Emergency Agricultural Livelihoods and climate resilience Project

Integrated Pest Management (IPM) Plan

NOVEMBER 21, 2018

MINISTRY OF AGRICULTURE, FOOD AND FISHERIES

Commonwealth of Dominica

ACRONYMS

BAM Banana accompanying measures
BrCA Brown Citrus Aphid
BSD Black sigatoka diseases
CGPC The Coordinating Group of Pesticides Control Boards of the Caribbean
CFC Chlorofluorocarbons
CTV Citrus tristeza virus
DEALCRP Dominica Emergency Agricultural Livelihoods and Climate Resilience Project
DSWMC Dominica Solid waste management Corporation
FAO Food Agricultural Organization
HCFCs Hdydrochlorofluorocarbons
IPM Integrated Pest Management
IPMP Integrated Pest Management Plan
MAFF Ministry of Agriculture Food and Fisheries
PCB Pesticide Control Board
PPQ Plant protection quarantine

Table of Contents

LIST OF TABLES

1.0 Background

Dominica is located in the Caribbean island chain of the Lesser Antilles between the two French islands of Guadeloupe to the North and Martinique to the South. Its coordinates, 15º20" N Latitude and 61º20" West longitude, put the island directly in the path of destructive hurricanes. The temperature range from 25 - 28ºC and the rainfall from 1,250 – 7,500 mm. The mountainous interior experiences torrential rainfall whilst the coastal lowlands receive much lesser precipitation. The vegetation is lush and diverse. This island can be said to represent the ideal tourist destination.

The agricultural sector is mainly characterized by banana, plantain, coconut, tree crops and root crop plantations. A wide range of short term vegetables are also featured. These locally grown crops provide the basis for a favourable level of food security, rural employment and the export of products to the Caribbean, North America and Europe.

Farm sizes ranged from 0.5 – 10 ha; small, subsistence farms were mainly involved in food crop, complex multiple cropping systems whilst the larger commercial farms practiced monoculture of banana and plantain, coconut, citrus, mango, avocado or root crops (dasheen, tannia, yam, cassava and sweet potato). Approximately, 30% of the total land area was under farms of which 54% was cultivated.

The management strategies implemented in agricultural production as well as climatic factors such as rainfall, temperature and humidity all influence the development of pest and the severity of the effects of these pests. Conventional farming methods in Dominica utilizes the use of both organic based and synthetic chemicals coupled with agronomic practices such as weed control, moisture control and crop rotation are practiced for the management of pests.

Dominica has taken an approach of crop management as preferred means of controlling pest and less reliance on pest management. This crop management approach provides support for the plant so that its immunity towards pest and disease is high and adverse effects will not be significant. This approach will also allow for the minimal use of pesticides and focusses more on biological and cultural way to manage the pest. To help reduce the use of toxic/harmful chemical, this project

will foster Integrated Pest Management (IPM) which is a method that establishes a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks.

2.0 Introduction

Hurricane Maria hit the island of Dominica on September 18, 2017, with catastrophic effects. Hurricane Maria made landfall as a Category 5 storm (Saffir-Simpson scale), with winds exceeding 170 miles per hour (mph). The Post-Disaster Needs Assessment (PDNA) estimated total damages at EC$2.51 billion (US$931 million) and losses of EC$1.03 billion (US$382 million), which amounts to 226 percent of 2016 GDP. The agriculture sector (33 percent), tourism (19 percent), and the transport sector (14 percent) saw the largest losses as defined by changes in economic flow.

The agriculture and fisheries sectors were among the most affected sectors and suffered high damages and losses, severely affecting the livelihoods of the predominantly small-scale farming community. An estimated 80–100 percent of root crops, vegetables, bananas, and plantains and 90 percent of tree crops were damaged. Livestock losses are estimated to be 45 percent of cattle, 50 percent of small ruminants, 65 percent of pigs, and 90 percent of chicken stocks. Together with damages to farm buildings and equipment, the crop and livestock sectors suffered a total loss estimated at US$179.6 million.

The fisheries sector was also heavily affected, where it is estimated that about 370 vessels were damaged or destroyed, as well as much of the fishing gear and engines. Overall, the situation is expected to dramatically affect crop and livestock production in 2018 and beyond, particularly vegetable, tree crop, poultry, and pork production, which would seriously threaten people's livelihoods as well as food and nutrition security. The hurricane defoliated almost all trees and totally uprooted an estimated 10-20 percent of tress, and severely damaged the entire infrastructure of the Forestry Department (forestry and national parks buildings, nurseries, trail infrastructure).

The proposed project builds on World Bank immediate response activities and post-disaster support following Hurricane Maria. