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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Twenty-fourth Meeting
Montreal, 25-27 March 1998

PROJECT PROPOSAL: KENYA

Fumigant

• Demonstration project - alternatives to the use of methyl bromide for soil fumigation in cut-flowers at Kenya Agricultural Research Institute - KARI	UNIDO

PROJECT EVALUATION SHEET
KENYA

SECTOR: Fumigant (Methyl bromide) ODS use in sector (1996): 395 ODP tonnes

Project Title:
Demonstration project - alternatives to the use of methyl bromide for soil fumigation in cut-flowers at KARI

Project Data		**Methyl Bromide**
		KARI
ODS phase-out (ODP tonnes)		N/A
Proposed project duration (months)		24
Incremental capital cost (US $)		352,000
- including contingency (%)		10
Incremental operational cost (US $)		N/A
Total project cost (US $)		352,000
Local ownership (%)		-
Export component (%)		-
Amount requested (US $)	{Original}	352,000
	{Revised}	328,900
Cost effectiveness (US $/kg)		N/A
National Coordinating Agency		Ministry of Environment and Natural Resources
Implementing Agency		UNIDO
Technical review completed?		-

Secretariat's Recommendations:	
Amount recommended (US $)	
Project impact (ODP tonnes)	N/A
Cost effectiveness (US $/kg)	N/A
Implementing Agency support cost (US $)	
Total cost to Multilateral Fund (US $)	

PROJECT DESCRIPTION

Demonstration project - alternatives to the use of methyl bromide for soil fumigation in cut-flowers at KARI

1. The project is to demonstrate the technical and economic feasibility of four alternative methods to the use of methyl bromide for cut-flower production, including soil-solarization; non-soil cultivation techniques; use of alternative chemicals; and steam pasteurisation. The four techniques will be used as part of an Integrated Pest Management (IPM) programme.

2. Soil pasteurization by steam (SPS), consists of heating the soil at a depth of 65 centimeters up to 80° Celsius, in order to inactivate nematodes and 95 per cent of the spores of the pathogenic fungi.

3. The non-soil cultivation technique is used in nurseries, greenhouses and seedbeds to prevent infestation by bacteria and fungi. Soil is replaced with synthetic or sterilized soil substitutes which provide reliable support. Two types of soil-less media are available: (i) organic media, such as peat, sawdust, straw bales, which have good cation-exchange and water holding capacity, and (ii) inert media, such as rock wool, perlite, polyurethane, expanded clay and polystyrene, which have high water holding capacity but low cation-exchange capacity.

4. The Integrated Pest Management (IPM) approach for crop protection utilizes a combination of cultural practices, including crop rotation, cover crops, fertilization and plant nutrition; physical methods, including steam, solarization, and heat, and use of chemical compounds.

5. A workshop on alternatives to methyl bromide in growing cut flowers was held in Kenya in October 1997. The workshop was organised by Health and Environment Watch in collaboration with the Pesticide Action Network of North America and supported by the Danish Government. The workshop drew participants from governmental and non-governmental organisations, flower growers and external technical experts from Colombia with years of field-based experience in using alternatives to methyl bromide.

6. The use of alternatives to methyl bromide have been tested in Kenya. Soil pasteurization techniques have been tested in the country by the private sector, but the results have not been very successful. Several growers have started testing IPM techniques with alternative chemicals (basamid, telone, captan and telone in combination with captan). Other growers have also tested biological products (trichoderma 2000 and bio algeen). Based on the preliminary results obtained from applying these alternatives, the project will seek to demonstrate to farmers their viability for effective replacement of methyl bromide.

7. The project will be implemented in Naivasha (approximately 100 km from Nairobi) at one of the largest producers of cut flowers and one of the largest individual consumers of methyl bromide in the country. The project consists of the following operative modules: (i) open circuit non-soil cultivation of cut flowers in greenhouses, (ii) application of alternative chemicals (basamid and metham

sodium) in combination with IPM system, (iii) steam pasteurization of soil combined with IPM, and (4) solarization of soil, alone and together with the use of other chemical alternatives to methyl bromide and IPM.

8. Soil preparation will be carried out applying the same methodology used by the company. Alternatives to methyl bromide will be applied simultaneously with methyl bromide applications in order to have a control field. Soil samples will be analysed before and after soil treatment and three days after planting has taken place.

9. Results of the demonstration project would be transferred to producers within the region of Naivasha and to key personnel responsible for extension services in the other producing regions in the country through the Kenya Flower Council, which represents 75 per cent of total cut-flower producers, and Kenya Agricultural Research Institute (KARI).

10. The project will be co-ordinated by the Ozone Office (under the Ministry of Environment and Natural Resources), and will be implemented by UNIDO in close cooperation with KARI, and the major producers of selected flowers.

11. A national project coordinator (NPC) will be recruited for managing and supervising the demonstration project, including designing the tests, collecting and analyzing the data, supervising field activities and coordinating the services of project personnel. The total costs of human resources is US $220,000 including a subcontract for local trials (US $127,000) and study tours (US $18,000), representing 73.6 per cent of the cost of the project. The total cost of the equipment is US $55,000.

