Asian Development Bank

Greater Mekong Subregion

Capacity Building for Efficient Utilization of Biomass for Bioenergy & Food Security in the GMS [TA7833-REG]

Feasibility Study for a Pilot Investment Project for Scaling-Up Adoption of Improved Cookstoves

Cambodia

January 2014

Landell Mills
DEVELOPMENT CONSULTANTS

nexus
Carbon For Development

KEY DATA

Name of Project:	
Contractor:	Landell Mills Limited (LML), Bryer-Ash Business Park, Trowbridge, Wiltshire, BA14 8HE, UK Tel: +44 1225 763777 (www.landell-mills.com) in consortium with: Nexus Carbon for Development (Nexus), #33 E3 Sothearos Blvd, Corner St. #178, Phnom Penh, CAMBODIA (www.nexus-c4d.org)
Contracting Authority:	Asian Development Bank (ADB)
Start/End Date:	15 Dec 2011 - 15 June 2014
Budget:	N/A
Beneficiary:	Ministries of Agriculture of Cambodia, Lao PDR and Viet Nam
Location:	Greater Mekong Subregion, incl. Cambodia, Lao PDR and Viet Nam

QUALITY ASSURANCE STATEMENT

Version		**Status**	**Date**
Feasibility Study for a Pilot Investment Project for Scaling-Up Adoption of Improved Cookstoves in Cambodia		Final	22/01/2014
	Name	**Position**	**Date**
Prepared by:	Mr. Greg Munford		22/01/2014
Checked by:	Mr. Simon Foxwell	Director, Asia/Pacific	31/01/2014

Report submitted by
LANDELL MILLS LTD

CONTENTS

LIST OF TABLES

LIST OF FIGURES

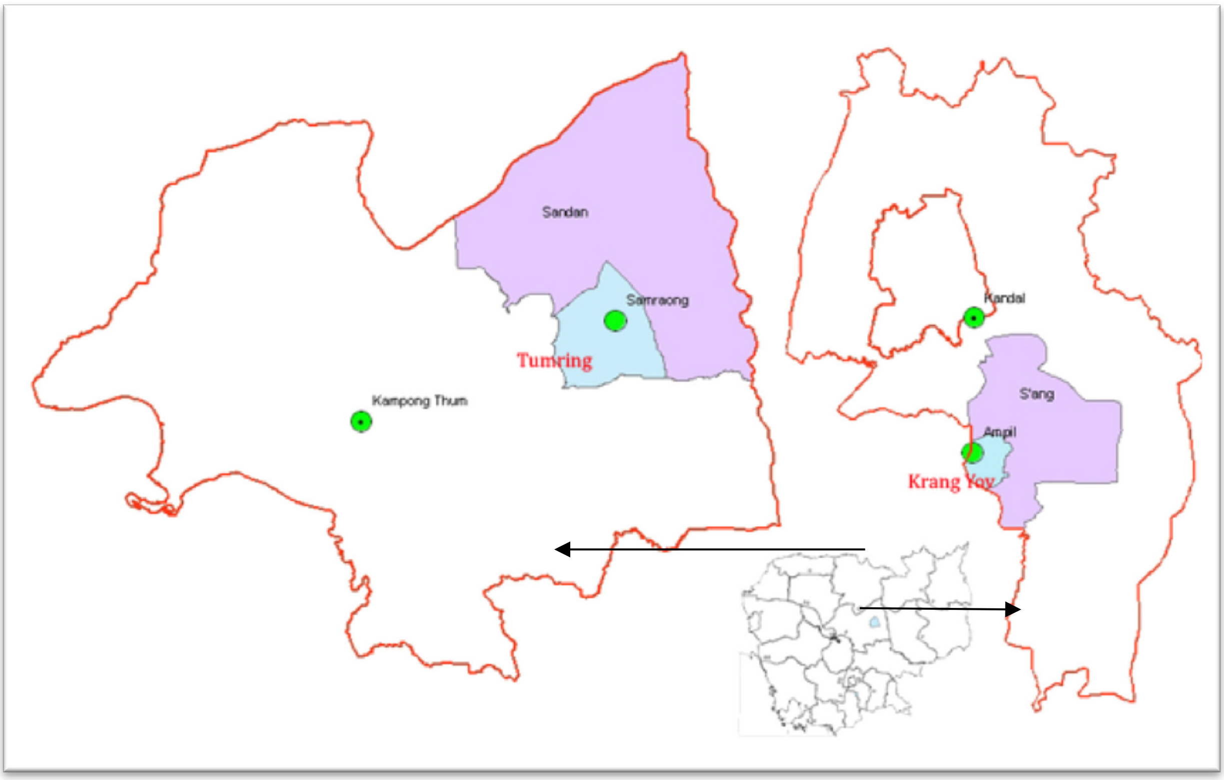
1. INTRODUCTION

With the concern of climate change affecting countries in Greater Mekong Sub-region, the GMS Working Group on Agriculture (WGA), through series of consultations and studies in 2007, supported the GMS countries to launch project on Capacity Building for Efficient Utilization of Biomass for Bio energy and Food Security in the Greater Mekong Sub region (GMS) in May 2011 for Cambodia, the Lao PDR and Viet Nam. The purpose of the project is to aid in the financial and technical assistance of the development of adoptable technology; thus, coping with the issues bio-fuels and rural renewable energy, including building human and institutional capacity for its implementation. The synergy of the project outcome will be a new technology that improves the use of biomass well adopted into the community setting.

In Cambodia, pilot project on the investment of the efficient operation of biomass utilization and improved cookstoves (ICS) was launched at in two districts of different provinces. The Sandan district is located in Kampong Thom Province and the S'Ang district is located in Kandal province.

To support the scale up, the investment on new technologies will be developed and adopted; the feasibility study is designed to acquire knowledge from two villages of the two pilot districts. The key characteristic of Ampil village is that it has a floodplain rice farming area and is located in a non-community forest commune within the pilot district. Samraong village is a cash crop farming area and it is located in a community forest commune in the pilot district.

Figure 1: **Map of Study Villages: Ampil & Samraong Village**



Ampil, which is located in, KrangYov commune, S' Ang district, Kandal province, consists of 170 households and it is about 30 km from Takmau Town which is the nearest down town in Kandal province or it is about 42 km from Phnom Penh City.

Samraong, which is located in Tumring commune, Sandan district, Kampong Thom province, is comprised of 117 households and it is about 90 km from Kompong Thmar, which is the nearest down town in Kompong Thom province or it is about 215 km from Phnom Penh City.

This report describes the results of the feasibility study that seeks to understand knowledge on the use of improved cookstoves, biomass resources from crop residues for cooking energy including firewood. Based on the feasibility study, the report entails the design of pilot investment of Improved Cookstoves including budget and its implementation arrangements.

2. BACKGROUND

The feasibility study was conducted by interviewing selected households and conducting a focus group discussion with women users, women saving groups, forest community members, stove producers and distributors and village chiefs in Ampil and Samraong village.

Table 1: **Respondent Groups in the feasibility study**

	Kandal	Kompong Thom	Kompong Chhnang	
District	S'Ang	Sandan	Rolea B'ier	
Commune	KrangYov	Tumring	Srae Thmei	
Village	Ampil	Samraong	Andoung Ruessei	Total
Households	56	52		108
Women Saving Groups & Users	10	12		22
Forest Community members		3		3
Stove Producers, suppliers, Village chiefs, ICS coordinators	6	2	7	15
Total	72	69	7	148

To have the broader understanding of the ICS demand and supply, the feasibility study also conducted group discussions and key information interviews with ICS producers and distributors at Kompong Chhnang.

Furthermore, the analysis of biomass in the feasibility study and the ratio for biomass conversion is cited from other past studies.

According to Cooper, CJ and Laing, CA. (2007)1, crop residues include field residues and process residues. Field residues are those that remain in the fields after harvesting the crops and process residues are those that result from processing the crop. Crop residues produce biomass that is useful for soil fertility and producing energy, the amount that is converted is based on the production. Various studies used different residue ratios and this feasibility study used the ratio suggested by Koopmans, A. and Koppejan, J. (1997).

Table 2: **Production Residue Ratio**

Crop Residues	Ratio
Rice husk	0.267
Rice straw	1.757
Corn cob	0.273
Corn stalk	2
Corn husk	0.2
Cassava stalk	0.167
Peanut stalk	0.5
Soya bean stalk	2.5
Wood	0.5

[1]Cooper, CJ and Laing, CA. 2007. A macro analysis of crop residue and animal wastes as a potential energy source in Africa

Rubber green wood	180 tons/ha
Rubber dry wood	0.72 / tonne/cubic meter of green wood
Rubber leave	1400kg/ha/year

Sources: Koopmans, A. and Koppejan, J. 1997, Agricultural and forest residues generation, utilization and availability

2.1. S'ANGS DISTRICT

The S' Ang district is located about 26 km from Phnom Penh. The district comprises 16 communes on a total area of 518.6km2. In 2010 the district had 41,515 households with a total population 204,304 persons (on average 4.9 persons per household). The S' Ang district is a rice farming area and seasonally produces cash crops including: corn, soya bean, mung bean, and peanut. In 2010, total rice production for all cropping seasons was about 57,000 tons supplemented by corn production (about 3,000 tons), and peanut (600 tons).

Table 3: **Rice and Crop Production 2008- 2010 at S' Ang District (tons)**

S' Ang District	2013 Est	Husk/Cob	Straw/Stalk
Rice production	37,739.83	10,076.53	66,308.88
Corn Production (est.)	3,984.60	1,087.80	7,969.20
Soya bean Production (est.)	55.05		137.63
Peanut Production (est.)	745.80		372.90
Cassava Production (est.)	4.40		0.73

Crop production in S'Ang provides residues with estimated rice production in 2013 supplying 10,000 tons of rice husk and 66,300 tons of rice straw, corn cob residue estimations were about 1,000 tons and corn stalk about 8,000 tons. The district also has residues of about 400 tons of peanut stalk left from the production.

