Something fishy?

Thermal Energy for Productive Use in Malawi –

example of GIZ EnDev support to the fish processing sector

Presented at ETHOS 2020 by Christa Roth, foodandfuel consultant

energising development

Agenda

1 Wood consumption for fish processing in Malawi

2 Methods - Current, Recent Trials, Future plans

Methods	Sun-Drying	Smoking	Frying or parboiling
Current state & challenges	2.1.1	2.2.1	2.3.1
Recent trials	2.1.2	2.2.2	none
Future plans	2.1.3	2.2.3	2.3.3

3 Way forward – cooperation&synergies, funding

1 Wood consumption for fish processing

- Annual wood consumption of cottage industries in Malawi
  (source: WISDOM study Malawi 2019, tons dry wood equivalent in 2016)

1.	Brick making	452,945
2.	Tobacco curing	93,106
3.	**Fish smoking/drying**	**63,623**
4.	Poultry industry	34,787

- Double importance of fish value chain
  - Livelihoods (income generation on supply side)
  - Access to nutrition (proteins) for less affluent consumers
- Challenges
  - Depletion of resources due to overfishing on Lake Malawi
  - Massive wastages by inadequate processing (22-40%?)

1 Use of firewood from indigenous forests:

Not sustainable!!!

2.1.1 Sundrying - Current state

Advantage:
No firewood required

- One layer of fish on elevated drying racks with sturdy reedmats, size 20 m x 1.5 m
- One employee to turn fish around constantly to allow air from all sides
- In hot weather fish dry to 10-20% moisture in 3-4 days, then ready for sale
- Prices in capital Lilongwe: 5 l bucket ca. 6-9 USD, shelf life of dried fish = 2 weeks

2.1.1 Sundrying - Challenges

Challenge:
High loss of fish due to rotting on the rack in rainy season

- Quality of reed mats matter: with time mats tend to soak up more water and spaces between reeds get blocked, hampering airflow
- Major challenges in rainy season when they cover the fish with black plastic. If rain continues for over 4 days, they might lose 100% of the batch due to rotting

2.1.2 Sundrying – recent trials: SOLAR TENTS

- Developed from 2015-2017 in Malawi with support mainly by CIDA by University of Malawi, WorldFish Centre, Fisheries Research Unit etc. Publication claims significant improvement of quality of dried fish.
- Challenges deducted from publication only before site visit:
  cost 2,000 USD, low durability of clear plastic, large footprint and volume for little rack space, workers have to be inside the elevated heat, reduced regulation of airflow in tent

Challenges:
too small
too expensive
not durable

Figure 1: Picture of outside and inside view the design of the solar tent dryer that was adopted

2.1.2 (ctd.) Reality Check on SOLAR TENTS

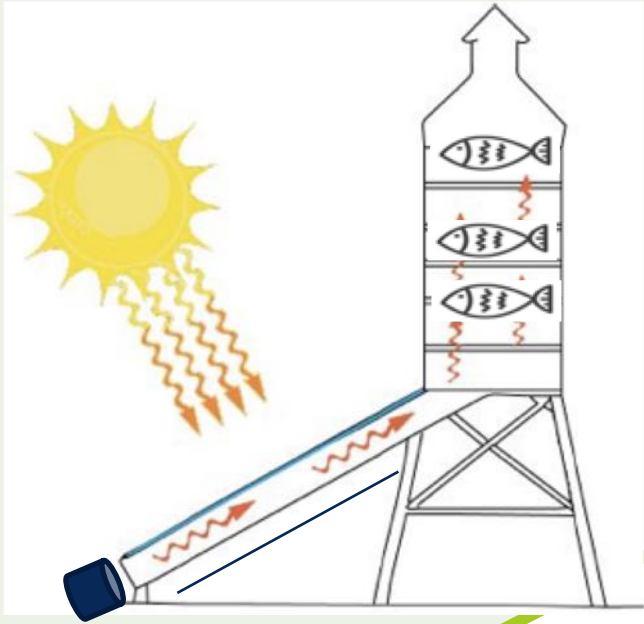
- Tent built in 2017, totally destroyed, used only twice to dry fish
- Reasons for non-acceptance of the solar tent (according to people we found on site):
  - Location: Built on a beach too far away from the landing zones of fish, thus too tedious to haul the fish from the boats to the drier and back
  - Capacity: little rack space, can accommodate not even one persons drying needs

