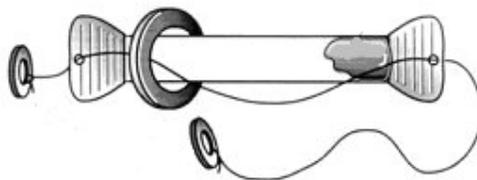
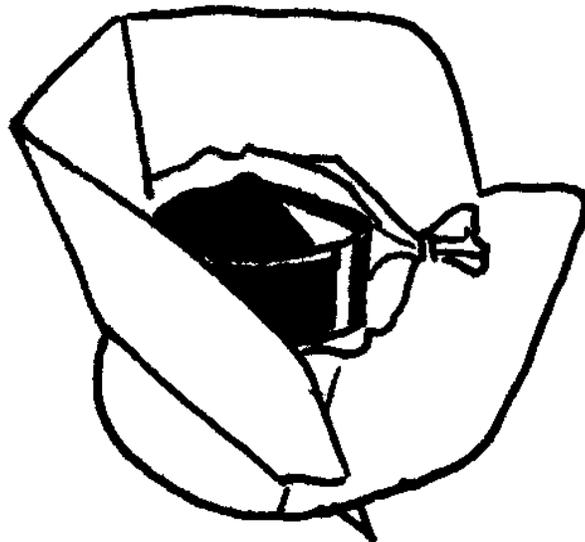


# HOW TO MANUFACTURE

## SOLAR COOKIT & WAPI Water Pasteurisation Indicator



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## CONTENTS

A. MANUFACTURING COOKITS.....	3
1. What is a CookKit?.....	3
CookKitset.....	3
2. How to make a CookKit.....	3
2.1. General.....	3
2.2. The mould.....	3
2.3. Rerolling the foil.....	3
2.4. Gluing aluminium foil on cardboard.....	4
2.5. Drying the sheets.....	5
2.6. Drawing cutting lines and folding points.....	5
2.7. Cutting the CookKit.....	5
2.8. Folding the CookKit.....	6
2.9. Folding instructions.....	7
2.10. Finishing.....	8
2.11 Quality control.....	8
3. Manufacturing cotton bags.....	9
4. Painting pans and water kettles.....	9
5. Requisites to manufacture a CookKit set.....	9
5.1. Space requirements for CookKit manufacturing.....	9
5.2. Personnel.....	9
5.3. Minimum equipment / tools needed.....	10
B. WATER PASTEURISATION INDICATOR (WAPI).....	11
1. What is a WAPI?.....	11
2. How to make a WAPI.....	11
3. Quality Control.....	12
4. Materials.....	12
Sources:.....	12
ANNEX I CookKit sheet.....	13
standard model with measurements/lines.....	13
ANNEX II.....	14
Checklist tools, equipment to make a CookKit and WAPI.....	14
ANNEX III CookKit set and cost price indication.....	15

## A. MANUFACTURING COOKITS

### 1. What is a CookIt?

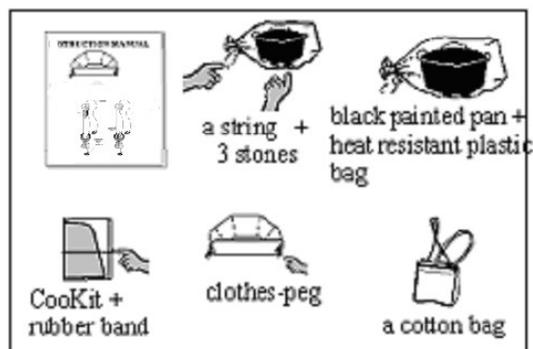
The CookIt is a reflective panel used to cook with the sun. A black painted pan is placed inside a plastic heat-resistant plastic bag. The CookIts can be made by hand in a shady place or in a workshop by at least 4 people.

This manual explains how to make a CookIt (and a WAPI) and what you need to make it.

