added by employing the existing government service to carry out the co-ordination of potter and installer. To understand how the procedure works, we must first take a brief look at the government system at the district level.

As a complete example let us look at Hambantota District. A summary of the government positions is given in Figure 4.1. In Hambantota, the stoves programme is part of the Norwegian Hambantota Integrated Rural Development Project (HIRDEP). The District is divided into eight Assistant Government Agent (AGA) divisions. Each AGA is responsible for some 8000 households. Within each division each village has a Gramasevaka or village worker, responsible for some 400-500 households. Supporting the Gramasevaka are Wisesaseva Nilandari or Special Service Officers. There is usually one Wisesaseva Nilandari for every two Gramasevaka. These Wisesasevas report to the Divisional Development officer who reports to the AGA. Co-ordinating the whole programme is a district co-ordinating officer who is an employee of the Ministry of Plan Implementation seconded to the Ministry of Power and Energy, of which the CEB is part.

If a household decides that it wants a stove it places an order with and pays R15 to the Gramasevaka or the Wisesaseva Nilandari. Which one largely depends on the interest and commitment of the individuals. The Gramasevaka/Wisesaseva then collects pottery liners from the AGA, who arranges for a stove builder to visit the family on a certain day to install the stove. The household is told to be ready that day with a certain quantity of mud mix (dung, anthill, ash and sand). A condition for all stove installations in Hambantota is that the household must build a table for the stove to sit on. These tables are usually made out of brick sides with a lattice of sticks on top covered with a thick layer of mud. These tables are semi-traditional and make cooking for the woman much easier. Their cost is only R5-10 for the bricks although discarded bricks can be and often are used.

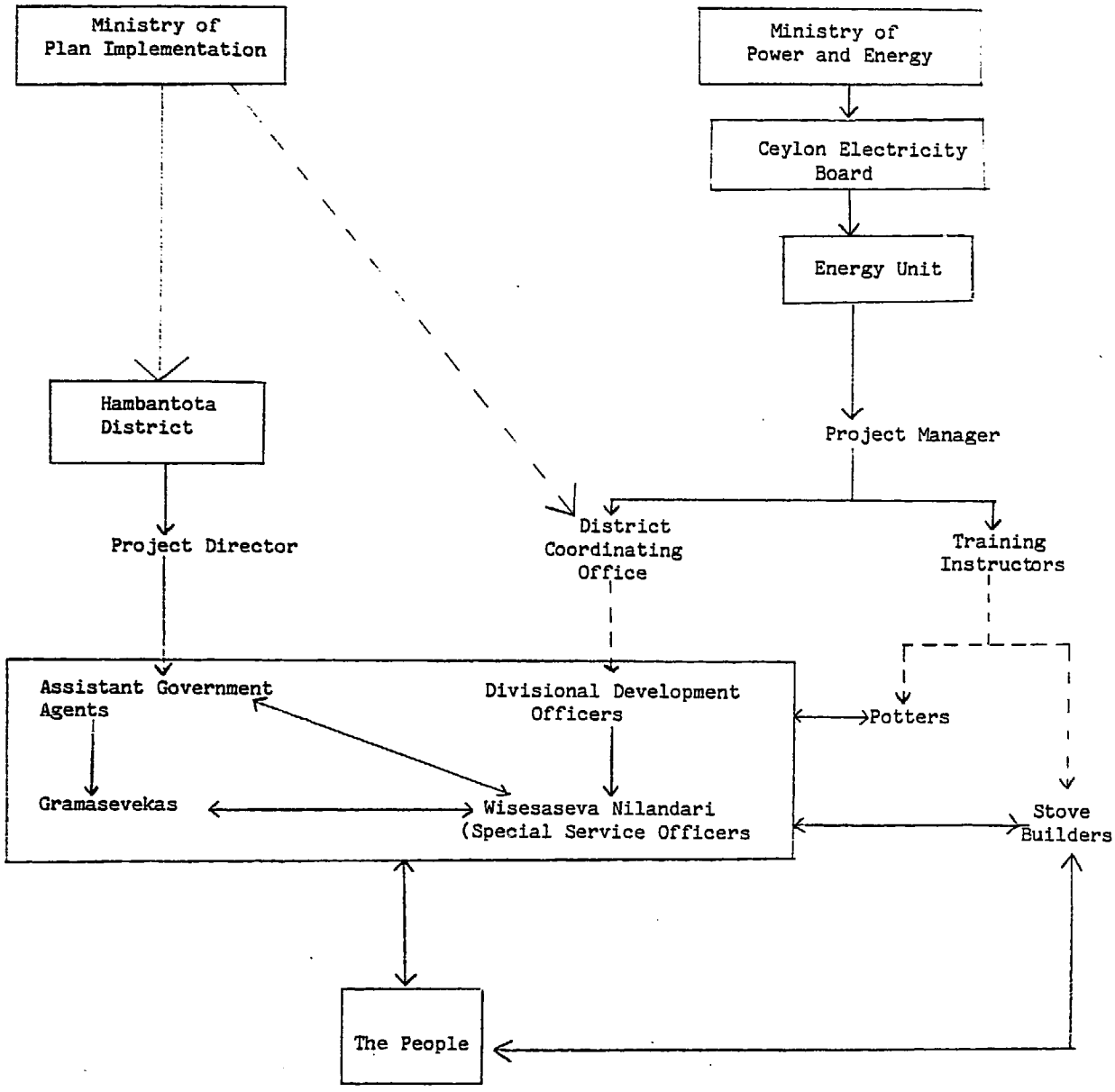
The installer is paid R15 by the AGA. The AGA also places regular orders with potters and collects from them, paying them R15 per accepted liner. The AGA exercises rudimentary quality control but in practice few liners get rejected. For this trouble, the AGAs get R5 to cover transport and other costs (plus) and the Gramasevaka/Wisesasevas get R3 per stove installed.

For a Gramasevaka this can be a significant source of income. One Wisesaseva we met took 125 orders in the last month which will bring him in R375, a significant income supplement. It is interesting to note that this level of activity took up 15 days per month of his time - seemingly not leaving much time for other activities. However, much of the Gramasevaka's and Wisesaseva's time is taken up on political activities, such as election and Shramadana (community development) duties, promoting government campaigns and being secretary to Gramodemandele (Village Council) meetings. These activities are by their nature cyclical and leave these officials with a large amount of spare time.

Although this procedure seems unnecessarily complicated it does appear to be working well if a little patchily. Where AGA's have not shown enthusiasm the CEB has been examining ways of potters selling direct to consumers, but with the clear endorsement of the President and his instruction to all Government staff to treat the stoves programme as a top priority it is likely that most AGA's will take the stoves programme seriously - especially when they see there is money to be made.

The CEB programme is only fully established in Hambantota while training of potters and installers is well under way in Kandy and Ratnapura. A summary of targets and achievements for these three areas can be seen in Table 4.1. Hambantota is on target, indeed it may well exceed the target. Ratnapura may achieve its quota but Kandy looks distinctly wobbly. For a programme that only

FIGURE 4.1: LOCAL GOVERNMENT STRUCTURE AND STOVES DISSEMINATION ACTIVITIES, HAMBANTOTA



started in earnest in 1985, however, the progress made has been excellent. The CEB is now developing programmes with IRDP's in all safe districts.

Table 4.1 : Targets and Achievements in the CEB Dissemination of Sarvodaya Stoves, January - July 1985

District	Trained Potters	Trained Builders	Liners Prod.	Stoves Built	Target All 1985
Hambantota	34	54	5198	3748	10,000
Ratnapura (1)	10	39	n/a	917	5,000
Kandy (2)	5	20	n/a	40	5,000
TOTAL :	49	113	5198	4705	20,000

NOTES :

(1) Until end June

(2) One month : May only.

4.2 Future Developments

As has been mentioned above, the future, especially in the eyes of the CEB, is very clear. The National Fuelwood Conservation Programme (Munasinghe, 1984) foresees the following programme of dissemination:

Year	No. Stoves to be Disseminated
1984	15,000
5	50,000
6	200,000
7	500,000
8	800,000
9	1,250,000

These figures are highly optimistic. In 1985, it is very unlikely that more than 20,000 stoves will be disseminated in the rural areas. While these figures include the urban areas as well, it is unlikely that more than 1-200 urban stoves will be disseminated in 1985.

In this section, we shall step back for a moment and consider the rural stoves programme from the perspectives of consumer, producer

and the country as a whole to try and identify areas where the programme could be strengthened or redirected in some way to facilitate the mass dissemination of a rural wood-burning stove.

4.2.1 The Consumers' Perspective

The first question we need to ask is whether the existing stove meets consumer requirements or whether another stove meets them better. Seven years of careful action research by Sarvodaya has meant that they have developed an excellent stove which meets all the major consumer requirements. These are : an ability to cook two pots at a time, fuel-efficient and relatively smoke-free.

There is, however, one draw-back which may restrict the success of the stove. Many women are unwilling to let strangers into their kitchen and the fuel-efficiency of this stove and its life depends on a skilled person installing the stove.

This problem could be overcome by the development of a single-piece stove which could be encased in mud by the householders themselves. Such a stove would be difficult to make and would require the use of moulds but would overcome this potential source of consumer resistance. By cutting out the installer, it could be that the one-piece liner stove would be cheaper than the two-piece variety.

