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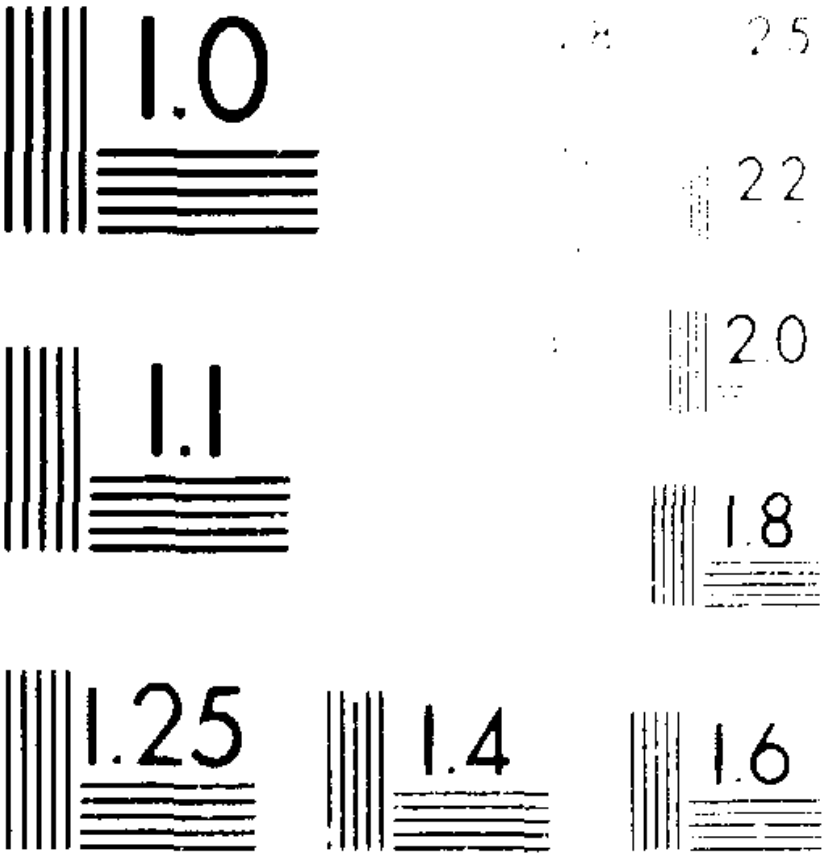
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14132 → Pamphlet

July 1984
English

Ethiopia.

ASSISTANCE TO A BIOMASS-BASED ENERGY PRODUCTION DEMONSTRATION PROGRAMME

UC/ETH/82/164

ETHIOPIA

Technical report: Biogas demonstration programme for 1 ÷ 2 family and large scale digestors for human, animal, agricultural and industrial wastes*

Prepared for the Government of Ethiopia
by the United Nations Industrial Development Organization,

Based on the work of Ulrich Loll, consultant in biogas technology

United Nations Industrial Development Organization
Vienna

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Summary

This report reflects the findings and recommendations of the author obtained during his mission as biogas expert in close co-operation with the Ethiopian National Energy Commission (ENEC) and members of the Ministry of Mines and Energy in April 1984.

An investigation was carried out to identify the kind of technology in the field of biogas most suitable for introduction in Ethiopia and to determine the needs for a demonstration programme followed by a dissemination programme throughout the country. The required contributions from the Ethiopian Government as well as from external financial resources are described and specified.

The chances for materialization of such a programme and its socio-economic implications are discussed. The report does not claim to be exhaustive in detail, but is meant to be a working concept.

1. Present state of biogas technology in Ethiopia

Presently, more than 50 small biogas plants are existing in Ethiopia. They are nearly all 1 to 2 family plants. For part of the plants start-up trials have been initiated, others have no function presently.

Approx. 80% of the existing plants are built by the Indian method, about 20% based on Chinese dome biogas plants.

For test purposes there is also an imported plastic foil plant in operation in an agricultural pilot plant. All these plants are sized according to the daily expected biogas production (e.g. 4 m^3 biogas/day-capacity). Unfortunately, at none of the existing plants the effective gas production resp. the gas quality has been controlled so far. Only a few of the plants

visited were correctly maintained or regularly protected against corrosion. The necessary equipment for the biogas utilization such as burners, lamps, etc. nearly all were imported from India.

First trials to produce these appliances locally have been done. The available fire-clay has been used as building material for burners. Also simple steel constructions have been produced.

The existing small biogas plants are mainly located in three of the 14 provinces of the country (see fig. 1). Part of the plants were built under foreign support. Most of the plants were erected with technical help by ENEC and the Ministry of Mines and Energy and financially supported with State-subsidies. The best maintained plants were found in private farm houses.

The trial to install demonstration plants in Colleges was not always successful since due to changes in the structure of the colleges and use of the buildings and room facilities the maintenance staff was dismissed or had no sufficient interest to run the plant. However, on the overall, there is a considerable interest in the biogas technology, especially among rural population.

Since there is an old tradition in the use of cow dung in Ethiopia, religious and ethically based opposition is not assumed. However, objections to the use of human excrements are to be expected.

2. The need for introduction of biogas technology

In many of the remote rural areas the land is extensively deforested, so that a further cutting of the remaining bushes and trees will have catastrophic environmental consequences. The soil erosion has reached an unrepairable level of damage. Furthermore, the daily firewood collection and transport consumes significant working time of a large portion of the population in rural areas.

