



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org



06169



Distr.
LIMITED

ID/WG.184/11
27 January 1974

ENGLISH
Original: FRENCH

United Nations Industrial Development Organization

Symposium on the Development of the
Plastics Industry in Latin America

Buenos Aires, Argentina, 8-17 September 1974

THE USE OF PLASTICS TO HELP FARMERS
IN THE SOUTHERN SAHEL 1/

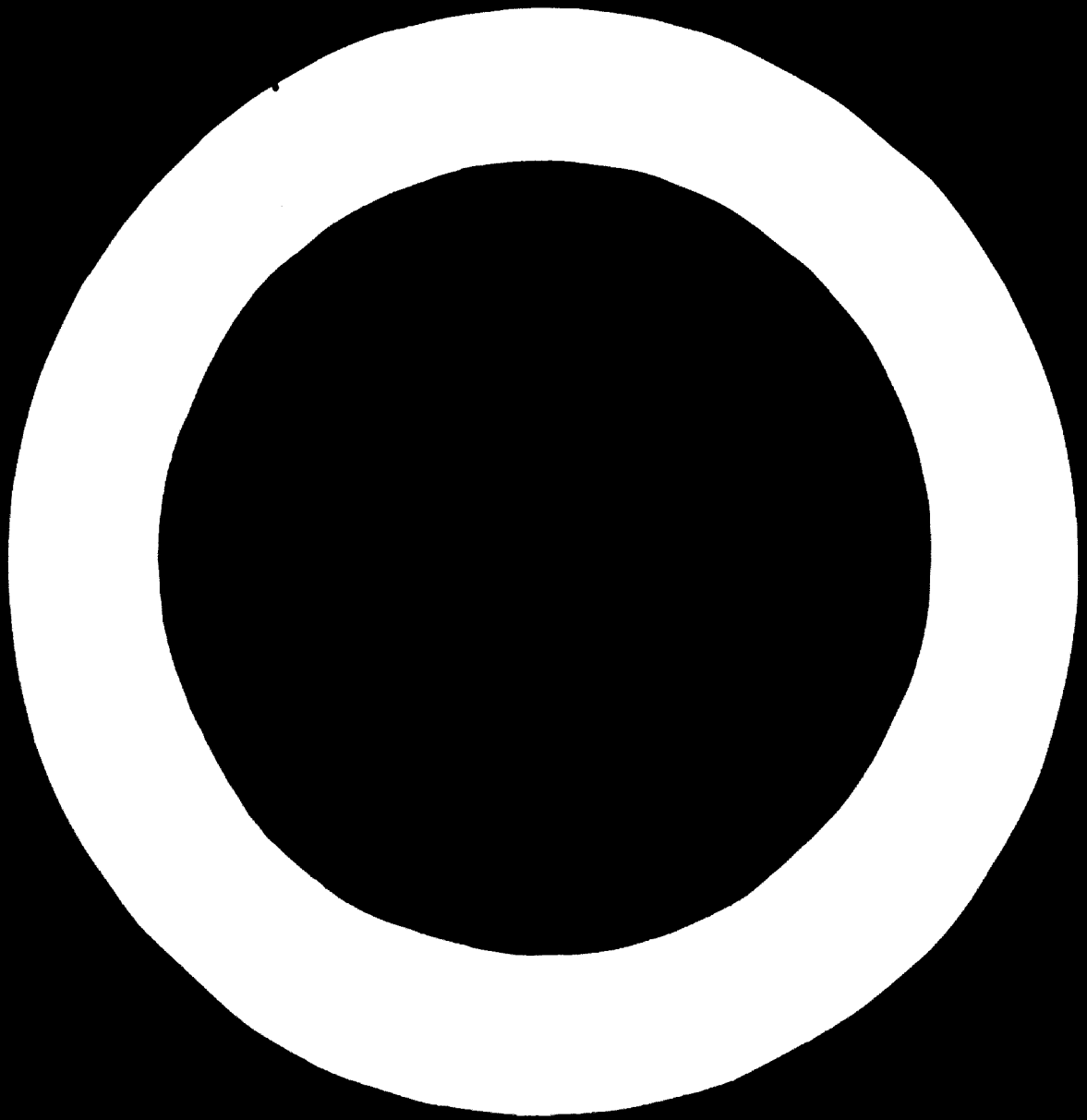
by

R. Brun
UNIDO Expert

1/ The views and opinions expressed in this paper are those of the author and do not represent the views of the secretariat of UNIDO.

