How to Overcome the Firewood Crisis

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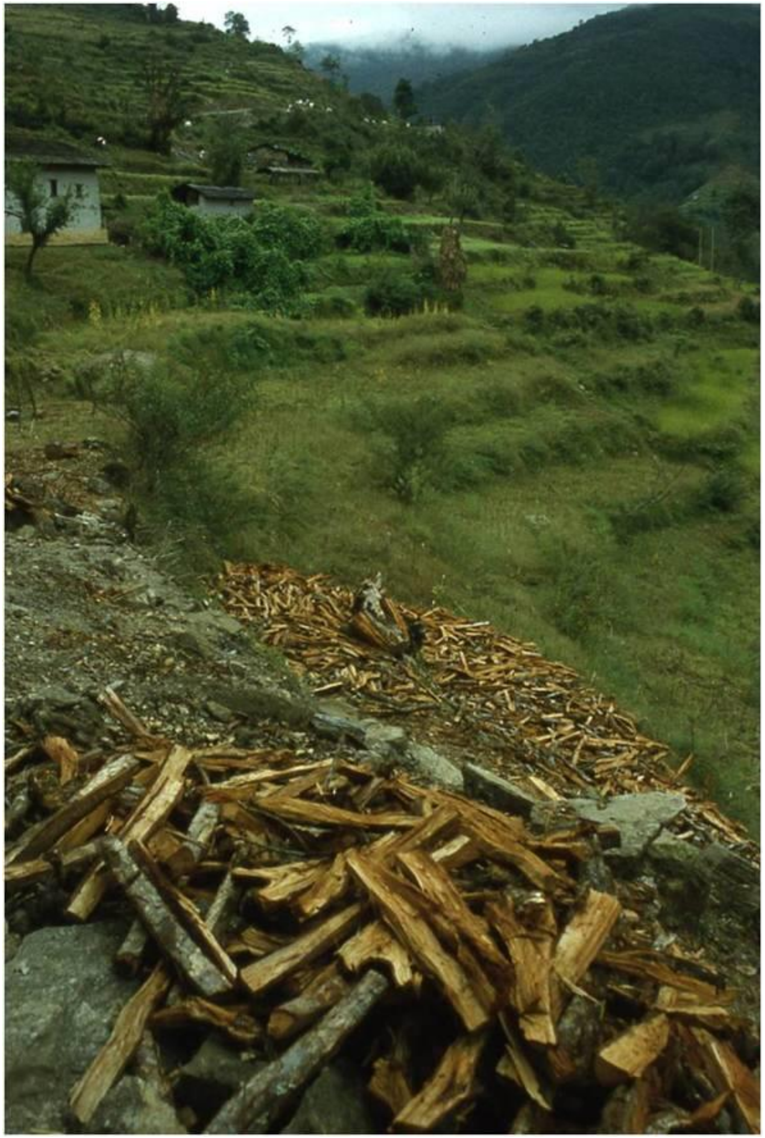
Picture from Madagascar
courtesy of Regula Ochsner, ADES

Firewood Crisis



About one billion cubic meters of firewood are burned in an unsustainable way every year. More than 2 billion people are affected by the fuelwood crisis. The induced CO_2 emissions corresponds approximately to the CO_2 emissions of Germany.

Picture courtesy of K. Schulte, Rotary Sweden, Solar Cooker Project Bamti Bandhar, Nepal

Traditional Cooking Methods Often Cause Deforestation

Traditional Cooking
in Nepal
Courtesy of K. Schulte, Sweden

School Kitchen
Zaroli-Monastery
in Gujarat

Charcoal Market in
Madagaskar
Courtesy of Regula Ochsner,
ADES, Switzerland

Reduction to less than 1/10 of the traditional wood consumption for cooking is possible with Improved Stoves, Thermos Technology and Solar Cookers
There are additional opportunities through Biogas Technology

Firewood Stove
Ben 2 and Ben 3 DS
for any pots or pans

Thermos-Basked
made from straw
Source: Jagadeeswara Reddy
NEDCAP, India

„Smokeless Villages“
(Biogas and solar cookers in India)
Source: Deepak Gadhia and Jagadeeswara Reddy

see also: Catalog with 257 stoves/cookers from GACC:
http://catalog.cleancookstoves.org/#/stoves

“Factor 16”: Transition of a Household from Charcoal to Renewable Biomass

A household in Lusaka consumes about 1.4 tons of charcoal per year, requiring about 8 tons of wood processed in kilns. The consequences are deforestation and health damage caused by carbon monoxide.

