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**PROJECT DOCUMENT**

| | |
|---|---|
| COUNTRY: | Dominican Republic |
| PROJECT TITLE: | Demonstration Project - Alternatives to the use of methyl bromide: soil pasteurization, non-soil cultivation, biological control, solarization with biofumigation, and low-dose chemicals, all in combination with an Integrated Pest Management system. |
| SECTOR COVERED: | Horticulture (melons, flowers, tomatoes) and tobacco. |
| ODS USE BY SECTOR: | 170 tonnes (68 to 102 ODP-weighted tonnes, based on recent methyl bromide ODP estimates of 0.4 to 0.6) |
| PROJECT DURATION: | 24 months |
| TOTAL PROJECT COSTS: | $335,500 |
| OVERHEADS OF IMPLEMENTING AGENCY: | $43,615 |
| PROPOSED FINANCING BY MULTILATERAL FUND: | $379,115 |
| COUNTERPART INSTITUTIONS: | Junta Agroempresarial Dominicana (JAD) and Instituto del Tabaco (INTABACO) |
| IMPLEMENTING AGENCY: | United Nations Industrial Development Organization (UNIDO) |
| COORDINATING INSTITUTION: | Secretaria de Estado de Agricultura, Comite Gubernamental de Ozono (SEA/COGO) |

PROJECT IMPACT: The project will demonstrate proven alternatives to the use of methyl bromide as a fumigant in horticulture and tobacco. The chosen alternatives are soil pasteurization, biofumigation with solarization, non-soil cultivation, biological control, and application of low doses of other pesticides, all in combination with an Integrated Pest Management system (IPM). Implementation of the project will involve providing appropriate equipment for soil pasteurization, soilless cultivation, and re-utilization of the media, as well as training in all technologies. It will also include the preparation of a technical and economic assessment of the technologies used and the dissemination of the results among qualified specialists.

## INDEX

## 1. INTRODUCTION

This document presents a proposal to conduct a demonstration project in the Dominican Republic to assist the horticultural and tobacco sectors identify and test alternatives to methyl bromide for control of soil borne pests, such as nematodes and fungi, as well as weeds. This assistance is needed because methyl bromide is used as an input in the production of several economically important crops, and the ability of farmers to replace methyl bromide with alternatives will be enhanced through successful demonstration of alternatives and strengthening of in-country expertise.

This project is being sponsored by the United Nations Industrial Development Organization (UNIDO) and the government of the Dominican Republic through its Agricultural Ministry (Secretaria de Estado de Agricultura -- SEA) and its ozone protection unit (Comite Gubernamental de Ozono -- COGO).

The document contains the following key sections:

- Section 2 provides background and justification for the project, including a discussion of methyl bromide use in the Dominican Republic and the importance of helping farmers develop economically viable alternatives.
- Section 3 describes the proposed project, including an outline of the project objectives, a description of the alternative technologies available for demonstration, and a detailed description of how the project will be implemented.
- Section 4 provides an overview of the activities and outputs that will be generated by the project and the timeline by which the project will be implemented.
- Section 5 provides an assessment of the funding required to implement the project.
- Annex A provides the equipment specifications for the project.
- Annex B presents the preliminary Terms of Reference for the subcontracts.
- Annex C presents the job descriptions for positions needed to support the project.
- Annex D provides the project budget.
- Annex E is a summary of the field visits to participating companies.
- Annex F is the official government request for the project.

## 2. BACKGROUND AND JUSTIFICATION

### The Importance of Methyl Bromide Consumption in the Dominican Republic

Agriculture in the Dominican Republic generated about seven percent of Gross Domestic Product (GDP) in 1997. The importance of this sector to the national economy is underscored by the production of many export crops, including melons, sugar cane and its derivatives, coffee and coffee beans, cocoa beans, tobacco, bananas, and tomatoes. These and other crops are produced on over 106,000 hectares of cultivated land. Table 1 presents the value of agricultural exports from 1993 to 1996. As the Table shows, the value of agricultural exports has increased 53 percent from 1993 to 1996 and now exceeds US$0.5 billion.

**Table 1. Agricultural Exports of Dominican Republic (in thousands of U.S. dollars)**

| 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|
| $416,399 | $529,674 | $554,940 | $635,440 |

Source: Junta Agroempresarial Dominicana 1998.

Consumption of methyl bromide has also recently increased. Total methyl bromide consumption for agricultural purposes has been provided by the Ministry of Agriculture in the Dominican Republic. As shown in Table 2, consumption of methyl bromide has increased from 56.5 tonnes in 1991 to 170.0 tonnes in 1997.

**Table 2. Methyl Bromide Consumption (in metric tons)**

| 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|
| 56.5 | 72.0 | 78.5 | 82.0 | 115.0 | 140.0 | 170.0 |

Source: Comite Gubernamental de Ozono 1998.

A profile of methyl bromide usage in the Dominican Republic was evaluated through a workshop and site visits to selected farms. At the workshop, growers met with government officials to discuss preliminary data on the use of methyl bromide. Based on the information gathered at the meeting, a field mission to major farms using methyl bromide for key crops was planned. Details on the results of this mission are provided in Annex E. In summary, the workshop and the field mission indicated the following:

- The major users of methyl bromide in the country are growers that use methyl bromide to treat soils prior to planting tomatoes, melons, cut flowers, and tobacco.
- Methyl bromide is used in a formulation containing two percent chloropicrin.
- Although most growers use methyl bromide for control of soil borne fungi and nematodes, some also rely on the fumigant for control of weeds.
- Alternatives to methyl bromide have been tested. Recent alternatives testing in the Dominican Republic include Basamid®, compost, *Trichoderma*, soilless substrates, and herbicides.
- Based on the initial alternatives testing, farmers were not convinced that the available alternatives can be used to successfully replace methyl bromide usage. The reasons for

dissatisfaction with the alternatives varied and included cost, unsatisfactory control of certain pests, and lack of availability.

**The Need for Assistance with Demonstration of Alternatives**

Given the importance of methyl bromide for several key agricultural sectors in the Dominican Republic, and the importance of agriculture to the economy, assistance in identifying, demonstrating, and evaluating alternatives is critical. Several issues concerning replacement of methyl bromide with alternatives were raised during the meetings and farm visits. Perceptions voiced by growers include:

- There is an economic advantage associated with using methyl bromide compared to the readily available alternatives. Further, farmers are concerned about lost productivity that may result from adoption of alternatives.
- Methyl bromide is preferred because it offers broad-spectrum control of soil pests, whereas some of the alternatives can only be used for more specific and targeted applications.
- Based on their initial tests of alternatives in the field, several farmers requested more detailed economic analysis to help determine cost effectiveness, while others indicated the need for international consultants to share with them the experiences of farmers from other countries.
- Overall, many growers were not familiar with some of the research being conducted on chemicals such as chloropicrin and metham sodium and all were interested in participating in an initiative to design and test alternative methods of controlling soil pests for economically important crops in the Dominican Republic.