Consumers in the rural areas currently pay R15 or R30 for installed stove depending on which district they live in. Stoves have yet to be disseminated in large numbers except in Hambantota, and it is not clear there exactly which families are receiving the new stoves. It is the writer's impression, however, that it is the wealthier families on the whole who are installing the new stoves. This has two implications for mass dissemination :

(1) should poor people not be able to afford the stove, then the improved stove will fail to reach the largest market.

(2) therefore, fuelwood savings will be much less than hoped for.

We need, therefore, to look at the economics of these new stoves to the consumer. These are detailed in Appendix 1. Much depends here on whether consumers are paying for their wood or not. In the rural areas, it is only the wealthiest who pay for their wood, although many others collect wood for sale. It could be assumed that a fuel-efficient stove means more wood for sale since less is burnt, but for the poorer households this does not hold, since they only burn lower grade fuels anyway (such as coconut husk or rice straw) which have no resale value.

However, when wood is monetised - and it is increasingly likely that as wood shortages grow, more and more people will start paying for

their fuel - one can look at stoves in terms of their payback period. This is the time taken to save the same amount of money spent in buying the stove. In Appendix 1 we can see that the payback period is 3-7 weeks at a price of R30 per stove. Whether this period is short enough to prove attractive depends upon how rural people receive their income. It is likely to be in 'lumps' with most money coming in around harvest time or when spice or fruit trees are in season. Remittances from urban areas are also likely to be 'lumpy' or at least on a monthly basis. The payback period may not be overly long, therefore, although peaks in demand for stoves caused by these seasons could well force prices up and thus lengthen payback periods.

Since most of the rural population does not buy its firewood, we need to look at the attractiveness of the stove from a different angle. Appendix 1 also examines kitchen investment levels - the amount of money a household invests in a kitchen in the course of a month. This shows that without a major switching of resources only some 20% of rural households could afford the new stove. However, the lumpiness of income and the fact that investment decisions are made jointly by both man and wife suggests that the number of households who could afford the stove would be much higher. If we take all groups who spend more than R30 annually on durables and semi-durables, the proportion of households rises to nearly 90%.

What may prove to be most important here is the marketing of stoves. For rural households the concept of investing in a home improvement may prove more attractive than fuel savings especially currently when few pay for their fuel. Another potential but unquantifiable benefit which could be used to market the stove is the scope for income generation. In our visit we were surprised by the number of householders we found who were using their stoves for income generation. That is, the fuel they saved was still collected but was used to cook simple foods such as hoppers and sweetmeats. This would greatly reduce the payback period of the stove and help generate additional rural employment.

The situation is not clear, therefore. What is clear, however, is that any further reduction in price can only help the stove's chances of success. This could be achieved either by reducing the price of the existing stove through increased competition or by market segmentation - the designing of a low-price stove for those who cannot afford the existing stove. This latter option has risks : the cheaper stove is always likely to offer lower returns to a potter than the dearer one and potters will therefore tend to concentrate production of the dearer stove. The price of the dearer stove will fall and of the cheaper stove will rise, thus negating the object of the exercise. The one-piece liner stove could offer price advantages over the two-piece liner and could thus help to expand the market.

4.2.2 The Producers' Perspective

Currently, stoves are being produced by rural potters in traditional ways. As was mentioned in Section 4.1, this has positive impacts on employment and is helping to regenerate a dying industry. There are, however, drawbacks in terms of quality control and a rapid build up of production. We should, therefore, consider alternative methods of production to ensure that we have chosen the right option.

The most obvious option is to centralise production in an existing tile factory. Appendix 2 details costs of a unit manufacturing 20,000 stoves per year using either wheel-potters or less well-trained moulders. Either way, the unit loses money because of its high overhead costs and the cost of transporting stoves to decentralised markets, and it is not a feasible option. Even if, as Childers suggests, piecework charges to potters could be reduced, it is unlikely that such a unit could break even.

Appendix 3, on the other hand, shows that stove liner manufacture should be extremely attractive to rural informal potters, and could substantially boost their current incomes. It also appears that prices paid to potters are currently quite high and that a reduction to R10 as competition builds up would not make liner production unattractive to potters.

It appears, then, that the right option for stove liner manufacturing has been chosen. How many potters need to be trained to meet likely demand? Table 4.2 shows the estimated potential demand for stoves using 1981 census data. Table 4.3 shows the number of potters that will have to be trained to meet this demand. This, however, greatly underestimates the number of potters required since it assumes that all potters will produce only stoves. The actual number of potters needed for training should be at least twice that number so that they can still earn a living from other products. Even so, it can be seen that only two districts are short of potters - Mullaittivu and Nuwara Eliya. In these two areas alternative arrangements will have to be made : stoves will have to be shipped in from other potters or from tile factories or a different stove option altogether may need to be pursued. One disturbing feature of potter training to date has been the remarkably small number of women trained. Section 3 showed that almost as many women as men are potters and yet only six women have been trained in Hambantota out of a total of 34 potters. The reason given that women are not mobile enough is of no relevance to a potter. More women must be trained : apart from arguments of equity it means that the potential stove-producing workforce is being effectively halved which could have serious repercussions for the stoves programme.

We can see clearly that stoves manufacture provides quite substantial rural employment, generating - or preserving - as many as 820 jobs by

TABLE 4.2: ESTIMATE OF POTENTIAL MARKET FOR TWO-POT WOODBURNING STOVES BY DISTRICT, RURAL AREAS, 1981

District	Rural Population (1)	Households (2)	Potential Annual Stove Demand (3)
Anuradhapura	546,537	105,103	26,276
Puttalam	430,805	82,847	20,712
Kandy	903,201	173,692	43,423
Colombo	434,957	83,646	20,912
Kurunegala	1,168,304	224,674	56,168
Polonnaruwa	241,068	46,359	11,590
Trincomalee	173,209	33,309	8,327
Ampari	335,694	84,557	16,139
Kalutara	651,633	125,314	31,328
Gampaha	1,002,520	192,792	48,198
Mannar	92,304	17,751	4,438
Hambantota	382,914	73,637	18,409
Mullaitivu	69,997	13,461	3,365
Matara	572,635	110,122	27,530
Batticaloa	250,918	48,253	12,063
Galle	648,160	124,646	31,162
Matale	319,246	61,393	15,348
Nuwara Eliya	566,289	108,902	27,226
Vavuniya	76,916	14,792	3,698
TOTAL:	8,867,307	1,705,251	426,313

NOTES:

1. Source: Dept. Census and Statistics, 1983
2. Assumes average household size of 5.2 (Dept. Census and Statistics, 1983)
3. Assumes 100% of households burn wood as principal cooking fuel and the average life of the stove is 4 years.

TABLE 4.3: POTENTIAL EMPLOYMENT GENERATION IN RURAL STOVE MANUFACTURE AND INSTALLATION

District	Potential Annual Stove Demand (1)			No. Potters (3)		No. Installers (4)		No. Existing Potters (5)
	1981	1985	1990	1985	1990	1985	1990	1981
Anuradhapura	26,276	28,220	30,853	23	25	23	25	51
Puttalam	20,712	22,244	24,319	18	20	18	20	514
Kandy	43,423	46,635	50,986	37	41	37	41	214
Colombo	20,912	22,459	24,554	18	20	18	20	103
Kurunegala	56,168	60,323	65,951	49	53	49	53	1,569
Polonnaruwa	11,590	12,447	13,608	10	11	10	11	24
Trincomalee	8,327	8,943	9,777	8	8	8	8	34
Ampari	16,139	17,333	18,950	14	16	14	16	67
Kalutara	31,328	33,645	36,784	27	30	27	30	250
Gampaha	48,198	51,763	56,592	42	46	42	46	935
Mannar	4,438	4,766	5,211	4	5	4	5	22
Hambantota	18,409	19,771	21,616	16	18	16	18	1,063
Mullaitivu	3,365	3,614	3,951	3	4	3	4	0
Matara	27,530	29,566	32,324	24	26	24	26	357
Batticaloa	12,063	12,955	14,164	11	12	11	12	92
Galle	31,162	33,467	36,589	27	30	27	30	51
Matale	15,348	16,483	18,021	14	15	14	15	73
Nuwara Eliya	27,226	29,240	31,968	24	26	24	26	37
Vavuniya	3,698	3,972	4,343	4	4	4	4	27
TOTAL:	426,312	457,845	500,562	373	410	373	410	5,483

NOTES:

(1) Taken from Table 4.2

(2) Assumes population growth of 1.8% p.a. (World Bank, 1984)

(3) Assumes one potter can produce 1,250 stoves per year when fully trained

(4) Assumes one experienced potter can install 1,250 stoves per year when fully trained

(5) Taken from Table 3.1

1990. However, training needs are at least double this : 820 potters and 820 installers need to be trained by 1990 as a minimum, within the 19 districts enumerated in the Census. More than 2,000 potters and installers would probably need to be trained in total.

What about stoves distribution? Has the right option been chosen there? Obviously, the simplest option for any product's distribution is directly from the manufacturer to the user. This option is not possible for two reasons :

(1) Two different skills involving different people are used to make and install a stove. It is unlikely that potters could afford to employ installers (or vice versa) and also unlikely that they would be interested in the management implications of this.

(2) The retail trade in Sri Lanka has always relied on middlemen - at least one and often two or more. Any attempt to bypass this could lead to conflict and be counterproductive.

