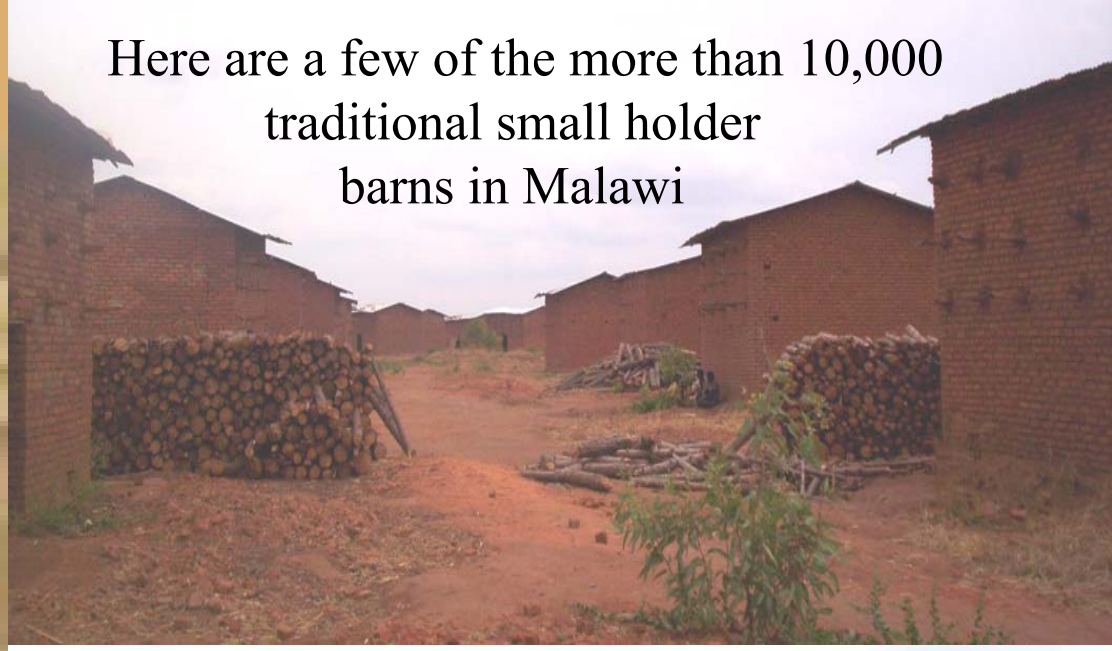
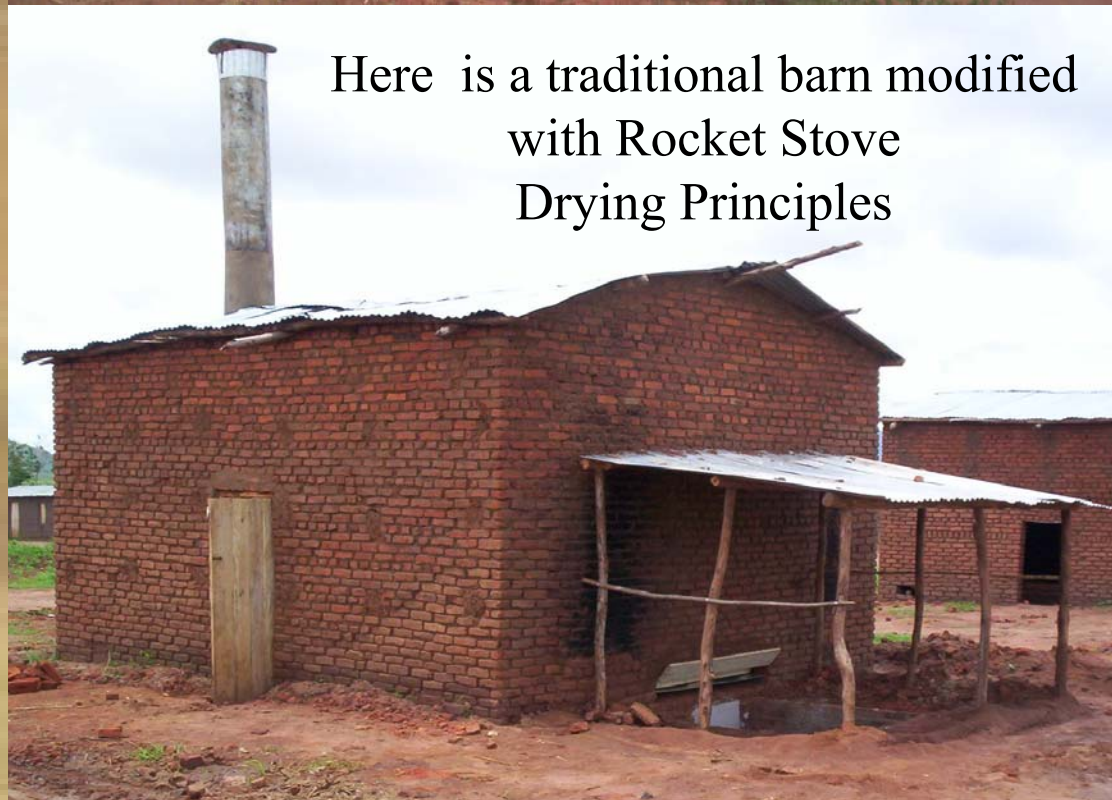
Development of Tobacco Rocket Barn for Small Holder Farmers in Malawi