Government officials also stressed the importance of helping farmers implement alternatives to methyl bromide. Each of the farms visited are important contributors to the national economy and together provide over 2,000 jobs to the local population. The vegetable farms in the northwest part of the country expect continued growth, and can be strong leaders in the demonstration of alternatives to methyl bromide for production of vegetables. The flower farms of Jarabacoa are constantly seeking efficiency improvements to maintain competitiveness in international markets and expressed interest in implementing alternatives to methyl bromide that are proven to be cost effective. Tobacco growers indicated a strong need for an alternative method of weed control. Some of the herbicides that farmers have tested were toxic to the tobacco seedlings. Assistance in identifying alternative chemicals that can be targeted for weed control will be needed.

## 3. PROJECT DESCRIPTION

This section provides a description of the proposed project. Specifically, this section identifies the project objectives, outlines the proposed methodology, presents the proposed alternative technologies, and provides an overview of how the project will be implemented.

**Project Objectives**

There are four main objectives of the project:

- Demonstrate the application of treatments that can be used to control pests currently treated with methyl bromide, both on a small-scale experimental level and on a larger-scale commercial level;

- Help farmers evaluate the cost effectiveness of the various options available to them;

- Strengthen communication and increase sharing of knowledge about alternatives to methyl bromide both within the Dominican Republic and between countries that use methyl bromide for controlling soil borne pests; and

- Increase the knowledge base of agricultural experts in the Dominican Republic.

**Methodology**

Overview

The project objectives will be met through the implementation of a program that will involve field trials, analysis, and outreach. Given the existing expertise in the Dominican Republic, the program will strive to rely on in-country experts to the maximum extent practicable. The demonstration trials will be conducted at sites where crops currently produced with methyl bromide are grown. The main products targeted are tomatoes, melons, tobacco, and cut flowers.

The primary alternatives that will be tested and evaluated are soil pasteurization, non-soil cultivation techniques, biological control, and application of various mixtures of other chemicals in low doses. The project will stress the importance of combining approaches, where appropriate, and focusing pest control efforts using an integrated pest management system. Results will be disseminated to other interested parties from the Dominican Republic and other Article 5 countries.

The demonstration program in the Dominican Republic will consist of two phases, each lasting one year. During the first phase (year 1), small experimental plots will be designed and used to demonstrate to farmers the use of alternative technologies. Before the planting season begins, a workshop will be held to ensure participating stakeholders understand the goal of the project, the approach that will be used, and the responsibilities each stakeholder faces. During the experimental phase, farms hosting the experimental trials will agree to allow others interested in the project to observe the results. At the end of the first year, a workshop will be held to discuss the results of the first trials and to design the second phase of the program. This will include, for instance, selecting the preferred alternative technology for each crop that will be implemented on a larger scale.

During the second phase (year 2), the preferred alternative technology for each crop will be implemented on pilot plots at a commercial-scale level. At the end of the second year, the results of the project will be summarized in a report for distribution, and seminars will be held to share the findings.

For the experiments, alternative technologies will be compared to a methyl bromide plot and a control plot that receives no treatment. For the methyl bromide plots, no changes to the typical preparation and planting procedures will occur. For each of the alternative treatments, preparation and planting procedures may be varied based on the specific techniques identified for the application. The exact location of the demonstration plots and the specified treatments will be determined by the coordinating institutions and UNIDO with input from the national experts.

A variety of data will be gathered during the experiment to help evaluate the effectiveness of the treatments. Exact timing of the data gathering will be determined by the project directors in collaboration with the project coordinators. The data collected will include measures of soil pest pressures such as nematode, weed, and fungal counts, disease incidence, and root galling, and may include measures of crop productivity, including total marketable yield, fruit size, and general observation of plant health. Data will be gathered by a field worker who will supervise the process and will file a report that will be sent to the appropriate personnel for processing and analysis.

Analyses to assess the effectiveness of the alternative treatments will include an assessment of the cost effectiveness of the treatment as compared to methyl bromide and the control.

Demonstration of Alternative Technologies

Alternatives to methyl bromide will be demonstrated for four crops -- tomatoes, melons, cut flowers, and tobacco. The following well-proven alternative techniques are identified as candidates for demonstration for these crops:

- Use of Integrated Pest Management (IPM).
- Use of a combination of various fumigants, herbicides, fungicides, or nematicide.
- Use of steam (for nursery soil) or solarization combined with biofumigation (for field soil).
- Use of non-soil culture media, either organic or inert, for production of either seedlings or crops.
- Use of biological control agents.

Table 3 provides an overview of the alternative treatments for each of the crops.

**Table 3. Alternative Treatments for Crops in the Dominican Republic**

| Alternative Treatment | Crops | | | |
|---|---|---|---|---|
| | Tomatoes | Melons | Cut Flowers | Tobacco |
| Integrated Pest Management | ✓ | ✓ | ✓ | ✓ |
| Low dose pesticides | ✓ | ✓ | ✓ | ✓ |
| Soil pasteurization (steam) | | | ✓ | ✓ |
| Soil biofumigation with solarization | ✓ | ✓ | ✓ | ✓ |
| Soilless substrates | ✓ | | ✓ | ✓ |
| Biological control | | ✓ | ✓ | |

*Integrated Pest Management (IPM)*

Integrated pest management (IPM) relies on knowledge about pest population levels to determine the appropriate type of treatment and/or management practice to prevent populations from reaching damaging levels. A good IPM program attempts to maintain population levels below damaging levels using a variety of techniques. Specifically, IPM makes use of all possible resources - not just chemical control - to reduce and prevent the incidence and effects of a given disease or pest. 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, and segregating

nurseries from production facilities. IPM leads to far less usage of chemical pesticides and, according to specialists, is at present the only real and last lasting solution to severe diseases and pests attacking many crops.

Combining technologies with 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. For example, Colombian cut flower growers that use an IPM approach report annual losses of only 1-2 percent due to bacterial and fungal diseases, as compared to much higher losses when relying on methyl bromide. The IPM approach is not only environment-friendly, but is also economically feasible.

*Soil Pasteurization in Combination with IPM*

One pest management tool that can be used as part of an IPM program is pasteurization of the soil using steam. The goal of the treatment is to heat the soil in order to inactivate nematodes, fungi, and weeds. Steam treatments have been practiced for over a century. Steam sterilization can be an effective pest control method for many nursery crops, including ornamental bedding plants, potted foliage and flowering house plants, fresh cut flowers and greens, bulbs, container perennials, propagating material, vegetable starts, greenhouse grown vegetables, garden seeds, and sod. As a replacement to methyl bromide, steam is most applicable for nursery soils and containers, and might prove to be cost effective in the case of seedbeds, as has been shown by the extensive use of this technique by several firms in the cut flower sector in Colombia, the United States, the Netherlands, and the Dominican Republic.

There are several advantages afforded by steam sterilization. Specifically, steam sterilization:

- can be a highly efficient, cost-effective technology for the control of soil-borne pathogens, pests, and weeds;
- can eliminate the need for tarps and fumigants;
- can be a neat, clean, and easy-to-use control technology, leaving no toxic residues or fumes and is therefore less harmful to other greenhouse crops and growers (with no toxic fumes, workers can harvest or plant new cuttings in adjacent fields);
- is non-selective (lethal to all pests);
- requires little aeration time (steamed soils can be planted as soon as they cool, whereas chemically treated soils can have a relatively long treatment and aeration period); and
- can also be used to disinfest non-soil substances such as perlite, peat, and compost and can be adaptable to many situations (i.e., most types of boilers used to heat greenhouses can be adapted to supply steam for sterilizing benches or soil bins).