12. The expected results from project implementation are: (i) a technical and economic analysis of utilization of proposed alternatives to methyl bromide, (ii) flower growers fully trained in the alternative technologies used; and (iii) dissemination of the results of the demonstration project among Article 5 countries.

SECRETARIAT'S COMMENTS AND RECOMMENDATIONS

COMMENTS

1. The Fund Secretariat reviewed the project in the context of the Executive Committee's interim guidelines on methyl bromide projects (adopted at the 20th Meeting), the demonstration projects approved at the 22nd and 23rd Meetings of the Committee, the report of the Methyl Bromide Technical Options Committee (MBTOC), several publications on methyl bromide and in the light of the two-day meeting held in the Fund Secretariat (3-4 February) to develop a strategy and guidelines for projects in the methyl bromide sector (to be submitted for consideration of the Executive Committee at the 24th Meeting).

2. The project concept follows the Executive Committee's guidelines and is consistent with MBTOC reports.

3. The Executive Committee approved at its 21st Meeting (February 1997) a demonstration project on replacement of methyl bromide with non ozone depleting substances in grain storage to be implemented through a bilateral cooperation by the Government of Australia (US $232,834). The project is to demonstrate the use of carbon dioxide and phosphine applied to commodities in-transit, in outdoor storage and in sealed stack systems as alternatives to methyl bromide. In addition, the Government of Canada has also prepared a project in Kenya to demonstrate the value and usefulness of formulations of diatomaceous earth as an alternative methyl bromide technology for stored grains and structural treatment. The Government of Canada and the Secretariat are still discussing some issues regarding the project.

4. The Secretariat discussed with UNIDO issues regarding incorporation of the results of the workshop between Colombian and Kenyan flower producers where the Colombian experience and know-how in the production of flowers without methyl bromide was explained as well as consideration of the use of existing equipment in the country, the cost of equipment being requested, and the salaries of international and national experts. Subsequently, some of the costs items were adjusted accordingly.

5. UNIDO informed the Secretariat that during the workshop in Nairobi (October 1997), representatives of the flower producers and the government officials involved in the project preparation that a visit to Colombia and to other countries, would be considered essential for the successful implementation of the project. Therefore a study tour for two to three weeks of four participants (US $18,000) has been included in the proposal.

PROJECT DOCUMENT

COUNTRY:	Kenya
PROJECT TITLE:	**"Demonstration Project**: - Alternatives to the use of methyl bromide for soil fumigation in cut-flowers".
SECTOR COVERED:	Floriculture (*mainly **carnations and roses***)
ODS USE BY SECTOR:	395 tonnes in 1996
PROJECT DURATION:	24 months
TOTAL PROJECT COSTS:	US$ 352,000.
OVERHEADS OF IMPLEMENTING AGENCY:	US$ 45,760.
PROPOSED FINANCING BY MULTILATERAL FUND:	US$ 397,760.
COUNTERPART INSTITUTION:	KARI - "Kenya Agricultural Research Institute".
IMPLEMENTING AGENCY:	UNIDO
COORDINATING INSTITUTION:	Ministry of Environment and Natural Resources (*Kenya Ozone Office*) .

PROJECT IMPACT: The project will focus on the demonstration of the effectiveness of four alternatives to the use of Methyl Bromide (*MeBr*) for cut-flower production. These alternative technologies consist of **a)** soil-solarization; **b)** non-soil cultivation techniques; **c)** the use of alternative chemicals; and **d)** steam pasteurization. All techniques will be used as part of an IPM (*Integrated Pest Management*) system. The implementation of the project will involve the installation of demonstration facilities and equipment in the experimental station of one of the largest cut-flower producer in the country (*responsible for the consumption of around 26% of the MeBr used in the country*). It will also include the preparation of a techno-economic assessment of the technologies and the dissemination of the results among qualified experts from Article 5 countries.

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I. BACKGROUND

1. Methyl bromide (*MeBr*) is registered in Kenya by the Pest Control and Products Board for use in: a) commodity and soil fumigation; b) quarantine; and c) space and pre-shipment treatment. In 1995, the total consumption of MeBr in these applications was approximately 375 tonnes. Of this amount, soil fumigation used 185 tonnes (*49%*), quarantine measures represented 150 tonnes (*40%*), and storage and fumigation of harvested crops used 41 tonnes (*11%*).

2. Presently (*during 1997*), it has been estimated that the county consumed about **400 tons** of MeBr, with approximately **70%** in soil, **20%** in durable and **10%** in perishable (*fruits*) fumigation. The use of MeBr is well accepted in Kenya because of its broad spectrum, high biological activity, cost effectiveness and ease of use. It can be expected (*from the consumer viewpoint*) that its use will continue in the coming years, particularly due to some exemptions for MeBr use for developing countries. The Government, however, is prepared to initiate a concrete programme for phasing out MeBr in the country and concrete action has already taken place within the last months. A demonstration project for phasing out MeBr used in grain fumigation has been developed in cooperation with Australia, and approved by the 23rd Executive Committee Meeting of the Montreal Protocol. The implementation shall start by March 1998.