Table 4: **Crop Residues for Biomass in S' Ang pilot district (tons)**

S' Ang District	2013 Est	Husk/Cob	Straw/Stalk
Rice production	37,739.83	10,076.53	66,308.88
Corn Production (est.)	3,984.60	1,087.80	7,969.20
Soya bean Production (est.)	55.05		137.63
Peanut Production (est.)	745.80		372.90
Cassava Production (est.)	4.40		0.73

Cooking habit

The TA7833 feasibility study identifies rice farming to be the main livelihood. Other income is being generated from cash crops, leaf vegetables, selling labour outside of the village, local retailing - selling groceries and cake at home shops, and raising livestock and poultry.

Firewood is used by 95 percent of interviewed households - only one household reported using crop residue, that being rice husk. Villagers mainly collect firewood from trees around their houses such as branches, small plant growing on rice fields, dikes, in swamps in village areas.

Table 5: **Cooking energy used in Ampil (N = 56 hhs)**

Firewood	53	95%
Charcoal	1	2%
Gas or Biogas (gas 11 and biogas 3)	14	25%
Crop Residue	1	2%

Electricity	3	5%

An average household uses 95 kg of firewood in Ampil, which is located in flood plain areas with no forest hills or forest community. Three households that own biogas plants used cattle manure totaling 120 kg every month in each household. The one household that used rice husk for cooking used 150 kg every month. Other cooking energies are 28 kg of charcoal, 7 kg of gas and 6 kw of electricity.

On a monthly basis the average cost of energy for cooking for the differing cooking systems are presented in table 2.5.

Table 6: Average of energy used per month and estimated cost in Ampil (N = 56 hhs)

Ampil Village	N	Average Use	Unit Cost $	Monthly Cost
Wood (Kg)	53	95	0.38	35.63
Charcoal (Kg)	1	10	0.25	2.50
Crop Residue (rice husk (Kg)	1	150	0.00	0.00
Gas (Kg)	11	7	1.33	9.33
Biogas (Kg)	3	77	0.00	0.00
Electricity (Kw)	3	6	0.30	1.80

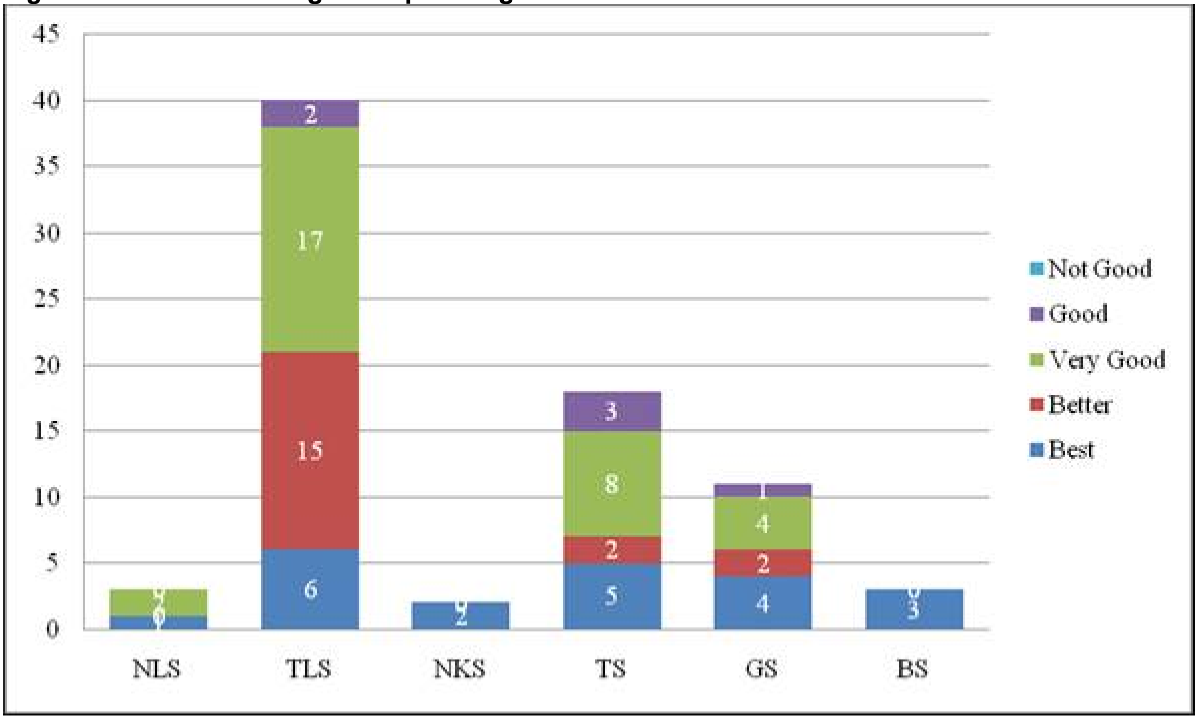
ICS Demand:
Most households reported using improved cookstoves but few use the New Lao Stove (NLS). Traditional Lao Stove (TLS) is the most common stove along with older traditional stoves including 3 stone wood fire (3SWF). It is estimated that 5 percent of households use NLS, while 71 percent use TLS and 30 percent use the 3SWF.

***Table 7:* Kinds of stoves used in Ampil (N = 56 hhs)**

Stove Used in Ampil (N=56 hhs)	Frequency	Percent
Improved cookstoves (ICS)	45	80%
– New Lao Stove (NLS)	3	5%
– Traditional Lao Stove (TLS)	40	71%
– NeangKorngrey Stove (NKS)	2	4%
Traditional stove (TS)	17	30%
Gas stove (GS)	11	20%
Biogas stove	3	5%
3 stone wood fire (3SWF)	2	4%
Other - electrical stove	7	13%

Household experience with new stoves based on stated preferences using a ranking of 1 = best and 5 = worst – see Figure 1. The rankings indicate very little differentiation of stove quality.

Figure 2: **Stoves Ranking in Ampil Village**



ICS Distribution Channel:
ICS supply is mostly from outside the village, with purchase outlets reported as being dominated by village shops, followed by markets, shops in the village or nearby markets. Occasionally, they can be bought when mobile oxcarts arrive in the village. In Ampil, there is one stove producer who invented a cement stove for local sale however only one household of those interviewed purchased the local made stove.

Table 8: **Where stoves are bought in Ampil (N = 56 hhs)**

	Frequency	Percent
Shops in village	35	63%
Markets	20	36%
Mobile market/carts	7	13%
Stove producers	1	2%
Self made (for 3SWF and TS)*	4	7%

* This study found that households made 3SWF from three pieces of stone and TS is made by mud for cooking or a dug hole in the ground for cooking traditional cakes.

2.2. SADAN DISTRICT

Sandan district is located about 240 km from Phnom Penh and consists of 9 communes with a total area of 2,963.9 km2. In 2010, the district had 10,862 households with 51,025 person (an average of 4.7 persons per hh).

Agricultural production is based on cash crops including: cassava, and soya bean. Rice farming is second main crop for the district – see table 6. Furthermore, crop production in Tumring village found cassava production had dropped significantly while rice production was maintained.

Table 9: **Production of rice and major cash crops in Sandan District**

Sandan District	2008	2009	2010	2013*
Dry rice production	789.29	926.96	874	900.48
Wet rice production	10,483.70	9,282.52	10,356.22	9,819.37

Intensive rice production	94.63	71.83	92.15	81.99
Upland rice production	2,383.08	2,796.19	2,603.88	2,700.035
Total rice production	13,750.70	13,077.50	13,926.25	13,501.875
Corn Production (est.)	345.3	289.1	308.2	298.65
Soya bean Production (est.)	2,921.40	1,655.40	2,183.10	1,919.25
Mungbean Production (est.)	130.9	154.4	239.6	197
Peanut Production (est.)	37.1	111.9	73.5	92.7
Cassava Production (est.)	47,067.80	16,272.10	25,721.80	20,996.95
Sweet potatoes Production (est.)	57	91.2	82.1	86.65
Sesame Production (est.)	23.1	47.7	23.4	35.55

*Source: Commune Database Online: http://db.ncdd.gov.kh/cdbonline/home/index.castle, browsed 30 Sep 2013; * estimated by average of 2009 and 2010*

Based on 2013 crop production data, estimated residue from cassava production was about 7,800 tons of cassava stalk, 3,600 tons of rice husk and 24,000 tons of rice straw, soya bean residues were about 7,300 tons of stalk left from production. In addition, there are an estimated 95 tons of Corn cob and about 690 tons of corn stalk.

Table 10: **Biomass of Crop Residues in Sandan District**

Sandan District	2013 Est	Husk/Cob	Straw/Stalk
Total Rice production	13,750.70	3,671.44	24,159.98
Corn Production (est.)	345.30	94.27	690.60
Soya bean Production (est.)	2,921.40		7,303.50
Peanut Production (est.)	37.10		18.55
Cassava Production (est.)	47,067.80		7,860.32

Cooking habit

Samraong, which is about 40 km from Sandan district center, has similar livelihood activities such as cassava production, soya bean and rice farming to the Tumring commune. Thus, biomass from the production above should be significant for villagers. In addition, the village has a 10 yr old rubber plantation of about 100 ha. In this regards, biomass from rubber leaves was also found and the average of the biomass created from the rubber leaves annually is about 1,400 kg per hectare.

All households interviewed in the Samraong use firewood for cooking energy. The villager has access to abundant firewood from forest and community forestry land. The focus group discussion reported that they collect dead trees totaling a few oxcarts every few months and leave them around their house for use at any time. The recent establishment of a household furniture making enterprise provides additional access to good firewood. Villagers collect this free from the enterprise. This wood is in small pieces and short lengths which are ideal for stoves. There is no use of biomass or crop residues from the farming production.