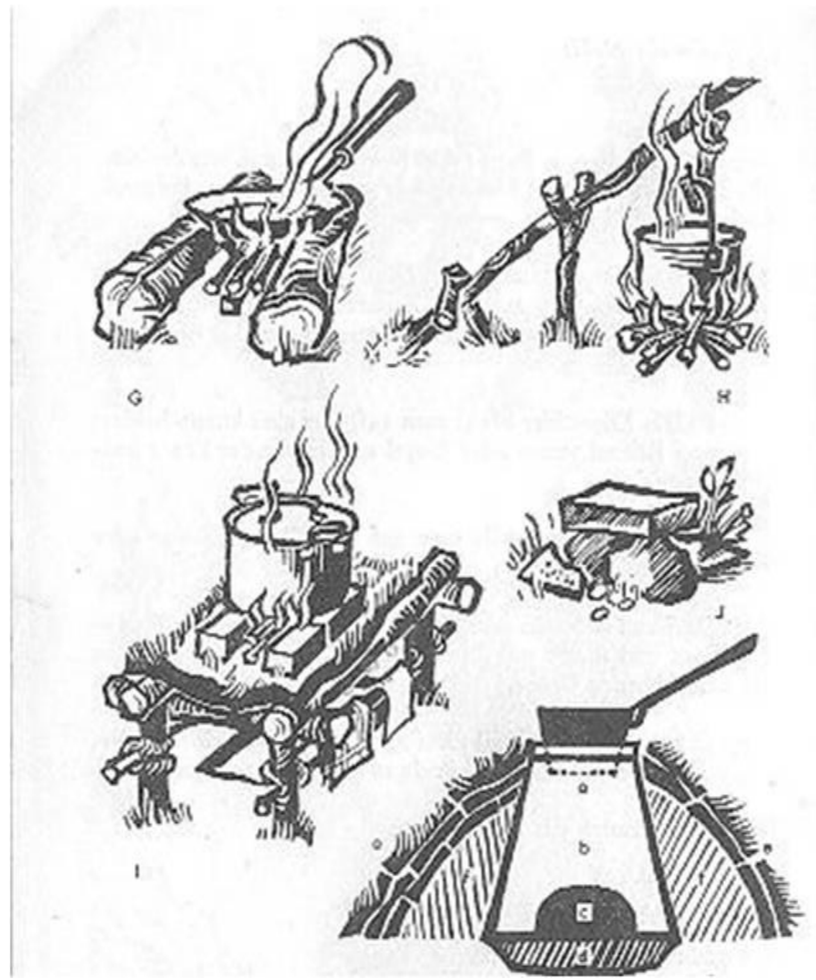
It is possible to reduce the consumption of wood from 8 tons to 0,5 tons, that is to 1/16.