#### CookItset

A CookIt is part of a **CookIt set**<sup>2</sup>,

- CookIt
- 4 litre black-painted light-weight pan
- cotton bag
- set of 2 plastic heat-resistant plastic bags
- 2 pieces of string
- 2 clothes pegs
- black painted water kettle 3½ litre
- WAPI (water pasteurisation indicator)
- instruction manuals 'How to use the CookIt & WAPI, etc
- flyer Solar Cooking



### 2. How to make a CookIt

#### 2.1. General

- CookIts have to be made in a clean, dry and shady workspace.
- The craftsmen / women are selected and trained by a CookIt expert.
- The manufacture of a perfect quality CookIt requires qualified technical and handicraft skills.
- Good quality CookIts are made by using standard working methods as described in this manual.

#### 2.2. The mould

- **Always use a plywood or metal CookIt mould for all production steps. The mould matches the CookIt drawing (Annex II) with the exact measurements, lines, points, slots and angles.**
- The mould is made of plywood or metal. A metal mould has the advantage that cutting along its edges does not damage it. Indeed, a plywood mould is more easily damaged because of cuts into the soft edges.
- The fold lines are indicated by small punctured slots at the end of each fold line (See drawing, Annex II)
- When you link the punctures with a stick or a ruler, the straight fold line will be in exactly the same place for each new CookIt.

#### 2.3. Rerolling the foil

- Transfer / reroll a segment of aluminium foil onto the PVC pipe for about 6 - 10 CookIt sheets from the big and heavy roll.
- Roll the foil outside in onto the smaller roll.
- During transfer, hold the rolls as close together as possible. The foil will crease less.

<sup>2</sup> Annex I Price indication CookIt set

- Use a stick that is longer than the width of the foil, because rerolling tends to be crooked! 190 cm often is long enough.



Transferring aluminium from the heavy, big roll onto small rolls



Stirring the glue

## 2.4. Gluing aluminium foil on cardboard

### Preparing the glue

Mix 1 measure of cassava or another type of flour with 3 measures of cold water. Add the water very slowly to the flour while constantly stirring. Stir well while heating in order to avoid lumps. Boil the glue very carefully on gas. The glue is ready when it is as thick as porridge. The glue has to be used cold.

### Gluing

- Put the corrugated side of the cardboard down and the smooth side up.
- Apply the cold glue to the smooth side of the cardboard.
- Glue the foil, paper side down, on the smooth side of the cardboard.
- Always use clean brushes.
- Always glue with 4 people
- 2 people start gluing and then slowly and gradually unroll the aluminium foil. If necessary, that is to say if the surface is too dry, more glue can be applied with one hand (the foil is in the other hand).
- At the same time, the other 2 people very gently rub the aluminium foil on the cardboard with a clean rag to ensure that there are no air bubbles and that the foil is thoroughly glued on the cardboard.
- **Note! Do not lean on the freshly glued CookIt sheet! It will create creases.**



Apply the glue and fix with a rag



Gently wipe the surface of alum foil with clean and soft cloth

## 2.5. Drying the sheets

- Stack the glued sheets with 3 strips of used cardboard between each sheet, place plywood on top and add some extra weight.
- Stack up to  $\pm$  25 sheets.
- Leave the sheets to dry for a minimum of 24 hours. Wet CookIts are very difficult to cut!

## 2.6. Drawing cutting lines and folding points



Draw the precise form of the CookIt using a mould



Mark all the fold lines and points using the mould, (CookIt example)

- Select dry cardboard sheets and put the aluminium side down on the table covered with cardboard to protect the wooden table.
- Put the CookIt plywood mould on the CookIt sheet.
- Use clamps to fix the sheet on the table.
- Draw the shape of the CookIt on the cardboard sheet with a black ballpoint or marker (fine point).
- Draw the two slots very precisely. Carefully pierce all **14 folding points** and the **2 slot points** with a pointer.
- Cutting should take place in a clean and dry place protected from direct sunlight.

## 2.7. Cutting the CookIt

- Use a very sharp knife (Stanley knife or equivalent) to cut all the outside lines of the CookIt and the 2 slots.
- The slots must be precisely 0.3 cm / 1/8" (Annex II). If the slots are too big, the edges of the CookIt will slip out. If the slots are too narrow, you will force the edges and you will damage them.
- You can cut along the model or you can follow the lines drawn.