A collaboration of ProBEC/GTZ, Limbe Leaf and Aprovecho



Here are a few of the more than 10,000 traditional small holder barns in Malawi



Here is a traditional barn modified with Rocket Stove Drying Principles

Environmental costs of producing flue cured tobacco in developing countries

In Southern Africa alone, an estimated **140,000 hectares of Woodlands** [55,000 hectares in Malawi alone] are cleared annually to cure tobacco, accounting for 12 percent of the deforestation in the region.

Since 1999, when this data was published, deforestation has increased significantly as production has switched away from politically unstable (yet fuel - efficient) Zimbabwe to other Southern African countries that use far more primitive curing systems!

Country	Mean Annual Tobacco Production ('000 tons)	Total Annual Wood Consumption ('000 tons)	Area of Natural Woody Biomass Removed hectare	Total Annual Deforestation ('000 hectares)	Percentage of Tobacco Related) Deforestation
South Korea	85.5	272.2	5846	13.0	45.0
Uruguay	1.4	7.6	162	0.4	40.6
Bangladesh	55.0	128.0	2750	9.0	30.6
Malawi	**125.4**	**485.4**	**14382**	**55.0**	**26.1**
Pakistan	96.0	486.1	10443	55.0	19.0
China	3049.0	722.8	15527	87.0	17.8