Cooking maize porridge with charcoal in Sambia

Ancient Fuelwood Burning Cookstoves

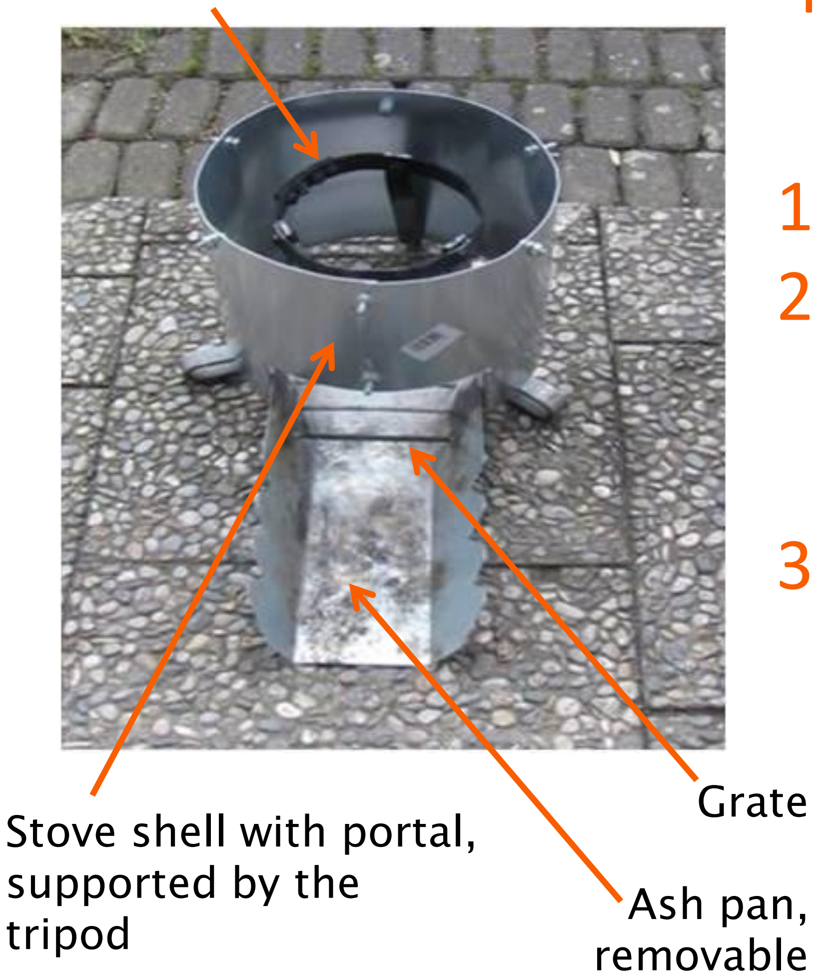
(Abb. 2) Titelbild der Küchenmeisterei, Augsburg 1507. Auf dem Herd stehen dreifüßige Grapen und ein Bratspieß mit Windantrieb; an einer Kette hängt ein Kessel über dem Feuer (vgl. S. 71).

Cover picture of „Küchenmeisterei", Augsburg (1507). There are pots of iron with three feet and a roasting spit driven by wind power; a kettle hangs on a chain above the fire



Scout Fireplaces for Cooking
Source: Der Georgspfadfinder – Handbuch für Pfadfinder DPSG (1949) S.196,199

Fuelwood Burning Stoves Ben 2 and Ben 3 for any Pot or Pan



Three components adapted to the size of the pot or pan

1. Ash pan with integrated grate
2. Tripod for stable positioning of the pot or pan, also for curved base
3. Stove shell for guiding the exhaust gas, raised on the tripod-feet for air intake