1d.74-8336

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.



Introduction

In recent months world opinion has become very much aware of the serious problems facing the people of the Southern Sahel. We are therefore eager to contribute to the generous programme launched by UNIDO to the extent that our modest means permit.

After studying the secretariat's note, we realize the complexity of the problem and the difficulty of answering all the questions put.

For myself, I shall deal with the subject I am most familiar with, on which I can put forward ideas and figures without too much risk of going wrong.

I shall discuss more particularly, in accordance with the Secretariat's note, the scale, equipment and operation of one of the research establishments it is proposed to set up.

The Research Establishment

Its characteristics, equipment and operation

It is proposed to set up three such establishments. Each of them should be located in an area which is fully characteristic from the standpoint of the climate and the soil, so that the results obtained will be applicable over as wide an area as possible.

The tasks to be set for each establishment are as follows:

First, practical and vocational training of the staff. It will be necessary as a matter of priority to train:

Workers and supervisors needed to run the establishment;

Extension workers based on the establishment who will be able to pass on the techniques developed there to the private sector successfully.

Secondly, supporting services for the farmers in the area, so that they can come and study the centre's achievements and developments on the spot.

In short, the establishment would have the following functions:

To train specialized workers and supervisors;

To do applied research;

To provide development services.

In order to achieve this threefold aim, we envisage the establishment of a research unit which will be relatively modest but will have enough human and material resources to become operational very quickly.

Size of the site

The site should be about 20 hectares in area and all in one lot.^{1/} Two hectares would be used for buildings and the remaining 18 would be distributed as follows:

- 6 hectares for small-scale tests;
- 10 hectares for full-scale trials, i.e. on the same scale as in agriculture proper;
- 2 hectares for a permanent exhibition on the uses of plastics;

Drinking water storage

Irrigation water storage

Piping of various kinds

Silos for storing grain and fodder, etc.

General programme for setting up the research establishment

Staff

3 engineers:

One acting as Director, more particularly responsible for the management of the establishment and development activities;

One responsible for experimental work;

One responsible for training specialized workers and supervisors.

4 technical specialists to support the engineers:

There should also be one very good person in charge of the workshop.

30 workers, including 3 foremen

2 administrative officers

6 staff to maintain the trainees' hostel and run the canteen

^{1/} In calculating the cost of establishing the centre, no allowance has been made for the cost of the site. We have in fact no basis on which to estimate the price, even approximately.

Site and buildings

Development and irrigation of the site:

Access

Layout of plots

Drilling

Installation of irrigation system

20,000 francs per hectare x 20

France

400,000

Construction of buildings

(a) Main building

Offices

Practical rooms

Lecture rooms

Cloakrooms, sanitary installations

Storage space

800 m² on one level

900 francs per m² x 800

720,000

(b) Workshop

1,000 m² on one level

500 francs per m² x 1,000

500,000

(c) Product packaging and storage area

500 m² on one level

500 francs per m² x 500

250,000

(d) Trainees' hostel

Capacity: 30 trainees

Rooms: 6 (bedrooms, sanitary installations, kitchen, refectory, lounge)

1,000 m² on two floors

600 francs per m² x 1,000

600,000

(e) Ten dwellings for engineers and technical staff^{2/}

150,000 francs x 10

1,500,000

^{2/} If the establishment is near a town, the estimate for staff housing can be omitted, which would reduce the amount for the construction of buildings to 2,310,000 francs (3,810,000 - 1,500,000).