Table 11: **Cooking energy used in Samraong (N = 52 hhs)**

Firewood	52	100%
Charcoal	1	2%
Gas	1	2%
Crop Residue	0	0%
Electricity	0	0%

Firewood use totals 139 kg/month/hh in Samroang, which is located in upland forest areas with a forest community. Having access free to firewood in their forest land or factories requires no cash expenditure. Other fuels which are used as supplements include 45 kg of charcoal used by one household, and 12 kg of gas used by another household in Samraong.

***Table 12:* Average of energy used per month and cost in Samraong (N = 52 hhs)**

Samraong Village	N	Average Use	Unit Cost $	Monthly Cost
Wood (Kg)	52	139	0.00	0.00
Charcoal (Kg)	1	45	0.30	13.5
Crop Residue (Kg)	0	0	0.00	0.00
Gas (Kg)	1	12	1.33	16.00
Biogas (Kg)	0	0	0.00	0.00
Electricity (Kw)	0	0	0.30	0.00

ICS Demand

In Samraong, 77% of interviewed households use 3 stone wood fire (3SWF), however, ICS is used by 30 percent of the interviewed households including NLS by 15 percent and TLS by 13 percent.

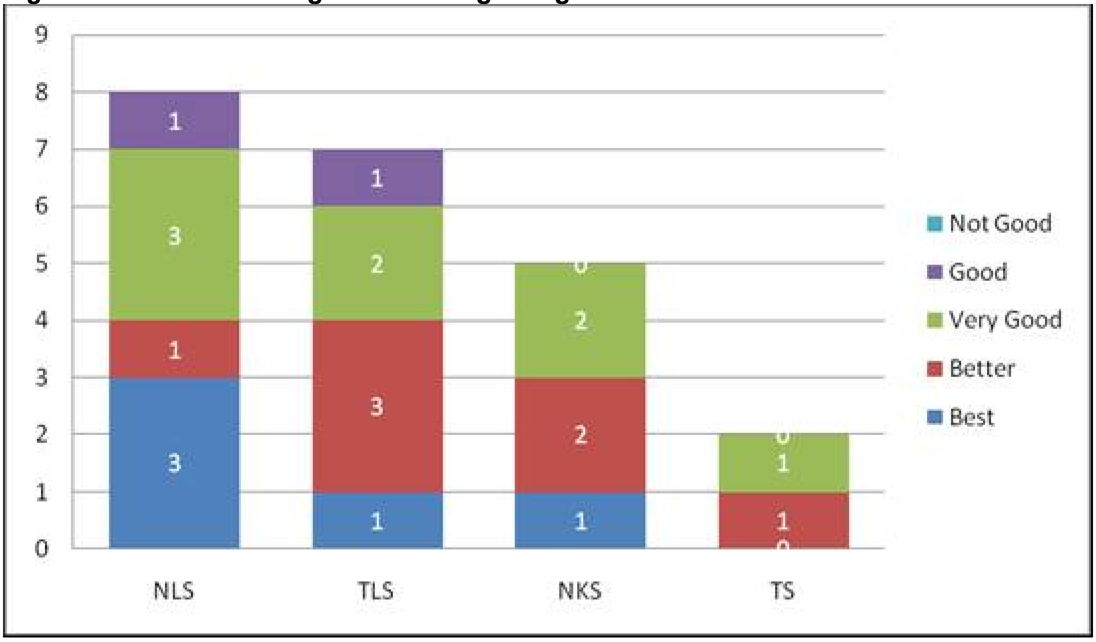
***Table 13:* Kinds of stoves used in Samraong (N=52 hhs)**

	Frequency	Percent
Improved cookstoves (ICS)	16	30%
– - New Lao Stove (NLS)	8	15%
– - Traditional Lao Stove (TLS)	7	13%
– - Neang Korngrey Stove (NKS)	1	2%
Traditional stove (TS)	5	10%
Gas stove (GS)	2	4%
Biogas stove	0	0%
3 stone wood fire (3SWF)	40	77%
Other - electrical stove	1	2%

Similar to Ampil, those households that use ICS ranked them between 1 and 3 which is 1 is the best. Specifically, TLS is ranked the best by one third, and ranked good or very good by the remaining two thirds.

Users of ICS suggest that the NLS and TLS provide a fast cooking stove; it is strong, operates with less smoke and less firewood. Every factor of the stove appears to be very important for next stove generation but it is critically important that the stoves should be an affordable price, strong, operated with less smoke, cook fast and safely.

Figure 3: **Stoves Ranking in Samraong Village**



Stove Distribution Channel

In Samraong, ICS are bought from market or producers in other areas but about 71 percent of 52 households interviewed install the 3 stone wood fire (3SWF) by themselves. Similar to Ampil village, improved cookstoves are sourced predominantly from outside village. Aside from the household interest in buying ICS through shops, the group discussion informed of the strong interest from the village authority of Samraong to introduce the ICS into the village and it is believed that this support will increase demand of the ICS in local markets.

***Table 14:* Where stoves are bought in Samraong (N=52 hhs)**

	Frequency	Percent
Shops in village	2	4%
Markets	10	19%
Mobile market/carts	8	15%
Self-made (for 3SWF and TS)*	37	71%

* This study found that households made 3SWF from three pieces of stones and TS is made by mud for cooking or a dug hole in the ground for cooking traditional cakes.

2.3. BIOMASS FLOW

Ampil village: Ampil village is the study village in KrangYov commune and has an estimated total rice production in 2013 is about 10,281 tons, according to Commune Database.

***Table 15:* Rice and Crop Production 2008- 2010 at KrangYov Commune (tons)**

	2008	2009	2010	2013*
Total dry rice production	7,184	6,825	6,825	6825
Total wet rice production	3,142.00	3,456.20	3,456.20	3456.2
Total rice production	10,326	10,281	10,281	10,281

*Source: Commune Database Online: http://db.ncdd.gov.kh/cdbonline/home/index.castle, browsed 30 Sep 2013; * estimated by average of 2009 and 2010*

Biomass available from rice production above is about 2,700 tons of husk and about 18,000 tons of rice stalk.

***Table 16:* Crop Residues for Biomass in Krang Yov Commune (tons)**

KrangYov Commune	2013 Est	Husk	Straw/Stalk
Total rice production	10,281.20	2,745.08	18,064.07

Crop production in Tumring, where the feasibility study is conducted in one of the villages, found that cassava production dropped significantly but rice production is maintained. An estimate for 2013 based on average of 2009 and 2010 and field observation during the study, cassava production should be more than 3,500 tons.

***Table 17:* Production of rice and major cash crops in Tumring Commune**

	2008	2009	2010	2013*
Total wet rice production	339.18	280.29	356.96	318.63
Total upland rice production	556.50	516.80	422.50	469.65
Total rice production	2,903.68	2,806.09	2,789.46	2,797.78
Corn Production (est.)	18.70	11.30	9.00	10.15
Soya bean Production (est.)	489.60	467.70	530.40	499.05
Mung bean Production (est.)	27.60	7.90	5.30	6.60
Peanut Production (est.)	10.70	10.70	3.60	7.15
Cassava Production (est.)	1,984.50	6,200.00	912.00	3,556.00
Sweet potatoes Production (est.)	8.50	8.50	5.00	6.75
Sesame Production (est.)	9.50	5.10	2.90	4.00

*Source: Commune Database Online: http://db.ncdd.gov.kh/cdbonline/home/index.castle, browsed 30 Sep 2013; * estimated by average of 2009 and 2010*

Biomass in Tumring is also significant from the crop production. A total rice husk of about 750 tons and about 4,900 tons of rice stalk should be found in the communes. Soya bean stalk and cassava stalk was about 12,500 tons and 590 tons respectively.

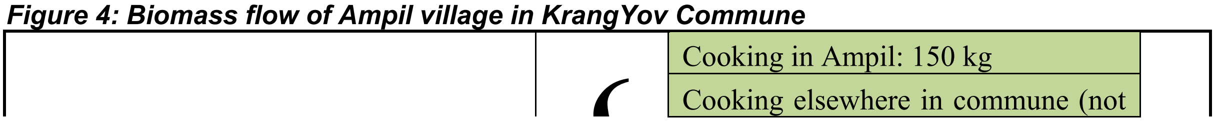
***Table 18:* Biomass of Crop Residues in Tumring Commune**

	2013 Est	Husk/Cob	Straw/Stalk
Total rice production	2,797.78	747.01	4,915.69
Corn Production (est.)	10.15	2.77	20.30
Soya bean Production (est.)	499.05		1,247.63
Mungbean Production (est.)	6.60		16.50
Peanut Production (est.)	7.15		3.58
Cassava Production (est.)	3,556.00		593.85

The discussion above on the cooking energy in both villages informs that biomass from crop residues in both village are not used for cooking except one household in Ampil, who use rice husk of about 150 kg for cooking. Therefore, it signifies that crop residues are either used for animal feed or decay as fertilizer.

Households in both villages use firewood and each household, on average, uses about 117 kg monthly. In non-forest community, firewood is collected from fruit trees around their house and bought from local markets or mobile firewood traders from other provinces in forest community, firewood.

Figure 4: Biomass flow of Ampil village in KrangYov Commune



Rice husk	2,745.08 tons	quantified)
		Animal feed (not quantified)
		Used to keep ice from melting (not quantified)
		Other uses (not quantified)
Rice Straw	18,064.07 tons	Cattle feed(not quantified)
		Fertiliser/compost (not quantified)
		Cooking elsewhere in commune (not quantified)
		Mushroom production (not quantified)
		Other uses (not quantified)

Collected from their farm land or local furniture factory at no expenses.

Figure 5: Biomass flow of Samraong village in Tumring Commune

Rice husk	747.01 tons	Cattle feed (not quantified)
Rice straw	20.3 tons	Fertilizer/compost (not quantified)
Corn cob	2.77 tons	Cooking (not quantified)
Soya bean stalk	1247.63 tons	Animal feed (not quantified)
Mungbean stalk	16.5 tons	Other uses (not quantified)
Peanut stalk	3.58 tons	
Cassava stalk	593.85 tons	

2.4. IMPROVED COOKSTOVES

In Cambodia, ICS has 3 types: New Lao Stove (NLS), Traditional Lao Stove (TLS) and Neang Kangrey Stove (NKS). According to Geres, ICS lifespan is about 30 months.