The only other option, therefore, is to distribute stoves through the existing network of wholesalers and retailers with wholesalers buying from potters and retailers sub-contracting installers. Appendix 4 shows the economics of this. It is clear that if potters and installers maintain their current charges then the lowest price possible for consumers is R34. This is unlikely to prove popular with consumers who are currently paying R30 or less. However, should prices come down a retail price of R28 could be achieved. We have seen that potters could bring down their prices to R10 and still earn a good living. It is unlikely that installers could effect a similar cut in prices. Installers theoretically can build five stoves per day giving them an income of R75 per day. Master masons only earn R75 per day for a much more skilled job. In practice, stove installers are unlikely to install more than three stoves per day, an income of R45 per day. Thus, R15 per stove is likely to remain the installation charge.

Could the existing system match these prices? It is less likely that competition will bring down prices so far, since the Gramasevaka/Wisesaseva is effectively a monopoly in his or her own area. They have a vested interest in maintaining a steady demand for stoves providing them with a steady income. Promoting competition provides them with little or no extra income. There is another danger with the existing system : a new political priority or a new activity with a higher payoff could overnight destroy the stoves programme.

As a matter of priority, therefore, an alternative marketing structure using wholesalers and retailers should be developed. The sooner this can be done the better : as time goes on the vested interest of the government workers will militate against a new system.

The one-piece stove liner may have benefits here too. By removing the need for a stove installer prices would tend to be lower because the distributing system would be simpler. Appendix 5 shows that a potter could achieve an acceptable level of income selling each stove liner at R20, retailing at R23. Competition here could perhaps reduce the retail price further to R17-18.

4.2.3 The National Perspective

The main objective of the national stoves programme is to disseminate stoves as rapidly as possible. The obvious course to follow is to continue with the existing stove and the existing production and distribution strategy. However, as the previous two sections have shown this might have longer term implications which could reduce the impact of the stoves programme.

Three options have been identified as possible long-term production and distribution options. Table 4.4 lays out the implications of following these different strategies. While it is not being suggested that the whole programme should be changed overnight, it is felt that the best choice to make is not clear and that certain steps should be instituted to keep options open as long as possible :

(1) An alternative distribution strategy should be tried in at least one district.

(2) Competition should be encouraged by training an excess of potters and installers .

(3) A one-piece two-pot liner should be field-tested to gauge consumer and producer reaction.

(4) The dissemination process should be properly monitored so that changes to the stove programme can be made in reaction to consumer and producer needs.

While the first two of these recommendations can be instituted by the CEB it is felt that Sarvodaya would be the best people to carry out the other recommendations : they have an extensive network of village workers who with the right training and a strengthened support system could provide an excellent stove development and monitoring service.

Table 4.4 : Decision Matrix for Different Stove Production and Distribution Options

			Two-Piece	One-Piece Moulded
Potential No. Stoves Disseminated	1985	Gov. 20,000	Private 20,000	Private -
	6	50,000	50,000	20,000
	7	200,000	200,000	70,000
Training :				
Potters		820	820	1,025
Installers		820	820	-
Prices:				
Current		37	34	23
Long-term		37	23	17
Consumer Acceptance		Good	Potentially Very Good	Potentially Excellent
Quality Control		Variable	Variable	Good
Employment Generation (Full-time Equivalent)		820	820	510

5. The Urban Areas

5.1 Progress to date

5.1.1 The CISIR Stove

This one pot portable ceramic stove was designed by the Ceylon Institute for Scientific and Industrial Research (CISIR). Originally two designs were produced, one with (Type A) and one without (Type B) a pot shield and 40 stoves were tested by the National Housing Development Authority (NHDA) in Wanathamulla Shanty Improvement Project, 18 type A's and 22 type B's. From research carried out two months after installation it was concluded that Type B was the more popular stove. The statistics hardly support that conclusion and during our own visit to Wanathamulla some six months later, only Type A stoves were in use. All Type B stoves had broken.

However, on the strength of the survey's findings a further 40 Type B stoves are being tested at Navagamgodde, a Government Sites and Services Scheme. These appear to be proving more popular and the design has been improved somewhat lengthening the stove's life. Clogging grates, however, still cause efficiencies to fall quite rapidly, and wood-savings at Navagamgodde seem if anything, less than at Wanathamulla (16% against 18%).

While the stoves were given free at Wanathamulla, the households were charged R15 at Navagamgodde which was paid into a community fund so that a bank account could be opened to hold savings for future community activities. It proved very difficult even so to persuade people to part with the R15, although this problem appears to have eased in more recent tests.

It is clear that there is still scope for design development here prior to dissemination. As a consequence competing designs are appearing. The Industrial Development Board (IDB) have produced a one pot stove with a small chimney which is claimed to be more efficient. The CEB themselves are experimenting with one and two pot designs, although the CISIR stove remains the only stove to have been extensively field tested.

5.1.2 Production Methods

The first fifty stoves were built by an artisan, Jayakodi, who has a small pottery at Waikkal. The stoves were thrown on a wheel using clay mixed by hand and foot and then the door to the firebox was cut out and the pot rests added at the leather hard stage. Jayakodi specialises in flower pots (as well as well liners) and found it very difficult not to throw stoves that looked like flower pots. However, in the newer stoves he has made, the shape is nearer the specification and quality is more consistent. He was paid R20 per stove.

As a result of quality problems, the second batch of stoves was made at the Sumagi Tile Factory, Dankotua. The production method used was the same although the clay was first mixed in a pug mill before secondary hand/foot mixing with sand. Quality on the whole was higher than for Jayakodi's stoves.

The major problem besetting these stoves appears to be consistency of the clay body which leads to extensive cracking and a reduction in the life of the stove. Not one Type B stove survived six months at Wanathamulla. We have yet to know how long the Navagamgodde stoves will last.

An alternative production method is now being tested using plaster of paris moulds set into reinforced cement. It is hoped that this will further standardise the stoves and provide employment for people less skilled than potters.

5.1.3 Distribution Methods

No method of distribution has yet been developed. All the stoves produced so far have been collected from Jayakodi and Sumagi by either CISIR, CEB or NHDA, and delivered direct to households. At Wanathamulla no attempt was made to get payment for the stoves but at Navagamgodde householders were "charged" R15, although that money still belonged to the community. A great deal of work still needs to be done on developing distribution systems and marketing methods.

5.2 Further Developments

A development plan for urban stoves has been drawn up and is currently in the process of seeking funding. The aim of this programme is to establish production capacity of 100,000 stoves within two years to service the Colombo market. Other urban markets are not included and seem to fall between the two stools of the urban and rural stoves programmes.

Much work needs to be done before this objective can be achieved and in this section we shall examine different options from the perspectives of the user, the producer and the country as a whole.

5.2.1 The Consumers' Perspective

For any stove to be successful it must meet consumer requirements, at least those requirements which are perceived as most important and it must also be affordable.

Some may ask if developing a woodburning stove is the most appropriate way forward or whether alternative fuels should be examined. While in the very long term a wood-substitute - such as coir-dust briquettes - may be desirable, Table 5.1 shows that the

only rapid response to improved fuel usage in Colombo is through the development of an efficient wood-burning stove.

In Colombo, the highest priority appears to be given to the portability of a stove. This is especially true in poorer households where a shortage of space and no separate kitchen means that it is necessary to clear a stove away when it is not in use. From this it has been assumed by most people that a one-pot stove is the answer, and most stove designs have worked on that principal. This assumption must be questioned. In even the poorest houses visited, we saw in almost every case two fires burning rather than one and Sri Lankan cooking practice would dictate the need for two fires.

Table 5.1 : Principal Cooking Fuel used by Households, Colombo, 1981

Fuel	Households	
	No.	%
Firewood	219941	83
Kerosine	21354	8
Electricity	12014	4.5
Gas	9617	3.5
Others	2333	1
	265259	100

SOURCE : CEB

It could be and is argued that this simply means buying two one pot stoves but in the rural areas, a major benefit of the two pot stoves that was pointed out by many people we saw was that the stove cooked two pots but required the lighting and maintenance of only one fire. It appears that there is no reason why this should not be regarded as a major benefit in the urban areas too, and a portable version of the two pot stove should at least be actively investigated and tested.

A complaint by users of the CISIR stove (both types A and B) is that it is too large and is better suited to cooking food for sale than for domestic consumption and, indeed, many families were using the new stove expressly for that purpose, while continuing to use an open hearth for domestic cooking. This indicates that either a range of stove sizes needs to be developed or that a two pot stove usable with a range of pot sizes needs to be developed.

A further problem which could affect repeat buying of the stove is its short life. The first stoves at Wanathamulla had a life of 2-6 months. Admittedly, the quality was poor and the clay body's

refractory qualities could be improved, but the traditional clay stove available in markets for R6.50 has a life of up to 2 years and any new stove should have a similar lifespan, otherwise it could develop a reputation which more than negates any fuel saving qualities.

Appendix 6 looks at the affordability of the CISIR stove. The payback period depends crucially - obviously - on the amount of woodfuel that can be saved. At a conservative estimate of 16% savings, the payback period at current wood prices is 7 - 13 weeks. If the design is improved sufficiently to achieve 25% savings, the payback period falls to 4 - 8 weeks which is still a long time for poor families. It should be noted that these calculations are for two stoves, since two are required to achieve the full savings possible.

Appendix 6 also shows kitchen investment levels, which are almost as low as in rural areas. Where wood is monetised, these investment levels are less important than where it is not, if the savings on fuelwood are enough to pay for the stove within the normal income period of the household (i.e. less than four weeks). With savings of this level, people can divert resources from one sort of current expenditure to another. Where payback periods are greater than four weeks, no such transfer is possible and people must make a special investment. R40, the cost of two stoves, is realistically within the scope of 80% of the population if stoves are purchased only once a year. With lives of less than a year, the proportion of the population who can afford a stove would decline sharply.