3. During December 1997, the basis for establishing a demonstration project to phase-out MeBr used for fumigation in general (*and soil fumigation in particular*) has been discussed with the **Kenyan Government**, and the management of an enterprise (***SULMAC Company Ltd.***, *located in* ***Naivasha***) where the field trials would be carried out.

4. The demonstration project for phasing out MeBr as soil fumigant will be carried out on cut-flower cultivations (mainly *carnations* and *roses*), due to the great importance of the floriculture industry in the country. The project would have, as the main counterpart, the **Kenya Agriculture Research Institute (*KARI*)**, which has identified **one** out of its **seventeen** Branches to be directly responsible for implementing the project. Since limited facilities for field trials are available at KARI, it has been agreed upon that the trials would be carried out in one of the leading companies in the cut-flower production sector (***SULMAC Company Ltd***). The company will allocate an area of **0.8 ha** with all basic facilities. The trial area will work independently of all other production facilities of the company. The implementation of the project will consist in the installation of demonstration facilities in the experimental station at SULMAC Company Ltd., designed to co-operate with KARI.

II. PROJECT OBJECTIVE

5. The objective of the project is to demonstrate the technical and economic feasibility of four alternative methods to the use of methyl bromide in cut flowers cultivation (*i.e. solarization, steam pasteurization, non-soil cultivation techniques and application of alternative chemicals [according to strategies of low environmental impact], as part of an integrated pest management-IPM system*), and to disseminate the results within Article 5 countries, particularly in Africa.

III. PROJECT DESCRIPTION

3.1 Proposed Technologies

3.1.1 Integrated Pest Management (*IPM*) incorporating steam pasteurization

6.

(a) Integrated pest management (*IPM*). IPM makes use of all possible resources - not just chemical control - to prevent and reduce the incidence and effects of diseases and pests. It includes crop sanitation, disease free plant material, physical and cultural controls, disease or pest resistant varieties, scouting for diseases and record keeping, sanitary barriers, segregating nurseries from production facilities, use of biological treatments, etc. IPM leads to decreased use of chemical pesticides and, according to specialists, is at present the only real and long lasting solution to severe disease and pest attacks on many crops.

(b) Soil pasteurization by steam (*SPS*) is a technology known for many years and it has been successfully utilized since 1985 by several firms in the cut-flower sector in Colombia. It consists of heating the soil up to 80° C, 65 cm deep, in order to inactivate nematodes and 95% of the spores of the pathogenic fungi. **In Kenya the technique has been introduced by the private sector, but not successfully. However, the project will include a specific module to demonstrate the effectiveness of the corresponding technique if applied as part of an IPM system.**

7. A combination of SPS and IPM for the control of pests and diseases in horticulture is a proven technology package, widely used in other countries for more than ten years. Growers using this approach report annual losses of only 1-2% due to bacterial and fungal diseases, as compared to much higher losses when relying on soil fumigation with methyl bromide only. Steaming is a environment-friendly technique and, although energy consuming, in crops such as roses and carnations its relatively high costs can be tolerated.

3.1.2 Non-soil cultivation systems in combination with IPM

8. In nurseries, glasshouses and seedbeds, as well as in other cases, synthetic or natural sterilized soil substitutes prevent infestation by nematodes, bacteria and fungi. Soilless media might be roughly classified into **two** classes: **organic** and **inert**. Organic media, such as peat, sawdust, straw bales, etc., have high to good cation-exchange and water holding capacity. Inert media, such as rock wool, perlite, polyurethane, expanded clay, polystyrene, etc., have high water-holding capacity, but low cation-exchange capacity. Organic media and some inert media can be easily sterilized with steam or solarization and re-utilized. Some inert media can also be re-extruded.

9. Inert soilless media are extensively used in the Netherlands, Italy, Denmark and other countries. Cheap organic substitutes, such as sterilized grain-hulls and waste bark, are also used. The experience accumulated through years of commercial cropping of tomatoes, cantaloupes, peppers, strawberries, etc., is now large and the use of soil alternatives is currently predominant in many countries. **In Kenya the cut-flower production sector is highly interested in knowing the experience of other countries in using non-soil techniques for cultivation of selected flower varieties in order to introduce it in the country. The project foresees to demonstrate through a visit to other countries, the advise from qualified experts and the establishment of a demonstration plot, the results of this technique when applied to the cut-flower production sector.**

10. The project intends to apply the technology by using in open circuit:

(i) organic media available in the area, alone or in mixtures with inert media;
(ii) inert media, available locally at competitive prices.

11. Three different systems are planned to be applied in the project:

(i) suspended plastic trays;
(ii) plastic trays lying on soil; and
(iii) floating polyurethane trays.

12. Finally, the re-utilization capacity of the various medium/system combinations will be carried out by sterilizing them with steam or solarization and using them again.