(f) Site development

		<u>France</u>
Roads and access ways	80,000	
Drinking water and electricity supply	80,000	
	<u>160,000</u>	160,000

(g) Enclosure of site

80,000
<u>3,810,000</u>

Rounded off to: 3.8 million francs

Purchase of equipment**(a) Agricultural and workshop equipment**

Purchase of two 45-hp tractors with the following agricultural equipment:

Ploughs (all-metal wheel, disc)		
Harrow		
Rotary cultivator		
Rotary spade		
Sub-soil plough		
Loader		
Sprayer		
Leveler		
2 trailers	180,000	
Purchase of 4 equipped cultivators	<u>30,000</u>	
	210,000 francs	
Workshop equipment	120,000 francs	
Tools and implements:		
Mattocks		
Hooks		
Combined hoes and forks		
Forks		
Shovels		
Picks		
Scythes		
Billhooks, etc.	<u>20,000</u>	
	390,000	390,000

		<u>FRANCS</u>
(b) <u>Laboratory equipment</u>		
Thermometers		
Anemometers		
Thermohygrographs		
Oven		
Ice box		
Central display panel for measuring instruments		100,000
(c) <u>Office equipment</u>		
Working surfaces		
Chairs		
Armchairs		
Files		
Typewriters		
Calculating machines		100,000
(d) <u>Equipment for business' hostel</u>		100,000
(e) <u>Motor vehicles</u>		
3 small cars at 15,000 francs each	45,000	
1 van at 20,000 francs	20,000	
1 3-ton lorry at 35,000 francs	35,000	
	<u>100,000</u>	
		<u>100,000</u>
		<u>800,000</u>

Summary of investment

Development and investigation of site	400,000
Construction	3,000,000
Purchase of equipment	800,000
	<u>5,000,000</u>

1/1/1964

Annual operating costs

A. Salaries and wages

Qualified staff from abroad

3 engineers at 75,000 francs	<u>FRANCE</u>
4 technical specialists at 50,000 francs	225,000
	<u>200,000</u>

Locally recruited staff

2 administrative officers (4,800 francs x 2)	9,600
--	-------

Staff for maintenance of buildings and trainees' hostel[✓]

6 persons - 2,400 hours per year at 1.25 francs per hour

6 x 2,400 x 1.25 francs

18,000

Workers

20 specialised workers - 2,400 hours per year at 1.25 francs per hour

20 x 2,400 x 1.25

60,000

10 labourers - 2,400 hours per year at 0.75 francs per hour

10 x 2,400 x 0.75 francs

18,000

530,000

Rounded off to: 530,000 francs

B. Administrative and operating costs

(a) Administrative costs

Building maintenance

Water, gas, electricity

Postal services, telephone, etc.

Office supplies

Documentation

60,000

[✓] The workers' wages are calculated on the basis of the information provided by UNIDO.

(b) Workshop and motor vehicle operating costs

France

Fuel and lubricants

Maintenance and repair of vehicles and equipment

Insurance

40,000

(c) Agricultural estate operating costs

Purchase of various supplies:

Plastics

Fertilizers

Pesticides, etc.

Hiring of equipment

130,000

250,000

Summary of annual operating costs

A. Wages and salaries

530,000

B. Administrative costs

250,000

780,000

Although no income can be expected during the first year of operation, from the second year there should be some from the sale of the establishment's products. After three or four years, such sales should cover the agricultural estate's operating costs, amounting to about 150,000 francs per year. The annual operating costs will then be:

$$780,000 - 150,000 = 630,000 \text{ francs}$$

Proposals regarding possible uses of plastics
choice and cost of materials

choice of techniques

The very comprehensive document prepared by the UNIDO Secretariat describes the different techniques that can be advocated and developed in the Southern Sahel zones. A number of these techniques could be used in the various research establishments that are envisaged, depending on the environmental conditions and farmers' needs.