There are, therefore, a number of key areas to be improved on the CISIR stove :

(1) Reduction of the retail price.
(2) Improvement of the life of the stove to at least one year.
(3) Improvement in fuel saving (in practice, <u>not</u> in the laboratory), reducing payback period to 2 - 4 weeks.
(4) Development of a range of sizes.

Rather than simply concentrating on the CISIR stove, it appears from the above that the parallel development of a two pot stove is also needed. The parameters for such a stove would be :

(1) A retail price as near to R20 as possible.
(2) Minimum wood savings of 35% (= payback period of one and a half to three weeks)
(3) Portability.
(4) A life of at least one year, preferably 2+.

Up until now we have been talking simply about Colombo. But there

are substantial urban populations outside Colombo as Table 5.2 shows and little consideration has been given to the needs of these people. It is suggested that the needs of urban consumers outside Colombo be actively investigated to see whether their requirements can be met more effectively by rural or urban stove designs. For the rest of the discussions on urban stoves, however, we shall concentrate on Colombo.

5.2.2 The Producers' Perspective

There are two effective production options for manufacturing stoves for Colombo. One makes use of the informal sector potters of Colombo, Gampaha and Kurunegala. The other involves the establishment of more centralised stoves factories, most likely as adjuncts to the tile factories to the north of Colombo. Appendices 7 and 8 show that both options are feasible, with the formal sector business achieving an internal rate of return of over 30% if moulds are used, and the informal sector potters being able to achieve substantially higher incomes and securer markets than with existing products. What is less clear is whether moulds in the centralised units are desirable above thrown pottery. Laurie Childers' figures in Appendix 7 shows that throwing is very attractive financially while moulding is not. Further clarification of these figures is necessary before any final conclusions can be drawn. It is likely, then, that upon the establishment of a market, both these options will develop which should be to the benefit of the stoves programme. Both should, therefore, be encouraged. It is quite possible that the higher quality control of the factory-made item will enable it to command a price premium over the informal sector stove which would be affordable by the poorer sections of the Colombo community.

There is plenty of room in Colombo for both methods of production. Table 5.2 shows just how big the market is both in Colombo and, potentially, in other urban centres too. On the assumptions of a six-month life and two stoves per household (that is, the current CISIR stove design), the Colombo market is nearly 900,000. The market for a one-piece two-pot stove with a life of one year would be 225,000 per year.

The employment and hence the training implications of this are significant (See Table 5.3). Over 500 informal sector potters would have to be trained, over a third of all potters in Colombo, Gampaha and Kurunegala. A mobilisation on this scale, certainly over a small number of years, would be very difficult to achieve. To achieve rapid increases in production, the development of centralised units appears to offer more hope, although this would still involve the establishment of 50 units of the size detailed in Appendix 7. However, with quality improvements to the stove, and assuming at least for five years a market penetration of 50%, the actual market is probably nearer 225,000 stoves per year, requiring 10-12 units to

TABLE 5.2: ESTIMATE OF POTENTIAL MARKET FOR ONE-POT WOODBURNING STOVES BY DISTRICT, URBAN AREAS, 1985, 1990

	Urban Population	Households (3)		Potential Annual Stove Demand (2)	
District	1981	1981	1985 (3)	1990 (3)	1985 (3)	1990 (3)
Anuradhapula	41,392	7,810	8,621	9,754	31,036	35,114
Puttalam	61,628	11,628	12,835	14,522	46,206	52,279
Kandy	145,109	27,379	30,221	34,192	108,796	123,091
Colombo	1,264,284	238,544	263,308	297,909	874,183	989,058
Kurunegala	43,497	8,207	9,059	10,249	32,612	36,896
Polonnaruwa	20,495	3,867	4,268	4,829	15,365	17,284
Trincomalee	82,739	15,611	17,232	19,496	62,035	70,186
Ampari	53,276	10,052	11,096	12,554	39,946	45,194
Kalutara	178,071	33,598	37,086	41,959	133,510	151,052
Gampaha	388,342	73,272	80,879	91,507	291,164	329,425
Mannar	49,394	9,320	10,288	11,640	37,037	41,904
Hambantota	41,430	7,817	8,629	9,763	31,064	35,147
Mullaitivu	7,192	1,357	1,498	1,695	5,393	6,102
Matara	71,151	13,425	14,819	16,766	53,348	60,358
Batticaloa	79,415	14,984	16,540	18,713	59,544	67,367
Galle	166,371	31,391	34,650	39,203	124,740	141,131
Matale	38,109	7,190	7,936	8,979	28,570	32,324
Nuwara Eliya	37,288	7,035	7,765	8,785	27,954	31,626
Vavuniya	18,512	3,493	3,856	4,363	13,882	15,707
TOTAL:	2,787,694	525,980	580,583	656,876	2,016,372	2,281,340

NOTES:

(1) Assumes average household size of 5.3 (Dept. Census and Statistics, 1983)

(2) Assumes 83% of households in Colombo and 90% elsewhere burn wood as principal cooking fuel and that the average life of a stove is 6 months. Also assumes 2 stoves perhousehold.

(3) Assumes annual urban growth rate at 2.5% p.a. (World Bank, 1984)

SOURCE: Dept. Census and Statistics, 1983

TABLE 5.3: POTENTIAL EMPLOYMENT GENERATION IN URBAN STOVE MANUFACTURE BY DISTRICT

District	Potential Annual Stove Demand (1)		Potential Employment Generation Centralised Prodn. (2)		Informal Potters (3)	
	1985	1990	1985	1990	1985	1990
Anuradhapula	31,036	35,114	14	15	19	22
Puttalam	46,206	52,279	20	23	28	32
Kandy	108,796	123,091	47	53	66	74
Colombo	874,183	989,058	372	421	525	593
Kurunegala	32,612	36,896	14	16	20	23
Polonnaruwa	15,365	17,384	7	8	10	11
Trincomalee	62,035	70,186	27	30	38	43
Ampari	39,946	45,194	17	20	24	28
Kalutara	133,510	151,052	57	65	81	91
Gampaha	291,164	329,425	124	140	175	198
Mannar	37,037	41,904	16	18	23	26
Hambantota	31,064	35,147	14	15	19	22
Mullaitivu	5,393	6,102	3	3	4	4
Matara	53,348	60,358	23	26	32	37
Batticaloa	59,544	67,367	24	29	36	41
Galle	124,740	141,131	54	60	75	85
Matale	28,570	32,324	13	14	18	20
Nuwara Eliya	27,954	31,626	12	14	17	19
Vavuniya	13,882	15,707	6	7	9	10
TOTAL:	2,016,372	2,281,340	857	970	1,219	1,379

NOTES:

(1) From Table 5.2

(2) Assumes 0.425 jobs per 1,000 stoves (see Appendix 5)

(3) Assumes 0.6 jobs per 1,000 stoves (see Appendix 6)

be established. The competition created by this number of units should be enough to keep prices down. It is recommended, therefore, that options are kept open by training a number of informal potters but also by encourage entrepreneurs to invest in stove-making factories as adjuncts to their tile factories.

What will be extremely important to the success of any production unit is the marketing of the stoves. It will not be enough to have a wonderful stove design that really does everything a consumer could want apart from the washing up. Awareness of the new stove, its benefits and its value will have to be developed; a distribution network will have to be established so that people can easily buy the stoves; and the whole process will need to be monitored, complaints quickly dealt with and design changes incorporated where necessary.

The experience of the State Timber Corporation in marketing its charcoal stove is worth drawing on and developing. To develop awareness of their stove - and of the benefits of charcoal - they hold regular demonstrations for Housewives Associations and Flat Dwellers Associations. Stoves were always on sale after the demonstrations. The former are predominantly middle and upper class groups of housewives who meet once a month for cooker demonstrations, flower shows, interesting talks, etc. There are six or seven of these in Colombo. The flat dwellers associations tend to have a broader social mix. While these groups may not be the best to promote woodstoves through, the concept of demonstration and sale need pursuing and developing.

STC aimed from the start at distributing stoves through established wholesaling and retailing channels. Initially, retailers were invited to these demonstrations so that they could see the enthusiasm generated. They were then offered stoves on a week's credit. No sale-or-return deals were offered although this may be a valid option to pursue. Once retailers became interested, STC started supplying them regularly until the number of retailers had grown to the level where a wholesaler became interested in handling the stoves.

A rapid consumer complaints service was established so that any faulty stoves were replaced immediately without charge. STC has yet to pass this service on to the wholesaler and it still collects stoves from the informal sector potters and delivers to the wholesaler, but they have largely succeeded in extricating themselves from the distribution process and have left behind a self-sustaining distribution network.

It should be noted that the scale of the STC operation is much smaller than the proposed woodstoves project. The charcoal stove was designed to replace kerosine cookers, used by only 8% of Colombo households. Stoves are now produced and sold at the rate of 500 per month. Interestingly, their stoves have a six month life : they have

been unable to improve on that. The stresses caused by the higher temperatures in the firebox of a charcoal stove suggests that a ceramic wood-burning stove should be able to achieve a life substantially longer than that.

5.2.3 The National Perspective

The national perspective is clear : the urban stoves programme, or rather the Colombo stoves programme, must create as rapidly as possible a demand for and a supply of fuel-efficient woodstoves to reduce the pressure on diminishing forest reserves and the financial burden of especially the poorer people of Colombo. None of what has been set out above is in conflict with this objective.