Cutting lines following the lines drawn



Cutting the outer lines of the CookIt

## 2.8. Folding the CookKit

- There is **only ONE WAY of folding** to obtain a sound marketable product.
- Follow the folding instructions step-by-step. Always do this with 2 people.
- Use the edges of the table and a long flat and smooth piece of wood/ large ruler to bend the cardboard upwards / downwards, etc.
- You can press the folding lines with the ruler before folding with the ruler.

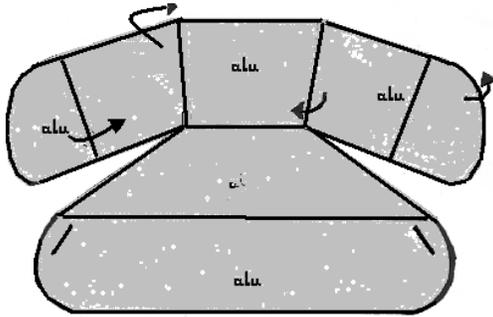


Use the edges of the table



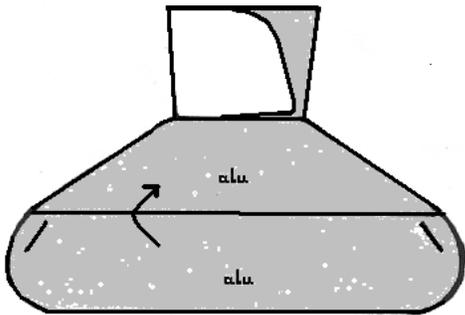
- Start by putting the aluminium side up and follow the 6 steps below /next page

## 2.9. Folding instructions

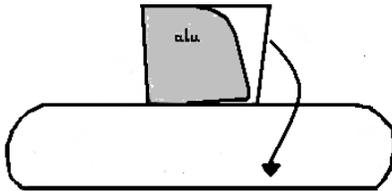


Small left part forward  
Whole left part backward

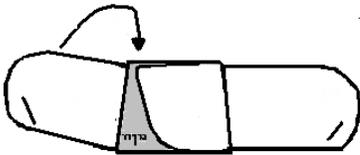
Small right part backward  
Whole right part forward



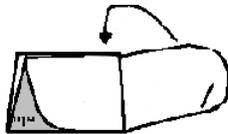
Close big part forward



Close small part towards big part



Fold left wing backward



Fold right wing backward

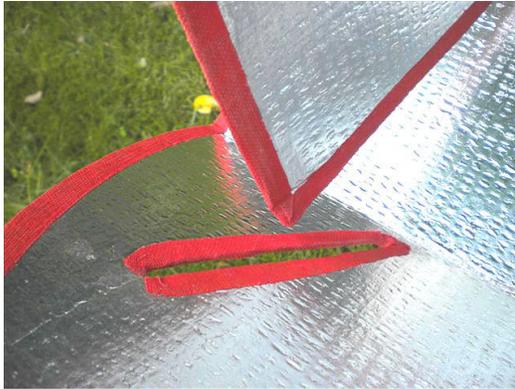


Put a rubber band around the Cookit  
Put Cookit in cotton bag

## 2.10. Finishing

### Coloured ribbons for durability

- Take a 2½ cm coloured cotton ribbon: glue the ribbon along the sides and the 2 slots with office glue.



Detail of the red ribbon



Red-coloured CookKit

### Varnishing cardboard side

- Mix transparent varnish with red (or other colour) oxide and a little thinner; stir well before application.
- Open the CookKit and varnish the outside of the CookKit in parallel lines taking care to follow the lines of the cardboard.
- Dry in ± 30 hours!

## 2.11 Quality control

To achieve the same high quality for all CookKits, they must be checked on a regular basis (at least once every 2 weeks). Assemble the CookKit and check the following points:

### Gluing:

***Is the surface of the CookKit smooth, without dents and lumps?***

- Open the new CookKit and check the surface.
- If there is any area where the glue has not stuck well***, repairs will be needed.
- Carefully cut a cross and paste the four corners underneath the cross on the cardboard.
- Or make only one cut, paste underneath and affix the aluminium foil again.