The plan proposed for the establishment of a research establishment allows for the cost of the labour needed to introduce and apply these techniques. In addition to these applications, of course, other lines of work should be envisaged at the establishments, including:

Research into varieties and their adaptation to these applications

Development of cultivation techniques:

Preparation of the soil

Fertilisation

Care of plants, etc.

For the time being we shall confine ourselves essentially to the choice of materials and their cost.

In the African climate, at a latitude of 11 to 12 degrees north, we think it necessary to use only materials of very high quality with great durability so that they can stand up to the climate. The unit costs given below may seem high, but we would stress that these prices, which we have been given by French industrialists, are only for high-quality products.

1. Storage of drinking water

Using a tube placed in a ditch which can be sealed at either end: black polyethylene film, 300 microns thick, 6.50 m flat or 4.14 m in diameter, in rolls of about 60 metres with a weight of 113 kg.

Price: 19.60 francs per linear metre exclusive of tax.

2. Storage of water for irrigation

Film used: black polyethylene, 300 microns thick, 6.50 m wide.

Ex-works, these films can be welded to a width of 19.50 m (3 bands of 6.50 m), so that the maximum area obtainable in the workshop is 60 m x 19.50 m = 1,170 m².

Price: 3.70 francs per linear metre exclusive of tax.

For larger areas the film has to be welded on the spot: 5,000 m² seems to be the maximum. To spread the risk, it is preferable to have a larger number of smaller reservoirs.

The slopes of the reservoir should be at 45 degrees and the ground should not be rough in any way. The earth dug out can serve as an embankment provided it is fully compacted. There should be a ditch all around to bury the tank in. The whole thing should be surrounded with a grille to prevent wild animals from falling into it and spoiling the film with their claws. Under strong sun, it is advisable to paint the non-submerged part of the tank with a latex paint.

The cost of the digging work is about 6 to 7 francs per m³.

3. Lining of irrigation channels

Same type of film as before: black polyethylene, 300 microns thick, the width depending on the specific circumstances in which it is to be used.

Weight of film per m²: 280 grammes.

Area covered by 1 kg of film: 3.6 m².

Price: 11 francs per kg exclusive of tax.

In the French climate, these films can last five years. There are black films with a traditional resin base which are marketed at 6 francs per kg, but they have a life of no more than 1 year.

4. Pipes and tubes

For rigid pipes, 2 materials are proposed:

High-density polyethylenes (delivered in coils) able to withstand a pressure of 6 bars.

Internal diameter of pipe in mm	50	63	75	90	110	125
Price per linear metre in francs	3.20	5.90	8.00	10.80	16.00	21.00

Rigid PVC able to withstand a pressure of 10 bars

Internal diameter of pipe in mm	30.4	53	75	112	125	143	179	187*
Price per linear metre in francs, exclusive of tax	2.85	6.57	12.5	15.9	20.1	26.7	41.7	42.02

* The 187-mm pipe can only withstand a pressure of 3 bars.

5. Localized irrigation

As its name indicates, localized irrigation means watering only limited areas around the plants. There are many systems on sale in the world. They can be classified into two main groups:

1. Those with a high instantaneous flow rate equivalent to about 40 to 50% of rainfall per hour;
2. The different drop-by-drop systems, which give the plants very small quantities of water varying between 2 and 6 mm per hour.

In the first group, we have used the following two systems:

(a) Perforated watering tube

Black polyethylene film, 200 microns thick, 61 mm flat or 40 mm in diameter.

This system is widely used in light soil with good permeability, for plants cultivated in rows spaced at a distance of 80 cm to 2 m. One tube is needed per row.

Price: 0.38 francs per metre exclusive of tax.

(b) Localized irrigation by means of perforated pipes

The water is supplied to the plants through perforated pipes in rigid polyethylene with dimensions 28/32, the initial pressure varying between 0.500 and 1 bar.