No direct comparison will be made between centralised factory production and decentralised informal sector pottery production. Both options are valid, and, in the opinion of this writer, complimentary. It is almost certain that the informal sector will be better able to supply a woodstove affordable by the poorer sections of the community while centralised factory production will enable the development of consistent refractory clay bodies and thus higher quality - at a higher price. The stoves programme should develop both of these options through training and support and should also concentrate on developing the demand for these stoves in all sectors of the urban woodfuel market.

APPENDIX 1

Rural Stoves

Economics of Improved Stoves to the Consumer

1. Payback Period

In many parts of rural Sri Lanka fuel is a free commodity. The most common fuel is wood from jungle areas, but around the coast substantial amounts of coconut husk and branch are burnt. In both cases, the household (usually women and children) collect sufficient fuel from their own land or from nearby jungles. The poorest tend to use lower grade fuels (smaller branches, palm fronds, rice husks) not yet used widely.

Where fuel is free it is difficult to cost and hence to calculate a payback period for a stove. The opportunity cost of labour used to collect fuel will be low for much of the year except when there are labour shortages at times of planting and harvesting. There is, however, a growing market for fuel in the towns and in Hambantota District, we found women selling wood to passing trucks for R5 for a 10 kg bundle. In Manikine in Kandy District, itinerant sellers sell wood for R20 a hundredweight or approximately R4 for a 10 kg bundle. It can be said, then, that the opportunity cost of burning 10 kgs of wood is the loss of the sale of 10 kgs of wood - in other words R4-5. While this is not totally realistic since householders tend to use lower grade fuels for themselves and sell the higher quality wood, these figures can give a rough guide.

Current fuel usage for a family of 5 - 6 members is 30-60 kgs per week. At a cost of R5 per 10 kgs, weekly fuel expenditure amounts to R15-20 per week.

Just how much wood does the Sarvodaya stove save? There have been widely varying reports. Herath (1984) reported 9.3% savings in controlled cooking tests. Stewart (1983) reported that in field tests, savings of 25-33% were achieved. Abeyratne (pers. comm. 1985) suggests savings in the region of 50-60% and our own conversations with stove owners suggest savings of up to 50%. For our calculations here, we shall assume savings of 30%.

At this level of fuel saving, weekly fuel expenditure drops to R10.50-21 per week, a saving of R4.50-9 per week. If the stove costs R30, then the payback period is 3-7 weeks.

2. Kitchen Investment Levels

In poor houses, the family may own 3-5 pots while a rich house would

have cooking pots for each day plus others for special occasions and dishes, totalling 10 or more. There are six standard pot sizes, ranging in price from R2.50 to R8 with an average price of R5. Each year every household buys at least one new pot to celebrate New Year.

Households also possess water jars costing approximately R10 each, at least one and as many as 5. Other items include curd pots and aluminium washing bowls.

The total value of kitchen items, then, can vary from R25 to R150. Assuming a two year life for most items this suggests an annual expenditure of R12 to R75 or R1 to R7 per month. Poorer groups may be able to spend less than R1 and wealthy groups may spend considerably more than R7. This appears to be confirmed by the findings of the Labour Force and Socio-Economic survey 1980/81, although kitchen items are not listed separately and we must assume that they form a proportion of total semi-durable and durable household goods. Monthly expenditure by expenditure group is given in the table below.

What is clear is that expenditure of R30 per month on durables and semi-durables is only achieved by the very wealthiest (only 20.9% of all households). A R30 stove may therefore be beyond the reach of a large proportion of households. When wood is currently not monetised, the stove would have to have major non-monetary attractions to justify the expense for the poorer half of the population.

The "lumpiness" of rural incomes, however, means that annual investment of R30 is likely to be accessible to over 80% of the rural population.

TABLE: Number of Households and Average Expenditure on Major Expenditure Items by Expenditure Groups, Sri Lanka, Rural Sector, 1980/81

Expenditure Group	No. Households	Monthly Expenditure (R)			
		Total Expenditure	Semi-durable goods	Consumer Durables	Total
All Groups	2,266,677	1,155.39	3.86	18.12	21.98
Less than 300	55,498	225.75	0.15	0.44	0.59
300 less than 500	185,666	413.86	0.56	0.24	0.80
500 " " 600	147,404	550.09	1.06	2.71	3.77
600 " " 800	401,488	699.62	1.23	2.40	3.63
800 " " 1,000	375,522	896.79	2.12	4.78	6.90
1,000 " " 1,500	626,736	1,221.03	3.38	11.64	15.02
1,500 " " 2,000	261,905	1,705.98	6.65	23.64	30.29
2,000 " " 3,000	157,458	2,360.99	12.10	52.55	64.65
3,000 +	55,000	4,490.21	25.81	292.40	318.21

Source: Department of Census and Statistics, 1983

APPENDIX 2

RURAL STOVES

Centralised Stoves Factory (1)

Production Economics

	Wheel	Mould
Variable Costs		
Clay (2)	.74	.74
Labour (3)	7.00	6.00
Firing (4)	3.40	3.40
Rejects (5)	.78	.71
Delivery (6)	1.90	1.90
TOTAL VARIABLE COST	13.82	12.75
SELLING PRICE	15.00	15.00
Contribution to overheads	1.18	2.25
Annual Overheads		
Quality Controller (7)	10400	10400
Supervisor (8)	19500	19500
Labour (9)	8320	8320
Management Charge (10)	10000	10000
Factory Overhead (11)	10000	10000
Depreciation (12)	21500	29500
Interest (13)	27200	27840
	106920	115560
Annual Sales (14)	300,000	300,000
Annual Contribution	23,600	45,000
Net Profit (loss)	(83,320)	(70,560)
Net Profit Percentage	Negative	Negative
Return on Capital	Negative	Negative

NOTES

(1) All the costs are based on the Sumagi Tile Factory Dankotua.

(2) Clay costs R120 per cube (100 cubic feet) at the mine site. Transport costs another R25 per cube to bring it to the factory gate.

The Sumagi pugmill - an ancient machine powered by a Massey Ferguson tractor - can process 3.66 cubes of clay per 8 hour shift. Operating costs per shift are :

10 gallon diesel @ R36.96/gallon	369.60
2 pints oil @ R90/gallon	22.50
Machine minder @ R50/day	50.00
5 x labourers @ R32/day	160.00
TOTAL OPERATING COSTS	602.10
OPERATING COSTS PER CUBE	164.51
PLUS : COST OF RAW CLAY AND TRANSPORT	145.00
MARGINAL COST OF PROCESSED CLAY PER CUBE	309.51

No charge for depreciation or maintenance has been made, since it is assumed that these marginal costs are zero.

The Sarvodaya two-pot liner weighs 9.45 kgs wet. One cube of clay weighs 3983.61 kgs, which is enough for 421 stoves. The marginal cost of clay per stove is, therefore, R0.74.

(3) It is assumed here that all labour involved in stove making will be paid piecerate. In practice, it is likely that they will be paid a basic wage plus bonusses - i.e. not a truly variable costs.

Wheel-working potters can currently earn up to R1000 for a six day week. In timing tests, it took an experienced rural potter 20 minutes to make a stove. At speed, this could be reduced to 15 minutes. Thus a potter working 48 hours on stoves alone could manufacture 140 stoves, allowing for down-time, etc. A potter would thus expect payment of approximately R7 per stove to compete with existing earnings.

Moulding requires less skill and could be carried out by Sumagi employees currently earning R32 per day, or R192 per six day week.

According to Laurie Childers, these costs could be reduced somewhat (say, to R5 per stove) for thrown work. This is not enough, however, to make such a centralised unit profitable.

One worker could mould six stoves per day or 36 per week. At R6.00 per stove this gives earnings of R216 per week, which should prove attractive to these workers.

(4) The small kiln at Sumagi uses 16 cubic yards of firewood to fire 5,500 tiles to 850oC. The total weight of these tiles is 33,000 lbs fired. 200 stoves weigh 3080 lbs fired, which, pro rata, should use 1.5 cubic yards of firewood. The different nature of stoves and the extra space occupied by stoves, suggests that 4 cubic yards would be needed per firing of 200 stoves.

Fuelwood costs R130/cu. yd. from the rubber plantations and a further R40/cu. yd. for transport. Total fuel cost per firing is, therefore, R680 or R3.40 per stove. No loading/unloading charge is made since there is excess labour available for this at no marginal cost.

(5) Reject rate is estimated conservatively at 7% and is calculated at 7% of clay, labour and firing costs.

(6) Assumes average distance of delivery is 100 miles round-trip. A 5 tonne lorry carrying 500 stoves is used.

Ceylon Ceramics Corporation (CCC) charges at R9.50 per running mile, which is comparable to urban commercial rates. This works out at R1.90 per stove.

(7) Quality controller would be a newly qualified graduate with credits in chemistry and physics, hence the low pay.

(8) One supervisor is charged for. This may be more than is necessary and this cost would be reduced, or used to employ a more highly qualified person part time.

(9) The labourer is employed in wedging, assisting with kiln loading and unloading and general tasks.

(10) Estimate. CCC charges at 21% on-cost, which would be over R50,000 but is very high.

(11) Estimate. CCC charges at 19-20% of variable costs, which would be R30,000. This is very high for a private factory.

(12) Depreciation is charged as follows :

Item	Value	Dep. Rate	Annual Depr.
Building	85,000	10%	8,500
Kiln	60,000	20%	12,000
Sundries	5,000	20%	1,000
Moulds	8,000	100%	8,000
			29,500

Throwing stoves removes the need for moulds, and thus reduces depreciation to R21,500.