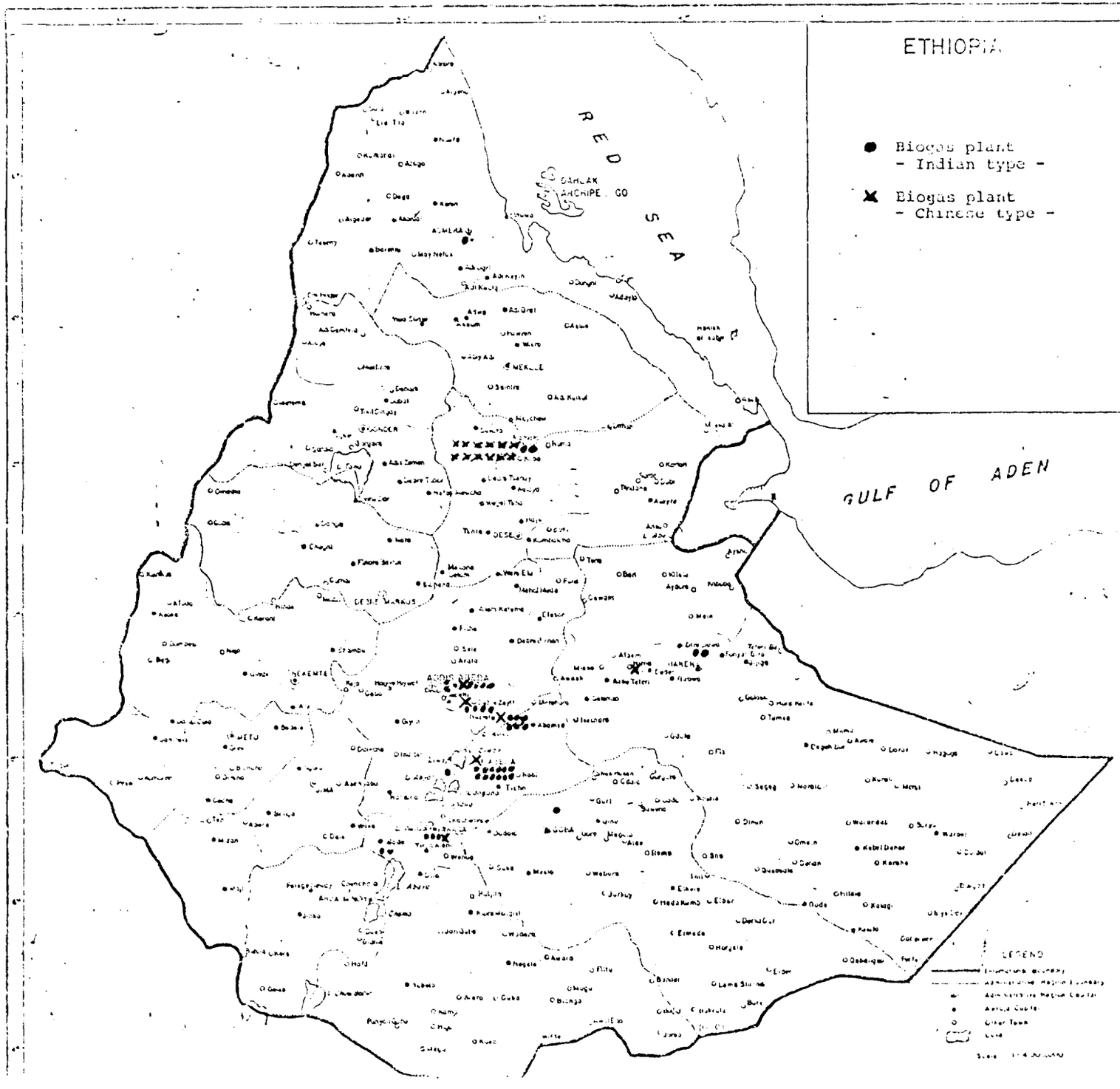

Fig. 1: Existing biogas plants

The firewood is partly collected within distances of more than 10 km away from the houses. Burning practice is rather inefficient. In some of the rural areas the introduction of the biogas technology is the only prospective alternative to guarantee a minimum supply of energy for cooking and lighting.

In these areas, the remaining stock of trees and bushes has to be protected and afforested under all circumstances. The cow dung has to be used for the soil quality improvement and should no longer be used for heating purposes.

3. Launching of a biogas technology programme by the Government of Ethiopia

The Ethiopian Government, through the Ministry of Mines and Energy, has in principle decided for the introduction and dissimination of the biogas technology in all parts of the country. About 10.000 plants should be erected within a 10-year's-program. Since so far only a few experts are educated in this field, the possible support of UNIDO is highly appreciated and welcome. Compared to all other energy conversion forms from biomass, such as charcoal production, gasification or pyrolysis, the biogas technology has priority in rural areas.

4. Suitability of certain small biogas plant types for extensive application in Ethiopia under local specific conditions

Investigations have shown that the investment costs of biogas plants of the Indian type in Ethiopia are considerably higher than those of the Chinese type. This is mainly explained by the high costs for the steel manufactured domes of the Indian plants.

The costs for this part of the plants range between 30-40 % of the investment costs for the whole plant. Since there is positive experience with the plants of Chinese construction, the use of this basic type is strongly recommended for small plants in rural areas.

As there is a wide range of different types of these plants, the optimal system and its constructions has to be selected and developed individually according to the different site conditions, such as soil characteristics, availability of water and building material, etc.

Due to the unavailability of certain building materials in some areas, the transportation costs are very often a significant factor. For cement transportation distance of more than 500 km might be necessary. For sand, maximal transportation distances of 100-200 km are assumed. Therefore the material costs for the biogas plant may differ significantly from region to region. Also workers are paid different salaries in different regions. Since unskilled workers are paid 2 Birr/day (≙ 1 US $/day) all over the country, skilled workers and specialists are paid 6-15 Birr/day. In general, manpower in the northern provinces - especially in Eritrea - is more expensive, whilst the wages in southern provinces are lower. Another observation made is the decrease of wages with increasing distance from the provincial capital. Therefore considering the above mentioned facts, the building costs for a 1 family biogas plant will amount to 1.500-3.000 Birr (≙750-1.500 US $). Even in future the high difference in costs can not be influenced very much. It seems sensible to supply pre-manufactured components to unfavourably located places, since transportation costs are clearly cheaper than those for the supply of the individual building materials. The production possibilities of these pre-fabricated components near the 3 cement manufacturies of the country should be investigated particularly. Other favourable manufacturing places could be close to high quality sand deposits.