Wood Burning Stoves Ben 2 und Ben 3

D. Seifert (2015)

Net Power:1,5 kW

Weight about 3 kg

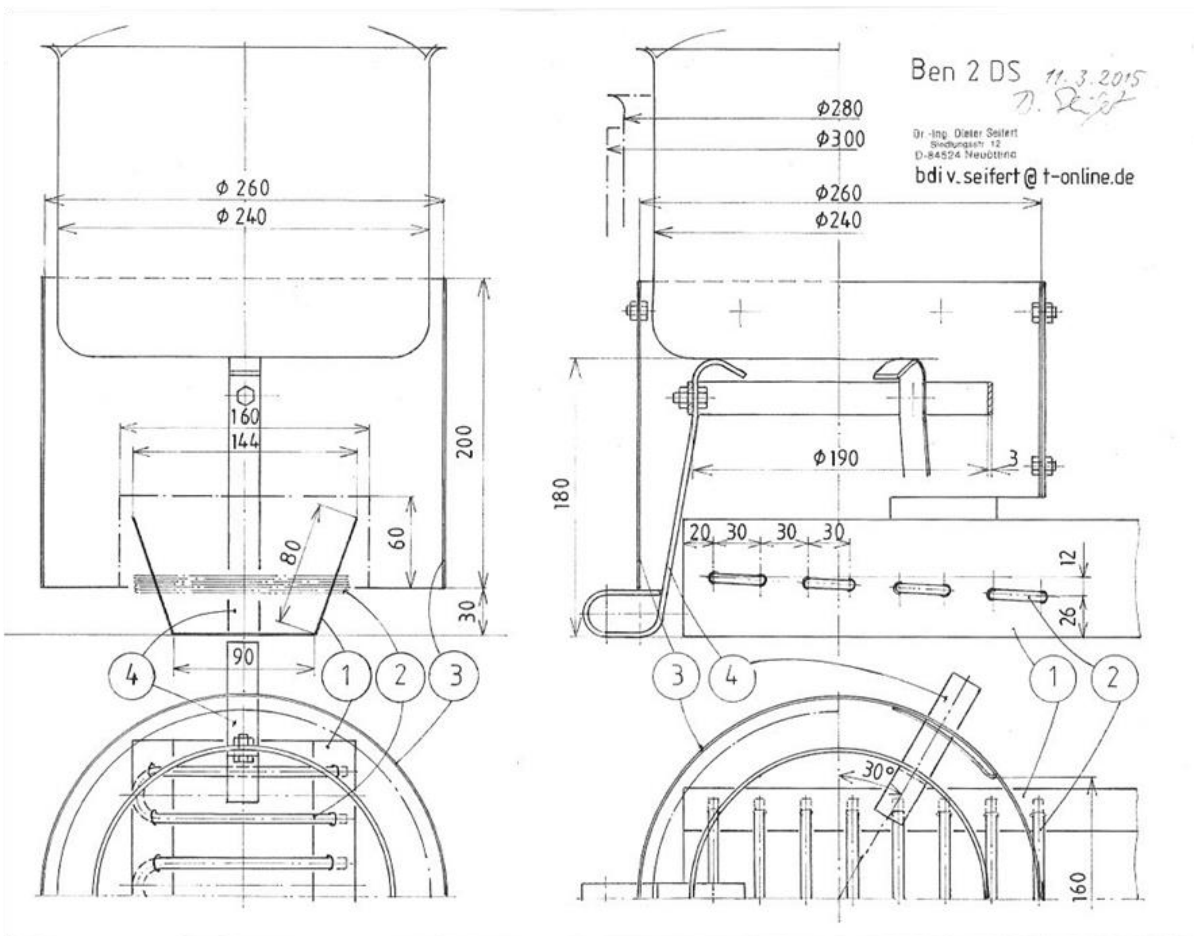
Efficiency
more than 40%

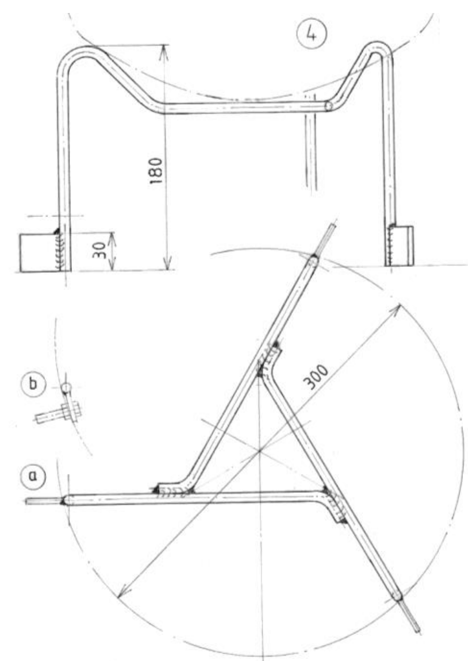
Little smoke if
properly operated
(not overloaded)

Can be produced from mild steel in very simple workshops
(even without mashines) at low costs (e.g. less than 10 USD)