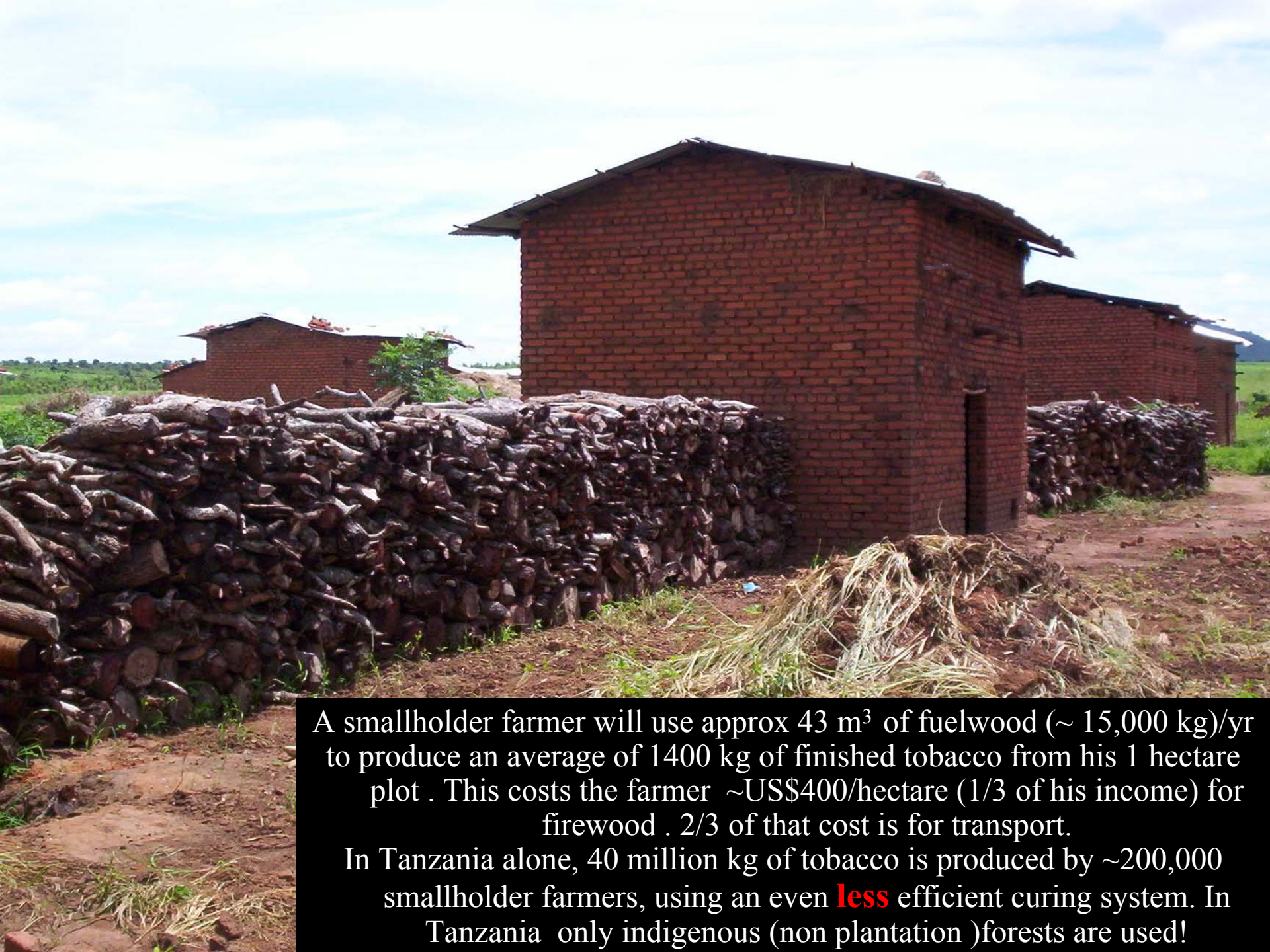
SOURCE: Helmut Geist, "Global Assessment of Reforestation Related to Tobacco Farming," Tobacco Control, Spring 1999.

The curing process:

Green tobacco is placed on strings and loaded into barns. The tobacco strings are suspended on tiers above hot metal flue pipes …

The barn is slowly heated from 35-70 C over a 6-9 day period. (It is much more challenging to cure tobacco than to dry other foodstuffs.)