As at the same time in these areas comparatively many skilled workers for reasonable wages are available, the maximum investment costs could be reduced by about 50 % by taking advantage of these facts. The quality of the major construction components could also be improved this way.

This is a general map based on Dainelli's, an Italian geologist who did a considerable amount of work in Ethiopia before the Second World War.

Figure 2

The basic geology and location of the cement factories are outlined in fig. 2. Table 1 shows the costs of major building materials for the region Addis Ababa.

BUILDING MATERAIL COSTS / ADDIS ABABA

Cost basis 1984, including all taxes,
transportation- and loading costs

ITEMS	Price per Unit
Bricks	0,15-0,25 Birr/ea
Broken rocks	15-25 Birr/m³
Concrete	25 Birr/100 kg
Sand	40 Birr/m³
Strengthened Steel	
Ø 6 mm	1,27 Birr/kg
Ø 8 mm	1,35 Birr/kg
Ø 10 mm	1,40 Birr/kg
Galvanized Iron Rods including bending and fittings and conditioning	
Ø 1"	
Ø 3/4"	25-30 Birr/m
Ø 1/2"	

Table 1: Building material costs / Addis Ababa
- cost basis 1984 -

5. Climatic conditions and consequences for the biogas plant design

Compared to other countries where the biogas technology has become a major energy supply in rural areas, the climatic condition in most of the Ethiopian areas can be called to be ideal. For this purpose as shown in fig.3-6, almost the same