Description and Drawings are on the Website of Solar Cookers International

http://solarcooking.wikia.com/wiki/Ben_3_Firewood_Stove



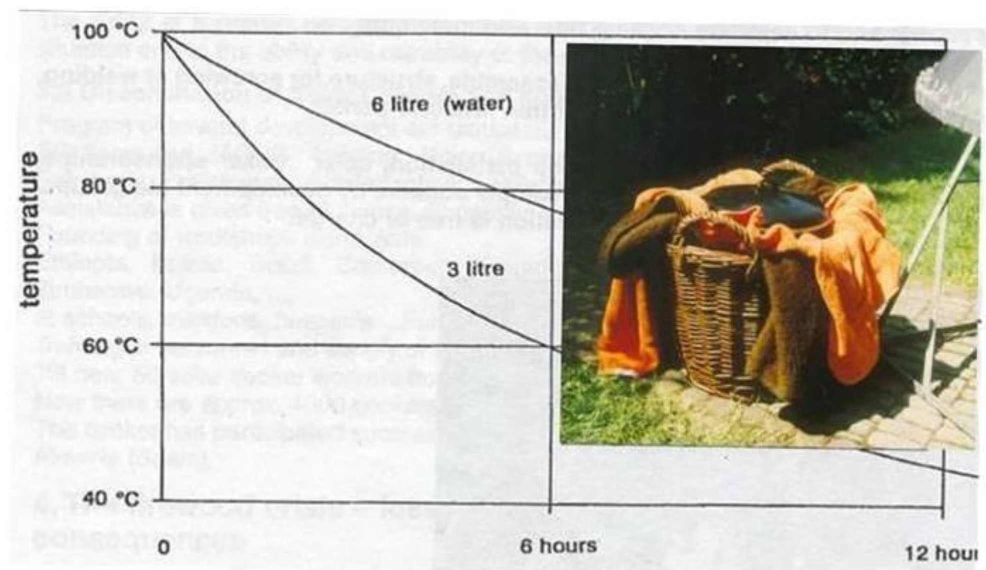


Alternative: welded tripod

Thermos-Technique - Cooking with Retained Heat

http://solarcooking.wikia.com/wiki/Heat-retention_cooking

Example of a technique that requires only information and locally available material. Saves expenses, time and emissions
Example: Reduces time for cooking dry beans
from 4 hours to about ½ hour



It is crucial that there is enough water in the pot

The Solar Cooker is More Than a Device for Cooking
It Can Avoid the Rebound Effect

Source: Süddeutsche Zeitung

Rebound Effect

"Efficiency increase oftentimes reduces product or service costs, which can in turn ramp up consumption (due to reduced prices), thus partly canceling out the original savings. This is known as the rebound effect."

Products of the parabolic solar cooker presented by Imma Seifert

Source: http://www.umweltbundesamt.de/en/topics/waste-resources/economic-legal-dimensions-of-resource-conservation/rebound-effects

Rebound Effect

„If indirect rebound effects are factored in, it is probable that an even larger portion of efficiency gains would be negated. In some cases, the savings effect may even backfire – although this happens only rarely and is associated with the impact of growth and structural change and hence cannot be regarded as a genuine rebound effect.”

Source: http://www.umweltbundesamt.de/en/topics/waste-resources/economic-legal-dimensions-of-resource-conservation/rebound-effects

Calculation of Efficiency of Wood Stoves and Charcoal Stoves

Calulation of Stove Efficiency	Equipment	3-Stones-firewood	Ben 2	Charcoal tradit.	Charcoal improved
	Fuel	Firewood	Firewood	Charcoal	Charcoal
	Unit	**Assumptions**	**03.02.2015**	**Assumptions**	**Assumptions**
Amount of Water	kg	6	6	6	6
Rise of Temperature	K	75	88	75	75
Net Energy for Heat Up	kJ	1.881	2.207	1.881	1.881
Amount of Vaporized Water	kg	0,1	0,05	0,1	0,1
Heat of Vaporization	kJ	226	113	226	226
Effective Energy Delivered	kJ	2.107	2.320	2.107	2.107
Amount of Fuel	g	1.405	411	351	234
Energy Used	kJ	21.070	6.165	10.543	7.022
Remaining Amount of Produced Charcoal	g	0	15	0	0
Remaining Energy	kJ	0	450	0	0
Stove Efficiency		10%	41%	20%	30%
			Bailis:	15% … 25%	25% … 35%

- Efficiency of traditional fireplace: UNFCCC default value: 10%
- Efficiency of charcoal stoves see R. Bailis: Wood in Household Energy Use. Encyclopedia of Energy, Vol. 6, Elsevier (2004)
- Efficiency firewood stove Ben 2 (41%): Test result from D. Seifert