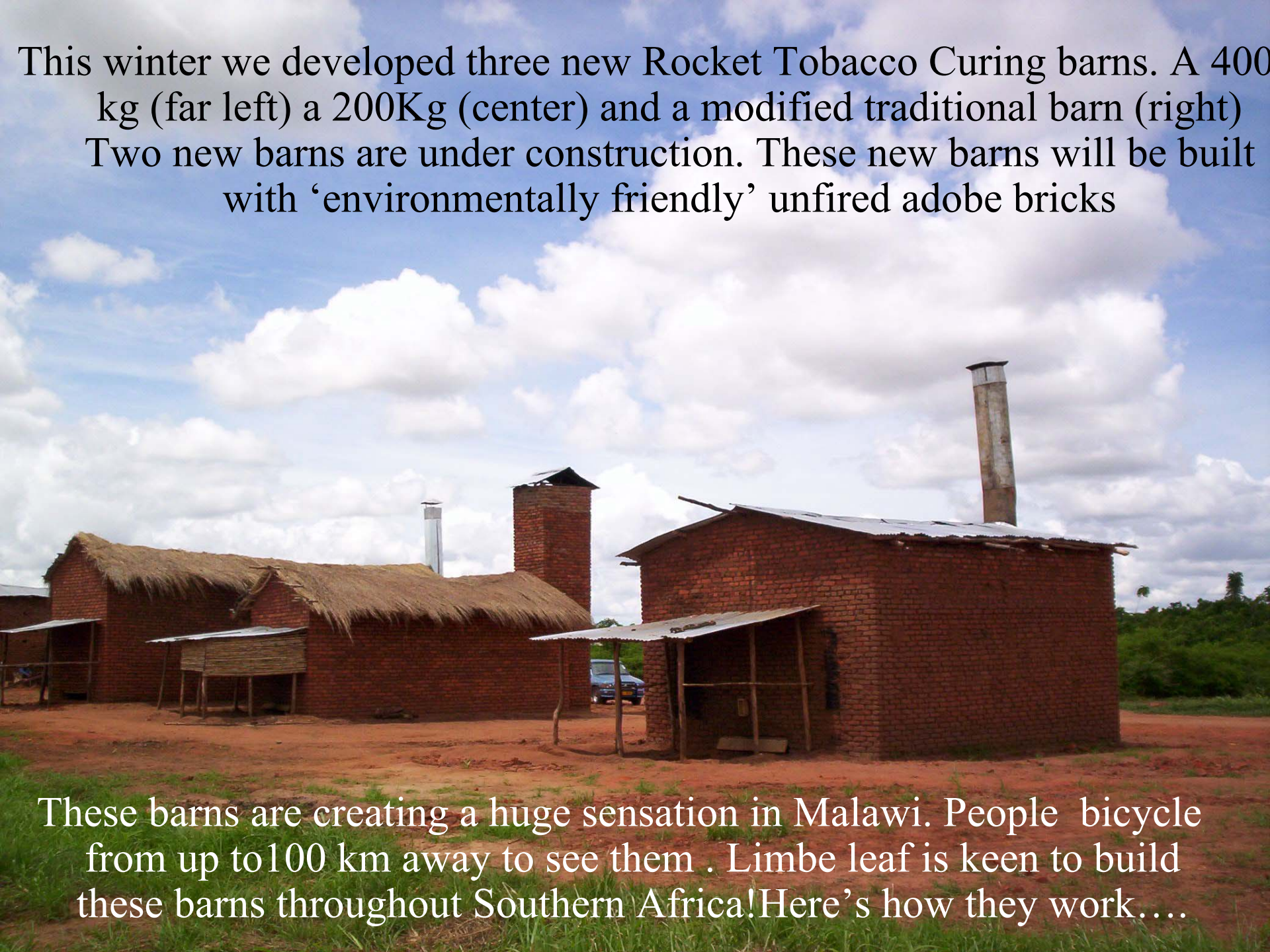
At the end , the yellow fermented tobacco is removed



A smallholder farmer will use approx 43 m^3 of fuelwood (~ 15,000 kg)/yr to produce an average of 1400 kg of finished tobacco from his 1 hectare plot . This costs the farmer ~US$400/hectare (1/3 of his income) for firewood . 2/3 of that cost is for transport.

In Tanzania alone, 40 million kg of tobacco is produced by ~200,000 smallholder farmers, using an even **less** efficient curing system. In Tanzania only indigenous (non plantation)forests are used!

If that wasn't bad enough, 18% of all barns burn down while full of tobacco. If a farmer loses one barn of the 9 that he cures each season, then he looses ~30% of his income for the year.Barns burn because dry tobacco falls on red hot pipes and ignite. You can imagine its difficult to get fire insurance for these things!