In Ampil village, TLS is used more than NLS. TLS are expected to last for 11 months. While few households have bought NLS and NKS, purchasers of the NLS expect it to last for 28 months and NKS is expected to last for about 30 months.

In Samraong, only NLS and TLS are used. Of the 52 households, 15 households used ICS and NLS was expected to last for 16 months and TLS was expected to last for 23 months. On average, the purchase price was about 17,300 riels for NLS, 5,700 riels for TLS and 6,500 riels for NKS in Ampil and 21,800 riels for NLS and 7,500 riels for TLS in Samraong.

Households in Samraong paid higher prices than those in Ampil, due to the further distance from producers to retailers. Furthermore, considerations of the lifespan were tested by Geres and each ICS should cook well for 30 months.

Table 19: **Stove evaluation and ICS Performance**

Ampil Village		**N**	**Average**	**Price per Month**	**Price per Month based on lifespan***	**Month shorter in Lifespan***
NLS	How old is it (when did you buy it)	3	15			
	How long each stove will last?	3	28	28	30	-2

	(month)					
	How much did it cost?	3	17,333	619	578	
TLS	How old is it (when did you buy it)	40	6			
	How long each stove will last? (month)	40	11	11	30	-19
	How much did it cost?	40	5,713	519	190	
NKS	How old is it (when did you buy it)	2	11			
	How long each stove will last? (month)	2	30	30	30	0
	How much did it cost?	2	6,500	217	217	
TS	How old is it (when did you buy it)	18	10			
	How long each stove will last? (month)	18	17			
	How much did it cost?	18	7,389			
GS	How old is it (when did you buy it)	11	16			
	How long each stove will last? (month)	11	41			
	How much did it cost?	11	69,455			
	Valid N (listwise)	11				
BS	How old is it (when did you buy it)	3	40			
	How long each stove will last? (month)	3	320			
	How much did it cost?	3	2,000,000			
Samraong Village						
NLS	How old is it (when did you buy it)	8	6			
	How long each stove will last? (month)	8	14	14	30	-16
	How much did it cost?	8	21,850	1,561	728	
TLS	How old is it (when did you buy it)	7	16			
	How long each stove will last? (month)	7	23	23	30	-7
	How much did it cost?	7	7,500	326	250	
TS	How old is it (when did you buy it)	5	23			
	How long each stove will last? (month)	5	46			
	How much did it cost?	5	19,900			
BS	How old is it (when did you buy it)	2	13			
	How long each stove will last? (month)	2	30			
	How much did it cost?	2	40,000			
3SWF	How old is it (when did you buy it)	38	87			
	How long each stove will last? (month)	38	404			
	How much did it cost?	40	-			

Interviewed households find current prices expensive and they suggested a lower price for ICS. The average price suggested for NLS was about 10,000 riels (USD 2.5/stove), TLS was about

5,000 riels (USD 1.25/stove) and NKS was about 6,000 riels (USD 1.50/stove). Some households were willing to pay for current price but others suggested a much lower price.

Table 20: **Price Purchasers are willing to pay**

	N	Minimum	Maximum	Mean	Std. Deviation
New Lao Stove (NLS)	10	3,000	20,000	10,700	4,785
Traditional Lao Stove (TLS)	47	2,000	14,000	5,213	2,293
Neang Korng Rey Stove (NKS)	2	5,000	8,000	6,500	2,121
Traditional stove (TS)	21	2,000	15,000	6,548	3,464
Gas stove (GS)	13	20,000	150,000	43,538	35,385
Biogas stove	3	3,000	1,200,000	734,333	641,199

Based on their experience and observation from using the ICS, households suggested that NLS and TLS help speeds up cooking, it is strong, operated with less smoke and less firewood, this could save some trees. According to Geres, using ICS could save 22% of firewood and charcoal compared to traditional stoves. In this study, wood used for ICS in each village is less than wood used for non-ICS. On average, 12 kg of wood could be saved by using ICS in Ampil and 28 kg in Samraong. Statistically, if both studied districts were to use ICS for all households, it could save about 170 ha of trees from using firewood.

Table 21: **Estimated total wood used and saving between ICS and Non ICS***

	Households	Mean (kg/month)	Ton/month	m3/month	ha/month	ha/year
Wood used						
Ampil Villages						
ICS	43	92.07	3.96	6.60	0.03	0.34
Non-ICS	18	104.17	1.88	3.13	0.01	0.16
Samraong Villages						
ICS	14	122.50	1.72	2.86	0.01	0.15
Non-ICS	44	150.45	6.62	11.04	0.05	0.58
Both Villages						
ICS	57	99.54	5.67	9.46	0.04	0.49
Non-ICS	62	137.02	8.50	14.16	0.06	0.74
Saving trees/wood						
Ampil Villages	170	12.10	2.06	3.43	0.01	0.18
Samraong Villages	117	27.95	3.27	5.45	0.02	0.28
Both Villages	287	37.47	10.75	17.93	0.08	0.94
Krang Yov commune	3,723	12.10	45.04	75.08	0.33	3.92
Tumring commune	1,123	27.95	31.39	52.33	0.23	2.73
Both communes	4846	37.47	181.59	302.71	1.32	15.79
S'Ang district	41,515	12.10	502.20	837.17	3.64	43.68
Sandan district	10,862	27.95	303.64	506.17	2.20	26.41
Both district	52377	37.47	1,962.69	3,271.80	14.23	170.70

** ICS=NLS + TLS+ NKS; Non ICS = TS + 3FWS; 1 ton = 1.667 m³ 1 ha = 230 m³ (source GERES, 2005)*

Using ICS was found to reduce the number of hours spent in cooking. On average, a cooks may spend about 2.4 hours cooking meals with ICS and about 2.6 hours with using non-ICS. According to focus group discussions, those who prefer using 3swf because they found ease to use firewood that is not much prepared for size or length, and they can be fitted into 3swf. Especially, in Samraong village, where plenty of firewood is collected free, cooks can just put as much firewood as the want in 3swf for faster cooking.

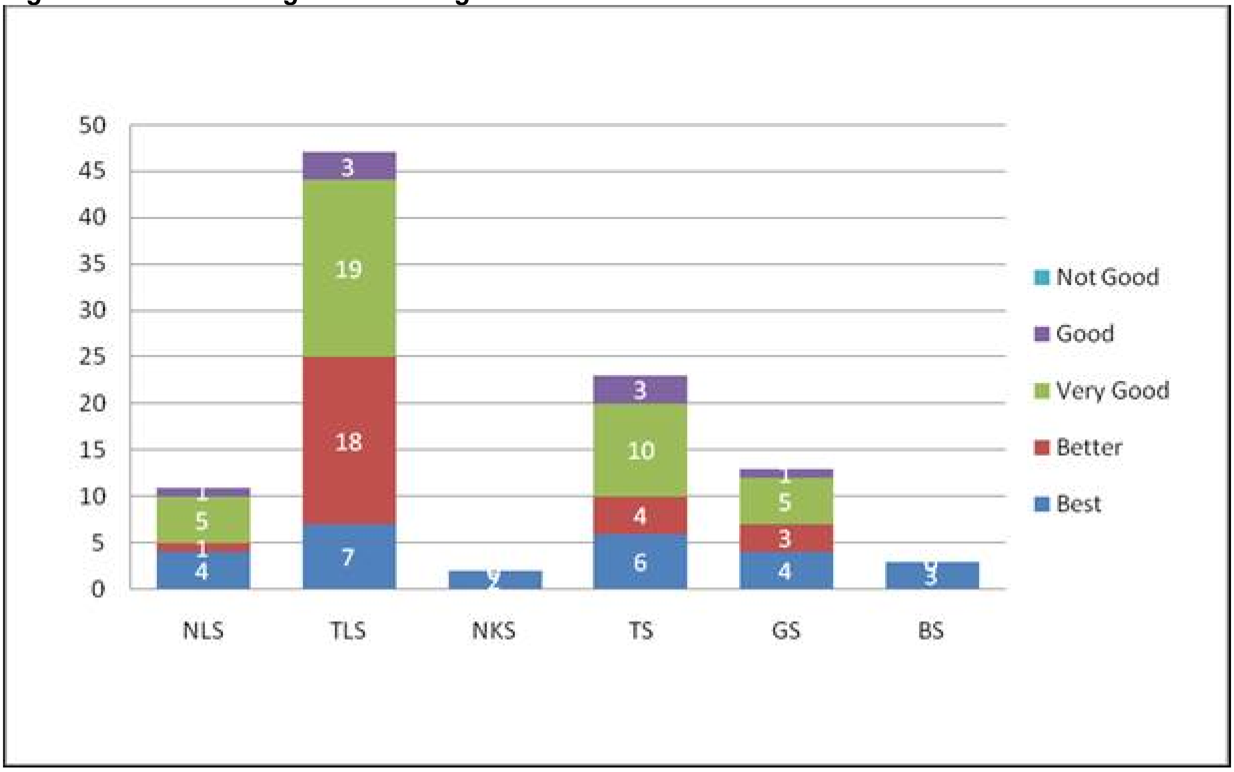
Table 22: **Hours spent for cooking per day**

	N	Min	Max	Mean	Std.
Hours spent with ICS	57	0.5	8	140.6	2.47
Hours spent with non-ICS	62	1	6	163.8	2.64