(13) Interest rates in Sri Lanka currently vary between 12 and 16% in the commercial sector. 16% is used here for conservatism, and interested is charged on :

	Wheel	Mould
Capital Costs	150,000	158,000
Working Capital	20,000	16,000
	170,000	174,000

(14) 20,000 stoves at R15 per stove.

DISCOUNTED CASH FLOW

CENTRALISED RURAL STOVES FACTORY (R000)

Year	0	1	2	3	4	5	6	7	8	9	10
Capital Costs	158	8	8	8	8	73	8	8	8	8	73
Variable Costs		256	256	256	256	256	256	256	256	256	256
Overheads		58	58	58	58	58	58	58	58	58	58
Total Cash Outflows	158	186	314	314	314	379	314	314	314	314	379
Sales		150	300	300	300	300	300	300	300	300	300
Net Inflow/Outflow	(158)	(36)	(14)	(14)	(14)	(79)	(14)	(14)	(14)	(14)	(79)

NPV : Negative (at any discount rate)

IRR : Negative

APPENDIX 3

Rural Stoves Manufacture

Informal Sector - Informal Economics

These figures are based on the pottery businesses of Cyril Amitepale in Maniking village in Kandy District, Mr. V. P. Wijeysiri of Kirimagedere village in Hambantota District and of other potters in the same village.

(1) Current Income

The main alternative products which a rural potter could produce are cooking pots and flower pots. The former is a declining market while the latter is static or falling due to substitution of cement pots for ceramic. Thus any income comparison may not be realistic since the long-term choice facing rural potters may be stove production or unemployment.

Product	Price	Potential Daily Production Per Skilled Worker	Potential Daily Income
Curd Pots	1	40	40
Rice Pots			
- Small	2.5	20	50
- Large	6*	15	90
Flower Pots	4	20	80
Stoves	15	7	105

* R10 during New Year.

Stove production is, therefore, attractive. However, it is likely that during the New Year when rice pot prices rise that production of stoves will tail off and potters will concentrate on rice pots.

(2) Operating Costs.

- In Hambantota, clay is free from the base of dried out tanks. Transport costs vary depending on the distance from the tank. A tractor costs R150 for a large load of 110 balls of clay (one ball of clay being enough for three stoves). Clay costs, therefore, approximately R0.50 per stove.

- In Kandy, there are no tanks and Cyril Amitepale has to pay for his clay. A tractor load currently costs him R100 which is enough for 250 stoves. The tractor hire costs him a further R80. Clay costs, therefore, R0.72 per stove, although Cyril has to keep on changing sources and costs may vary.

- Labour is all family labour. Other potters sometimes help out but not on a formalised basis.

- Kiln loading and unloading is by the potters themselves. There is no opportunity cost since these activities are skilled and without them the pottery work would be worthless.

- Firing uses whatever local materials are available. Thus in hilly areas like Kandy, wood and sawdust tend to be used. On the coast, coconut husks and some coconut wood is used.

Cyril Amitepale uses R500 of firewood per month and R40 (transport only) of sawdust. This works out at R1.80 per stove at his current production level of 300 stoves pr month. V. P. Wijeysiri uses 1000 coconut husks per firing, costing R40 plus R40 transport (= R80). He also uses 10-12 pieces of coconut wood costing R10-12. (A coconut palm costs R40-50 and is enough for four firings.) Thus firing costs are R0.92 per stove at a kiln capacity of 100 stoves per firing.

- No other financial costs are incurred, since the property is rent-free and there are no power costs.

- An imputed cost needs to be calculated to cover the costs of replacement of capital items (namely the kiln and shed) and an interest charge for setting up and working capital made even if no interest is being paid. This charge should be at the opportunity cost of capital facing the potter (i.e. that interest which could be earnt by the potter if (s)he invested his/her money elsewhere). Thus, an existing potter's opportunity cost of capital nears zero, since the selling price of his or her assets would be very low (if anything) and thus the potter could not re-invest that capital. If a new potter sets up, then the opportunity cost of capital is calculated based on the full capital cost of the equipment and buildings.

(3) Capital Costs.

A 100 stove kiln uses 1,000 bricks which cost approximately R500 in rural areas. However, many potters fire their own bricks, although Cyril Amitepale said that the level of orders for stoves means that were he to build another kiln, he would buy the bricks and hire a mason. A 100 stove kiln would cost, therefore :

Bricks x 1000	500
Mason x 5 days	325
	825

The building housing the kiln would use :

100 liner feet of timber @ R5/l.f	500
12 sheets 32 ga. 8' x 2' @ R80/sheet	960
	1460

A carpenter would build this in five days or the potter could build it. Many potters use coconut fronds rather than corrugated iron for roofing. It should be noted that the cost of timber in rural areas is very variable (as is the quality) and R5/l.f. is taken as an average.

The total costs of the kiln and housing, therefore, will range from near zero (i.e. self-made bricks, self-built, coconut frond roof, cheap timber) to more than R2500 (Purchased bricks, built by mason and carpenter, corrugated iron roof, expensive quality timber.)

The pottery shed is likewise very variable in cost and quality. Some potters work in "lean-to's" attached to their house, self-built with very low quality materials. Others have built more spacious sheds with corrugated iron rooves and sturdier timber poles. Shelving for drying pottery does not appear to be used much : pots are laid out on the ground to dry. It is not known how many pots are damaged this way by children, dogs, chickens etc.

A shed could, thus, vary from the R8000+ of the urban pottery shed (see Appendix 8) to little more than zero.

Total capital costs, therefore, can vary from R10,000+ to as little as a few hundred rupees (the opportunity cost of the potter's labour for constructing the assets). The life of the assets would vary accordingly, but even the cheapest kiln and shed would last several years.

(4) Working Capital

Working capital requirements are very small. Only the costs of clay and fuel will be paid for before cash is received for finished goods.

Since it will take approximately one month from clay collection through preparation, potting, drying and firing to final cash sale, a month's working capital should be allowed for :

Fuel	R 368 - 540
Clay	R 200 - 288
	R 568 - 828

(5) Total Capital Requirements

Total capital requirements for a new operation, then, are :

Kiln	R 200 - 2500
Shed	R 200 - 8000
Working Capital	R 500 - 900
	R 900 - 11400

(6) Returns to the Potter

Costs per stove completed should be in the following region :

Clay	0.5 - 0.8
Fuel	0.9 - 2.0
	1.4 - 2.8
+ Reject Rate @ 10%	.14 - 0.28
	1.54 - 3.08

Selling at R15 per stove, this yields a gross profit of R13.46 to R11.92. If we assume a capacity of 400 stoves per month (or 5200 stoves per year), this yields a gross profit of R69992 to R61984.

From this needs to be deducted depreciation and interest. On assets

worth R500 - R10,000, if we assume a life of 2 - 10 years, depreciation is R250-R1000. Interest at 15% of total capital requirements of R900- 11400 is R135-R1710.

Thus net annual profit - or rather net earnings distributable to family members - is :

	Gross Profit	69992 - 61984
Less :	Depreciation	250 - 1000
	Interest	135 - 1710
	Net Income to Potter's family	69607 - 59274

At a production level of 25 stoves per week per potter, capacity of 100 stoves per week would require four potters.

(7) Labour Creation

To manufacture 20,000 stoves per year, 18 potters would be employed full-time.

Capital cost per workplace : R225 - 2850

Average income per potter : R14818 - 17401

(8) Price Sensitivity

It is likely that as competition builds up prices will fall. Even if the price of a liner fell to R10, it would still prove attractive, especially when sales of other items were slack. Furthermore, as demand for other items is falling anyway, this could put further downward pressure on stove prices.

At R10 per stove, annual gross profits would be in the range of R43992 to R35984 or a net income per potter of R10902 to R8318.

APPENDIX 4

Rural Stoves

Economics of Stove Retailing

(1) Method of Distribution

Retailer collects liners from potters and transports them to shop. Customers then come and purchase liner from retailer and carry home. Installer visits home where mud mixture has already been prepared at a pre-arranged time and instals stove.

2. Returns to Retailer

Two options are considered here : one using prices currently paid to installers and potters, and the second option of what long term prices are considered likely to settle at. Average mark-ups for retailers are currently 7-8%, so these mark-ups of nearer 10% are attractive.

Mark-ups are added at two stages. This is to reflect the producer - wholesaler - retailer relationship that currently exists. While the inclusion of a wholesaler may push prices up (their mark-ups tend to be higher than for retailers), it is believed that the overall equation remains very similar.

	Current Prices	Long-Term Prices
Liner	15	10
Transport (1)	1	1
	16	11
Mark-up	1.50	1
Retail Pice	17.50	12
Installation	15	15
Mark-up	1.50	1
Total Price	34.00	28.00
Total Mark-up	3.00	2.00
Gross Margin (2)	8.8%	7.1%

NOTES

(1) 1 size 2 tonne truck costs R150-200 for a 10-15 mile journey in rural areas. This can carry 200 liners. Thus transport costs per stove are R1.

(2) Gross margin is total mark-up divided by total price.

APPENDIX 5

Rural Stoves Manufacture - The One-Piece Option

Informal Sector - Informal Economics

Accurate estimates cannot be made here since no production work has been carried out on this model.

However, certain assumptions can be made :

(1) A potter would need a mould since the skills of slabwork are not available in Sri Lanka.

(2) A mould would cost approximately R500 and be enough for 500 stoves.

(3) A potter could use a mould 5 times per day.