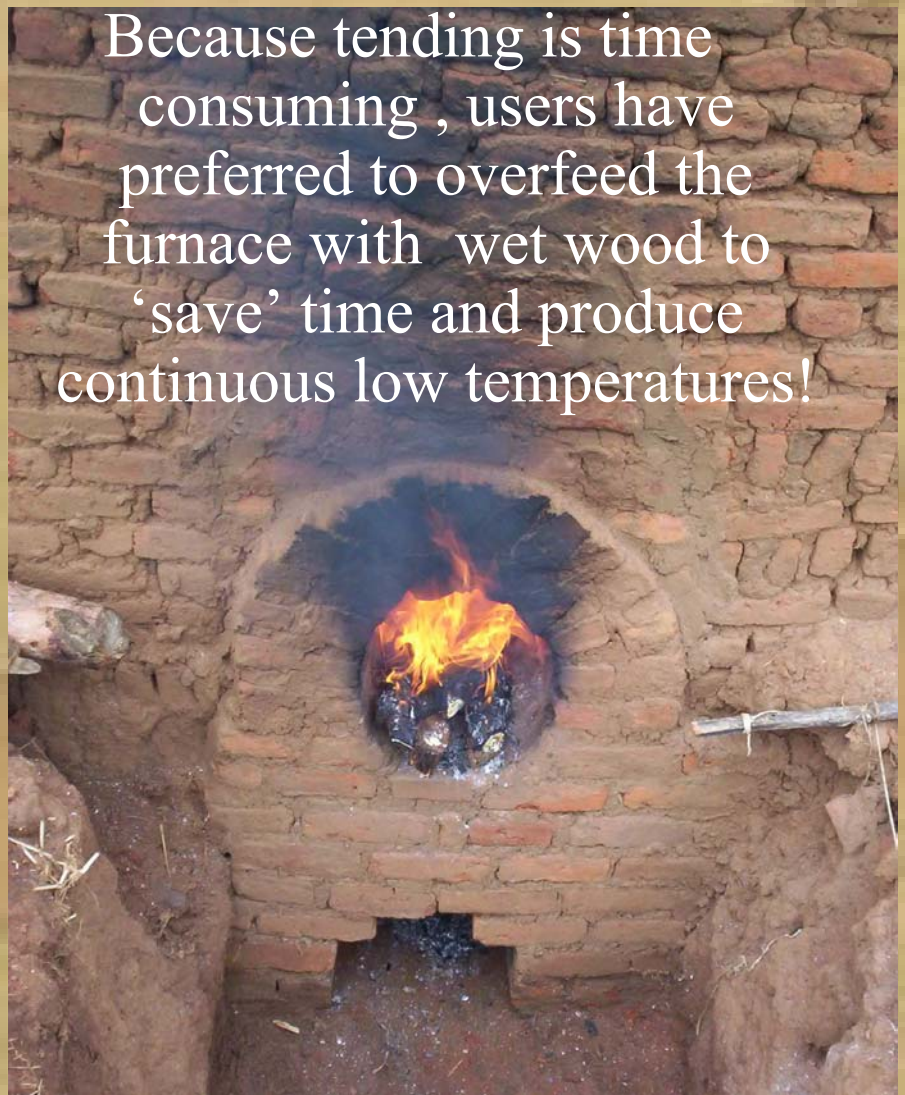


This winter we developed three new Rocket Tobacco Curing barns. A 400 kg (far left) a 200Kg (center) and a modified traditional barn (right) Two new barns are under construction. These new barns will be built with ‘environmentally friendly’ unfired adobe bricks

These barns are creating a huge sensation in Malawi. People bicycle from up to100 km away to see them . Limbe leaf is keen to build these barns throughout Southern Africa!Here’s how they work….