3.1.3 Alternative chemicals in combination with IPM

13. The application of an Integrated Pest Management Programme greatly reduces the applied pesticides [including methyl bromide] by using, as far as possible, any other cultural or physical methods of treatment instead of chemical control. When chemicals are used, they are specially selected on the basis of their toxicity and restricting the applications to the optimal moments, according to the pests biology. **In Kenya, several growers have already started testing some IPM activities with alternative chemical products alone and combined to each other. For instance, in the cut-flower production sector, informal tests have already been carried out with a) "Basamid"; b) "Telone" (*alone*); c) "Captan" (*alone*) and d) "Telone" combined with "Captan". Some of the tests have given promissing results whereas others have not. The project will apply the most successful products under proper advises from international experts and using improved technologies in order to reduce their environmental impact and to demonstrate to farmers that the use of these chemicals in combination with IPM techniques can be effective in replacing methyl bromide.**

3.1.4 Solarization in combination with IPM

14. This technique consists of simply heating the soil by covering it with a plastic sheet of appropriate material. It is effective against many pathogenic bacteria, a wide range of nematodes and, to some extent, fungi. The usefulness of the technique depends largely on climatic conditions, availability of irrigation, and good application procedures. Solarization is a component of great importance in an IPM system. In countries with a temperate climate and marked seasons, this technique may block the use of land during the early summer when important species are in cultivation. Also container used for vegetable and ornamental crops can be solarized with very positive results in terms of disease control and increased growth response. Solarization will require the use of plastic sheets, which will have to be disposal/recycled.

3.1.5 Use of resistant cultivars and biological control

15. The use of resistant cultivars, which are slowly being commercially released, is one of the cheapest and easiest way to control soil borne pathogens. Many resistant cultivars are now used for specific crops in industrialized countries. Although no completely resistant (immune) varieties to fusarium wilt of carnations have been developed so far, there are now varieties available with different levels of resistance that greatly contribute to the management of this disease.

Several biological agents (*BCA*) have been successfully exploited for their use against soil-borne pathogens and some of them have already been made commercially available. Among them are fungi like *Trichoderma harzianum* and non-pathogenic isolates of *Fusarium oxysporum*. However, due to their narrow spectrum of activity, the biological agents can not be realistically considered as the only alternative to the use of fumigants. **In Kenya, several growers have already started testing some biological products, such as "Trichoderma 2000" and "Bio Algeen". Since there is already good evidence that many biocontrol agents commercially available can play a major role in management of important diseases of carnations and roses, the project will use the same and**

other new products in order to demonstrate to farmers their effectiveness if used as part of an IPM system,

3.2 Evaluation of alternative techniques

15. Basically, there are **four** well-proven, alternative techniques available:

(a) Use of a combination of various registered fumigants, such as metham sodium and basamid, the costs of which is comparatively low, but requires a waiting period before planting. It must be integrated with an Integrated Pest Management System.

(b) Use of steam to pasteurize the soil, which is costly, but eliminates waiting period and can be adapted according to the intensity of the incidence of the disease. It also needs to be applied within the framework of an Integrated Pest Management System.

(c) Use of non-soil culture media [organic and/or inert] in open or closed circuits, has been widely adopted in non-open air cultures in Holland, where the use of methyl bromide was banned some years ago, as well as in other European countries and in the USA.

(d) Solarization is a promising technique in Kenya, where temperature and light intensity (sun radiation) are relatively high year round. Therefore, soil temperatures sufficiently high to suppress or eliminate soil borne pests and pathogens can be easily reached in any time of the year.

3.3 Project Implementation

3.3.1 Location of the Project

16. The project will be implemented in the region of Naivasha [which is located approximately 100 Km from Nairobi] with one of the largest producer of cut flowers [and one of the largest individual consumer of methyl bromide] of the country: the **SULMAC Company Ltd.** The demonstration trials will take place in an area that the company will allocate for that purpose (*total area available is **0.8 ha***) which will work independently of all other production facilities of the company.

17. The pilot operations to demonstrate the alternative methods to methyl bromide will be undertaken mainly with **carnations** and **roses** grown in greenhouses. Fusarium wilt and *Rhizoctonia solani* have been identified as the main phytopathological problems of the two selected crops.