2.1.3 Sundrying – Future plans (1)

Simply improve airflow from underneath replacing reeds with wire mesh

2.1.3 Sundrying – Future plans (2)

- Reduced outer shell at less cost, better relation to rack space
- Racks can be used in smokers and reduce handling of fish
- More vertical extension as heat rises
- Preheating of incoming air (optional heating with biomass)
- Reduced relative humidity of incoming air, higher absorption capacity
- Enhanced airflow with forced draft
- Controllable airflow rate (adjustable speed)
- No exposure of workers to heat



Addition of solar PV powered fan to push air for enhanced air flow and drying capacity,
Potential to add a biomass-powered heating source for night or rainy hours

More info and experience from GIZ EnDev https://energypedia.info/wiki/Solar_Drying

2.2.1 Smoking – Current status

Challenges:
High wood consumption
Low processing capacity
Overcooking of fish
PAH from dripping fat

- Enclosures without proper firechamber, fire wasted outside of the stove
- No splitting of wood
- Maximum 3 layers of wire-trays, little vertical extension to use rising heat
- Fish heated to temperatures exceeding 130 °

2.2.2 Smoking – recent trials Malawi

- Trial for a smoking kiln done in Nsanje

Observations by Christa Roth:

- Two firechambers are less effective as one as fire needs to be kept hot
- Airflow might not have been optimal
- A lot of metal in the structure, that might end up weakening the walls due to different thermal expansion coefficients

Challenges:
Expensive
Not durable
Thus not adopted

Photos provided by Baird Chigora

2.2.2 Smoking – recent trials in Ghana by SNV

Photo credit: Elisha Moore-Delate

Photo credit: Christa Roth

2.2.2 Smoking – recent trials in Ghana by FAO

Theory and practice- good idea but suboptimal design disregarding biomass burning principles and convenience for users

Figure 5 FAO Thiaroye Technology (FTT)

2.2.3 Smoking – Future plans

Apply principles like in Germany, US with smoking cupboard:
Curing and smoking done in a ‘cupboard’ style enclosure in subsequent steps, with indirect heat and sand-pan to catch grease
If possible hang fish to enhance airflow:
larger fish on hooks, small fish on a spit (model ‘Kieler Sprotten’)

2.3.1 Frying – Current status

- deep-frying of fish preferred method (quick, labour saving, fetches better prices in Lilongwe)
- Pre-drying in sun for 3-8 hours, then deepfrying in oil in metal basin on open fire, back on drying rack, market-ready in 24-36 hours
- Frying in wok (lid of oil drums), bath basins from galvanized sheets or pots (half drum)
- 10 bundles of firewood every day = 25 USD

Challenge:
High wood consumption
High expenditure
High exposure to heat for users

2.3.3 Frying – ongoing pilots: 1st stove for wok

- Started with Fish frying: no prior attempts in Malawi,
- Existing proven design from Mayankho institutional stoves

-> Participatory development of innovative user-centred designs for fish frying, based on preferences in fishing community in Ngwalu, together with local partner Owen Mbilizi and company operating a fishing trawler

- Vessel shape: shallow wok
- Scoop size: larger scoop
- Ergonomy: raised position
- Sheltered fire (reduced heat exposure and danger)

2.3.3 Frying – ongoing pilots: 2nd stove for 1/4 drum

Rationale: bigger scoop from existing foodgrade wire mesh

Feedback from first firing today (25.1.2020): VERY ENCOURAGING!

- Stoves easy and convenient to handle, no smoke, firepower sufficient
- Substantial savings of firewood (probably over 50%, tbd when stoves dry)
- Better quality of fish (less burns as fish in cage does not touch vessel)
- Oil stays cleaner as more fish particles get scooped out, savings on oil expected (tbd over a longer period of use)

3 Way forward - cooperation&synergies, funding

Fish Frying:

Opportunity:
Innovation of the
¼ drum now preferred
over Wok

- Pilot is generally on the right track
- Finetune ¼ drum to address user feedback
- Expertise for further development available within EnDev

Next 2 weeks: 2 more stoves for ¼ drum

- Improve scoop of ¼ drum for easier handling, add handles

Next 2 months: > 20 stoves for ¼ drum

- Finetuning design with larger sample size, evaluate performance
- Determine unit cost (expected <100 USD) and cost-benefit analysis

Next 6 months: Get ready for roll-out

- Rollout with existing partners and funded programmes in the country
- Needed: R&D funds for refining prototypes to become market ready for commercialisation (beyond EnDev budget)

3 Way forward - cooperation&synergies, funding

Drying and smoking:

GIZ/EnDev like to cooperate with others in developing solutions on drying and smoking, even for other countries

However, this requires other expertise than cookstoves.

Thus the pressing questions:

- Who has expertise to contribute?
- Who can and wants to cooperate?
- Are there synergies with ongoing programmes?
- Who can lead to funding opportunities?

THANK YOU!

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