If deemed necessary, steam sterilization can be used in combination with other control mechanisms, such as nematicides, botanicals, soil amendments, and biological control agents. For example, one possible biocontrol agent that has been used successfully in combination with alternatives such as steam is the fungal antagonist, *Trichoderma*, which has been shown to increase biological control and horticultural productivity. *Trichoderma* can hasten flowering of periwinkle, increase the number of blooms in petunias and chrysanthemums, and increase dry weights of flowers and vegetables such as tomato, pepper, and cucumber.

*Biofumigation with Solarization in Combination with IPM*

Solarization is a recently developed technique that consists of heating the soil in a field by covering it with a plastic sheet (i.e., tarp). Solarization is a hydrothermal process that can be used in moist soils covered with clear plastic tarps and exposed to direct sunlight in tropical climates or during warm

summer months in more temperate regions. Solarization traps solar radiation, and thereby heat, in the soil in order to raise temperatures sufficiently to suppress or eliminate soil-borne pests and pathogens. The IPM component is required to complement the efficiency of solarization against pests.

Solarization is applicable for field soils, especially if there is a period of time during the hot season during which the fields will remain fallow. The usefulness of the technique depends on climatic conditions, adequate soil moisture, and good application procedures. Solarization as a preplant soil treatment to control soilborne pathogens and pests can be a viable alternative to methyl bromide for shallow-rooted, short-season crops.

Solarization offers several advantages. In particular, solarization:

- can be effective against a broad spectrum of soil diseases, fungi, weeds, nematodes, insect pests and most soilborne bacteria;
- causes complex changes in the biological, physical, and chemical properties of the soil that improve plant development, growth, quality, and yield for up to several years;
- in areas with a suitable climate, can be used alone or in combination with lethal or sublethal fumigation or biological control to provide an effective substitute to methyl bromide;
- in addition to disinfecting the soil while reducing or eliminating the need for fumigants, leaves no toxic residues;
- conserves water; and
- can serve as a mulch when maintained as a row cover during the growing season.

In certain climates, solarization alone may not adequately heat the soil to control pests. In these situations it is possible to combine biofumigation techniques with solarization. Biofumigation consists of adding organic material to soil that will release heat and/or biocidal off-gases (e.g., methyl isothiocyanate) during the decomposition process. Organic material can be added as either compost, or can be grown in-situ and be directly incorporated into the soil. The combined effects of solarization and biofumigation can result in sufficient control of soilborne pests. Diseases that have been shown to be effectively suppressed by solarization and compost use include those caused by *Fusarium*, *Phytophthora*, *Pythium*, and *Rhizoctonia solani*. Addition of organic amendments can also create soil that allows for better water transmission, thereby decreasing the potential for disease development. Use of compost is particularly valuable as a way to utilize what would often be considered waste products: tree barks, municipal solid waste components, green wastes, peanut hulls, and sewage sludge.

*Soilless Media*

In nurseries, glasshouses, and seedbeds, as well as in other cases, synthetic or natural sterilized soil substitutes provide a reliable planting substrate which can resist infestation by fungi, nematodes, and weeds. The experience accumulated through years of commercial cropping of tomatoes, cantaloupes, pepper, and strawberries is now extensive and the use of soil alternatives is currently predominant in many countries.

Soilless media might be roughly classified into two classes: organic and inert. Both types are appropriate for production of most crops. The choice of materials is often driven by local availability and cost. Organic media are often available locally and can be an inexpensive alternative to soil culture. Some widely used organic media include peat, grain-hulls, certain crop residues (e.g., corn husks), and waste bark. Organic media can be often be sterilized with steam and re-utilized. Inert

media include rock wool, perlite, vermiculite, polyurethane, expanded clay, and polystyrene. Some inert media can also be re-extruded.

Inert soilless media are extensively used in the Netherlands, Italy, and Denmark for production of fruits, vegetables, and cut flowers. Also, the tobacco nursery industry in the United States is rapidly shifting from the outdoor seedbed method, which requires fumigating the soil (often with methyl bromide), to on-farm greenhouses, which use soilless systems instead of methyl bromide fumigation. The shift is occurring primarily because growing seedlings in greenhouses is less labor intensive and therefore can be less costly in the long run. There are several types of greenhouse production systems including the direct-seeded float system, the overhead watering system, and the plug and transfer system. The direct-seeded float system, which provides plants with water and nutrients through a waterbed, is the most common system in the United States. Direct-seeded float systems use a variety of commercially prepared and sanitized media. The most commonly used media preparations contain 50 percent peat and 50 percent vermiculite; these man-made mixtures can be sterilized using steam treatments.

*Low-dose Chemicals in Combination with IPM*

Combination treatments, the use of a variety of narrow spectrum pesticides and/or fumigants, have the potential to control all pests and/or maintain pest populations below economic threshold levels (i.e., the point at which the marginal benefits equal the marginal cost of application) in the production of many different types of crops. The application of IPM can greatly reduce the required pesticide dosage. Reduction in the use of synthetic chemical treatments can also be achieved through use of pesticides manufactured from naturally occurring plant extracts. Technically feasible combination treatments include:

- one or more narrow spectrum pesticides combined with a fumigant, solarization, or steam;
- a combination of fumigants (e.g., 1,3-dichloropropene, metham sodium, and chloropicrin);
- use of pesticides made from plant extracts; and
- a fumigant combined with solarization.

Following are brief descriptions of some of the key alternative fumigants:

- ***Basamid®.*** Basamid® Granular, a chemical soil sterilant, is a technically feasible and cost-effective chemical alternative to methyl bromide. The pesticide's active ingredient breaks down into methyl isothiocyanate when Basamid® comes into contact with water. Basamid® has a broad spectrum of effectiveness against soilborne pests including nematodes, fungi and weeds. It offers advantages over existing soil sterilizing procedures or chemicals because it is relatively safe, economical, and easy to use. Basamid® is a solid material, and, as such, the product stays inert until application. Basamid® may be purchased in large quantities and stored easily, and overall, the product may decrease possible worker health risks compared to methyl bromide. In addition, environmental degradation is rapid with a half life of less than 24 hours under favorable conditions.

- ***Chloropicrin.*** Preplant soil treatment with chloropicrin (trichloronitromethane) alone, or in combination with other soil fumigants and pest control measures, can be used by growers as a pest control tool, especially for control of fungi. Chloropicrin use parameters are relatively familiar to applicators and its efficacy on economically important pests has been well documented. Chloropicrin is a restricted use pesticide and is available in formulations with Telone® or as the sole active ingredient.