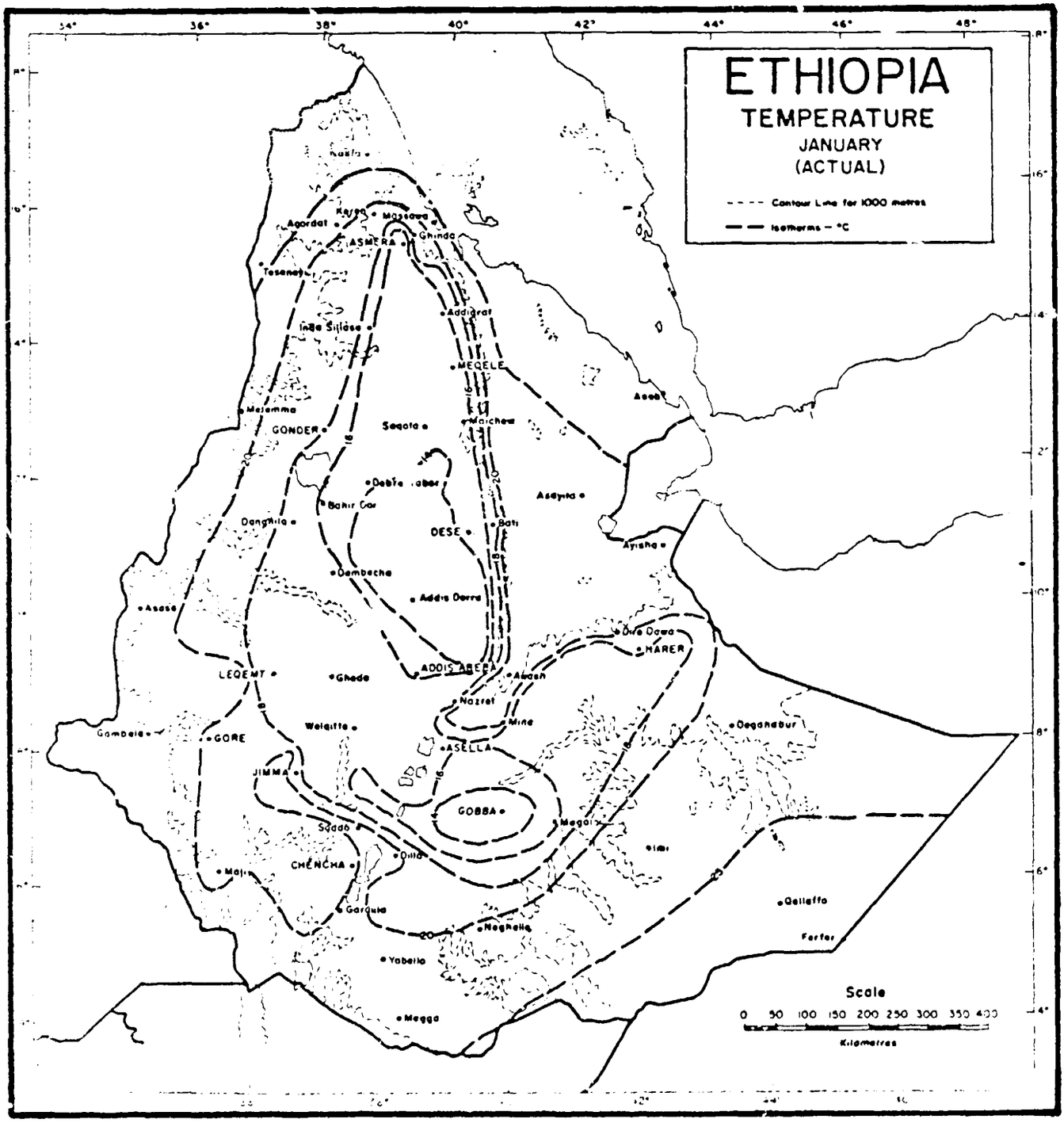

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Figure 3

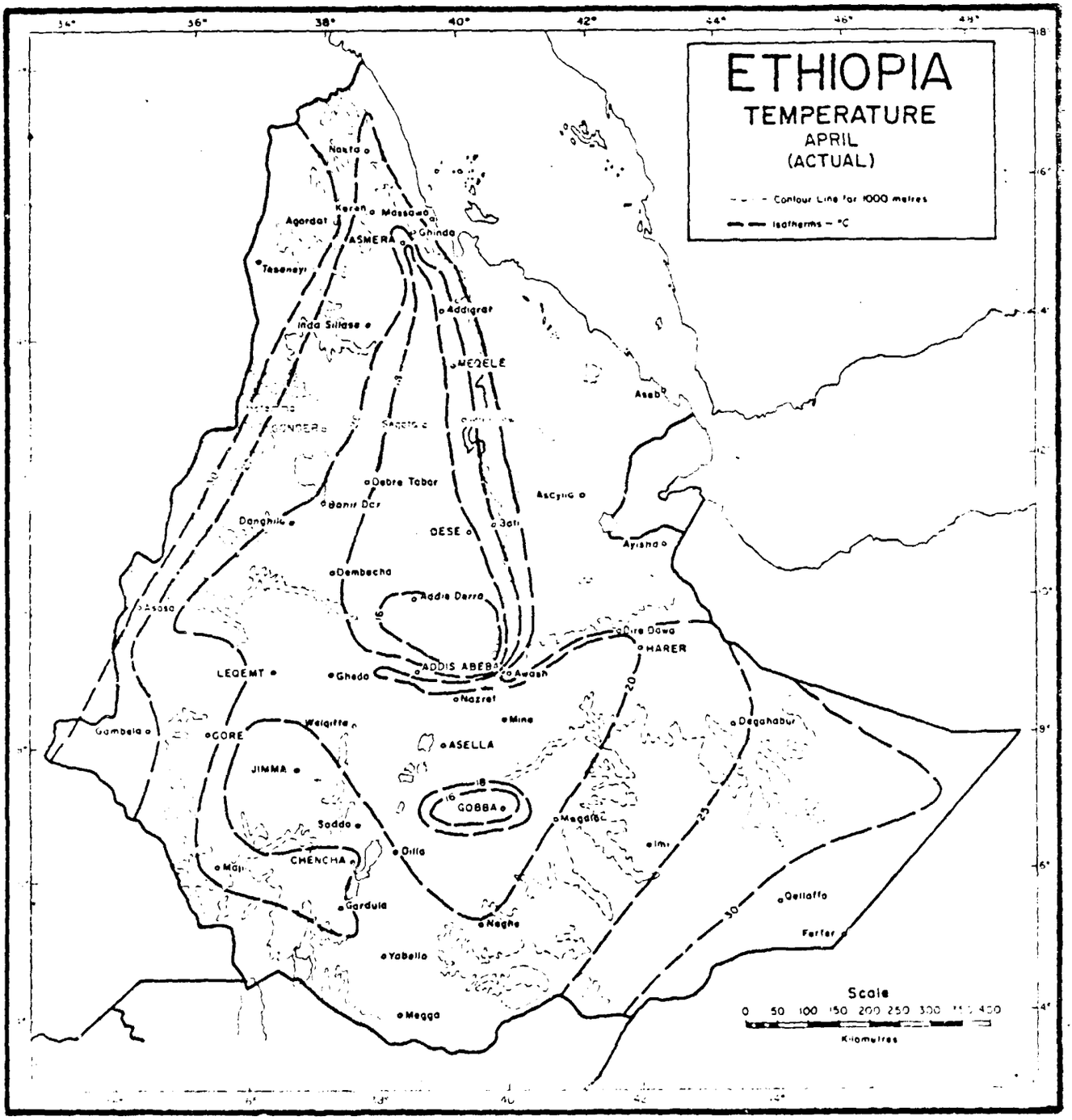
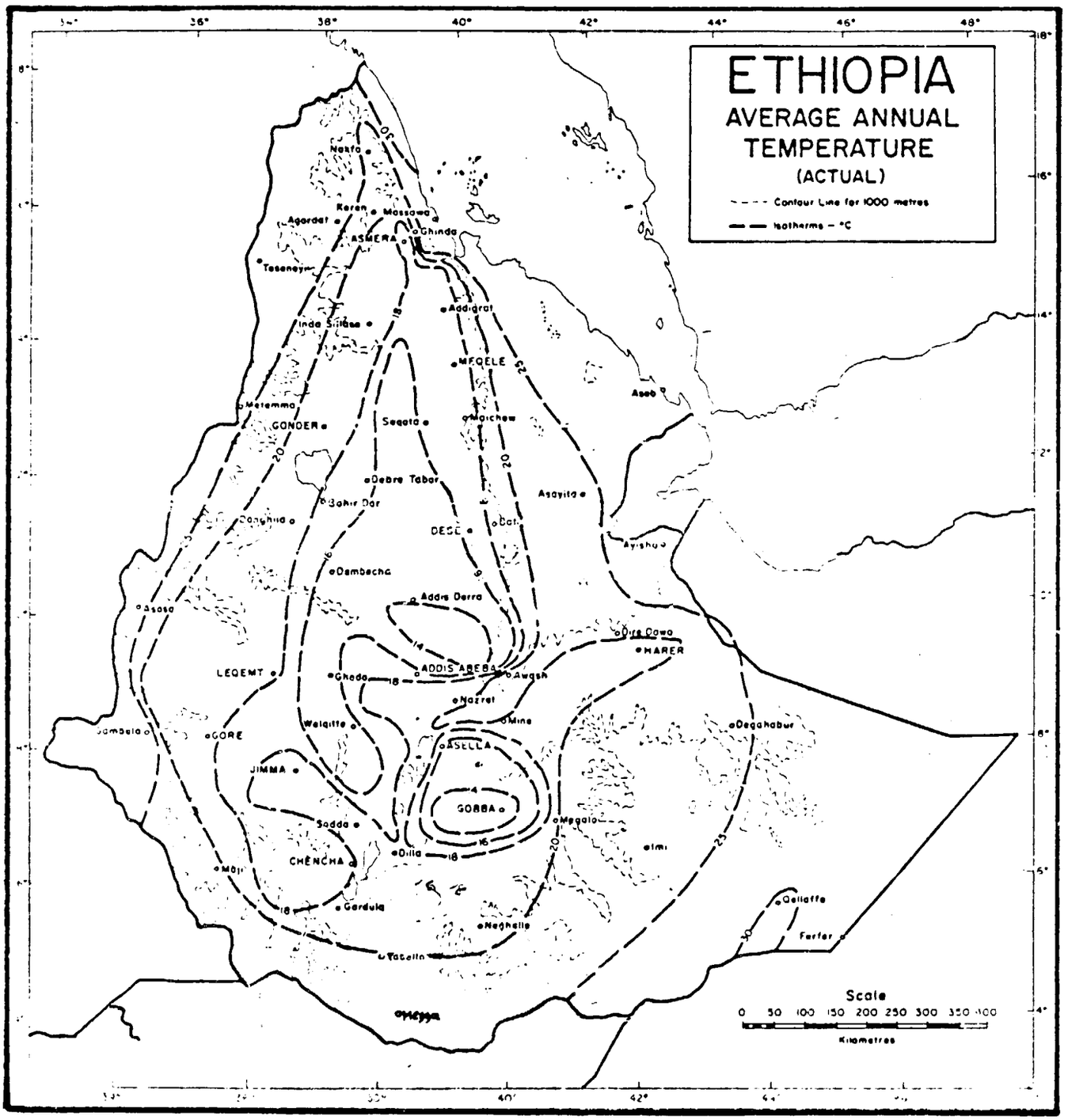