3.3.2 Methodology

18. The project consists of **five operative modules**, as follows:

a) **Open circuit non-soil cultivation** of cut-flowers in greenhouses (*mainly **roses and carnations***). The development of the module would demonstrate the physical and financial feasibility of non-soil cultivation in **open circuit** greenhouses, which is a **less expensive** alternative.

b)[1] **Application of alternative chemicals** (***mainly basamid and metham sodium***) in combination with an **IPM** system in soil cultivation of cut-flowers in greenhouses (***mainly roses and carnations***). The development of the module would demonstrate the technical and financial feasibility of the use of an effective IPM together with pesticides alternative to methyl bromide.

c) **Steam pasteurization** of soil of cut-flowers planted in greenhouses (***mainly roses and carnations***), integrated by an appropriate IPM strategy. The development of the module would demonstrate the technical and financial feasibility of steam pasteurization of soil in the production of ornamental flowers.

d) **Soil solarization** [alone or together with the use of other chemical products alternative to methyl bromide] combined with an IPM system for the disinfection of protected soil cultivated with cut-flowers (***mainly roses and carnations***). The development of the module would demonstrate the technical and the eventual financial feasibility of solarization in the cultivation of ornamental flowers in Kenya.

e) **Extension, transfer** and **diffusion** to producers within the region of Naivasha and to key personnel responsible for extension services in the other producing regions in the country. (*Kenya Flower Council, which represents 75% of total cut-flower producers of Kenya, and KARI- Kenya Agricultural Research Institute*)

19. For the purpose of comparison, the soil preparation will be carried out using the same methodology usually applied by the company. When the time comes for methyl bromide application, the project will apply the alternative treatments simultaneously in order to have a control field.

20. In the project site, **two** people (*medium level technicians with either a Qualification Diploma or Certificate in Agriculture*) will be responsible for collecting and processing the data on a daily basis. They will also file a daily report that will be sent to the National Expert in Crop Pest Control (***NECPC***), and to the National Project Coordinator (***NPC***), both located at KARI. The two field technicians will be supervised by **one** National Field Manager (***NFM***) with a university background in agronomy and a large experience in floriculture (*located at SULMAC*). The data will be processed and analysed in terms of comparative product effectiveness, productivity and cost. The monitoring phase and the collection of data will start with the pasteurization of the soil and will continue until planting starts.

21. Soil samples will be analysed before and after the soil treatment and three days after planting has taken place (*when possible*). During cultivation, symptomatic plants will be detected, counted and eradicated; then, the disease site will be marked on a map, noting disease severity, the variety affected, time of the year and others for future reference. The control will take also into account the yield and quality data for the corresponding crop.

22. The alternative techniques **will be compared to methyl bromide and non-treated trials**, and will be implemented all in combination with an **Integrated Pest Management** (***IPM***) system in the above-mentioned site as follows:

- Alternative pesticides;

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[1] In modules **b**), **c**), and **d**) a comparison with application of MeBr will be carried out as part of the demonstration activities.

- Solarization;
- Steam pasteurization;
- Soilless techniques in open circuits.

23. The whole demonstration project will be distributed in an area of **0.8 hectare**: the field trials will take place on plots of no less then **200 m²** each. All tests will be carried out in randomized block design (*replicated three times*) using each of the alternative technologies selected.

24. An evaluation of the results will be carried out from the technical and economic viewpoints.

3.4 Project coordination

25. The Project will be coordinated by the **Kenya Ozone Office** (*established under the Ministry of Environment and Natural Resources*), and will be implemented by **UNIDO** in close cooperation with **KARI**- "Kenya Agricultural Research Institute", and the **major producers of selected flowers**.

26. A National Project Coordinator (*NPC*), with multidisciplinary expertise, will be responsible for the implementation of the project in close cooperation with the National Expert in Crop Pest Control (*NECPC*) and the field staff composed of: a) **one** National Field Manager (*NFM*); b) **two** medium level technicians, as described in para. 20.

27. The **NPC** will be responsible for managing and supervising the entire demonstration project and evaluating the results. He is expected to establish good working relationships with the agro-business managers, field agronomists, government authorities and implementing agency officers and experts. The **NFM** will be responsible for designing the tests; collecting and analysing the data; supervising field activities and coordinating the services of project personnel.

28. Project activities will start with a study tour organized to enable the **NPC, NECPC, NFM** and the general manager of SULMAC Company to become familiar with the technologies that will be used.

29. In close cooperation with the local agronomists, the international experts will propose the alternative technologies, design the tests to be carried out and establish the analytical methods to be used for monitoring pests and diseases.

3.5 Institutional Arrangements

30. **KARI** in cooperation with staff from **SULMAC Company Ltd.**, will be the counterpart institution in charge of field operations. KARI will be responsible for the logistic aspects and transport of experts. The Kenya Ozone Office at the Ministry of Environment and Natural Resources will be responsible for the government coordination of the project. KARI (*in coordination with the Kenya Ozone Office*) has agreed to support this demonstration project in accordance with the guidelines of the Montreal Protocol and the Country Programme Projects.

31. Final specifications for the equipment and work plan will be prepared after the approval of the project proposal. It will be formulated in cooperation with KARI, SULMAC Company Ltd., and the Kenya Ozone Office.

32. As the implementing agency, UNIDO has the necessary experience and capabilities for the successful implementation of projects at the enterprise level. Upon approval by the Multilateral Fund

for the Implementation of the Montreal Protocol (*MFMP*), the project budget will be transferred to UNIDO. The corresponding project allotment document will then be issued by UNIDO's Finance Section. Any substantive or financial deviation will be subject to approval by the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol.