- ***Metham sodium.*** First marketed in the 1950's, metam sodium is a soil pesticide that has been sold under the trade names Busan®, Sectagon 42®, and Vapam®. Once in the soil, this pesticide degrades rapidly to methyl isothiocyanate, the product's primary bioactive agent. Metam sodium is a broad spectrum soil fumigant that can be used to control plant parasitic nematodes, weeds, germinating weed seeds, and soil-borne plant pathogenic fungi affecting a variety of economically important fruit and vegetable crops. This pest control tool can be a cost-effective, technically viable alternative to methyl bromide for controlling soil pests affecting high-value fruit, vegetable, and orchard crops.

- ***Telone® C-35.*** Telone® C-35, a product registered for preplant fumigation, contains 65 percent 1,3-dichloropropene (1,3-D) and 35 percent chloropicrin (an effective fungicide). Telone® C-35 and other Telone® products are recognized as effective preplant nematicides and have been proven to suppress some plant diseases (e.g., Fusarium wilt of cotton, Verticillium wilt of mint, and southern stem blight). Researchers have been investigating formulations of Telone® with varying percentages of chloropicrin for control of root-knot nematode, soil-borne diseases, and weeds. For example, Telone® C-25, Telone® C-30, and Telone® C-35 contain 25, 30, and 35 percent respectively in combination with Telone®, while Telone® II contains 1,3-D as the sole active ingredient. Increases in the percentage of chloropicrin are intended to raise the level of disease control achievable. In general, these formulations have compared favorably with methyl bromide.

*Biological Control in Combination with IPM*

Biological control can involve both direct application of biological agents to the soil as well as use of specific seed or rootstock that is resistant to particular diseases or pests. The application of biological control agents to the soil, especially in combination with amendments of organic matter, has been shown to greatly reduce disease incidence and increase the health of the crop. Successful implementation of this approach has allowed certain growers to produce a variety of crops without the use of methyl bromide, including nursery crops, fruits, and field crops. One organism in particular that has been shown to control soil borne pests includes *Trichoderma.* This approach can be particularly useful if used in conjunction with IPM practices such as crop rotation.

Expanding the use of resistant rootstocks, in combination with Integrated Pest Management (IPM) practices, may also help to reduce the need for soil fumigation with methyl bromide for many crops. Research is being conducted to identify disease-resistant germplasm for a variety of crops that currently receive methyl bromide treatments at planting. It is believed that germplasm with resistant traits may be useful for grafting, as well as the development of new cultivars. Specifically, with regard to reducing the need for soil fumigation, the primary use of grafting will be to increase disease and nematode resistance through the use of select rootstock with known resistance to soilborne pests. Currently, grafted plants are widely used in the United States for a variety of orchard and vineyard crops (e.g., apples, grapes). Other countries also have experience with grafting techniques. For example, in Japan, where land use is intensive and the availability of new farmland is scarce, almost 95 percent of the watermelons (Citrullus lamanis), Oriental melons (Cucumis melo var. makuwa), greenhouse cucumbers (Cucumis sativus), and solanaceous crops are grafted before being transplanted to the field or greenhouse. In 1992, Japan cultivated almost 24,000 hectares of grafted watermelon seedlings in the field, and over 3,000 hectares in the greenhouse. Most of the Oriental melons are grafted to squash rootstocks (Curcurbita spp.). Watermelons and cucumbers are grafted with either gourd stocks (Lagernaria siceraria or C. ficifolia) or mixed hybrids (e.g., C. maxima x C. moschata).

**Project Implementation**

The project will be implemented by UNIDO in close cooperation with the institutions and coordinating agencies in the Dominican Republic. 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.

Project Coordination

The Dominican government's ozone protection unit (COGO) will coordinate the project. COGO has agreed to support this demonstration project, in accordance with the guidelines of the Montreal Protocol and the Country Program Projects. COGO is experienced in managing projects involving the phaseout of ozone depleting substances. Further, housed in the National Ministry of Agriculture, COGO is well positioned to coordinate activities under this assignment.

Two counterpart institutions will be in charge of implementing the day-to-day operations. The Junta Agroempresarial Dominicana (JAD) will be one counterpart institution, in charge of operations for the tomato, melon, and flower sectors. The Instituto del Tabaco (INTABACO) will be the counterpart institution in charge of operations for the tobacco sector. JAD and INTABACO will be responsible for handling the logistical aspects of the field trials, including transporting materials and experts, arranging workshops, and preparing a report of the findings. Final specifications for the equipment and work plan can only be established after an agreement of the project proposal has been reached with JAD, INTABACO, and COGO.

Under the subcontract budgets for the counterpart institutions, two National Project Directors (NPD) will be responsible for the implementation of the project in close cooperation with the implementing and coordinating agencies. One NPD from JAD will handle the work in the tomato, cut flower, and melon sectors. The other NPD from INTABACO will handle the work in the tobacco sector. Each will be responsible for managing and supervising the demonstration project and evaluating the results. They will also be responsible for designing the tests, collecting and analyzing the data, supervising field activities, and coordinating the services of project personnel. Each NPD is expected to establish good working relationships with the agribusiness managers, field agronomists, government authorities and implementing agency officers and experts.

Qualifications

*Junta Agroempresarial Dominicana (JAD)*

Founded in 1984, the JAD is a private, non-profit association that serves as an umbrella organization for the majority of agricultural businesses in the Dominican Republic. By offering direct technical assistance, information, and services that contribute to the creation and transfer of technologies that benefit producers of agricultural products and the market, the JAD promotes and supports the agribusiness sector. The JAD's self-declared goals include increasing production and productivity and enhancing the quality of products and the management capability of producers so that they can become more competitive in national and international markets. With laboratory, meeting, and office facilities, and with a broad base of member farms, this organization can provide strong support for a project designed to help farmers develop and test alternatives to methyl bromide. The JAD has the

expertise, facilities, and management structure to be the counterpart institution for the tomato, melon, and flower sectors.

*Instituto del Tabaco (INTABACO)*

INTABACO is a SEA institution and is located in Santiago. The Institute has many years of experience providing technical and research support to tobacco growers in the Dominican Republic. The Institute will be responsible for managing all work under this assignment related to tobacco.

Facilities

The following sites are available for implementation of the project:

- There are two farms in the northwest part of the country, near the town of Villa Vasquez (southeast of Monte Cristi), where demonstration plots can be established. Impale Agricola, which produces tomatoes, and Rainbow Farms, which produces melons, have both offered plots for the demonstration project.

- Four farms in the flower producing region surrounding Jarabacoa (southwest of Santiago) have offered plots to conduct demonstrations. The farms include Agro Industria del Valle, Flordom, Bohio Agroindustrial, and Flores de Jarabacoa. All farms produce cut flowers.

- Two locations in the central part of the country, between Santiago and Sabaneta (west of Santiago near the Haitian border), are available for establishment of demonstration plots for tobacco. INTABACO has facilities and fields available for establishment of experimental plots. The cooperative nursery supporting the contract growers of Agroindustrias Leon Jimenez near Sabaneta has also offered plots for the demonstration.

- There are two farms in the southern portion of the country where tomatoes and melons are produced using methyl bromide. One of the farms is in the town of Azua (west of Santo Domingo), is owned by Rainbow Farms, and is available for experiment trials.