** ICS=NLS + TLS+ NKS; Non ICS = TS + 3FWS;*

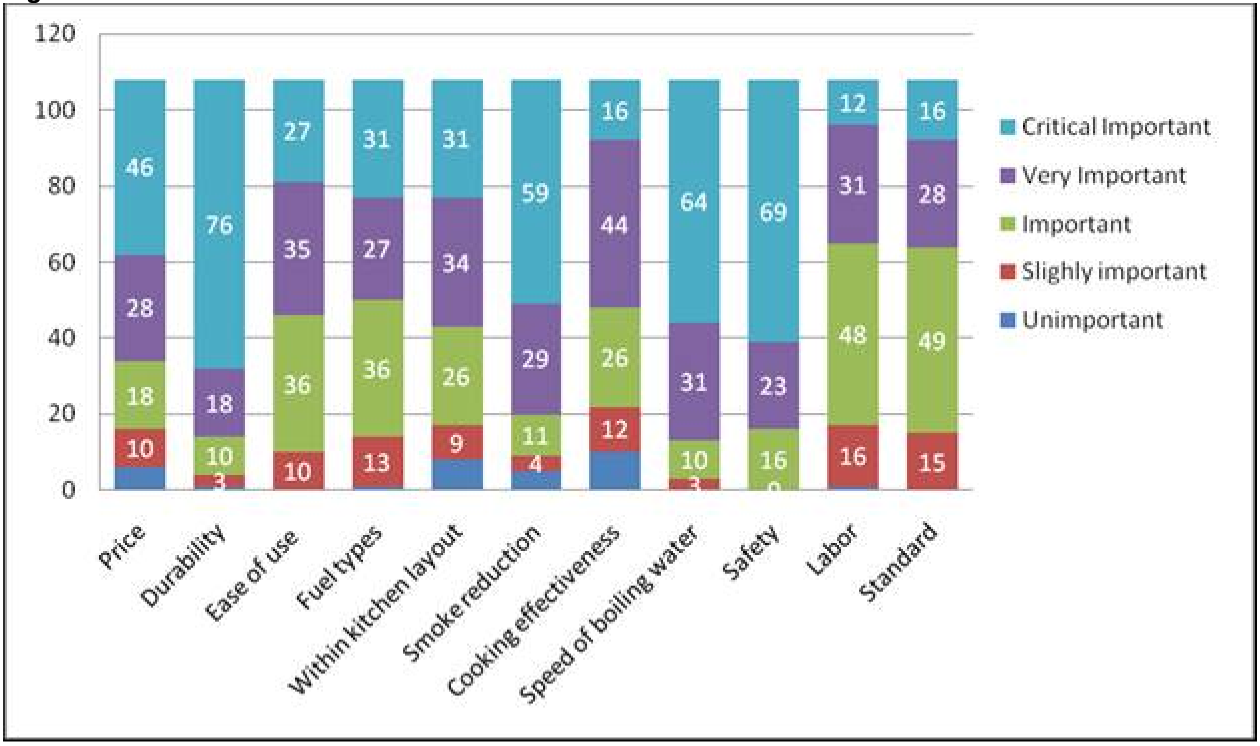
The study found that about two thirds ranked ICS and one third ranked other stoves. Based on ranking value of 1 as "Best" and 5 as "Not Good", it found that most ranked NLS, TLS and NKS between "Best" and "Very Good" in both villages by those who used ICS. Among one third who used traditional stoves they ranked them between "Best" and "Very Good". According to focus group discussions, they like traditional stoves due to familiarity and the use of local mud or dug holes on the ground by themselves, little care is necessary, due to zero cost to buy, it can fit large sizes and amounts of pots/pan and it is easy to fit different size and kinds of firewood. All these characteristics are not available for ICS, which is designed for to be environmentally friendly, reduce smoke, increase speed of cooking and save on firewood. So, "Best" or "Very Good" for ICS is meant as a lifesaving stove.

Figure 6: Stove ranking in both villages



Every factor of the stove appears to be very important for next stove generation but it is critically important that the stoves should be an affordable price, strong, operate with less smoke, cook fast and safe.

Figure 7: **Characteristics of Next Stove Generation**



2.5. ICS SUPPLY CHAIN & TRAINING NEEDS

Household demand:
In Ampil, there is a potential to distribute the NLS in the village. Women Saving Groups are seeking the opportunity for involvement in ICS distribution. In Samraong, the potential to promote using ICS is high, according to focus group discussion. Households keep using 3 stone wood fire (3SWF) stove due to plentiful firewood and lack of awareness on advantages, conveniences, and increased cooking speed of ICS. Local authorities express the interest to promote the use of ICS for safer housing, as careless management of 3SWF stoves cause fires.

Distribution network:
Current ICS production is one of the activities coordinated by the Environment, Renewable Energy and Solidarity (GERES) through building the capacity of the association of producers and distributors of improved cookstoves in Cambodia that was established in 2004. ICS training workshops, distribution networks and price and quality have been acknowledged and registered in Ministry of Industry, Mine and Energy.

The main actors of ICS include producer, distributor, and whole sellers. Current producers are mainly in Kampong Chhnang, Battambang, Takeo, Kandal, Kapot, Kampong Cham, Phnom Penh, Siem Reap, and Prey Veng. Price and quality of ICS from all producers are monitored and licensed regularly. GERES is working to expand more producers but there are some challenges:

- Knowledge and skill for ICS production: producers have participated successfully in the ICS production. It comes to be a real challenge when soil or clay for production standards are not met, despite design and layout following the ICS standards;
- Investment cost for a small scale ICS production is about $US5,000 and up to $USD10,000 for a medium scale ICS production;
- Current net income for ICS per unit is about US$0.4 for producer and the event of the costs of raw materials continuing to increase has not yet been revised.

ICS Producers' capacity:

A medium size ICS factory produces about 6,000 units of ICS per months and it takes about 2 - 3 months to sell them. Contract distributors take stoves on credit and repay after sales or before subsequent orders.

Data received from focus groups discussed with a producer group in Kampong Chhnang provided some possible estimated costs and incomes of stove production and distribution. For the production of New Lao Stove No 1 total unit cost for NLS is about 6,300 riels. Price is set by the Producer Association. Sale price at producer level is fixed for NLS No 1 at about 8,300 riels and retail price for NLS is about 9,000 riels minimum. Net Income for producer per NLS unit is about 1,992 riels and Net Income for retailers or distributors is about 700 riels.

Table 2.23 Production of New Lao Stove No 1.

1	**Production cost**			
	Labour cost	**No. of stoves/day**		**Unit Cost (Riel)**
	Mixing raw materials and molding stoves	85		350
	Design and cutting molded stoves	30		550
	Cutting stove cover from zienc sheet	65		400
	Installing heat insolence and cover	40		500
	Installing ashtray and painting	50		150
	Kilning stoves	80,000 riel		160
		(for 500 stoves)		
	Sub-total (A):			**2,110**
	Raw Materials	**Total cost (Riel)**	**Number of Unit produced**	**Unit cost**
	Clay (2 trucks)	240,000	500 stoves	480
	Cement (one bag)	19,500	150 stoves	130
	Sand (one truck)	70,000	700 (700-800 stoves)	100
	Rice husk ashes (one Remork)	160,000	400 stoves	400
	Zinc steel (3.6m x 0.8m)	14,900	7 stoves	2,128
	Stove ear and steel wire for carrying		1 stove	100
	Rice husk for firing stoves in kiln (2 big trucks)	800,000	1060 stoves	754
	Petroleum for generating engine for mixing clay (3 liters)	15,600	250 stoves	62
	Sub-total (B):			**4,154**
	Other expenses	In Riel and $USD	riels /month	6,000 units / month
	Patent for 1 year	80,000 riel	6,667	1.11
	Land (own land)	0	0	0
	Workshop construction for 15 years	9,000 $	200,000	33.33
	Machine and facility for 8 years	1,200 $	50,000	10.42
	Sub-total (C):			**44.86**
	Total Unit Cost: D = A+B+C:			**6,308**

2	**Producer Net Income(minimum sale price is 8,300 riels)**			
	Sale price at producer for New Lao Stove			8,300
	So, Net Income (riels)			1,992
3	**Retailer Net Income (minimum sale price is 9000 riels)**			
	Sale price at retailers for New Lao Stove for nearest producer factories			9,000
	So, Net Income (riels)			700

Supply Chain Length

Long distribution distances increases the price for retail sales. Distributors and retailers have freedom to sell ICS for higher than minimum price. For example, in this feasibility study, the average price for NLS bought in the villages is about 17,000 riels in Ampil and 20,000 bought in Samraong. So the retailer price maybe higher but the Stove takes longer to sell and thus payment to ICS producers may take longer too. On other hand, the fluctuation price of raw material price such as metal sheet, labour cost and utility make the Net Income for producer low.

By considering the distribution channels and distance, the nearest distribution network and retailers are encouraged to arrange among existing representative producers in each province.

3. PILOT DESIGN

The TA7833 feasibility study for the pilot project for ICS demand and supply in two districts - S'Ang district in Kandal province and Sandan district in Kompong Thom province. The two districts have demands for differing kinds of ICS, due to their geographic areas and biomass resources, including behavior of households.

The pilot will seek to increase ICS uptake and supply in the two districts. The pilot will support existing ICS stove producers located close to the pilot sites, to increase production through the use of a revolving grant. The pilot will work with 4 existing ICS producers to produce the stoves for pilot project. Stoves to be distributed in each pilot location will be supplied by ICS producers that are located in near the pilot places and each will receive a revolving grant to expand their production of up to $3,000 per ICS producer. The grant will be revolved back to the ICS Producer Association to ensure production capacity is improved and it is available only if stove the Quality Control systems of the stove producers association are applied – this would again be an output based payment but with an advancement of 50% up front and 50% based on increased production level. The terms of the revolving fund will be negotiated during implementation but will not exceed a 3 year term.

The Pilot will also promote ICS use through increased awareness and education; through demonstration of new ICS by the local women's union or other women's group. The women's groups will form direct agreements with the stove producers and are expected to build demands for ICS and also provide additional competition within the supply chain to ensure lower prices to consumers. The unions will receive a grant to purchase their initial sales stock on which they will also receive commission. The combination of grant and commission will enable subsequent orders and continued activities.

The women saving group or female group of forest community members are both potential partners and will require training and education on ICS – with demonstrations. It is proposed that the group receive commission as an output based incentive for each ICS sale amounting 7% – 10 % of retail price – effectively lowering local retail prices and adding competitive forces with existing resellers. To help for their investment, the group will receive an advance cash flow of $5,000 each to order ICS stoves. Through the direct purchase by producers the groups will also make their commission on each stove.