(4) All other costs would be the same as in Appendix 3.

Many of these figures are disputed by Laurie Childers. She suggests a mould would be lucky to produce 150 stoves and a maximum of 3 - 4 per day. A potter would thus have to purchase two moulds and the mould cost per stove rises from R1 to R3.33.

According to her, however, making a one-piece two-pot stove on the wheel is not as difficult as had earlier been thought. More investigation is needed here. These observations need to be borne in mind when reading the calculations produced below.

(1) Comparative Incomes.

To achieve comparable incomes to the two-part liner option, a price of R20 per liner is necessary :

Product	Price	Potential Daily Prod. Per Skilled Worker	Potential Daily Income
One-piece liner	20	5	100
Two-piece liner	15	7	105

(2) Operating Costs

As Appendix 3, except that a charge of R1 per stove for the cost of the mould is necessary.

(3) Returns to the Potter

Costs per stove completed should be in the following region :

Clay	0.5 - 0.8
Fuel	0.9 - 2.0
Mould	1
	2.4 - 3.8
+ Reject Rate 10%	.24- .38
	2.64- 4.18

Selling at R20 per stove, this yields a gross profit of R17.36 to R15.82. At capacity of 5200 stoves per year, this yields a gross profit of R90,272 to R82,264.

Net earnings distributable to family members is :

Gross Profit	90,272 - 82,264
Less : Depreciation	250 - 1,000
Interest	135 - 1,710
Net Income to Potter's family	89,887 - 79,554

At a production level of 20 stoves per week per potter, capacity of 100 stoves per week would require 5 potters.

(4) Labour Creation

To manufacture 20,000 stoves per year, 20 potters would be employed full time.

Capital Cost per Workplace	:	R 180 - 2,280
Average Income per Potter	:	R15,911 - 17,977

This compares favourably with the two-piece option.

(5) Price Sensitivity

As for the two-piece stove, competition and declining markets could reduce the price to the potter by some R5 say to R15 per liner.

At R15 per stove, annual gross profits would be in the range of R64,272 to R56,264 or a net income per potter of R12,777 to R10,711.

APPENDIX 6

Urban Stoves

Economics of Improved Stoves to the Consumer

1. Payback Period

In most urban areas of Sri Lanka and certainly within Colombo, wood prices are fairly uniform. The current price in Colombo is R30 per hundredweight (112 lbs = 51 kgs), smaller 25 kg bundles sell for R15, so poorer people who can only afford smaller amounts do not appear to be exploited. Wood is still used as the principal cooking fuel by the large majority of urban dwellers (83% of Colombo households, 90% in Hambantota and Tangalle).

Fuel usage is much more variable depending on cooking practice, family income and family size. A 5-6 member household would use a hundredweight of wood in 5-10 days, or in other words, weekly fuel usage varies from 35 - 70 kgs. At a cost of R30 for 51 kgs, weekly fuel expenditure works out at R20 to R40.

The amount of wood saved by the CISIR stove is uncertain since only limited results are currently available. Herath (1984) found the stove saved 15.7% in controlled cooking tests. The surveys at Wanatamulle carried out by the National Housing Development Authority suggested savings in practice of 18%. In later surveys at Navagamagodde, savings appeared to be in the region of 16%. In the interests of conservatism, we shall assume that the stove, under normal conditions, can achieve 16% savings. Further planned improvements to the stove may push this up to 20 or 25%.

At this level of fuel saving, weekly fuel expenditure drops from R20-40 to R17-34, a saving of R3-6 per week. While a stove would cost R20 retail, most households have two fires and thus to achieve all these savings, two stoves would have to be purchased. Thus at a cost of R40, the payback period for the stoves is 7-13 weeks. If savings are 25%, the payback period falls to 4-8 weeks, still a long time for poor households.

2. Kitchen Investment Levels

In urban areas, where firewood is monetised, consideration of kitchen investment levels is not so important as in the rural areas.

It becomes important, however, for those groups who face a higher payback period than their "income period" - that period within which

a household receives its regular income, usually monthly in Sri Lanka.

Investment levels are considerably higher in urban areas since aluminium pots are preferred to clay pots and cost R5-30 depending on size.

The total value, therefore, of kitchen items is probably in the range of R50 to R400. If we assume a four-year life, for aluminium pots and bowls, this suggests an annual expenditure of R12.50 to R100, or R1 to R10 per month.

The Labour Force and Socio-Economic Survey 1980/81 (See Table below) suggests expenditure levels substantially below even R1 per month for some 10% of the population. At a retail price of R20, 80% of the population could afford two stoves per year without a shift in resource allocation.

Table : Number of Households and Average Expenditure on Major Expenditure Items by Expenditure Groups, Sri Lanka, Urban Sector, 1980/81.

Expenditure Group	No. Households	Monthly Expenditure			
		Total Expenditure	Semi-Durable Goods	(R) Consumer Durables	Total
All Groups	567159	1662.00	5.81	56.62	62.43
Less than 300	14879	234.39	0.13	-	0.13
300 less than 500	23204	423.10	0.22	-	0.22
500 less than 600	19808	552.27	0.05	0.04	0.09
600 less than 800	58732	698.16	0.53	0.59	1.12
800 less than 1000	70317	897.50	1.37	5.52	6.89
1000 less than 1500	152239	1229.38	2.78	9.02	11.80
1500 less than 2000	90538	1734.44	6.08	16.76	22.84
2000 less than 3000	68911	2396.67	8.63	71.01	79.64
3000+	68531	4449.23	23.21	348.84	372.05

Source : Department of Census and Statistics, 1983

APPENDIX 7

Urban Stoves Factory (1)

Production Economics

	Wheel		Moulds	
Variable Costs	(1)	(2)	(1)	(2)
Clay (2)	.53	.53	.53	
Labour (3)	5.50	2.50	3.00	
Firing (4)	2.55	2.55	2.55	
Rejects (5)	.60	.39	.43	
Delivery (6)	.95	.95	.95	
TOTAL VARIABLE COST	10.13	6.92	7.46	
SELLING PRICE	15.00	15.00	15.00	
CONTRIBUTION TO OVERHEADS	4.87	8.08	7.54	
ANNUAL OVERHEADS				
Quality Controller (7)	10400		10400	10400
Supervisor (8)	19500		19500	19500
Labourer (9)	8320		8320	8320
Management Charge (10)	10000		10000	10000
Factory Overhead (11)	10000		10000	10000
Depreciation (12)	21500		29500	48500
Interest (13)	27200		27840	30880
	106920		115560	137600
Annual Sales (14)	300,000	300,000	300,000	300,000
Annual Contribution	97,000	161,600	150,800	150,800
Net Profit (Loss)	(9,520)	54,680	35,250	13,200
Net Profit Percentage	Negative	18.23%	11.75%	4.4%
Return on Capital	Negative	32.16%	20.25%	6.84%

NB: The figures in Columns numbered (1) were given to the writer. The figures in columns numbered (2) were given to Laurie Childers.

Workplaces created : 5 1/2 potters, 2 management, 1 labour

Capital cost per workplace : R20,471

Average Income per potter : R10,800 pa.

NOTES

(1) All the costs are based on the Sumagi Tile Factory, Dankotua.

(2) Clay costs R120 per cube (100 ft3) at the mine site. Transport costs another R25 per cube to bring it to the factory gate.

The Sumagi pugmill - an ancient machine powered by a Massey Ferguson tractor - can process 3.66 cubes of clay per 8 hour shift. Operating costs per shift are :

10 gallon diesel @ R36.96/gallon	369.60
2 pints oil @ R90/gallon	22.50
Machine minder @ R50/day	50.00
5 x labourers @ R32/day	160.00
TOTAL OPERATING COSTS	602.10
OPERATING COSTS PER CUBE	164.51
PLUS : COST OF RAW CLAY AND TRANSPORT	145.00
MARGINAL COST OF PROCESSED CLAY PER CUBE	309.51

No charge for depreciation or maintenance has been made, since it is assumed that these marginal costs are zero.

The CISIR one-pot stove weighs 6.825 kgs wet. One cube of clay weighs 3983.61 kgs, which is enough for 583 stoves.

The marginal cost of clay per stove is, therefore, R0.53.

(3) It is assumed here that all labour involved in stove making will be paid piecerate. In practice, it is likely that they will be paid a basic wage plus bonusses - i.e. not a truly variable cost.

Wheel-working potters can currently earn up to R1,000 for a six day week. A good potter could throw 180 stoves per week and would thus expect to be paid approximately R5.50 per stove to compete with existing earnings.

Moulding requires less skill and could be carried out by Sumagi employees currently earning R32 per day or R192 per six day week. One worker could mould 12 stoves per day or 72 per week. At R3.00 per stove this gives earnings of R216 per week, which should prove attractive to these workers.

These figures are called into question by the figures collected by Laurie Childers. She estimates that potters could throw up to 80 - 100 stoves per day and that potters currently earn R600-800 rather than R1,000 per week. Thus a piecework payment of R1.50 per pot plus a further R1 for cutting doors, fitting potrests and general labour would be sufficient.

(4) The small kiln at Sumagi uses 16 cubic yards of firewood to fire 5,500 tiles to 850oC. The total weight of these tiles is 33,000 lbs fired. 200 stoves weigh 2,310 lbs fired, which, pro rata, should use 1.1 cubic yards of firewood. The different nature of stoves and the extra space occupied by stoves, suggests that 3 cubic yards would be needed per firing of 200 stoves.