Traditional Barn

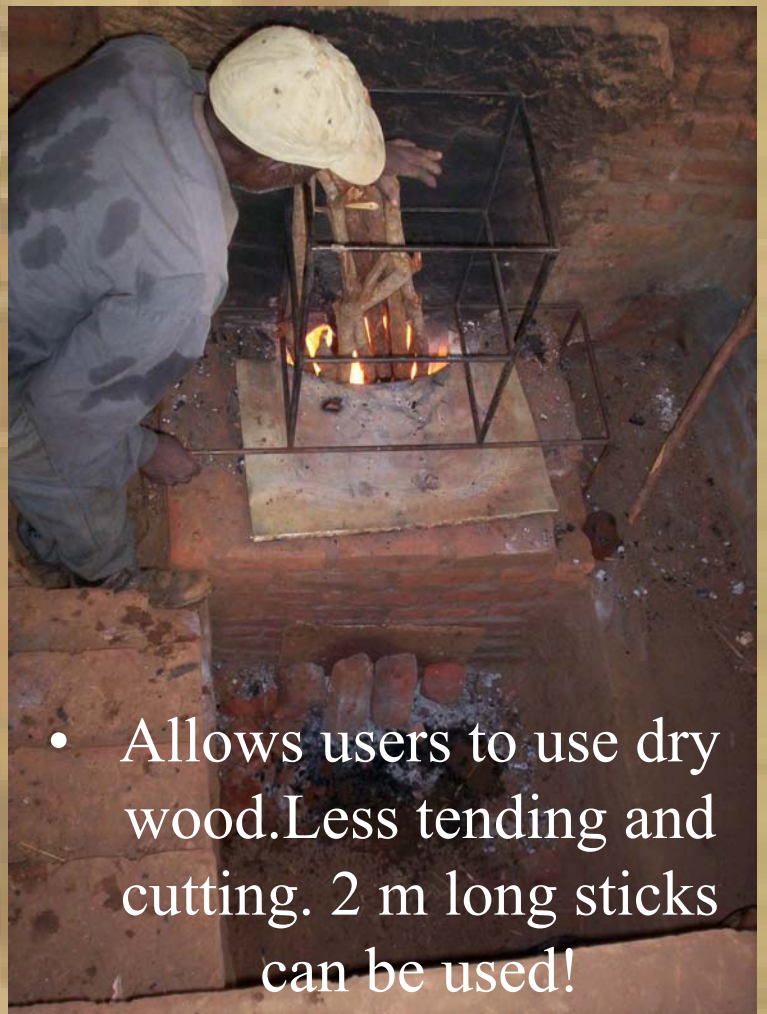
Horizontal feed chamber



Because tending is time consuming , users have preferred to overfeed the furnace with wet wood to ‘save’ time and produce continuous low temperatures!

New rocket Barn

Vertical self feeding Rocket combustion chamber



- Allows users to use dry wood.Less tending and cutting. 2 m long sticks can be used!

New rocket Barn

Vertical self feeding combustion chamber

Only a few sticks are needed to keep the barn at 71C

Construction detail of Rocket elbow

Combustion chamber made with high -fired, locally produced, insulative ceramic bricks. 30 by 30 cm feed chamber produces 8.5 – 85 kW/hr

Traditional Barn

New rocket Barn

Single Brick chimney

Double chimney system

External (60cm) chimney draws air through tobacco. The entire barn is sealed with the exception of a single air inlet shown on next page