Another distribution channel is the existing retailers in each pilot location. They can be found in village market or commune or district downtown. They use their own capital to order stoves and sell them for their income. The benefit they will receive from the pilot project is the support, awareness and education in the market place on ICS advantages. The Women's group could choose to work through local retailers.

Two distribution models in each location will be arranged using (i) women's group and (ii) existing retailers. The performance from these two groups will be compared as part of the pilot monitoring.

3.1. PILOT LOCATION

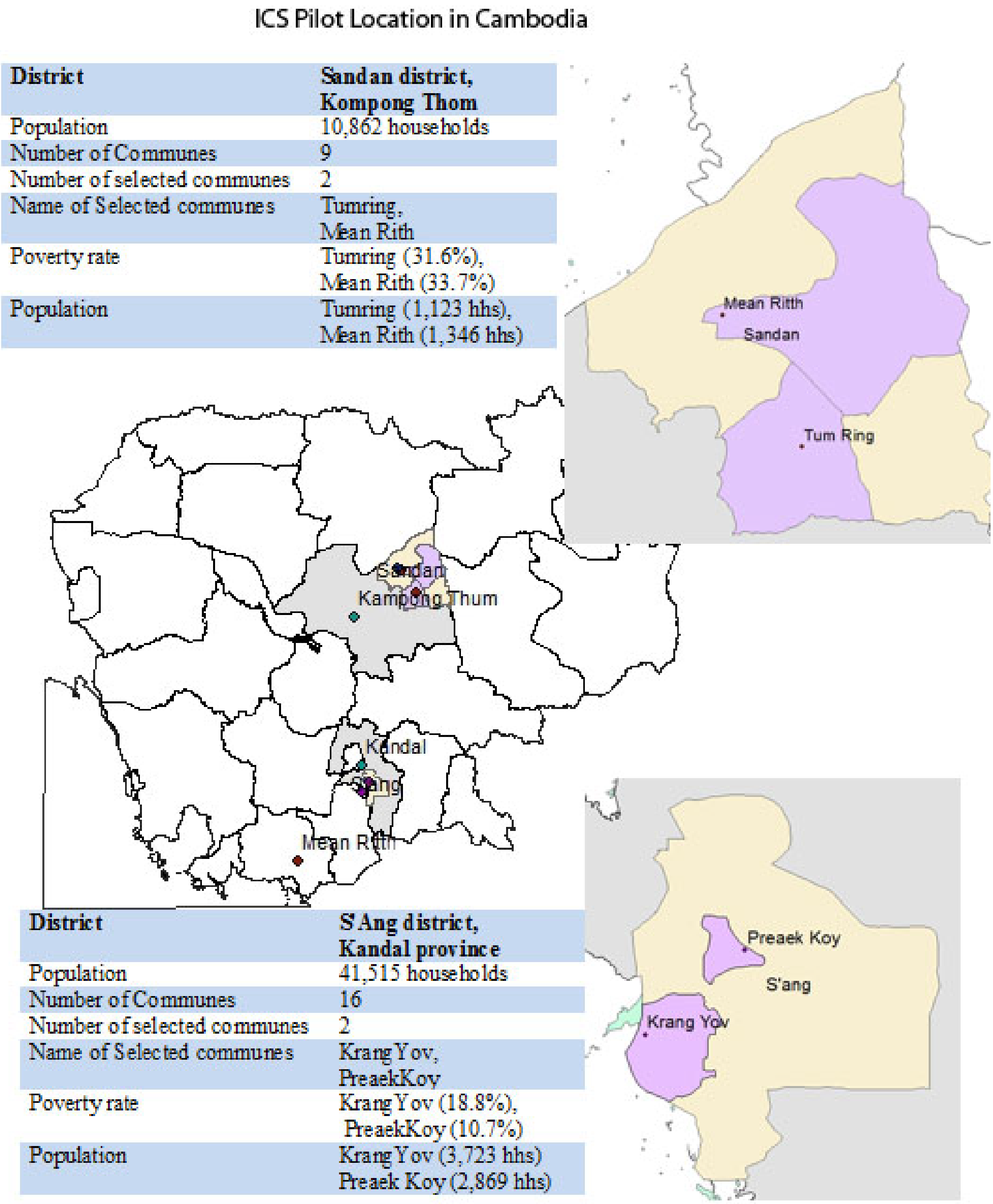
The pilot will be implemented in 2 communes in each pilot district. Characteristics of the communes including agricultural production and biomass availability are discussed above and further details are presented below:

District	S'Ang district, Kandal province	Sandan district, Kompong Thom
Population	41,515 households	10,862 households
N of Communes	16	9

No of selected communes	2	2
Name of Selected communes	KrangYov, PreaekKoy	Tumring, Mean Rith
Poverty rate	KrangYov (18.8%), PreaekKoy (10.7%)	Tumring (31.6%), Mean Rith (33.7%)
Population	KrangYov (3,723 hhs) Preaek Koy (2,869 hhs)	Tumring (1,123 hhs), Mean Rith (1,346 hhs)

Source: CDB online 2010

Figure 8: **Suggested Pilot Location**



3.2. PILOT STAKEHOLDERS

The Pilot project stakeholders should include a service provider, ICS producers, ICS distributors, ICS promoters, and retailers. The respective roles for involvement in the pilot project as follows:

- Service Provider: to manage and coordinate the pilot project and take responsibility for the success and failure of the project, holding an accountability to the funder.
- ICS producers: ICS producers should be existing ones and the nearest to the pilot location. Their role is to produce the ICS as recommended for affordable price, and durability
- ICS distributors: to transport the ICS to retailers with right specification, agreed price and quality maintained.
- ICS promoters: The promoters are identified as a local authority, for example: commune councilor, village chief, women saving groups, forest community leaders and elders and health workers in the commune. They have message about the advantages of ICS to inform the villagers for the interest of environment, tree saving, health and economics and so on.
- Retailers: the retailers should be those who are currently selling ICS and other stoves. They should also be the from existing development groups like women saving groups or new established groups that could arrange ICS outlets within the pilot location. They ensure that ICS retail price are affordable for buyers and profitable for themselves.

3.3. PILOT OUTPUTS, ACTIVITIES, PERFORMANCE INDICATORS

1. Output 1: Reliable ICS supply Chain Established – Output Indicators: ICS producer contracts and ICS availability in pilot districts
2. Output 2: Increased Uptake of ICS in two districts – Output indicators: Two women Groups contracted to ICS suppliers, a minimum of 500 ICS stoves purchased in each district
3. Output 3: Pilot Assessment and Reporting - Output Indicator – Monthly reports, Project completion report

Output and Activities	Performance Indicators	Key Stakeholders
Output 1: Reliable ICS supply Chain Established		
1. Identified existing ICS producers nearest to the pilot location		
Activity 1.1: Identify existing ICS producers nearest to the pilot location	List of identified producers	Service Provider/stove producer Association
Activity 1.2: Select the existing producers for production capacity that meet demand in pilot project	Short listed ICS producers	Service Provider
Activity 1.3: Sign LOA for specific location in pilot location with a revolving grand arrangement	Singed LOA	Service Provider
2. Enhanced quality of ICS with agreed price point		
Activity 2.1: Review the new specification desired by ICS users	Desired ICS quality	Service Provider/ICS Producers
Activity 2.2: Review on profitable production and producer price	Acceptable profit	Service Provider/ICS Producers
Activity 2.3: Sign LOA and Desired ICS production	Singed LOA	Service Provider/ICS Producers
Output 2 Increased Uptake of ICS		
A: ICS Awareness in the community		

Activity 1 Identify key ICS promoter groups in each pilot location	List of promoter groups	Service Provider
Activity 2 Design promotion message and materials	Message on ICS Advantages; Produced leaflet	Service Provider/WU
Activity 3 Distribute the message and materials	List of events; Number of households informed about ICS advantages	WU
Activity 4 Set up demo ICS for different kinds of ICS and different biomass use	3 ICS models	WU

B: Reliable distribution channels and outlet of ICS		
Activity 1: Identify existing ICS distributors and retailers in each pilot location and establishing women groups for ICS distribution with incentive policy and cash flow arrangement	Selected distributors and outlets	Service Provider
Activity 2: Make agreement on delivery location for price point with ICS distributors;	Selected distributors for accepted price	Service Provider/WU/Retailer
Activity 3: Make agreement on retail price with ICS retailers	Selected outlets for accepted price	Service Provider/WU

Output 3: Pilot Assessment and Reporting		
A: Monitored ICS production and ICS outreach		
Activity 1: Review ICS production for best management practice	Desired quality, capacity and profit	Service Provider
Activity 2: Monitor ICS outreach	Number of ICS bought and used	Service Provider
Activity 3: Document the processes from producers, distributors, promoters and retailers	Documents	Service Provider
B: Completion report		

3.4. WORK PLAN

Output, Activities	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	M 9	M10	M11	M12
Output1: Reliable ICS supply Chain Established												
1. Identified existing ICS producers nearest to the pilot location												
Activity 1. Identified existing ICS producers nearest to the pilot location	x											
Activity 1.1: Identify existing ICS producers nearest to the pilot location	x											
Activity 1.2: Select the existing producers for production capacity that meet demand in pilot project	x											
Activity 1.3: Sign LOA for specific location in pilot location												
2. Enhanced quality of ICS with agreed price point												