IV. OUTPUTS

4.1 Outputs and Activities

OUTPUT 1: A practical technical and economic analysis of the utilization of four alternatives to methyl bromide, namely, non-soil cultivation, steam injection, solarization and the use of various other chemicals in combination with an integrated pest management system performed. The demonstration cases will be similar in size to those of the local average farmer and will be carried out under the same local conditions.		
ACTIVITIES	MONTH OF COMPLETION	RESPONSIBILITY
Equipment - purchase, delivery & installation as per **Annex II.**	3	Kenya Ozone Office; NPC; UNIDO
Preparation of IPM programme.	3	NPC; 11-51
Application of soilless technologies using at least three different media and three systems.	24	NECPC; NFM; NPC; 11-52
Optimum application of alternative chemicals	24	NECPC; NFM; NPC; 11-51
Application of the solarization technology.	24	NECPC; NFM; 11-51; 11-54
Application of steam pasteurization techniques	24	NPC; NECPC; NFM; 11-53
Application of IPM principles and its monitoring throughout entire demonstration project.	24	NPC; 11-51; NFM
Preparation of technical/economic analysis of the results.	24	NPC

OUTPUT 2: At least four agronomists and 2 technicians fully trained in the technologies implemented during the course of the demonstration project.		
ACTIVITIES	MONTH OF COMPLETION	RESPONSIBILITY
Three-week study tour. (*Italy, the Netherlands and Colombia*)	2	UNIDO
On-the-job training on IPM, as per **Annex III.**	24	11-51
On-the-job training in soilless cultivation, as per **Annex III.**	24	11-52
On-the-job training in steam pasteurization as per **Annex III.**	24	11-53
On-the-job training in solarization, as per **Annex III.**	24	11-54

OUTPUT 3: Dissemination of the results of the demonstration project (*locally and among qualified representatives of Article 5 countries*)		
ACTIVITIES	MONTH OF COMPLETION	RESPONSIBILITY
Preparation of a publication with the results of the project experiences.	24	Kenya Ozone Office; NPC; NECPC-(KARI)
Editing and distribution of 200 copies of the report	24	UNIDO
Organization of three 3-day seminars to present the results to qualified specialists from Kenya and the neighbouring countries (Article 5 countries).	24	UNIDO/KARI; Kenya Ozone Office; NPC; NECPC

4.2 Milestones

PROJECT MILESTONES

YEAR	ONE				TWO			
QUARTER	1	2	3	4	1	2	3	4
1. Equipment, purchase & installation	###							
2. Non-soil cultivation		###	###	###	###	###		
3. Alternative pesticides		###	###	###	###	###		
4. Solarization		###	###	###	###	###		
5. Steam sterilisation		###	###	###	###	###		
6. Study tour	###							
7. On-the-job training		###	###	###	###	###		
8. Prep. of publication						###	###	
9. Editing and distribution of publication							###	###
10. Workshops								###

V. PROJECT COSTS

Total project costs are as follows:

TOTAL INCREMENTAL COSTS	320,000
Contingency allowance (*10%*)	32,000
TOTAL PROJECT COSTS	352,000
Overhead Costs (*13%*)	45,760
FUNDING FROM THE MULTILATERAL FUND REQUESTED	**397,760**

VI. PRE-REQUISITES

33. In accordance with the rules and regulations of the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol, project funds will cover only incremental capital costs related to the project. All other expenses, particularly those related to civil and construction works, provision of additional equipment, machinery, tools, services, instrumentation, soil and microbiological analysis, fuel-oil, transportation of experts, etc., will have to be covered by the counterpart (*KARI and SULMAC*).

34. Therefore, prior to the start of project implementation, a memorandum of understanding has to be prepared and approved by the project/government authorities concerned and UNIDO. The memorandum will specify all responsibilities of the counterpart and will be considered an integral part of the project document.

ANNEX I.

PRELIMINARY EQUIPMENT SPECIFICATIONS[2]

Preliminary equipment specifications and breakdown of costs are as follows:

ITEM	DESCRIPTION	TOTAL COST *(in US dollars)*
1	One compact steam boiler, with a capacity of 1,200 kg/h of steam at 10 Bar, complete with fittings and a 500 l/h water softening system.	25,000
2	One 10,000-litre, steel-plated tank, to store fuel.	2,000
3	Two mobile platforms, one for the boiler and the other for the fuel tank and water softening system.	3,000
4	100 m of flexible pipe for steam, at 10 Bar, and 60 m of flexible diffusion pipes, plus fittings, connecting devices, filters, waterproof electrical connections, etc.	5,000
5	Auxiliary equipment, consisting of: plastic sheets, all chemicals, plant materials, trays, substrates, accessories for non-soil cultivation and unforeseen material.	41,000
	Total	**76,000**

[2] **Since the equipment will be used only for the demonstration project, they will be under the custody and responsibility of the Kenya Ozone Office.**

ANNEX II.