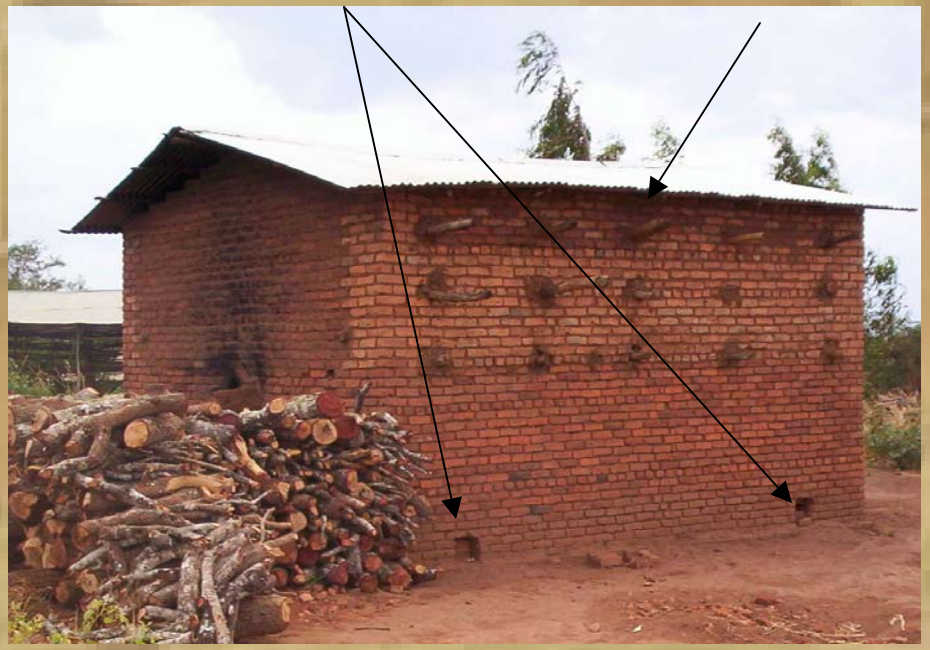
The external chimney is powered by the internal (30 cm) hot flue gas chimney. Ask Dr Larry for more info….

Traditional Barn

Multiple air intakes

Air enters through 4 bottom vents….
(In theory these need to be opened and closed at different intervals for optimum efficiency)

…and exits through the continuous gap between roof and walls. No Preheating of air!



New rocket Barn

Single air intake

Single air intake (powered by double chimney system) pulls air into the barn and preheats it between a 200*60cm by 4mm mild steel plate (not visible) and a .6 mm tin sheet . The opening is 150 by 7 cm

Traditional Barn

Metal flue pipes

- Dangerous
- Poor tobacco quality
- Need to be replaced regularly
- Requires use of wet wood to mediate temperatures