Annual Fuel Consumption of a Household in Africa - Savings in Wood and CO_2

Fuel Consumption per Year	Equipment	3-Stones-firewood	Ben 2	Charcoal tradit.	Charcoal improved
	Fuel	Firewood	Firewood	Charcoal	Charcoal
	Unit	Assumptions	03.02.2015	Assumptions	Assumptions
Net Energy Demand E_eff per Household per Year	MJ/Year	6.000	6.000	6.000	6.000
a) Fuel Consumption B per Household per Year	kg/Year	4.000	985	1.101	667
Percentage of Saving f_thermo via Thermos Technique		45%	45%	45%	45%
Percentage of Saving f_solar via Solar Technique		45%	45%	45%	45%
b) Fuel Consumption including Thermos Technique	kg/Year	2.200	542	550	367
c) Fuel Consumption including Thermos- and Solar Technique	kg/Year	1.210	298	303	202
Conversion to Fuelwood Consumption per Household per Year:			Short rotation plantation	Thick stems and branches for charcoal	
Mass Ration Wood/Charcoal (IPCC default value)	kg/kg			6	6
a) Without Thermos- and Solar Technique	kg Wood/Year	4.000	985	6.005	3.999
b) Including Thermos Technique	kg/Year	2.200	542	3.303	2.200
c) Including Thermos- and Solar Technique	kg/Year	1.210	298	1.816	1.210

Result: The fuelwood consumption per household per year can be reduced from 4000 kg to 300 kg
(Transition from charcoal saves even more!)

Saving of CO_2-Emission

Saving of CO2-Emission from Transition to Ben Stoves, Thermos- and Solar Technique		
Emission Factor EF Wood (IPCC 2006)	kg CO2/MJ	0,112
Net Calorific Value NCV Wood (UNFCCC default value)	MJ/kg Wood	15
Factor f_n Non Renewably Harvested Wood		85%
Saving of CO2-Emission per kg Wood	kg CO2/kg Wood	1,428
Saved Amound or Wood = 4000 kg - 300 kg	kg Wood	3700
Saved CO2-Emission per Household per Year	kg CO2/Year	5,28

This reduction of the annual fuelwood consumption
from 4000 kg to approximately 300 kg
corresponds to saving of CO_2 emission of approximately
5 tons per year, if 85% of wood is not harvested sustainably.
This corresponds to about the emission of a car drive from the length
of the equator (40 000 km * 0.125 kg CO_2/km)
as a possible saving of each of more than two hundred million
households in fuelwood crisis regions.

Vision: 500 Million Fuelwood Stoves, Hay Baskets and Solar Cookers

500 million x 1.5 kW = 750 billion watt (750 GW) of installed capacity, i.e., the power of more than 700 nuclear power plants - of course no continuous operation – but with 1/50 of the installation costs (0.09 €/W), without danger, with complete and easy recycling.

A peace-making technology

Manufacturing Instead of Unemployment

Cookers, helping to save expenses, time, health, environment and climate,

to learn skills,

to learn and create applications,

develops peacemaking collaborations and new ideas,

creating jobs through sustainable technology (Perma Technology)

Solar cookery course at ICNEER/Gadhia Solar, India

Escuela Taller, Bullas/Spain

Summary
How the firewood crisis can be overcome


Souce: Passauer Bistumsblatt

Increase efficiency:

- Firewood Saving Stoves
- Thermos Technology

Use solar energy:

- Solar Cookers
- Short Rotation Plantations
- Biogas Technology as possible

Avoid rebound effects through the variety of solar cooker applications

Thank You

Picture courtesy of Dr. Martín Almada,
Fundación Celestina Pérez de Almada/Paraguai:
GUIA DE USO de cocinas solares y hornos solares

Quotation from
Dr. Sena Gabianu (Officer World Bank):
"AFRICA'S GROWING AWARENESS OF PROBLEMS OF ECOLOGY AND ITS LINKS TO SOCIAL AND ECONOMIC DEVELOPMENT"

Neuendettelsau (1996)

„There is promise in Solar Energy but as one lady told us at a seminar, she had heard so much about solar energy and how abundant the sun is, yet she still has to look up to the skies every day, watch the sun go from east to west, shedding a lot of ist energy and there is no way she can bring it down to do their cooking with. May be, she added, those of you who have education can help us."

Source: O. Ischebeck (Hsg.): FROM FOSSIL FIRE TO THE SUN – Renewable Energies for Sustainable Development and Employment in Africa. Akademischer Verlag München, 1997, p. 18-19.