- The facilities of JAD in Santo Domingo are available as a base of operations, for conducting workshops and seminars, and for sample analysis.

- The facilities of the State University of Santo Domingo are available for integrated pest and disease management and laboratory services. These facilities can also supply the biological control agent *Trichoderma*.


North Atlantic Ocean
Monte Cristi
Puerto Plata
Santiago
San Francisco de Macoris
HAITI
La Vega
Elías Piña
Hispaniola
SANTO DOMINGO
Higüey
Haina
San Pedro de Macoris
La Romana
Barahona
Pedernales
Caribbean Sea
0 40 80 km
0 40 80 mi

## 4. PROJECT OUTPUTS AND ACTIVITIES

Tables 4, 5, and 6 provide an overview of the outputs and activities that will be undertaken as part of this project.

**Table 4. Output: Field Trials**

| **OUTPUT 1: A practical technical and economic analysis of the utilization of alternatives to methyl bromide, namely, non-soil cultivation, soil pasteurization, biofumigation with solarization, and the use of various other chemicals and/or biological control agents all in combination with an integrated pest management system. 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 | RESPONSIBLE |
| Equipment - purchase, delivery & installation as per Annex A. | 3 | UNIDO |
| Preparation of IPM program. | 3 | Subcontract |
| Application, monitoring, and evaluation of soilless technologies using at least three different locally available media and three systems. | 12 | 11-01; Subcontract |
| Application, monitoring, and evaluation of low doses of chemicals. | 12 | Subcontract |
| Application, monitoring, and evaluation of the soil pasteurization technology. | 12 | Subcontract |
| Application, monitoring, and evaluation of the biofumigation with solarization technology. | 12 | 11-02; Subcontract |
| Application, monitoring, and evaluation of the biological control techniques. | 12 | 11-03; Subcontract |
| Application of IPM principles and its monitoring throughout entire demonstration project. | 12 | Subcontract |
| Design of Phase 2 of the project. | 13 | Subcontract |
| Replication of the tests on a pilot-scale commercial basis. | 24 | Subcontract |
| Preparation of technical/economic analysis of the results. | 24 | 11-01, 11-02, 11-03; Subcontract |

**Table 5. Output: Training**

| **OUTPUT 2: At least five agronomists and/or crop specialists fully trained in the technologies implemented during the course of the demonstration project.** | | |
|---|---|---|
| ACTIVITIES | MONTH OF COMPLETION | RESPONSIBLE |
| Initial Workshop | 2 | Subcontract |
| On-the-job training on IPM | 12 | Subcontract |
| On-the-job training in soilless cultivation | 12 | 11-01 |
| On-the-job training in solarization with biofumigation | 12 | 11-02 |
| On-the-job training in biological control | 12 | 11-03 |
| Workshop at end of first phase presenting results | 13 | Subcontract |

**Table 6. Output: Dissemination of Results**

| **OUTPUT 3: Dissemination of the results of the demonstration project (locally and among qualified experts)** | | |
|---|---|---|
| ACTIVITIES | MONTH OF COMPLETION | RESPONSIBLE |
| Preparation of a draft report with the results of the first project phase | 13 | Subcontract |
| Preparation of a final publication with the results of the project | 26 | Subcontract |
| Editing and distribution of copies of the report | 26 | Subcontract |
| Organization of four 3-day seminars to present the results to local agriculturalists | 26 | UNIDO& Subcontract |

**Project Milestones**

Table 7 sets forth the proposed project milestones.

**Table 7. Project Milestones**

| YEAR | ONE | | | | TWO | | | |
|---|---|---|---|---|---|---|---|---|
| QUARTER | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Equipment, purchase & installation | ✓ | | | | | | | |
| Workshops/Seminars | ✓ | | | | ✓ | | | ✓* |
| Non-soil cultivation plus IPM | | ✓ | M | M | | | | |
| Mix of pesticides plus IPM | | ✓ | M | M | | | | |
| Steam plus IPM | | ✓ | M | M | | | | |
| Biofumigation with solarization plus IPM | | ✓ | M | M | | | | |
| Biological control plus IPM | | ✓ | M | M | | | | |
| On-the-job training for the national experts | | ✓ | ✓ | ✓ | | | | |
| Evaluate results of Phase 1 | | | | ✓ | ✓ | | | |
| Design Phase 2 of the project | | | | | ✓ | | | |
| Replication on pilot-scale commercial basis | | | | | | ✓ | ✓ | ✓ |
| Preparation of draft and final publications | | | | | ✓ | | | ✓* |
| Editing and distribution of final publication | | | | | | | | ✓* |

* Work may be completed during the first two months of the 3rd year.
M = Monitoring of treatments.

## 5. PROJECT COSTS

Detailed estimates of the project costs are provided in Annex D. Total project costs are as follows:

| | |
|---|---|
| TOTAL INCREMENTAL COSTS | $305,000 |
| Contingency Allowance | $30,500 |
| TOTAL PROJECT COSTS | $335,500 |
| Overhead Costs (13%) | $43,615 |
| FUNDING FROM THE MULTILATERAL FUND REQUESTED | $379,115 |

## 6. PRE-REQUISITES

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, raw materials, germplasm, chemical or microbiological analysis, fuel-oil, transportation of experts, etc., will have to be covered by the counterpart. Therefore, prior to the start of the implementation of the project, a memorandum of understanding will be prepared and approved by the project participants/government authorities concerned and UNIDO. The memorandum will specify all responsibilities of the counterpart and will be considered as an integral part of the project document.

## ANNEX A

## PRELIMINARY EQUIPMENT SPECIFICATIONS

Table 8 presents an overview of the equipment needs by crops.

**Table 8. Equipment Needs by Crop**

| Crop | Plastic Tarps | Irrigation and Fertilization System* | Thermometers | Tents | Soilless Trays and Accessories | Steam equipment and accessories |
|---|---|---|---|---|---|---|
| Tomatoes | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Melons | ✓ | ✓ | ✓ | ✓ | | |
| Cut Flowers | ✓ | ✓ | ✓ | ✓ | | ✓ |
| Tobacco | ✓ | ✓ | ✓ | ✓ | ✓ | |

* Irrigation and fertilization systems are needed for the experimental plots to allow researchers the flexibility to specify alternative treatments without hindrance from the existing commercial operational systems and procedures of the facility.

Preliminary equipment costs are as follows:

| ITEM | DESCRIPTION | TOTAL COST (in US dollars) |
|---|---|---|
| 1. | One compact steam boiler, and related accessories, including mobile platforms, flexible pipe for steam, flexible diffusion pipes, plus fittings, connecting devices, filters, waterproof electrical connections, and fuel tank. | $27,000 |
| 2. | Auxiliary equipment, consisting of tents, 85-cm bulb thermometers, polyethylene, latex paint, irrigation/fertilizing system for 4 experimental sites, etc. | $14,000 |
| 3. | Trays, media and accessories for non-soil cultivation | $20,000 |
| | TOTAL | $61,000 |

## ANNEX B

## PRELIMINARY TERMS OF REFERENCE FOR THE SUBCONTRACTS

This Annex contains the preliminary Terms of Reference for two separate subcontracts:

- Subcontract 1: Counterpart Institution for Tomatoes, Melons, and Cut Flowers
- Subcontract 2: Counterpart Institution for Tobacco

## ANNEX B

## PRELIMINARY TERMS OF REFERENCE FOR SUBCONTRACT

### Counterpart Institution: Tomatoes, Melons, and Cut Flowers (Budget Line 21-01)

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

1. Manage the services of 6 local experts (Posts 17-01 through -06), as described in Annex C, namely:

   - 1 Project Director, who will manage the project;
   - 1 Agro-economist, who will handle the analysis of cost effectiveness;
   - 3 IPM Specialists, who will help design and implement the program; and
   - 1 Crop Protection Specialist, who will provide technical expertise.