ETHIOPIA
TEMPERATURE
APRIL
(ACTUAL)
Contour Line for 1000 metres
Isotherms – °C
Nakfa
Keren
Massawa
Agordat
ASMERA
Ghinda
Tesenayi
Adi Ugri
Addigrat
Inda Silase
MEKELE
Asab
GONDER
Debre Tabor
Danghila
DESE
Ayisha
Dembecha
Addis Derra
Asosa
Dire Dawa
HARER
LEQEMT
Ghedo
ADDIS ABEBA
Awash
Nazret
Mina
Degahabur
Gambela
GORE
Welgitte
ASELLA
JIMMA
GOBBA
Megarec
Soddo
Dilla
CHENCHA
Garduia
Negha
Qellaffo
Ferfer
Yabello
Megga
Scale
0 50 100 150 200 250 300
Kilometres

Figure 4


ETHIOPIA
TEMPERATURE
OCTOBER
(ACTUAL)
Contour Line for 1000 metres
Isotherms - °C
Scale
0 50 100 150 200 250 300 350 400
Kilometres
Nakfa
Keren
Massawa
Agordat
ASMERA
Tesenay
Addigrat
MEQELE
Metemma
GONDER
Seqota
Maichew
Debra Tabor
Dangила
DESE
Asayita
Ayisha
Dombacha
Addis Derra
Asosa
Dire Dawa
HARER
LEQEMT
ADDIS ABEBA
GORE
JIMMA
Degahabur
GOBBA
Negelle
Imi
CHENCHA
Dilla
Gardula
Qellaffo
Ferfer
Yabello
Neghelle
Megga
Assab
30
25
20

Figure 5


ETHIOPIA
AVERAGE ANNUAL TEMPERATURE
(ACTUAL)
Contour Line for 1000 metres
Isotherms – °C
Scale
0 50 100 150 200 250 300 350 400
Kilometres
ASMERA
Keren
Massawa
Agordat
Ghinda
Tesseney
Addigrat
MEKELE
Asab
GONDER
Metemma
Segata
Waichew
Debre Tabor
Bahir Dar
Asayita
DESE
Ayisha
Dambacha
Addis Derra
Asosa
Dire Dawa
HARER
LEQEMT
Ghedo
ADDIS ABEBA
Awash
Nazret
Welgitte
GORE
Mine
Degahabur
JIMMA
ASELLA
GOBBA
Sodda
Megalo
Dilla
CHENCHA
Gerdula
Negheile
Gallaffe
Ferfer
Tocallin

21

Figure 6

high temperatures are found throughout the whole year. The lowest isotherms are about 14 °C. This means, that the small as well as the large biogas plants do not need temperature insulation for the conversion of animal, human, and agricultural wastes.

Even occasionally cooler nights will not disturb the regular function of these biogas plants, since the plants are mostly underground and the substrate being warmed up during reaction cannot cool down within short periods. However, biogas plants for the conversion of industrial sewage or waste might require some insulation, depending on the process method chosen. Please note that the isotherms as represented in figures 3-6 are based on data derived from a few numbers of stations and on data collected during one to three years only.

6. Draft for a biogas demonstration programme for Ethiopia

(see attached schedule of activities)

6.1. Basic concept and strategy

The demonstration program has to be worked out under consideration of the building materials available and the different local conditions, including the appropiate techniques and design.

The introduction of the biogas technology all over the country should be carried out in two steps - the demonstration and the dissemination.
The training of the Ethiopian experts should go so far, that after completition of the training program only in special cases the advice of foreign experts will be necessary. The design and construction should be based on scientific experience. For the execution of this program three different levels of responsibility will have to be defined.

a) Main Centre in Addis Ababa

with technically and scientifically educated staff and own testing and controlling laboratories. This unit should consist of a specialized working team. All offices and laboratories should be centralised in one building. The group should work under the control of the Ministry of Mines and Energy.

b) Regional Development Centres

which are run by a trained engineer being in close contact to the Main Centre. It is proposed to install 7 of these centres, each of them covering two provinces. The duty of the regional development centres is to train and inform craftsmen, skilled workers, and plant operators. Further, planning, design and building supervision is to be done. The regional centres have to train and advise contact persons and interested people in every administration district.

c) District experts

One ore more experts are trained for each administration district. These experts can be local craftsmen, plant operators, members of governmental organizations, colleges, etc. i.e. all persons who are able to give instructions for the construction and operation of a biogas plant.

These district experts should be able to supervise the building of small biogas plants during the dissimination phase of the program.

Besides the education and technical training of the experts, the above-mentioned organizations will establish a centrally controlled education and propagation program describing the social-economic advantages of the biogas technology and giving advice for building, operation and financing of plants.