Fuelwood costs R130/cu. yd. from the rubber plantations and a further R40/cu. yd. for transport. Total fuel cost per firing is, therefore, R510 or R2.55 per stove. No loading/unloading charge is made since there is excess labour available for this at no marginal cost.

(5) Reject rate is estimated conservatively at 7% and is calculated at 7% of clay, labour and firing costs.

(6) Assumes 500 stoves per 5 tonne lorry on a 50 mile round trip (Sumagi - Colombo shops - Sumagi).

Ceylon Ceramics Corporation (CCC) charges at R9.50 per running mile, which is comparable to commercial rates. This works out at R0.95 per stove.

(7) Quality controller would be a newly-qualified graduate with credits in chemistry and physics, hence the low pay.

(8) One supervisor is charged for. This may be more than is necessary and this cost could be reduced, or used to employ a more highly-qualified person part-time.

(9) The labourer is employed in wedging, assisting with kiln loading and unloading and general tasks.

(10) Estimate. CCC charges at 21% on-cost, which would be over R50,000 but is very high.

(11) Estimate. CCC charges at 19-20% of variable costs, which would be R30,000. This is very high for a private factory.

(12) Depreciation is charged as follows :

Item	Value	Dep. Rate	Annual Dep.
Building	85,000	10%	8,500
Kiln	60,000	20%	12,000
Sundries	5,000	20%	1,000
Moulds	8,000	100%	8,000
			29,500

Throwing stoves removes the need for moulds, and thus reduces depreciation to R21,500.

If the Childers figures are accurate, moulds would last for only 150 stoves maximum, increasing the annual capital cost to some R27,000, and thus increasing depreciation to some R48,500 for the mould option.

(13) Interest rates in Sri Lanka currently vary between 12 and 16% in the commercial sector. 16% is used here for conservatism, and interest is charged on :

	Wheel	Mould
Capital Costs	150,000	158,000
Working Capital	20,000	16,000
	170,000	174,000

The Childers figures increase the total capital to R193,000.

(14) 20,000 stoves at R15 per stove.

DISCOUNTED CASH FLOW

URBAN STOVES FACTORY (R000)

Year	0	1	2	3	4	5	6	7	8	9	10
Capital Costs	158	8	8	8	8	73	8	8	8	8	73
Variable Costs	-	75	150	150	150	150	150	150	150	150	150
Overheads		58	58	58	58	58	58	58	58	58	58
Total Cash Outflows	158	141	216	216	216	281	216	216	216	216	281
Sales		150	300	300	300	300	300	300	300	300	300
Net Inflow/Outflow	(158)	9	84	84	84	19	84	84	84	84	19

NPV : 137,654 (discounting at 16%)

IRR : 34.29%

APPENDIX 8

Urban Stoves Manufacture

Informal Sector Artisan

Informal Economics

These figures are all based on the pottery business of Mr. Jayakodi in Kochikadi village, north of Colombo.

1. Current Income

Mr. Jayakodi manufactures a range of products including water filters, well liners, charcoal stoves and wood-burning stoves. His potential daily income from these products are, taking current prices paid :

Product	Price	Potential Daily Product. Per Skilled Worker	Potential Daily Income
Water Filters	35	2	70
Wood Stoves	20	10	200
Charcoal Stoves	12.50	10	125

There is, therefore, potential for stove prices to fall before other products become more attractive, and a price of R15 per stove would appear attractive to potters.

2. Operating Costs

- Clay is collected free from Mr. Jayakodi's own land. Other potters may face varying costs. Let us assume R0.50 per stove (the same cost facing a formal sector business).

- Labour, mostly women, are paid R30-40 per day for clay preparation and some of the less complex tasks. One week's production would require one person day of preparation @ R40. Thus labour costs are roughly R1 per stove (assuming a weekly production per potter of 40 stoves).

- Potting is a family operation and cannot be charged as a direct cost. As long as stoves are more attractive than other options, they will be produced (see previous section).

- Kiln loading and unloading is by the potters themselves. There is no opportunity cost since these activities are skilled and without them the pottery work would be worthless.

- Firing is by coconut husk. It takes 3,500 husks per 300 stove firing and these cost R175 per 1,000 husks delivered, or R612.50 per firing. This works out at R2.04, say R2, per stove.

- No other financial costs are incurred, since the property is rent-free and there are no power costs.

- An imputed cost needs to be calculated to cover the costs of replacement of capital items (namely the kiln and shed) and an interest charge for setting up and working capital must be made even if no interest is being paid. This charge should be at the opportunity cost of capital facing the potter (i.e. that interest which could be earnt by the potter if (s)he invested his/her money elsewhere). Thus, an existing potter's opportunity cost of capital nears zero, since the selling price of his or her assets would be very low (if anything) and thus the potter effectively cannot divert resources. If a new potter is set up, then the opportunity cost of capital is calculated based on the full capital cost of the equipment and buildings.

3. Capital Costs

Both kiln and shed are fairly basic.

A 300-stove kiln takes 1,500 bricks, costing R650 per 1000 bricks or R975 in total. Broken pots or old car chassis/springs are used as the kiln floor, neither having any real-or opportunity-cost. It would take a mason 5 days to build the kiln at R75 per day (= R325). The building housing the kiln would use :

100 linear feet of 4" x 2 @ R16.50/l.f.	1650.00
12 sheets 32 ga. 8' x 2' @ R80/sheet	969.00
	2610.00

A carpenter would build this in five days at R75 per day (R325).

Total costs of the kiln are, therefore :

Kiln materials	975
Kiln construction	325
Building materials	2610
Building construction	325
	4235

These costs can be reduced by firing the bricks in the potter's existing kiln or in a clamp and by purchasing lower quality building materials. Coconut thatch could be used instead of corrugated iron. These savings would reduce the cost of the kiln to nearer R2,000 but would probably halve the life of the kiln.

The pottery shed is normally timber frame with brick walls in the drying area and a corrugated iron roof. A 150 square foot building is sufficient and would take 16 days to build - eight days masonry and eight days carpentry. The building would use 20 sheets of corrugated iron and 150 linear feet of 4" x 2" timber. Ten 8" x 1" 10' shelves would be sufficient for storage. This building would cost :

Carpenter 8 days @ R75/day	600
Mason 8 days @ R75/day	600
20 sheets 32 ga. corrugated iron @ R80/sheet	1600
150 linear feet of 4" x 2" @ R16.50/1.f	2475
100 linear feet of 8' x 1' @ R16.50/1.f	1650
2000 bricks @ R650 per 1000	1300
Cement, 4 bags @ R100/bag	400
	8625

Total capital costs re thus in the region of R12,860, ranging depending on quality of materials from R8000 to R14000.

Such a kiln and building should last approximately 10 years, but we shall conservatively assume a 5 year life.

4. Working Capital

As for most informal sector businesses, working capital requirements are small: only the costs of hired labour and firewood will be paid before cash is received for finished goods. Since it will take approximately one month from clay collection through preparation, potting, drying and firing to final cash sale, a month's working capital should be allowed for:

4 firings @ R612.50 per firing	2450
4 days clay preparation @ R40/day	160
	2610

5. Total Capital Requirements

Total capital requirements for a new operation are, therefore :

Kiln	4235
Building	8625
Working Capital	2610
	15470

6. Return to the potter

Costs per stove completed should be in the following region :

Labour costs	1
Clay	0.5
Firing	2
	3.5
+ Reject Rate @ 10%	.35
	3.85

Selling at R15 per stove, this yields a gross profit of R11.15 per stove. If the unit produces 15,000 stoves per year (its capacity), this yields a gross profit of R167,250.

From this needs to be deducted depreciation and interest. On assets worth R12,860, if we assume a life of 5 years, depreciation is R2,572. Interest at 15% of total capital requirements of R15,470 is R2,320.50. Thus net annual profit - or rather net earnings distributable to family members - is :

Gross Profit	167,250
Less: Depreciation	2,572
Interest	2,320
Net Income to Potters family	162,358

At a production level of 40 stoves per week per potter, capacity of 300 stoves per week would require 7 1/2 potters. This would require two families working jointly or hired potters would have to be employed. This latter option would greatly increase production costs as potters may have to be paid on piecework up to R5 per completed stove.

7. Labour Creation

To manufacture 20,000 stoves per year, 10 potters would be employed full time. Two full-time equivalent labouring jobs would also be created.

Capital cost per workplace : R1,719

Average income per potter : R21,648 p.a.

Average income per labourer : R10,000 p.a.

REFERENCES

DEPARTMENT OF CENSUS AND STATISTICS : Labour Force and Socio-Economic Survey 1980/81 : Household Income and Expenditure (Sri Lanka, 1983).

DEPARTMENT OF CENSUS AND STATISTICS : National Census of Sri Lanka, 1981 : District Census Abstracts (Sri Lanka, 1985)

M. HOWES, S. JOSEPH, Y. SHANAHAN, W. STEWART, H. NAVARATNE : The Sarvodaya Stoves Project : A Critical Review of Developments 1979 - 1982 (ITDG Stoves Project Report No. 3.6, London, 1983).

M. MUNASINGHE : National Fuelwood Conservation Programme , (Unpublished, Sri Lanka, 1984)

W. STEWART : A History of the Sarvodaya Stoves Project 1979 - 1982 (ITDG Stoves Project Report No. 3.8, London, 1983)

UNDP/WORLD BANK ENERGY SECTOR ASSESSMENT PROGRAM : Sri Lanka : Issues and Options in the Energy Sector (UNDP/World Bank, 1982)