2. Handle transportation for the local experts from the central premises to the demonstration fields for implementation of the experimental and demonstration activities (approximately 60 days of vehicle travel over two years).

3. Handle transportation for the international experts from the central premises to the demonstration fields to assist with training and design and implementation of the program (approximately 10 days of vehicle travel over two years).

4. Manage approximately 50 experimental trial plots of approximately 10 square meters each:

   - Tomatoes. Three treatments, one methyl bromide application, and one control plot, with three replicates;
   - Melons. Three treatments, one methyl bromide application, and one control plot, with three replicates;
   - Cut Flowers. Four to five treatments, one methyl bromide application, and one control plot, with three replicates.

5. Manage three demonstration trials plots of no less than 3,000 square meters (0.3 hectares) each.

6. Prepare soil, plant with own vegetable material, and implement alternative pest control technologies as determined by the project coordinators.

7. Provide fuel-oil for the steam boiler.

8. Contract the services of manual workers to implement the above and for the regular maintenance of the plots.

9. Organize two workshops at the beginning and end of the first year for 60-75 individuals. Coordinate with the counterpart institution responsible for the tobacco sector as needed.

10. Develop and produce 200 copies of a publication containing a description of the results obtained for tomatoes, cut flowers, tobacco, and melons.

## ANNEX B

## PRELIMINARY TERMS OF REFERENCE FOR SUBCONTRACT

### Counterpart Institution: Tobacco (Budget Line 21-02)

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

1. Manage the services of 4 local experts (Posts 17-07 through -10), as described in Annex C, namely:

    - 1 Project Director, who will manage the project;
    - 1 Agro-economist, who will handle the analysis of cost effectiveness;
    - 1 IPM Specialist, who will help design and implement the program; and
    - 1 Crop Protection Specialist, who will provide technical expertise.

2. Handle transportation for the local experts from the central premises to the demonstration fields for implementation of the experimental and demonstration activities (approximately 20 days of vehicle travel over two years).

3. Handle transportation for the international experts from the central premises to the demonstration fields to assist with training and design and implementation of the program (approximately 4 days of vehicle travel over two years).

4. Manage 15 experimental trial plots (three treatments, one methyl bromide, one control, each with three replicates) of approximately 10 square meters each.

5. Manage one demonstration trial plot of no less than 3,000 square meters (0.3 hectares).

6. Prepare soil, plant with own vegetable material, and implement alternative pest control technologies as determined by the project coordinators.

7. Provide fuel-oil for the steam boiler (if applicable).

8. Contract the services of manual workers to implement the above and for the regular maintenance of the plots.

9. Organize two workshops at the beginning and end of the first year for 20-25 individuals from the Dominican Republic. Coordinate with the counterpart institution responsible for the horticultural sector as needed.

10. Provide required information to the counterpart institution responsible for developing and producing 200 copies of a publication containing a description of the results obtained for tomatoes, cut flowers, tobacco, and melons.

## ANNEX C

## JOB DESCRIPTIONS

This annex provides descriptions of the following jobs that will need to be completed for successful project implementation:

- International Soilless Cultivation Expert (1)
- International Solarization and Biofumigation Expert (1)
- International Biological Control Expert (1)
- National Project Directors (2), one in charge of operations for tomatoes, melons, and cut flowers, and one in charge of operations for tobacco.
- National Crop Protection Experts (2), one to provide technical expertise for the tomato, melon, and cut flower program, and one to provide support for the tobacco program.
- National Agricultural Economics Experts (2), one to handle cost-benefit analyses for tomatoes, melons, and cut flowers, and one to handle analysis for tobacco.
- National IPM Experts (4), three to assist with design and implementation of the program for tomatoes, melons, and cut flowers, and one to design and implement the program for tobacco.

**UNIDO**
**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION**

**JOB DESCRIPTION**

| | |
|---|---|
| Post title: | International soilless cultivation expert (Budget Line 11-01) |
| Number of Positions: | One |
| Duration: | Phase 1 |
| Level of Effort: | Two weeks with one 1-week trip (0.5 man-month) |
| Date required: | 1998 |
| Purpose of project: | To demonstrate the technical and economic feasibility of four alternative methods to the use of methyl bromide in horticulture (i.e., solarization, non-soil cultivation techniques, biological control, and application of various mixtures of other chemicals in low doses, all in combination with an integrated pest management system) and to disseminate the results among qualified specialists from Article 5 countries. |
| Duties: | In cooperation with the national experts, the International Expert is expected to: |

1. Determine the availability of organic and inert media in the area.
2. Assist in the design, implementation, and monitoring of a program to demonstrate the use of soilless media in combination with IPM as an alternative to the use of methyl bromide on an experimental basis.
3. Design and conduct a program to demonstrate the pasteurization and re-utilization of the different media.
4. Design and execute a practical training program on soilless cultivation methods and the re-utilization of the media.
5. Review the draft document with the technical and economic data resulting from the demonstration cases of the alternative technologies.
6. Prepare a succinct mission report.

| | |
|---|---|
| Qualifications: | University degree in agriculture or related field, with significant experience in soilless cultivation techniques. |
| Language requirements: | Spanish and English |

**UNIDO**
**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION**

**JOB DESCRIPTION**

| | |
|---|---|
| Post title: | International solarization and biofumigation expert (Budget Line 11-02) |
| Number of Positions: | One |
| Duration: | Phase 1 |
| Level of Effort: | Two weeks with one 1-week trip (0.5 man-month) |
| Date required: | 1998 |
| Purpose of project: | To demonstrate the technical and economic feasibility of four alternative methods to the use of methyl bromide in horticulture (i.e., solarization, non-soil cultivation techniques, biological control, and application of various mixtures of other chemicals in low doses, all in combination with an integrated pest management system) and to disseminate the results among qualified specialists from Article 5 countries. |
| Duties: | In cooperation with the national experts, the International Expert is expected to:<br>1. Design, implement and monitor a program to demonstrate the solarization with biofumigation technique in combination with IPM as an alternative to the use of methyl bromide on an experimental basis.<br>2. Design and execute a practical training program on the solarization with biofumigation method to control soil pests.<br>3. Review the draft document with the technical and economic data resulting from the demonstration cases of the alternative technologies.<br>4. Prepare a succinct mission report. |
| Qualifications: | University degree in agriculture or related field, with significant experience in pest control by solarization. |
| Language requirements: | Spanish and English |