***If there are dents? How were they made? What can you do to avoid them?***

- Discuss the process with the craftswomen / men.
- Do they lean on the glued sheet during the process?

### Cutting:

***Are the edges curled or damaged?***

- If curled, repair the edges by gluing a ribbon.

***Do the edges fit in the slots?***

- Are the slots 0.3 cm / 1/8"?
- If the slots are bigger, throw away the CookKit! It won't work.
- If they are too narrow, cut to the right size.
- Why are they not correct? Do they use the mould?

***Have the edges of the CookKit been cut smoothly and sharply? If not?***

- Check if the cutting knives are sharp enough (such as a Stanley knife).
- If the CookKits have not been left to dry long enough, the edges will fray during cutting.

***Are all the CookKits of the same size? If not?***

- Is the *mould* used properly?
- Does the *mould* have the correct measurements? (Annex II)



Repairing gluing after quality control



Controlling sides to adjust front panel

#### Folding:

#### ***Does the folded Cookit resemble a nice square parcel?***

- Check the folding by comparing to the *mould* (see above).
- Check the CookKit when unfolded and check the corners in order to be able to adjust the front panel.

#### ***Is the Cookit not level?***

- Check the fold lines on the CookKit and compare with the model.

#### CookKit sets

#### ***Are the CookKit sets complete?***

- Check the contents of the CookKit sets. Have all the parts been included? “How to use” instructions as well?

### **3. Manufacturing cotton bags**

- Make cotton bags that can contain all the parts of the CookKit sets.

### **4. Painting pans and water kettles**

- To paint pans and kettles black use blackboard paint. Do not use glossy paint.

### **5. Requisites to manufacture a CookKit set**

#### **5.1. Space requirements for CookKit manufacturing**

- Minimum space of 6 x 6 metres, suitable for 2 working tables of about 122 x 90 cm, 2 metal rollers and at least 4 people.
- Space to dry (in the shade) and fold.
- Space to paint pans and water kettles black.
- Space to complete CookKit sets.
- Space to make WAPIs.
- Space to sew cotton bags using a sewing machine.

#### **5.2. Personnel**

Four craftsmen / women work as a team to do the entire job. Each selected for specific handicraft skills.

### 5.3. Minimum equipment / tools needed <sup>3</sup>

#### **Furnishing**

2 tables, each 122 x 90 cm (CookKit size). They may be larger but not smaller. Height 80 to 85 cm. These tables are used to unroll aluminium foil, to glue, to cut and to fold.

2 sheets of cardboard or plywood or any other material to protect the table while cutting the CookKits.

#### **Making the CookKit : materials and tools**

##### *To unroll the foil*

- rolls of big/heavy ( $\pm$  25 kg – 40 kg) aluminium foil, rerolled into smaller rolls on 50 mm
- 2 pvc pipes, 50 mm diameter, length 190 cm to reroll the foil.
- 2 metal rollers on stands for big/heavy ( $\pm$  25 – 40 kg) aluminium rolls.

##### *To glue:*

- corrugated cardboard from local market : 48"/ 122 cm x 36"/ 91 cm for each CookKit sheet
- small roll of foil (see above)
- 1 heater to prepare glue (and make WAPIs)
- 1 big pan and spoon to prepare glue
- 2 buckets for water
- cassava flour
- 2 large brushes to apply glue
- 4 (old) soft and always clean cloths to rub glued surfaces

##### *To cut, fold and finish:*

- *CookKit mould:* 2 standard plywood or metal/aluminium templates with standard cutting, piercing and fold lines<sup>4</sup>
- 4 clamps to fix plywood / metal on cardboard.
- Pencils and awl
- 8 very sharp cutting knives
- cotton fabric / ribbons around the CookKit
- red (or other colour) varnish for outside surface of the CookKit
- metal (or wooden) ruler for folding

##### *To dry:*

- 2 sheets of plywood  $\pm$  120 x 100 cm, thickness min. 12 mm to put on top of glued cardboard during drying

##### *To paint the pan*

- black paint (blackboard) and brush

##### *To finish*

- sewing machine to make cotton bags and cotton fabric
- red varnish and ribbon around the CookKit

#### ***Does the folded CookKit resemble a nice square parcel?***

- Check the folding by comparing to the mould (see above).
- Check the CookKit when unfolded and check the corners in order to be able to adjust the front panel.