Two-mm holes can simply be made in the pipe, using heat, or the holes thus made can be provided with 1.6 mm nozzles, which gives a better water distribution. These holes are protected by grooved rings with a diameter slightly greater than that of the pipe.

Depending on the plants and the texture of the soil, they can be spaced at 0.75 to 2.50 m.

In light and easily permeable soil, the pipes are simply placed on the ground, while in the case of silty, hard-packed soil, channels have to be made at the foot of the plants with divisions about every 2.50 metres to take a uniform quantity of water, which slowly penetrates the soil.

The cost of this system varies depending on the extent to which it is automated and the number of pipes per hectare, and also on the distance between the rows of plants

Price per m²:

Vines and fruit trees: 0.25 to 0.40 francs per m² exclusive of tax

Market garden produce: 0.50 to 0.80 francs per m² exclusive of tax

In the second group there are a large number of systems distributed throughout the world by some 60 commercial firms. We have used three of them:

- (a) Watering with mini-tubes
- (b) Watering with the Netafim dripper from Israel
- (c) Watering with the Eotradies dripper

Because of the quality of our water, and taking the precaution of using two successive filters, one with a strainer and one with gravel, we have never had any serious difficulties and the system has never got stopped up as happens in many countries.

If it is intended to use the drop-by-drop process, it is necessary to change the method of spreading fertilizer and supply the plants with fertilizer solutions distributed by means of a proportioning pump.

The cost often quoted is between 0.40 and 0.80 francs per m^2 for vines and fruit trees. It is markedly higher for thickly planted crops such as open-air market-garden produce, reaching 0.80 to 1.20 francs per m^2 exclusive of tax. On experimental plots and in cultivation under cover it amounts to 2 to 4 francs per m^2 exclusive of tax.

These costs per m^2 are for an entirely automated installation equipped with:

A clock

A proportioning pump

Filtering apparatus

Perforated pipes

Drippers

Protection of plants under light plastic shelters

Plastic shelters can be divided into small shelters and large or greenhouse-type shelters.

(a) Small shelters

These are mostly in the form of tunnels. Two types have been in general use for some years: the double-arch tunnel and the single-arch tunnel.

Double-arch tunnel

The plastic film, as the name indicates, is fixed between two arches. This type of cover makes ventilation easier. The film has simply to be slid between the two supports in order to give the plants more or less air.

Single-arch tunnel

Mechanical laying of the film is now very common in France. With this process a very rudimentary tunnel can be set up. The arches are installed and fixed in place by hand and the film is then stretched over them by means of a mechanical spreader attached to a tractor. The edge is buried under a ridge of earth on either side.

In order to ventilate the plants, perforated films have to be used, or, if high temperatures make it necessary, holes of the right size have to be made in the plastic afterwards.

These two types of tunnels cover a strip 0.80 to 1.20 m wide and are 0.40 to 0.60 m high. They are very useful for protecting low plants such as melons, cucumbers, haricots, beans and strawberries.

The initial costs consist mainly of the purchase of galvanised iron wire to make the arches with. Then provision has to be made for replacing the film. The quantity to be allowed for is an average of 150 grammes per linear metre with a thickness of 100 microns.

Costs: 2 to 3 francs per linear metre exclusive of tax.

(b) Large or greenhouse-type shelters

Small shelters, although relatively cheap, have the disadvantage that considerable labour is needed to set them up and to look after the crops.

In order to be able to mechanize the process of planting and care of the plants, structures have been brought into use which are as big as the traditional greenhouse.

They come in a large number of models, for different climates. In France, for example, by the sea there are structures known as "covered gardens" which allow permanent ventilation. They serve mainly to protect the plants against wind and rain, but affect the temperature very little.

Inland, on the other hand, one finds more enclosed structures which protect the plants better against cold. They may either be made by the farmer or local artisans, or be bought commercially.