PRELIMINARY TERMS OF REFERENCE FOR THE TRAINING PROGRAMME

Each expert will agree in writing to provide the following services corresponding to his/her field of knowledge:

1. Examine the present sanitary situation of the facilities.

2. Verify that the germplasm is certified and provide comments about its resistance.

3. Prepare an IPM in detail, taking into account the particular characteristics of the facilities, the pests present and their environment.

4. Identify and train at least two teams (*one from KARI and one from SULMAC*) in disease detection. This includes disease detection, data collection and interpretation, mapping and record keeping and incidence analysis.

5. Design and initiate the implementation of training programmes directed to three levels of production staff, namely technicians, supervisors and workers, in cultural control. This includes crop sanitation, maintenance of greenhouses (*when applicable*), management of fertilization and pH control.

6. Design and initiate the implementation of training programmes directed to three levels of production staff, namely, technicians, supervisors and workers, in the physical control of pests and disease. This includes, among others, protective disinfestation barriers, handling and removal of sick plants and restricted access to greenhouses (*when applicable*).

7. Implement training courses in on-the-spot chemical control of disease and pests.

8. Design and initiate the implementation of training programmes at the technician and supervisor levels in biological control of pests and disease, including the use of resistant varieties, biological pesticides, non-pathogenic strains of bacteria and fungi and antagonists-suppressive substrates.

9. Train at least two teams in the installation, use and maintenance of the steam pasteurization equipment (*when applicable*).

10. Design and initiate the implementation of training programmes at the technician and supervisor level in non-soil cultivation techniques including media pasteurization, irrigation and fertilizer management, surface optimisation and media re-utilisation (*when applicable*).

11. Design and initiate the implementation of training programmes at the technician level and at the supervisor level on the use of alternative chemicals applied in conjunction with IPM.

12. Implement training courses in solarization techniques.

13. Monitor the implementation of the programme by giving "ad hoc" advice when needed.

14. Prepare a comprehensive manual.

ANNEX III.

PROJECT BUDGET

Budget Line	DESCRIPTION	w/m	US$
11-50	Short-term consultants - (***1. IPM; 2. non-soil techniques; 3. steam pasteurization; and 4. solarization***;)	4.0	75,000.
21-00	Subcontract for local trials as per **Annex IV.**	120.0	127,000.
32-00	Study tour (*04 participants*)		18,000.
35-00	Three local workshops, 20 participants each; plus one international workshop for selected art. 5 countries.		20,000.
41-00	Equipment, as per specifications in **Annex I.**	76,000.	
51-00	Publication costs		4,000.
	SUBTOTAL		**320,000.**
51-00	Contingencies (*10%*)		32,000.
	TOTAL PROJECT COSTS		**352,000.**
	OVERHEAD COSTS (*13%*)		45,760.
	TOTAL PROJECT BUDGET		**397,760.**

ANNEX IV.

PRELIMINARY TERMS OF REFERENCE FOR THE SUBCONTRACT

The subcontractor is expected to provide the following services or inputs:

1. The services of local experts as follows:

   1 National Project Coordinator (*NPC - Expert in IPM - **24 months***)

   2 National Agronomists (***total of 48 months of work***)
   - National Expert in Crop Pest Control (*NECPC*)
   - National Field Manager (*NFM*)

   2 National Agricultural Technicians (***total of 48 months of work***)

2. Transportation for the local experts, from the premises to the demonstration fields.

3. Transportation for the international experts, from the central premises to the demonstration fields.

4. At least 40 demonstration trials plots of no less than 200 m^2 each.

5. Soil preparation, planting and implementation of alternative pest control technologies as determined by the international experts.

6. Fuel-oil for the steam boiler.

7. The services of manual workers, to implement the above and for the regular maintenance of the plots.

8. Collecting, processing, analysing and consolidating the field data in a final report.

9. Preparation of a paperback publication containing a description of the results obtained. (*200 copies*)

10. Organization of three (*2- or 3-day*) workshops, including visits to the field, for qualified specialists invited by UNIDO from Kenya and the neighbouring countries (*Article 5 countries*).

ANNEX V.a

UNIDO
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
JOB DESCRIPTION
xx/KEN/98/xxx/11-51

Post title:	Consultant, specialist in Integrated Pest Management (*IPM*)
Duration:	6.0 weeks
Date required:	1998
Duty station:	Nairobi and Naivasha, Kenya (*with other possible travel within the country*)
Purpose of project:	To demonstrate the technical and economical feasibility of four alternative methods to the use of methyl bromide as a fumigant in ornamental plants i.e., solarization, non-soil cultivation techniques, steam pasteurization and application of alternative chemicals, all in combination with an IPM programme. Disseminate the results among qualified specialists from Article 5 countries.
Duties:	The Consultant is expected to:

1. Prepare a detailed work plan.

2. Coordinate the whole demonstration programme in co-operation with the national and international experts and the National Institutions.

3. Prepare an IPM programme for implementation in combination with the four selected alternative methods.

4. Design and monitor a programme to demonstrate the use of different doses of various chemicals in combination with IPM as an alternative to the use of methyl bromide.