#### ***Are the CookKit sets complete?***

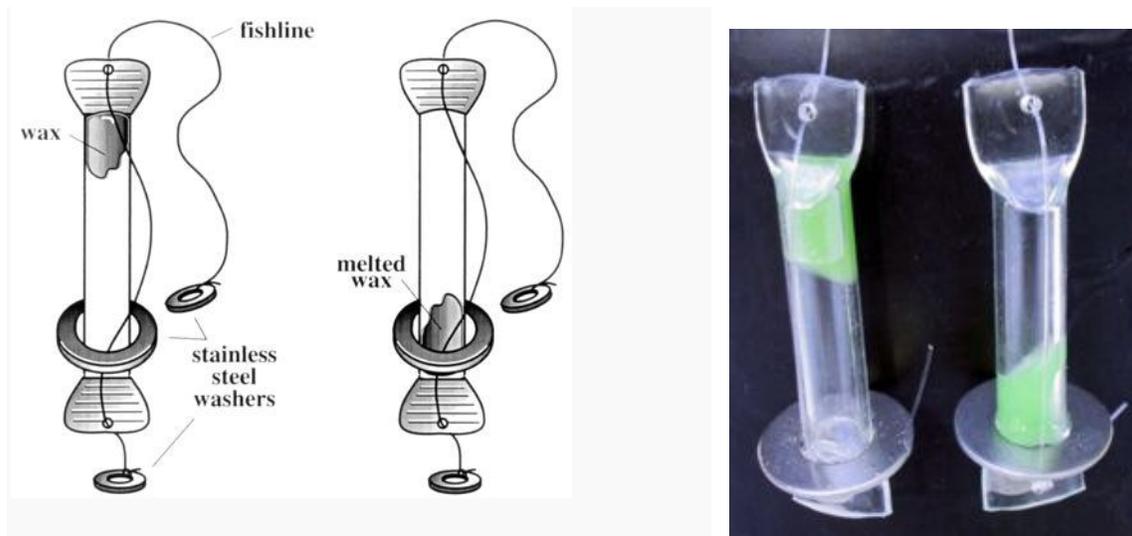
Check the contents of the CookKit sets. Have all the parts been included? "How to use" instructions well?

<sup>3</sup> Annex II Checklist manufacturing CookKit

<sup>4</sup> CookKit drawing in Annex

## B. WATER PASTEURISATION INDICATOR (WAPI)

### 1. What is a WAPI?



The WAPI is a clear plastic tube partially filled with some soybean wax or Myverol<sup>5</sup> that melts at about 70 ° C (158 ° F). With the solid wax at the top end of the tube, the WAPI is placed at the bottom of a black-painted water kettle that is solar heated. If the wax melts and falls to the bottom of the tube, it ensures that water pasteurisation conditions have been reached. The WAPI has a stainless steel washer around it to keep it at the bottom of the kettle. There are small holes at both ends of the WAPI through which nylon fish line is threaded; a small stainless steel washer is placed at each end - one end is kept outside the kettle in order to be able to remove the WAPI.