The cost of these large shelters varies to a considerable extent:

1. Metal-frame shelter in the form of a semicircular tunnel 5 to 7 m long and 2.50 to 2.80 m high:
Cost: 6 to 8 francs per m² exclusive of tax
2. Semicircular shelter produced industrially
7 to 7.50 m long and 2.80 m high:
Cost: 10 to 12 francs per m² exclusive of tax

3. Traditional metal-frame shelter of greenhouse type
Vaults 4 to 5 metres wide joined side by side - height 3 m
Cost: 18 to 22 francs per m² exclusive of tax
4. Semicircular cover fitted with opening leaves
0.50 to 9 m wide and 3.30 m high
Cost: 22 to 25 francs per m² exclusive of tax.

The walls of these shelters are films with high mechanical resistance and long life, 150 to 180 microns thick. They carry a quality seal and are guaranteed for a period of 24 months. All the farmer need do is thus to replace the films every two years.

The quantity of materials used is as follows:

Vault-shaped shelter: 170 grammes per m²

Tunnel-shaped shelter: 245 grammes per m²

Cost of film: 0.50 francs per kg exclusive of tax.

A film of ordinary quality which could at a pinch be used for a small tunnel is sold at the basic price of:

5.50 francs per kg exclusive of tax.

7. Protection of plants in a controlled environment

In some climatic zones of the Southern Sahel where the daily temperatures are very high and the humidity very low, it may be worth while and sometimes necessary to cool the atmosphere inside the shelter.

The installation of a cooling system together with dynamic ventilation is possible with the various types of shelters mentioned above.

The following additional costs should then be added to the figures given above:

5 to 6 francs per m² for dynamic ventilation

4 to 5 francs per m² for the cooling systems.

Through the kindness of a French company which makes greenhouses and equips them for climate control, we have been able to get an estimate for the installation of a group of light shelters of the greenhouse type covering 10 hectares, intended for a Middle-Eastern country.

The prices given below are for the equipment assembled and ready for use.

The proposed installation consists of:

- 44 raising greenhouses, 36.50 m long by 8.50 m wide
- 204 large shelters for growing, 60 m long by 7 m wide
- 4 packaging buildings, 30 m long by 8.50 m wide
- 4 storage greenhouses, 60 m long by 8.50 m wide

	<u>Francs</u>
Cost	2,322,000
Installation of heating system for all greenhouses and shelters excluding storage and packaging buildings	2,473,000
Installation of cooling system and dynamic ventilation in the 44 raising greenhouses and 4 packaging buildings	559,000
Installation of fogging system in 13 raising units	66,000
Localized irrigation with ringed perforated pipes	466,000
2 electrical generators	315,000
Steam disinfection unit	223,000
	<hr/> 6,424,000

Cost per m² installed, including the storage and packaging buildings:

$$\frac{6,424,000}{100,000} = 64.24 \text{ francs}^4$$

8. Mulching

This extremely simple operation, which consists in covering the ground with a plastic film, can be entirely mechanized. Its advantages are too well known to need dwelling on. In countries with low rainfall, it helps to ensure a better water supply for the plants.

Many crops should lend themselves to mulching in the Southern Sahelian zones.

There are very cheap films with a life of not more than 2 months. We do not think they can be used in the present case. In our opinion, only high-quality black polyethylene films 80 microns thick, of the "vine special" type, are to be recommended. In the French climate, they have a life of 4 to 5 years. They are marketed at 7 francs per kg exclusive of tax, giving a cost of 0.64 francs per m² covered.

^{4/} This cost per m² is particularly high because of the cost of installing a heating system in all the greenhouses.