UNIDO may be asked to supply initial help in connection with the demonstration program. This includes consultant service, equipment of the central laboratory, purchase of control and measuring instruments for the regional development centres and the costs for the Ethiopian experts for studies abroad.

It also seems necessary that external help may be required for the provision of vehicles at the beginning of the demonstration programme and contributions towards the investment costs of the demonstration plants.

The intention is to find external financial help for the hardware for small biogas plants which has to be imported, as well as the mechanical equipment, pipes, measuring instruments and special building material for large biogas plants.

The programme also includes studies related to environmental problems, on the availability of building materials and water, as well as on the socio-economic justification and profit for these techniques. Close contact has to be established and kept with all Ethiopian authorities connected to the project, such as Health, Agricultural and Forest Administration, etc.

The task of the demonstration programme is to educate and train local manpower and to introduce biogas technology all over the country.

Plant construction with local resources and manpower should be aimed at.

Especially in rural areas a considerable contribution to the energy production, working facilities, soil quality improvement and environmental protection is to be expected.

6.2. Components and time schedule of the demonstration programme

The demonstration programme mainly consists of three working phases:

a) Erection of 1-2 family biogas demonstration plants in rural areas.

b) Training, propagation, and socio-economic and technical analysis of biogas technologies.

c) Erection of large biogas demonstration plants for animal, human and agricultural wastes in rural communities as well as a demonstration plant for the conversion of industrial waste or waste water.

The actual demonstration programme should run over a period of 4 years, followed by a dissemination phase of 6 years, during which the Ethiopian authorities and experts need occasional supervision on special problems.

The individual working phases/activities and their time schedule are specified in the attached project plan. The single steps are described as follows:

6.2.1. 1 to 2 family biogas plants in rural area

6.2.1.1. Training of the Ethiopian experts

In agreement with the Ethiopian partners it is recommended to perform the training in two phases:

During phase 1 two engineers and one chemist from Ethiopia should be introduced into basic planning elements and process technique through a consultation in Europe or elsewhere. At the same time they should practise analytical work necessary for the process control of biogas plants in appropriate laboratories.

The training should be performed in an interdisciplinary working team in order to acquire expertise and understanding. The Ethiopian trainees should have the occasion to apply the acquired knowledge at different types of biogas plants.

After completion of the first training phase in Europe, a second one should follow three months later in the People's Republic of China. The two Ethiopian engineers should be accompanied by a biogas expert. It is proposed that the Ethiopian biogas programme should benefit from expertise available in other developing countries, e.g. in China. Therefore a study of different construction types in China seems advisable. The best training places in China would be:

a) Chinese-German demonstration project for regenerative energy at Daxing near Beijing. This project was co-planned by the UNIDO consultant of approx. 90 small biogas plants in more than 35 different construction types. Suitable accommodation and training facilities are directly located.

b) Biogas Centre Chengdu/Province Sichuan. This second important training centre works almost exclusively with appropriate biogas plants for rural areas.

6.2.1.2. Planning and design

Since the Ethiopian experts have already certain knowledge in biogas technology, the planning and design of plants could be performed parallel to the actual training period (6.2.1.1.). This activity is best be guided by a biogas expert.

6.2.1.3. Laboratory and monitoring equipment for research and control

It is planned to install a central control laboratory in Addis Ababa. The laboratory equipment has to be purchased after completion of the first training phase. The laboratory can start operating towards the end of the first year of the demonstration programme. Mainly control analysis for the demonstration plants have to be accomplished. The possibility of applied research work is given as well. In addition, the regional development centres have to be equipped with control and measuring instruments, which have to be purchased together with the other laboratory equipment.

6.2.1.4. Construction of the 1-2 family biogas plants

After completion of the planning work, the 1-2 family demonstration plants should be installed in all provinces of the country, if possible.

In connection with the demonstration programme 400 of such plants in total should be installed in two phases (60 + 340), followed by up to 10.000 plants during the following dissemination phase. According to the information received from the Ethiopian authorities, corresponding budgets for the financial support of the demonstration plants are available.

6.2.1.5. Production of burners, lamps, and other technical appliances

For the use of the biogas, the required burners, lamps and other technical appliances have to be procured, mainly imported from India or China.

This should be done through UNIDO in consultation with the biogas consultant. In the course of the demonstration programme, local craftsmen and small manufacturers should be trained to produce these appliances on their own, using individually available materials. It is assumed that the local production will increasingly be able to cover the demand after two years.

The production of the incandescent mantles should be done centrally at one factory for the whole country. This may involve the know-how transfer of a production method from Europe, India, or China.

6.2.2. Education, propagation and analysis of the results and experience

After the training of the Ethiopian experts, regional development centres should be installed, from where the information about the biogas technology is propagated among the population. Brief seminars and direct consulting will be available there. All advertising and information work requires appropriate education material, such as films, slides, instruction manuals, posters, etc., whereby UNIDO may be involved especially in the production of educational films.

In the last year of the demonstration programme results and experience acquired should be compiled and analyzed, in order to produce a basis for the Ethiopian authorities for the dissemination phase.

From the beginning the above-mentioned steps include the co-operation with all project relevant Ethiopian authorities, like Health, Forest and Agricultural Administration and colleges.

6.2.3. Large-scale biogas plants

Within 1 to 2 years after start of the 1-2 family biogas plant programme, the technological introduction into large scale biogas plants should be effected. Middle-sized units in rural communities for the conversion of animal, human, and agricultural wastes will be considered. The waste of co-operative animal farms, public latrines and harvest remainders can also be used for this purpose. Special attention has to be given to the problem of biogas distribution to the end users.

Besides the distribution through the gas network, the distribution in plastic bags and compressed gas in bottles can be considered.

The ultimate goal of this programme is the erection of a demonstration plant for industrial sewage.

Location of this plant close to Addis Ababa, so that it can be monitored by the Central Laboratory, appears reasonable.