Activity 2: Enhanced quality of ICS with agreed price point												
Activity 2.1: Review the new specification desired by ICS users	x											
Activity 2.2: Review on profitable production and producer price	x											
Activity 2.3: Sign LOA and Diesired ICS production	x	x	x	x	x	x	x	x	x	x	x	x
Output 2 Increased Uptake of ICS	x											
A: ICS Awareness in the community												
Activity .1 Identify key ICS promoter groups in each pilot location	x											
Activity .2 Design promotion message and materials	x	x										
Activity .3 Distribute the message and materials		x										
Activity .4 Set up demo ICS for different kinds of ICS and different biomass use		x										
B: Reliable distribution channels and outlet of ICS												
Activity .1: Identify existing ICS distributors and retailers in each pilot location	x	x										
Activity .2: Make agreement on delivery location for price point with ICS distributors;	x	x	x	x	x	x	x	x	x	x	x	x
Activity .3: Make agreement on retail price with ICS retailers	x	x	x	x	x	x	x	x	x	x	x	x
Output 3: Pilot Assessment and Reporting												
A: Monitored ICS production and ICS outreach												
Activity 1: Review ICS production for best management practice			x		x		x		x		x	
Activity 2: Monitor ICS outreach	x	x	x	x	x	x	x	x	x	x	x	x
Activity 3: Document the processes from producers, distributors, promoters and retailers											x	x
B: Completion report	x	x	x	x	x	x	x	x	x	x	x	x

3.5. MONITORING AND REPORTING

The project team, in cooperation with stakeholders in the supply chain, will monitor the pilot activities and report the progress on a regular basis. Monitoring and indicators are arranged as follows:

Key for monitoring	Schedule	Mean of verification/ Indicators
ICS production	Monthly	Number of stoves produced and quality ratings
ICS distribution	Monthly	Stock of ICS in pilot location

ICS outreach	Monthly	– No of meeting and events; – No of households; – No of visit to demo households; – No of discussion by demo households with others.
ICS use	Monthly	Number and type of ICS sale at outlet for retailers and women groups
Feed stock use	Monthly	– Kind of biomass availability; – Kind of biomass use; – Kind of ICS use for what biomass.

Reporting covers progress reports and financial reports on a quarterly basis. The progress report should include:

i) ICS production: Unit produced, distributed, and sold
ii) ICS production challenges
iii) ICS sales
iv) HH with ICS

Reporting will also provide detailed coverage of each output and activity under the pilot project and will provide a Pilot impact assessment within the completion report.

3.6. PILOT COST

2 experts are needed for the human resource of the pilot implementation. The team will coordinate the ICS supply chain set up and demo setup including production of promotional materials.

Cost Categories	Transport	Service Provider	Operation cost/Other	Amount $
Cost to set up the ICS supply chain in S'Ang and demo ICS (5 days)	500	2,500	500	3,500
Cost to set up the ICS supply chain in Sandan and demo ICS (5 days)	500	2,500	500	3,500
Cost for incentives for women groups				10,000
Cost for revolving grant for ICS producers				18,000
Cost of Promotional materials and distribution in both pilot districts (5 days)	500	1,500	2,000	4,000
Cost of monitoring ICS production and ICS outreach and reporting (24 days/year)	2,400	7,200	400	10,000
Monitoring costs		4,000		4,000
Communication and Reporting		1,500		1,500
				54,500

3.7. RISK ASSUMPTION AND UNCERTAINTIES OF THE PILOT

- Review of desired ICS quality and price is a challenging interest. Supply side, (producers, distributors and retailers) want high prices, while demand side- the users wants low prices with high quality. Fluctuation of input prices such as metal sheet, ash, clay, utility and labour drive the price setting and profitable production. Therefore, inclusive consultation with ICS stakeholders is needed.

- Among the 3 ICS, NKS is designed to have a cheaper price than NLS and TLS, for rural households. The durability of NKS does not look attractive like NLS and TLS. Therefore, achievements of NKS in the pilot project may be low.
- Firewood is likely the main biomass for ICS as availability and accessibility is high and crop residues may find little use in the pilot location. Therefore, selective residues to use for ICS should be careful in order to maintain advantage of ICS.
- Return on investment may take time and thus high commitment is needed to repay the grant

3.8. SUMMARY POVERTY REDUCTION AND SOCIAL STRATEGY (SPRSS)

Country:	Cambodia	**Project Title**:	Pilot investment project to scale up ICS

I. POVERTY AND SOCIAL ANALYSIS AND STRATEGY

A. Links to the National Poverty Reduction and Inclusive Growth Strategy and Country Partnership Strategy

B. Cambodia's Green Growth Roadmap aims to unify development and environmental objectives by means of implementing policies tailored to address the needs of all, including the most disadvantaged, to create jobs, to increase the resilience of the environment and of the population to adverse impacts, thus sustaining economic growth and human and environmental well-being long term. This roadmap is also intended to promote women's status for the realization of a gender-equal society[2].

According to Work Bank's overview, Cambodia's economy grew at almost 10 percent per year between 1998 and 2008. Although this remarkable growth was interrupted by the global economic downturn in 2008-09, Cambodia's GDP growth reached a four-year high of 7.1 percent. This growth momentum is expected to continue with projected growth rates of 6.7 percent in 2013 and 7.0 percent in 2014. It is driven by strong exports, private investment, agriculture, diversification, and a solid macroeconomic position. The rapid economic growth created employment opportunities which contributed to the decline in poverty headcount from 34.7 percent in 2004 to 20 percent in 2011. From 2004-09 Cambodia saw an even steeper decline in poverty rates. World Bank estimates suggest that Cambodia achieved the Millennium Development Goal (MDG) of halving poverty by 2009. However, rural poverty remains a challenge, with 90 percent of the poor residing in the countryside.[3]

The pilot will be implemented in the districts with 15.1% of poor households in S'Ang district and 30.7% of poor households in Sandan district. It will bring the knowledge on efficient use of biomass to the pilot residents, including poor households.

Cambodia and the Asian Development Bank (ADB) have forged a new Country Partnership Strategy (CPS) for 2011-2013. Under ADB country strategy, it has highlighted "the NSDP Update places emphasis on enhancing agriculture, which is critical to meeting the CMDGs, particularly gender-related goals, as 80% of the population and 90% of the poor live in rural areas."[4]

The pilot will set up supply chain of ICS from existing producers, distributors and retailers in S'Ang district and Sandan district. The supply chain is expected to bring income for stakeholders in supply chain by having more units sold and benefit for the households from ICS advantages, which is more efficient in using litter biomass than traditional cookstoves. Biomass is available for cooking from both rice-farming in S'Ang and forest in Sandan.

C. Results from the Poverty and Social Analysis during PPTA or Due Diligence

1. Key poverty and social issues: The poverty assessment of the ADB 2006 has identified the key poverty and social issues are different from one place to another. In upland sites the problems included poorly developed factor markets and product markets. In low land, being unemployed is one of the key issues. Increasing of environmental concerns, including deforestation and poor

[2] *The National Green Growth Roadmap (December 2009)-P.18.*

[3] *http://www.worldbank.org/en/country/cambodia/overview*

[4] *ADB.2011. Country Partnership Strategy (Cambodia 2011-2013)-P.4*

health condition are also key issues.

2. Beneficiaries: The pilot will introduce improved cookstoves to households in S'Ang and Sandan districts, where 34% and 87% of households are still using traditional cookstoves respectively. The pilot will also provide job opportunities and income for women saving groups and community forest members in 4 pilot communities.
3. Impact channels: To households: the usage of ICS requires less biomass for cooking and creating less smoke, thus better cooking environment for the health.
4. Other social and poverty issues: Due to no supply chain, the payment for ICSs are not secured on delivered quality, causing possibility of using more biomass than expected or wasting money for shorter life time of ICS.
5. Design features: The pilot is designed to create awareness on sufficient use of biomass for example to other communities. Time saving and cleanliness from using ICS will be appreciated by those whose jobs is cooking

II. PARTICIPATION AND EMPOWERING THE POOR

Summarize the participatory approaches and the proposed project activities that strengthen inclusiveness and empowerment of the poor and vulnerable in project implementation. The pilot will be implemented with 5 key partners:

- Consulting firm: to manage and coordinate the pilot project and responsible for the success and failure of the project, accountability to funder.
- ICS producers: ICS producers should be existing ones and the nearest to the pilot location. Their role is to produce the ICS as recommended for affordable price, and durability
- ICS distributors: to transport the ICS to retailers with right specification, agreed price and quality maintained.
- ICS promoters: The promoters are identified as local authority like commune councilor, village chief, women saving groups, forest community leaders and elders and health workers in the commune. They have message about the advantages of ICS to inform the villagers for the interest of environment, tree saving, health and economics and so on.
- Retailers: the retailers should be those who are currently selling ICS and other stoves. They should also be the existing development groups like women saving groups or new established groups that could arrange ICS outlets within the pilot location. They ensure that ICS retail price are affordable to buyers and profitable for themselves.

If civil society has a specific role in the project, summarize the actions taken to ensure their participation. The promoters are identified as a local authority like commune councilor, village chief, women saving groups, forest community leaders and elders and health workers in the commune. They have message about the advantages of ICS to inform the villagers for the interest of environment, tree saving, health and economics and so on.

Explain how the project ensures adequate participation of civil society organizations in project implementation.

4. What forms of civil society organization participation is envisaged during project implementation?
H☐ Information gathering and sharing M☒ Consultation M ☐Collaboration
M ☐Partnership

5. Will a project level participation plan be prepared to strengthen participation of civil society as interest holders for affected persons particularly the poor and vulnerable?

☐Yes. Specific budget has been defined ☒ No

III. GENDER AND DEVELOPMENT

Gender mainstreaming category: some gender elements

A. Key issues. The initial idea of feasibility study aims to support woman unions in both pilot districts communes to participate in this pilot. After the survey we find out that woman group included a man, Siem, who is stove producer in Ampil village and very interested in participation with the project. However, it will take time for women group of Samraong to participate with the project as they can easily access to firewood while many of their household still use 3SWF.

Key actions. During the pilot, the available and interested female household members will naturally participate as the ICS is relating to cooking or works of woman.