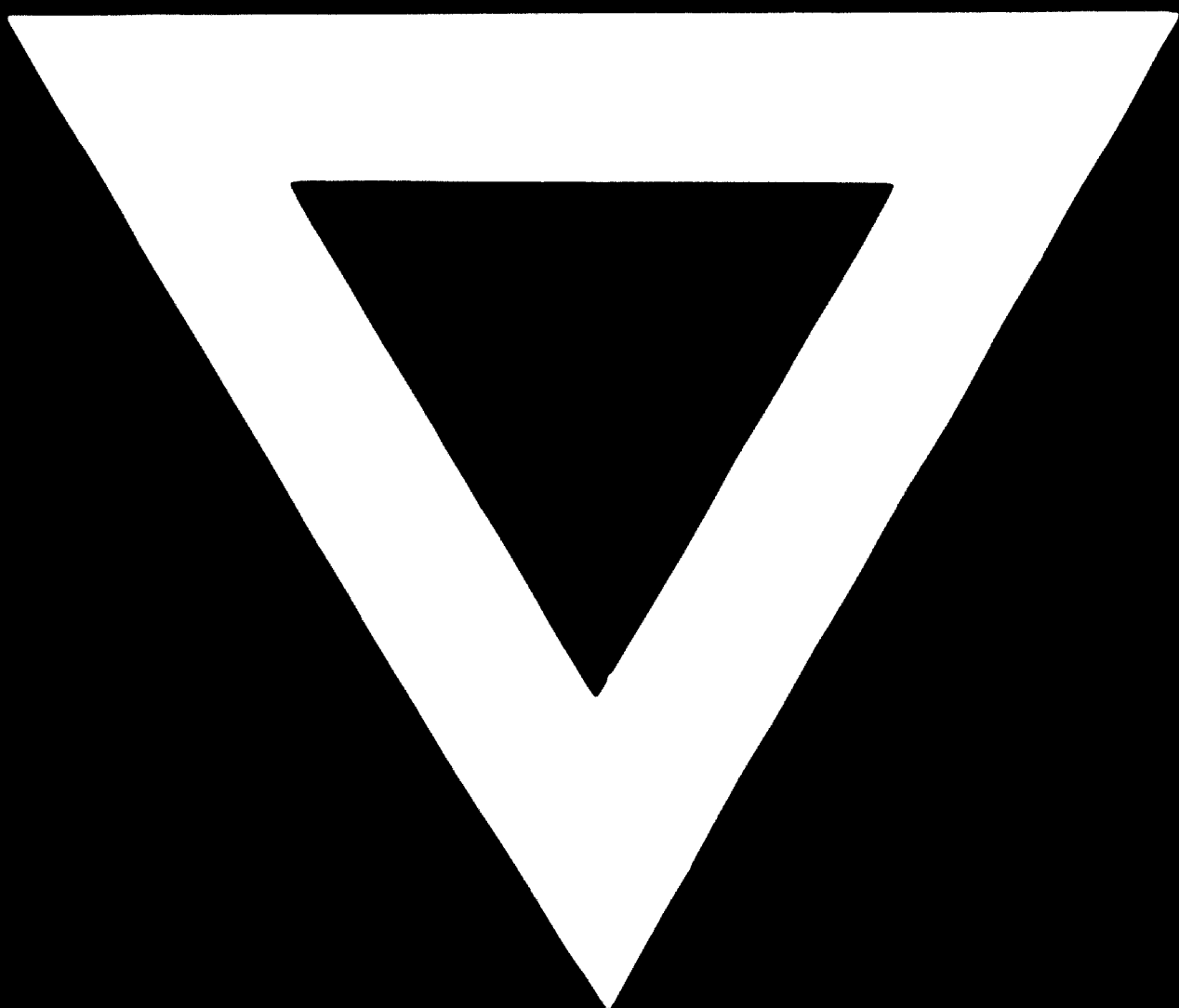
Conclusions

As requested, we have endeavoured in this report to provide information on the basis of which the cost of establishing one or more research establishments in the Southern Sahel could be estimated.

In the first part, we have taken our own experience as a basis for calculating the cost of establishing and operating one of these establishments. We have been able to make use of information obtained from running an applied research establishment in the south of France.

In the second part concerning the different techniques to be applied, we have tried to provide estimated unit costs ex-works for materials of high enough quality to withstand the African climate. We should like to stress this question of the choice of materials, which will be the basic factor in the success of this project.





75.06.06