Proposed locations are breweries, vegetable factories, etc.

The schedule for the training-, planning-, installation-, and research work is similar to the one for the small biogas plants. The time schedule is included in schedule for activities of the biogas development programme in Ethiopia (Appendix 1).

7. Contribution from Government counterpart

7.1. Staff

For the subject project, the Ethiopian side has to provide the manpower listed in table 2.

Major part of this staff is already available. According to the Ethiopian partner, increase of personnel is not difficult at all and can be ready for the programme start. Besides the aforementioned requirements for biogas experts to be trained, additional help of secretaries, drivers, etc., are to be provided.

7.2. Office and laboratory facilities

The laboratory of the Main Centre in Addis Ababa requires 3-4 rooms of total space approx. 50 m^2, including furniture. Space for offices, meeting and training rooms of 100-120 m^2 should be made available.

For the installation of the regional development centres, room facilities of each 50 m^2 minimum with suitable equipment are required. If necessary, other already existing room facilities of other organizations might be used for seminars and training.

7.3. Erection of demonstration plants

For the installation of all demonstration plants the Ethiopian authorities (public or private) have to provide all buildings and local material required for an acceptable performance of the biogas plants.

7.4. Training and education programmes

All related services have to be provided by the Ethiopian authorities, except the production of educational material (especially films) and the supervising consultant service.

Tab. 2: ETHIOPIAN STAFF MEMBERS AND QUALIFICATION FOR THE BIOGAS DEVELOPMENT PROGRAMME

1.) MAIN CENTRE IN ADDIS ABABA

No.	QUALIFICATION	EXISTING EMPLO-YEES	FUTURE EMPLO-YEES
1	SEN. CIVIL ENGINEER		X
2	SEN./JUN. CIVIL ENGINEER	X	
3	TECHNICIAN	X	
4	TECHNICIAN	X	
5	SEN. CHEMIST	X	
6	JUN. CHEMIST	X	
7	AGRICULT. ENGINEER	(X)	

FULL-TIME EMPLOYEES

DEMONSTRATION PROGRAMME

II.) REGIONAL DEVELOPMENT CENTRES

No.	QUALIFICATION	CENTRE	EXISTING EMPLO-YEES	FUTURE EMPLO-YEES
8	TECHNICIAN	ERITREA/TIGRAY	X	
9	"	SHOA/WOLLO		X
10	"	GONDER/GOJAM		X
11	"	WELEGA/ILLU BABOR		X
12	"	KEFA/GAMU-GOFA		X
13	"	SIDAMO/BALE		X
14	"	HARARGHE/ARSI		X

FULL-TIME EMPLOYEES

III.) DISTRICT EXPERTS

DURING THE DISSIMINATION PHASE 1 LOCAL EXPERT IN EVERY DISTRICT AS CONTRACTOR OR PART-TIME JOB EMPLOYEE.

DISSIMINATION PHASE

7.5. Vehicles

The Ethiopian authorities have to take care of a sufficient number of vehicles for the Main Centre and the regional centres.

8. Estimated external contribution required for the biogas development programme for a four year period

A detailed cost estimation is given in Appendix 2. Financial support is intended mainly for the fellowship and study tour programmes, for consultant services and equipment.

8.1. Fellowships and study tours

Funds must be provided for travel and subsistance costs of the Ethiopian staff for training abroad. Approximately a total of 21 months is foreseen.

8.2. Consultant services

A minimum of 80 months consultants services is estimated for assisting the Ethiopian authorities in the implementation of the programme comprising planning, construction, demonstration, dissemination and training of Ethiopian staff. Part of the training programme, e.g. during the design phase, may also be carried out at consultants' home offices for which funds must be also available.

8.3. Vehicles

The availability of the required cross-country vehicles in Ethiopia is very poor. For the programme as described the following vehicles are needed for the equipment of the Main Centre:

1 Pick-up-truck (small truck)
2 Cross-country vehicels (Land-Rover, Toyota, Mercedes o.o.).

Each of the regional centres requires 1 cross-country vehicle (total 7 items). According to the real situation at the beginning of the project all these vehicles have to be provided by the project partners. It is assumed that UNIDO can provide at least one small truck and three cross-country vehicles, possibly more.

8.4. Equipment of main laboratory and purchase for the regional centres

Cost of the instrumental equipment for the central laboratory and the regional centres is shown in Annex 2, point c.2.