☐ Gender action plan ☐ Other actions or measures ☒No action or measure

IV. ADDRESSING SOCIAL SAFEGUARD ISSUES

A. Involuntary Resettlement	Safeguard Category: ☐ A ☐ B ☒C☐ FI
1. Key impacts.	
2. Strategy to address the impacts	
3. Plan or other Actions.	
☐ Resettlement plan ☐ Resettlement framework ☐ Environmental and social management system arrangement ☒ No action	☐ Combined resettlement and indigenous peoples plan ☐ Combined resettlement framework and indigenous peoples planning framework ☐ Social impact matrix
B. Indigenous Peoples	Safeguard Category: ☐ A ☐ B ☒ C ☐ FI
Key impacts. Is broad community support triggered? ☐ Yes ☒☐No	
2. Strategy to address the impacts.	
3. Plan or other actions.	
☐ Indigenous peoples plan ☐ Indigenous peoples planning framework ☐ Environmental and social management system arrangement ☐ Social impact matrix ☒☐No action	☐ Combined resettlement plan and indigenous peoples plan ☐ Combined resettlement framework and indigenous peoples planning framework ☐ Indigenous peoples plan elements integrated in project with a summary

V. ADDRESSING OTHER SOCIAL RISKS

A. Risks in the Labor Market

1. Relevance of the project for the country's or region's or sector's labor market.
L☐ unemployment L☐ underemployment L☐ retrenchment L☐ core labor standards

2. Labor market impact.

B. Affordability

The pilot is expected to start immediately after completion of this study; therefore no big change from cost estimation is expected. The ICS cost is estimated as average cost and can be changed depending on the preferred ICS.

C. Communicable Diseases and Other Social Risks

1. Indicate the respective risks, if any, and rate the impact as high (H), medium (M), low (L), or not applicable (NA):
N/A☐ Communicable diseases N/A☐ Human trafficking
N/A ☐ Others (please specify) _______________
2. Describe the related risks of the project on people in project area.

VI. MONITORING AND EVALUATION

1. Targets and indicators: see work plan for pilot
2. Required human resources: See budget plan for pilot
3. Information in PAM:
4. Monitoring tools:

3.9. INITIAL ENVIRONMENTAL EXAMINATION (IEE) SCREENING MATRIX

The following matrixes are prepared for the two pilot locations in Sa Ang (Kandal) and Sandan (Kampong Thom).

Table 23: ***IEE screening matrix of S'Ang (Kandal)***

Screening Questions	Yes	No	Remarks (S'Ang)
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?		x	The project will be carried out in S'Ang district which is one among eleven districts in Kandal province. S'Ang district has a total area of 518. 5638 Km2.
1. Cultural heritage site		x	There is no cultural heritage site in the project site
2. Legally protected Area (core zone or buffer zone)		x	There is no legally protected area in the project site
3. Wetland		x	Wetlands in S'Ang are the small natural lakes, flooded rice field. These wetlands are not completely located within the project site.
4. Mangrove		x	There is no mangrove in the project site
5. Estuarine		x	There is no.
B. Special area for protecting biodiversity		x	There is no special area for protecting biodiversity in the project site
C. Potential Environmental Impacts Will the Project cause…			
1. Impairment of historical/cultural areas; disfiguration of landscape or potential loss/damage to physical cultural resources?		x	There will be no such impairment
2. Disturbance to precious ecology (e.g. sensitive or protected areas)?		x	The pilot is not situated in such sensitive or protected areas
3. Alteration of surface water hydrology of waterways resulting in increased sediment in streams affected by increased soil erosion at construction site?		x	There is no construction activity in the project site. Therefore, there will be no such alteration
4. Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?		x	No worker-based camps and no chemical are expected to be used under the pilot. Therefore, there will be no such deterioration
5. Increased air pollution due to project construction (using brick, cement …)?		x	No project construction
6. Increased air pollution due to project operation?		x	There will be less air pollution because people will use people will use better ICS which use less firewood and make better fire.
7. Noise and vibration due to project construction or operation?		x	There will be no noise and vibration due to project operation
8. Involuntary resettlement of people? (physical displacement and/or economic displacement)		x	There is no resettlement foreseen
9. Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		x	Many poor households participate in the pilot. Thus the project has a positive impact on poverty alleviation work in the pilot commune.
10. Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases (such as STI's		x	No camps

and HIV/AIDS) from workers to local populations?			
11. Creation of temporary breeding habitats for diseases such as those transmitted by mosquitoes and rodents (inadequate substrate preparation)?		x	There will be no creation of temporary breeding habitats for diseases in project site. On the other hand, the product from cooking process is biochar, which is very useful for environmental sanitation in the project site
12. Social conflicts if workers from other regions or countries are hired?		x	Mainly local workers required from Farmer Union
13. Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		x	The number of workers is very small, no camps. Therefore, there will be no burden on social infrastructure and services
14. Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation		x	There will be no such risks and vulnerabilities
15. Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		x	There are no chemical or explosives expected to be used in project operation
16. Community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		x	The project is expected to contribute to safer cooking because the improved cookstoves will be checked for smoke emissions and safety before being given to residents.
17. Generation of solid waste and/or hazardous waste?		x	Solid waste being generated is ash and biochar. This is the product of combustion process of improved cook stove. However, not only these solid wastes are completely harmless but these substances are also very useful for agriculture farming and environmental sanitation in the project site
18. Use of chemicals?		x	There are no chemicals involved in project operation. In addition, the project implementation will create biochar which is very useful for agriculture farming as well as rural sanitation.

Climate Change and Disaster Risk Questions **The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.**	**Yes**	**No**	**Remarks**
1. Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate changes?		x	Floods and storms may occur. But these are the natural weather phenomena. The project will not cause such hazards

2. Could changes in precipitation, temperature, salinity, or extreme events over the Project lifespan affect its sustainability or cost?		x	Nothing foreseen
3. Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (e.g. high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?		x	Definitely not. The project is expected to reduce cooking cost of households and limit the number of poor quality stoves
4. Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., increasing traffic or housing in areas that will be more prone to flooding, by encouraging settlement in earthquake zones)?		x	Definitely not. No such impact can be imagined

Table 24: IEE screening matrix of Sandan, Kampong Thom

Screening Questions	Yes	No	Remarks (Sandan)
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?		x	The project will be carried out in Sandman district, which is one among 8 districts of Kampong Thom province. This district has community forests. The district as a total area of 2,963.859 Km2.
1. Cultural heritage site		x	There is no cultural heritage site in the project site
2. Legally protected Area (core zone or buffer zone)		x	There is no legally protected area in the project site
3. Wetland		x	There is no wetland. Most of village land is on a hill. There is a water source from small stream.
4. Mangrove		x	There are no mangroves on the project site
5. Estuarine		x	There is none.
B. Special area for protecting biodiversity		x	In study village-Samraong, located in Tumring commune, Sandan district, there is the community forest which comprises of 688 hectare in size in 2001 when it was established. Now, some forests have been degraded by logging and make clearance for crops.
C. Potential Environmental Impacts Will the Project cause…			
1. Impairment of historical/cultural areas; disfiguration of landscape or potential loss/damage to physical cultural resources?		x	There will be no such impairment
2. Disturbance to precious ecology (e.g. sensitive or protected areas)?		x	The pilot is not situated in such sensitive or protected areas
3. Alteration of surface water hydrology of waterways resulting in increased sediment in streams affected by increased soil erosion at construction site?		x	There is no construction activity in the project site, so there will be no such alteration
4. Deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?		x	No worker-based camps and no chemical are expected to be used under the pilot. Therefore, there will be no such deterioration
5. Increased air pollution due to project construction (using brick, cement …)?		x	No project construction

6. Increased air pollution due to project operation?		x	There will be less air pollution because people will use better ICS which use less firewood and make cleaner fires.
7. Noise and vibration due to project construction or operation?		x	There will be no noise and vibration due to project operation
8. Involuntary resettlement of people? (physical displacement and/or economic displacement)		x	There is no resettlement foreseen
9. Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		x	Many poor households participate in the pilot. Thus the project has a positive impact on poverty alleviation work in the pilot commune.
10. Poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases (such as STI's and HIV/AIDS) from workers to local populations?		x	No camps
11. Creation of temporary breeding habitats for diseases such as those transmitted by mosquitoes and rodents (inadequate substrate preparation)?		x	There will be no creation of temporary breeding habitats for diseases in project site. On the other hand, the product from cooking process is biochar, which is very useful for environmental sanitation in the project site
12. Social conflicts if workers from other regions or countries are hired?		x	Mainly local workers required from Farmer Union
13. Large population influx during project construction and operation that causes increased burden on social infrastructure and services (such as water supply and sanitation systems)?		x	The number of workers is very small, no camps. Therefore, there will be no burden on social infrastructure and services
14. Risks and vulnerabilities related to occupational health and safety due to physical, chemical, biological, and radiological hazards during project construction and operation		x	There will be no such risks and vulnerabilities
15. Risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		x	There are no chemical or explosives that are expected to be used in project operation
16. Community safety risks due to both accidental and natural causes, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		x	The project is expected to contribute to safer cooking because the improved cookstoves will be checked for smoke emissions and safety before being given to residents.
17. Generation of solid waste and/or hazardous waste?		x	Solid waste being generated is ash and biochar. This is the product of combustion process of improved cook stove. However, not only are these solid wastes are completely harmless but these substances are also very useful for agriculture farming and environmental sanitation in the project site
18. Use of chemicals?		x	There is no chemical involved in project operation. In addition, the project implementation

			will create biochar which is very useful for agriculture farming as well as rural sanitation.

Climate Change and Disaster Risk Questions **The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.**	**Yes**	**No**	**Remarks**
1. Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate changes?		x	No flood, but rain storms may occur. But these are the natural weather phenomena. The project will not cause such hazards
2. Could changes in precipitation, temperature, salinity, or extreme events over the Project lifespan affect its sustainability or cost?		x	Nothing foreseen
3. Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (e.g. high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?		x	Definitely not. The project is expected to reduce cooking cost of households and limit the number of poor quality stoves
4. Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., increasing traffic or housing in areas that will be more prone to flooding, by encouraging settlement in earthquake zones)?		x	Definitely not. No such impact can be imagined