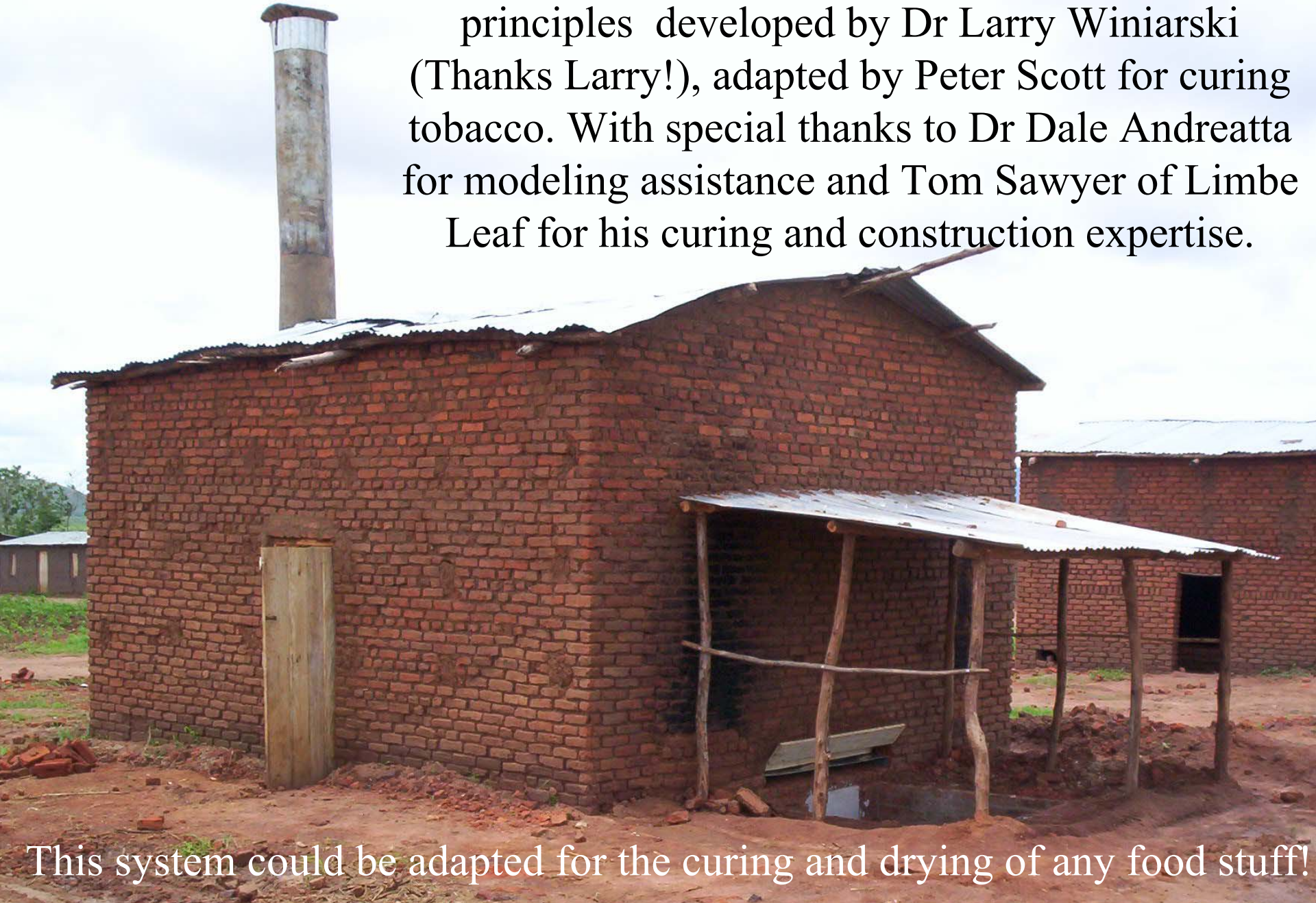
New rocket Barn

1 cm thick ceramic tiles

- New model has 6 flues (not the 4 shown here). Hot flue gases pass through the 6 flues which are each 20 cm wide by 4 cm deep. The flues are insulated from the earthen floor with a 3:1 sawdust:clay mixture.

- On our 2nd test we produced 200 kg of finished tobacco with 900 kg of wood, at this rate we will reduce consumption from 43m^3/yr to18m^3 /yr.
- Our goal is to reduce consumption to 10 m^3 /yr .
- The barn also produces better quality tobacco than any barn currently available
- Total cost (material and labor) ~US$ 250-400 .

Acknowledgements: Original rocket drying principles developed by Dr Larry Winiarski (Thanks Larry!), adapted by Peter Scott for curing tobacco. With special thanks to Dr Dale Andreatta for modeling assistance and Tom Sawyer of Limbe Leaf for his curing and construction expertise.



This system could be adapted for the curing and drying of any food stuff!

Dear Ethos Friends

If I was there in person (Dana, maybe you can do this for me) I would get down on my knees and plead with you that …

STOVES ARE NOT ENOUGH!

The Forests of Southern Africa and Brazil (among others) are aflame . Its happening very quickly and quietly. For example Tanzania tobacco production was non-existent 6 years ago when the last global production data was published

We need your help to limit the impacts of industrial and commercial users on the world's forests!

Thanks for your time

Peter Scott Jan 29,2006 Lilongwe , Malawi

See next slide for research suggestions…

How Ethos can help

- Equipment and interns are needed to test and improve the barns in Malawi!

Research Questions

- The goal is to have a high velocity but low volume of air enter the tobacco barn. How is that best accomplished?
- What is the minimum acceptable height of the external chimney and the internal chimney?
- Is it possible to build the external chimney from something besides metal? (Cost reduction)
- What is the optimal thickness and number of flue tiles for maximum heat transfer ?
- What is the optimal cross sectional area of the ambient air intake?
- What is optimal velocity and volume of air to enter the barn?

- Presently we are using a Hobo micro station to measure dry bulb/wet bulb/ %RH and 6 thermocouples to monitor the indoor and outdoor environment . Any suggestions for equipment to measure velocity in the stack and air intake?