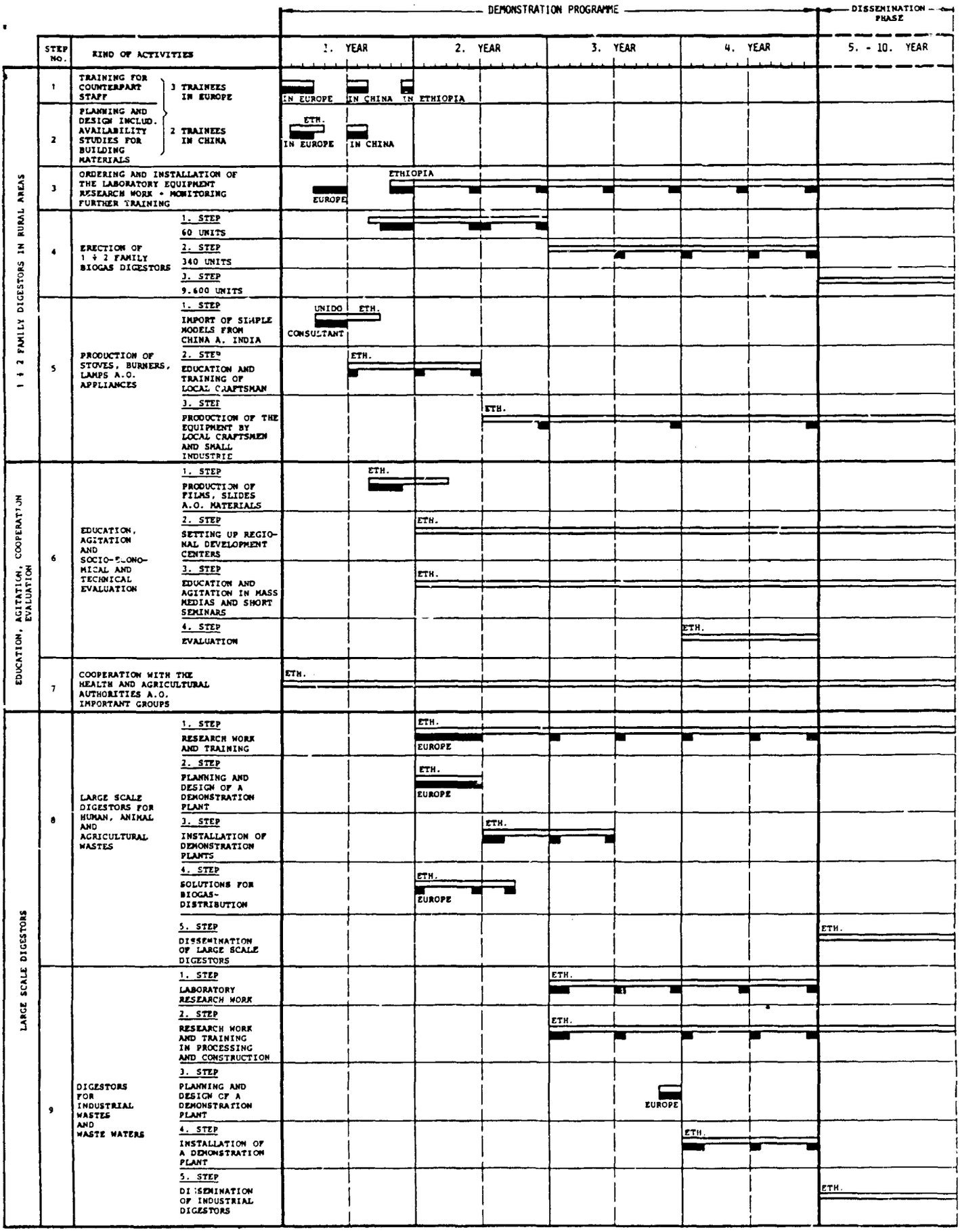
8.5. Investment support and hardware supply for the demonstration plants

Investment support for all demonstration plants such as the family biogas plants and the large-scale plants, will be required. Major costs are for instruments and machinery from abroad.

8.6. Additional costs

For the production of educational material, for transportation, packing, and insurance of supplies from foreign countries additional funds may be necessary.

SCHEDULE OF ACTIVITIES FOR A BIOGAS DEVELOPMENT PROGRAMME IN ETHIOPIA



Estimated external contribution required for the biogas development programme for a four year period

		US $
A.	Fellowships/study tour	
	8 flights abroad (China, Europe) 8 x $ 2,000	16.000,--
	Local travel	6.200,--
	Daily subsistance allowance 21 m/m x 30 days x $60	37.800,--
	Total	60.000,--
B.	Consultant services	
	15 flights to Ethiopia and China respectively 15 x $2,000	30.000,--
	Local travel	7.600,--
	Daily subsistance allowance 18 m/m x 30 days x $60	32,400,--
	Consultant fees 80 m/m x $4,500	360.000,--
	Travel and subsistance for consultant during visit of Ethiopian staff in Europe	3.000,--
	Cost of material needed for training in consultnat's office and laboratories	7.000,--
	Total	440.000,--

		US $
C.	Equipment for the demonstration program performance	
C.1.	Vehicles	
	3 Land-Rovers or equivalents	45.000,--
	1 small truck for material transportation	25.000,--
		60.000,--
C.2.	Equipment of the central laboratory	
	5-6 gas meters	15.000,--
	1 CH_4/CO_2-analyser	20.000,--
	2 dryers	8.000,--
	2 furnaces	8.000,--
	1 set of instruments for P, N and K analysis	12.000,--
	1 photometer	8.000,--
	various glasses and small material	11.000,--
	sundries	6.000,--
		90.000,--
C.3.	Technical equipment for the regional development centres	
	7 portable sets for gas quantity measuring	20.000,--
	7 pH/°C-meters	20.000,--
	7 x 100 sample containers	2.000,--
	7 sets of instruments and chemicals for sample stabilisation	14.000,--
	sundries	14.000,--
		70.000,--
	Total equipment costs:	250.000,--

		US $
D.	Investment support for biogas demonstration plants	
D.1.	1-2 family biogas plants	
	1st stage: 60 plants x 500 US $	30.000,--
	2nd stage.340 plants x 250 US $	85.000,--
C.2.	Large biogas plants for animal, human and agricultural waste	
	3 x 50.000 US $	150.000,--
D.3.	Large biogas plant for industrial sewage resp. waste	80.000,--
	Total investment support biogas plants:	345.000,--
E.	Contribution for the production of educational material transportation-, packing-, and insurance costs overhead costs and sundries	70.000,--
	Project total:	1,165,000

		US $
F.	Total costs including financing and cost increase	
F.1.	Total costs based on costs at beginning of project	
	A) Fellowship/study tours	60.000,--
	B) Consultant Service	440.000,--
	C) Equipment costs	250.000,--
	D) Investment costs/biogas plants	345.000,--
	E) Sundries	70.000,--
	Total costs at project begin:	1.165.000,--
F.2.	Total costs considering financing and cost increase	
	An interest rate resp. cost increase of 8,5 % p.a. is assumed.	
	Finance plan:	
	1st year: 0 %	400.000,--
	2nd year: 400.000 x 1,085	434.000,--
	3rd year: 200.000 x 1.085 x 1.085	235.445,--
	4th year: 165.000 x 1,085 x 1.085 x 1,085	210.753,--
		1.280.198,--
	Considering financing and cost increase UNIDO has to count with total costs of approx.	1.3000.000,-- US $