### 2. How to make a WAPI

1. Saw an 8 cm length of plastic tube. If a BIC tube is used, avoid the part with the small hole! It is faster and easier with 2 people (1 to hold, 1 to saw).
2. Soften one end (1 cm) of the plastic tube by warming it above the candle flame;
3. Try to flatten the 1 cm part immediately with a hammer and with some grease to avoid sticking to the plastic or use a pair of flat pincers. You can also use a small bottle on a flat protected table. Make the hole immediately as well with a nail. It happens that you have to heat again.
4. Put one stainless steel washer around the tube (see photo / drawing).
5. Put 1½ cm soybean powder (Myverol) into the tube
6. Close the other end of the tube by softening it above the candle flame
7. Put the nylon fish line (50cm) through the holes at each end of the WAPI and attach 2 small stainless steel washers on both ends.
8. Heat the water in the pan and put the finished WAPIs for about 5 minutes in nearly boiling water until the wax powder has melted and is transparent. Keep an eye on the WAPIs and avoid melting of the plastic tube!

<sup>5</sup> 1 kg Myverol is enough for 1000 WAPIs

### 3. Quality Control

- Remove the WAPIs from the water and check that the wax is not leaking. If so, throw the WAPI away: it won't work.
- Why does the WAPI leak? :
- Has it not been pressed closed properly?
- Has the hole been made in the wrong place?
- Did the BIC Ballpoint already have a hole?

### 4. Materials <sup>6</sup>

#### *WAPI materials*

- Plastic tubes, e.g. empty BIC ballpoints
- Nylon fish line (for 1 WAPI: ± 50 cm length)
- Stainless steel washers (for 1 WAPI: washers; size: + + diameter tube)
- Soybean wax powder / Myverol 18-8 K

#### *Tools/ equipment*

- Candle, matches (to make the plastic ends warm – soft)
- Hammer / pair of pincers (to flatten both ends) or small glass bottle
- Small saw (to saw the WAPI part of the plastic tube)
- Nail (to make small holes in the soft plastic)
- Pan with water (to boil the soybean powder into wax)
- Heater (gas or kerosene)
- Scissors (to cut fish line)
- Water to cool down your fingers (if necessary!)

### Sources:

**Solar Cookers International, Sacramento, California, U.S.A.**

[www.solarcookers.org](http://www.solarcookers.org)      [www.solarcooking.wikia.com](http://www.solarcooking.wikia.com)

**Photos de femmes ingénieurs, membres de l'AFIMA, Mali Bamako 2003**

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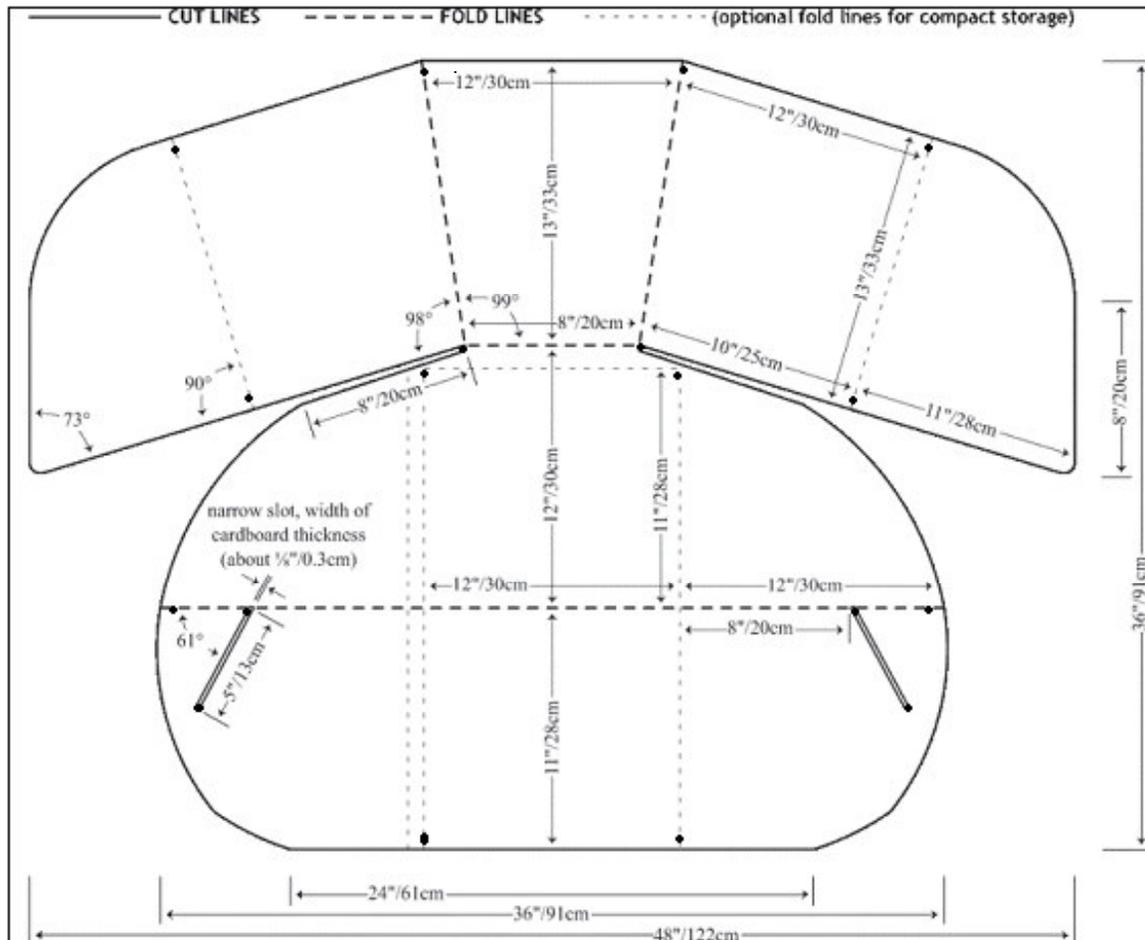
KOZON, Bennekom, The Netherlands