**UNIDO**
**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION**

**JOB DESCRIPTION**

| | |
|---|---|
| Post title: | International biological control expert (Budget Line 11-03) |
| Number of Positions: | One |
| Duration: | Phase 1 |
| Level of Effort: | Two weeks with one 1-week trip (0.5 man-month) |
| Date required: | 1998 |
| Purpose of project: | To demonstrate the technical and economic feasibility of four alternative methods to the use of methyl bromide in horticulture (i.e., solarization, non-soil cultivation techniques, biological control, and application of various mixtures of other chemicals in low doses, all in combination with an integrated pest management system) and to disseminate the results among qualified specialists from Article 5 countries. |
| Duties: | In cooperation with the national experts, the International Expert is expected to:<br>1. Design, implement and monitor a program to demonstrate the use of biological control agents in combination with IPM as an alternative to the use of methyl bromide, on an experimental basis.<br>2. Design and execute a practical training program on biological control.<br>3. Review the draft document with the technical and economic data resulting from the demonstration cases of the alternative technologies.<br>4. Prepare a succinct mission report. |
| Qualifications: | University degree in agriculture or related field, with significant experience in biological control techniques |
| Language requirements: | Spanish and English |

**UNIDO**
**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION**

**JOB DESCRIPTION**

| | |
|---|---|
| Post title: | National Project Director |
| Number of Positions: | Two (one for tomatoes, melons, and cut flowers; one for tobacco) |
| Duration: | Phases 1 and 2 |
| Level of Effort: | 2,000 man-hours for horticulture sector<br>600 man-hours for tobacco sector |
| Date required: | 1998 |
| Purpose of project: | To demonstrate the technical and economic feasibility of four alternative methods to the use of methyl bromide in horticulture (i.e., solarization, non-soil cultivation techniques, biological control, and application of various mixtures of other chemicals in low doses, all in combination with an integrated pest management system) and to disseminate the results among qualified specialists from Article 5 countries. |
| Duties: | The National Project Director is expected to: |

1. Execute the entire demonstration program in cooperation with the other national and international experts and the staff of JAD or INTABACO, as necessary.

2. Manage the preparation of an IPM program which will be implemented in combination with the alternative methods chosen.

3. Manage the design, implementation, and monitoring of an experimental program to demonstrate the use of low dose chemicals in combination with IPM as an alternative to the use of methyl bromide.

4. Manage the design, implementation, and monitoring of an experimental program to demonstrate the pasteurization method in combination with IPM as an alternative to the use of methyl bromide.

5. Manage the design, implementation, and monitoring of an experimental program to demonstrate soilless methods in combination with IPM as an alternative to the use of methyl bromide.

6. Manage the design, implementation, and monitoring of an experimental program to demonstrate the use of biological control agents in combination with IPM as an alternative to the use of methyl bromide.

7. Organize and conduct two workshops, directed to agricultural experts in-country, to present the design and results of the experimental trials.

8. Assist in the selection of alternatives to demonstrate on a pilot-scale commercial basis.

9. Manage the implementation of the demonstration tests on a pilot-scale commercial basis.

10. Help design and implement the training programs.

11. Manage the preparation of a comprehensive document outlining the technical and economic data resulting from the demonstration cases of the alternative technologies.

Qualifications: University degree in agriculture or related field, with significant experience in horticulture.

Language requirements: Spanish and working knowledge of English

**UNIDO**
**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION**

**JOB DESCRIPTION**

| | |
|---|---|
| Post title: | National crop protection expert |
| Number of Positions: | Two (one for tomatoes, melons, and cut flowers; one for tobacco) |
| Duration: | Phases 1 and 2 |
| Level of Effort: | 240 man-hours for horticulture sector<br>80 man-hours for tobacco sector |
| Date required: | 1998 |
| Purpose of project: | To demonstrate the technical and economic feasibility of four alternative methods to the use of methyl bromide in horticulture (i.e., solarization, non-soil cultivation techniques, biological control, and application of various mixtures of other chemicals in low doses, all in combination with an integrated pest management system) and to disseminate the results among qualified specialists from Article 5 countries. |
| Duties: | The National Crop Protection Expert is expected to: |

1. Assist in the preparation of the IPM program and implement it in the field.
2. Assist in the design, implementation, and monitoring of an experimental program to demonstrate the use of low dose chemicals in combination with IPM.
3. Assist in the design, implementation, and monitoring of an experimental program to demonstrate the pasteurization method in combination with IPM.
4. Assist in the design, implementation, and monitoring of an experimental program to demonstrate soilless methods in combination with IPM.
5. Assist in the design, implementation, and monitoring of an experimental program to demonstrate the biological control technique in combination with IPM.
6. Help implement the demonstration tests on a pilot-scale commercial basis.
7. Participate in the training program.

8. Help prepare a comprehensive document with the technical and economic data resulting from the demonstration cases of the alternative technologies.

9. Help organize workshops, directed to participants in the project and other agriculturalists in-country.

Qualifications: University degree in agriculture or related field, with significant experience in horticulture.

Language requirements: Spanish and working knowledge of English

**UNIDO**
**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION**

**JOB DESCRIPTION**

| | |
|---|---|
| Post title: | National agricultural economics expert |
| Number of Positions: | Two (one for tomatoes, melons, and cut flowers; one for tobacco) |
| Duration: | Phases 1 and 2 |
| Level of Effort: | 400 man-hours for horticulture sector<br>120 man-hours for tobacco sector |
| Date required: | 1998 |
| Purpose of project: | To demonstrate the technical and economic feasibility of four alternative methods to the use of methyl bromide in horticulture (i.e., solarization, non-soil cultivation techniques, biological control, and application of various mixtures of other chemicals in low doses, all in combination with an integrated pest management system) and to disseminate the results among qualified specialists from Article 5 countries. |
| Duties: | The National Expert is expected to:<br>1. Prepare a study of the cost effectiveness of each of the alternative methods chosen, as compared to the cost effectiveness of using methyl bromide, based on the demonstration program executed by JAD or INTABACO.<br>2. Provide necessary input for the preparation of a comprehensive document with the technical and economic data resulting from the experimental and demonstration cases of the alternative technologies.<br>3. Participate in the workshops and seminars. |
| Qualifications: | University degree in agricultural economics. Experience in horticulture is desirable. |
| Language requirements: | Spanish and working knowledge of English |

**UNIDO**
**UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION**

**JOB DESCRIPTION**

| | |
|---|---|
| Post title: | National IPM expert |
| Number of Positions: | Four (three for tomatoes, melons, and cut flowers; one for tobacco) |
| Duration: | Phases 1 and 2 |
| Level of Effort: | 400 man-hours for horticulture sector<br>120 man-hours for tobacco sector |
| Date required: | 1998 |
| Purpose of project: | To demonstrate the technical and economic feasibility of four alternative methods to the use of methyl bromide in horticulture (i.e., solarization, non-soil cultivation techniques, biological control, and application of various mixtures of other chemicals in low doses, all in combination with an integrated pest management system) and to disseminate the results among qualified specialists from Article 5 countries. |
| Duties: | The National Expert is expected to:<br>1. Execute, in cooperation with the other national and international experts, the entire demonstration program, in the assigned area.<br>2. Design the IPM program in conjunction with the NPD.<br>3. Participate in the technical discussions and in the training programs on alternatives to the use of methyl bromide in agriculture.<br>4. Participate in the preparation of a report on the results of the trials.<br>5. Participate in the workshops and seminars. |
| Qualifications: | University degree in agriculture, with experience in horticulture. |
| Language requirements: | Spanish and working knowledge of English |