5. Propose a plan for monitoring the implementation of the demonstration programmes for soilless cultivation (*in open circuit*), steam pasteurization and solarization technologies prepared by the other international consultants.

6. Design and propose a monitoring programme for the implementation of the demonstration tests on a full-scale commercial basis.

7. Collaborate in the design and the execution of a practical training programme on IPM directed to the National Counterparts.

8. Review the draft document with the technical and economic data resulting from the demonstration cases of the alternative technologies.

9. Prepare a succinct mission report. The report is to be submitted in 2 hard copies along with the diskette using WP 5.1. or WP for Windows.

Qualifications:	University degree in agronomy or related field, with extensive experience in Integrated Pest Management.
Language requirements:	English.

ANNEX V.b

UNIDO
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
JOB DESCRIPTION

xx/KEN/98/xxx/11-52

Post title:	Consultant, specialist in soilless cultivation techniques (*open circuit*) with organic and inert media.
Duration:	3.0 weeks.
Date required:	1998
Duty station:	Nairobi and Naivasha, Kenya (*with other possible travel within the country*)
Purpose of project:	To demonstrate the technical and economical feasibility of four alternative methods to the use of methyl bromide as a fumigant in ornamental plants i.e., solarization, non-soil cultivation techniques, steam pasteurization and application of alternative chemicals, all in combination with an IPM programme. Disseminate the results among qualified specialists from Article 5 countries.
Duties:	In cooperation with the expert on IPM, the Consultant is expected to:
	1. Examine the availability of organic and inert media in the area, as well as its cost effectiveness.
	2. Design, implement and monitor a programme to demonstrate the use of soilless media in combination with IPM as an alternative to the use of methyl bromide.
	3. Design and propose a monitoring programme for the implementation of the demonstration tests on a full-scale commercial basis.
	4. Design and conduct a programme to demonstrate the pasteurization and re-utilization of the different media.
	5. Design and execute a practical training programme on soilless cultivation methods and the re-utilization of the media directed to the national counterparts.
	6. Review the draft document with the technical and economic data resulting from the demonstration cases of the alternative technologies.
	7. Prepare a succinct mission report. The report is to be submitted in 2 hard copies along with the diskette using WP 5.1. or WP for Windows.
Qualifications:	University degree in agronomy or related field, with extensive experience in soilless cultivation techniques.
Language requirements:	English.

ANNEX V.c

UNIDO
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
JOB DESCRIPTION

xx/KEN/98//11-53

Post title:	Consùltant, specialist in Soil Steam Pasteurization.
Duration:	4.0 weeks
Date required:	1998
Duty station:	Nairobi and Naivasha, Kenya (*with other possible travel within the country*)
Purpose of project:	To demonstrate the technical and economical feasibility of four alternative methods to the use of methyl bromide as a fumigant in ornamental plants i.e., solarization, non-soil cultivation techniques, steam pasteurization and application of alternative chemicals, all in combination with an IPM programme. Disseminate the results among qualified specialists from Article 5 countries.
Duties:	In cooperation with the expert on IPM, the Consultant is expected to: 1. Design, implement and monitor a programme to demonstrate the use of steam injection in combination with IPM as an alternative to the use of methyl bromide. 2. Design and propose a monitoring programme for the implementation of the demonstration tests on a full-scale commercial basis. 3. Design and execute a practical training programme on steam pasteurization directed to the National Counterparts. 4. Review the draft document with the technical and economic data resulting from the demonstration cases of the alternative technologies. 5. Prepare a succinct mission report. The report is to be submitted in 2 hard copies along with the diskette using WP 5.1. or WP for Windows.
Qualifications:	University degree in agronomy or related field, with extensive experience in steam pasteurization techniques.
Language requirements:	English.

ANNEX V.d

UNIDO
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
JOB DESCRIPTION

xx/KEN/98//11-54

Post title:	Consultant, specialist in Soil Solarization
Duration:	3.0 weeks
Date required:	1998
Duty station:	Nairobi and Naivasha, Kenya (*with other possible travel within the country*)
Purpose of project:	To demonstrate the technical and economical feasibility of four alternative methods to the use of methyl bromide as a fumigant in ornamental plants i.e., solarization, non-soil cultivation techniques, steam pasteurization and application of alternative chemicals, all in combination with an IPM programme. Disseminate the results among qualified specialists from Article 5 countries.
Duties:	In cooperation with the expert on IPM, the Consultant is expected to: 1. Design, implement and monitor a programme to demonstrate the use of solarization in combination with IPM as an alternative to the use of methyl bromide. 2. Design and propose a monitoring programme for the implementation of the demonstration tests on a full-scale commercial basis. 3. Design and execute a practical training programme on soil solarization directed to the National Counterparts. 4. Review the draft document with the technical and economic data resulting from the demonstration cases of the alternative technologies. 5. Prepare a succinct mission report. The report is to be submitted in 2 hard copies along with the diskette using WP 5.1. or WP for Windows.
Qualifications:	University degree in agronomy or related field, with extensive experience in Soil Solarization
Language requirements:	English.