[www.kozon.org](http://www.kozon.org)

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<sup>6</sup> Annex IV checklist to make a WAPI

ANNEX I Cookit sheet standard model with measurements/lines



## ANNEX II Checklist tools, equipment to make a CookKit and WAPI

<b>CookKit</b>	<b>yes</b>	<b>no</b>
2 tables 120 x 240 cm each		
2 sheets of cardboard or plywood		
A model of the CookKit		
<b>To unroll the foil</b>		
Foil (big rolls and small rolls)		
2 pvc pipes 5cm diameter, 190cm long		
2 metal rollers on stands		
<b>To glue</b>		
Corrugated cardboard (see text)		
Small roll of foil		
1 heater (for CookKit and WAPI)		
1 big pan		
1 spoon for stirring		
2 water buckets		
Cassava flour		
2 large brushes for gluing		
4 (old) soft, clean cloths		
<b>To cut, fold, finish</b>		
CookKit mould / template / model		
4 clamps		
Pencils		
8 sharp cutting knives		
Awl		
Cotton fabric / ribbons		
Red varnish		
Metal (or wooden) ruler for folding		
<b>To dry</b>		
2 sheets of plywood 120 x 100cm		
<b>To paint the pan</b>		
Black paint (blackboard)		
1 brush		
<b>Finish</b>		
Red varnish		
Ribbon around the CookKit		
Sewing machine		
Cotton fabric		
<b>WAPI</b>	<b>yes</b>	<b>no</b>
<b>WAPI materials</b>		
Plastic tubes (BIC ballpoints)		
Nylon fish line		
Stainless steel washers		
Wax powder		
<b>Tools, equipment</b>		
Candle, matches		
Hammer or pair of pincers, or glass (bottle)		
Small saw		
Nail		
Pan with water		
Heater		
Scissors		
Water (to cool off your fingers!)		
Flat material to protect the table		

### ANNEX III Cookit set and cost price indication

#### A complete Cookit set

• Cookit sheet	Birr	75
• Cotton bag	Birr	5
• Set of 2 plastic heat resistant plastic bags, • 2 pieces of string, 2 clothes pegs	Birr	5
• 4 litre black-painted lightweight pan	Birr	50
• Black painted Water kettle 3 ½ litre )	Birr	65
• WAPI	Birr	10
• Instruction manuals : 'How to use the Cookit & WAPI , etc	Birr	5
• Flyer Integrated Solar Cooking & Water pasteurisation	Birr	3