## ANNEX D

## PROJECT BUDGET

| BUDGET LINE | DESCRIPTION | Man-months | US$ |
|---|---|---|---|
| 11-01 | International Expert | 0.5 | $8,000 |
| 11-02 | International Expert | 0.5 | $8,000 |
| 11-03 | International Expert | 0.5 | $8,000 |
| 21-01 | Subcontract for local trials, as per Annex B | | $150,000 |
| 21-02 | Subcontract for local trials, as per Annex B | | $50,000 |
| 35-01 | Final Seminar | | $20,000 |
| 41-00 | Equipment, as per specifications in Annex A | | $61,000 |
| | Subtotal | | $305,000 |
| 51-00 | Contingencies (10%) | | $30,500 |
| | TOTAL PROJECT COSTS | | $335,500 |
| | OVERHEAD COSTS (13%) | | $43,615 |
| | TOTAL PROJECT BUDGET | | $379,115 |

## ANNEX E

## SUMMARY OF FIELD VISITS

A field mission was conducted in July 1998 to determine usage of methyl bromide at farms in the Dominican Republic. The mission focused on three areas of the country: the northwest area near Villa Vasquez, where vegetable crops are produced; the central portion of the country near Santiago where tobacco is grown; and the central mountain region of Jarabacoa and Constanza, where cut flowers are produced. A brief description of the farms visited is provided below.

1. Rainbow Farms

Located near the town of Villa Vasquez in the northwest part of the country, this large farm produces melons and sweet corn and uses an average of 10 tonnes of methyl bromide a year. The manager indicated that they apply approximately 220 kgs. of methyl bromide per hectare where it is applied. The rotation is melon, melon, maize. The entire farm comprises approximately 1,500 hectares and is fully irrigated. Melons are mostly grown from manually planted seeds in plastic-tarped beds. A small greenhouse produces transplants which comprise about 5% of the annual planting. The manager is willing to set aside 28 hectares for a demonstration project.

2. Agro Industria del Valle

This flower farm is located in Jarabacoa, a high-plain valley in the mountains in the center of the country. This farm uses approximately 20 tonnes of methyl bromide a year, and applies 800 kgs. of the fumigant per hectare. A substantial portion of the 28-hectare farm is protected with plastic houses. Drip irrigation is used. Initial efforts are being made to compost the vegetative material produced on the farm. Transplants are grown in a disease suppressive non-soil substrate. Most of the production beds are soil and are fumigated with methyl bromide prior to planting. One notable production area consisted of a soilless substrate of peanut shells and coconut husks. The owner agreed to allocate 0.5 hectare as a demonstration plot.

3. Flordom

This flower farm is located in Jarabacoa, a high-plain valley in the mountains in the center of the country. This farm uses between 15 and 20 tonnes of methyl bromide a year, and applies 500 kgs. of the fumigant per hectare. Most of the planting beds are not under protection. Drip irrigation is used. This farm has tested some of the primary alternatives to methyl bromide with mixed results. The grower reported that strong control of soil-borne pests were obtained with *Trichoderma* and compost. The grower agreed to allocate a small parcel as a demonstration plot.

4. Bohio Agroindustrial

This farm produces liatris and vegetables and is located in Jarabacoa. Methyl bromide is used for the flower production fields. The manager indicated this farm uses an average of 15 tonnes of methyl bromide per year, and that they apply 500 kgs. of the fumigant per hectare. Liatris is produced from bulbs. Bulbs are treated before and after harvest. Careful attention is paid to suppliers of bulbs. The manager has an intensive plot tracking system in place that allows him to monitor yield and bulb production. Alternatives testing has indicated that cut flower yield is maintained; however, a decrease in the number of bulbs was noted. Given that the bulbs are quite expensive to purchase, alternatives must be evaluated in terms of their impact on bulb production after initial flower harvest.

Organic matter from flower crop is not reincorporated into production fields for fear of disease transmission. Rice husks are used to increase organic matter content. The farm has removed all of the greenhouse structures. The manager agreed to allocate 0.3 hectare as a demonstration plot.

5. Flores de Jarabacoa

This farm produces cut flowers and herbs. Methyl bromide is used to treat the production beds and is applied at a rate of 500 kgs. per hectare. Some alternatives such as Basamid and metham-sodium have been tested. Plants are both direct-seeded and transplanted. The farm is working to mechanize their bed tarping procedures. The technical manager agreed to allocate 2-4 hectares as a demonstration plot.

6. Jardin Constanza

This farm is located in the valley of Constanza. It is a large cut flower farm that produces both roses and mums. The farmer uses a mix of burnt rice hulls and sand as a substrate for the nursery beds. Most of the farm is under protection of plastic houses. Over the past two years, the farm has invested in a small steam generator and has implemented steam as an alternative to methyl bromide for treating the seedling beds for the mums. The grower has had such good success that the farm is now interested in trying to expand their capacity for generating steam to treat not only the seedling beds but the production beds as well. The farm manager has agreed to allocate 1 hectare as a demonstration plot.

7. Agroindustrias Leon Jimenez

With headquarters in Santiago, this large corporation works with over 150 contract farmers to produce tobacco for the domestic cigarette market. All inputs and technical support are provided to the growers by the company. One of their main farms is managed by a grower named Jose Jimenez and is located near the town of Sabaneta. This farm cooperatively produces tobacco transplants for a group of six growers. Methyl bromide is used in the seedling field primarily to control the weed *Cyperus rotundus*. Fumigation occurs in August. Seed is planted in September. Transplants are removed 45 days later. The technical managers agreed to allocate 0.5 hectare of this field as a demonstration plot.

8. Impale Agricola

Located in the northwest of the country, this farm produces tomatoes for the domestic market. Tomato transplants are produced on the farm in a greenhouse using a seed tray system. Over 3 million transplants are produced annually. The production fields are treated with Basamid prior to planting. Prior to application of the chemical the fields are irrigated. After application, the field is compacted and irrigated. After 7 days, the field is plowed. After another 7 days, the tomatoes are planted. The farm has been in operation 13 years. The owner is willing to allocate 1.5 hectares as an experimental site.

9. Instituto del Tobacco (INTABACO)

This research facility is managed by the Office of the Secretary of Agriculture in the Dominican Republic. Programs support growers of tobacco. The facility is located in Santiago. Equipment, irrigation, and land are available for demonstration trials. Technical research staff are located on-site. The Director of the Institute agreed to allocate resources for the project and was willing to facilitate collaboration with the technical staff of firms such as Agroindustrias Leon Jimenez.

## ANNEX F

## OFFICIAL GOVERNMENT REQUEST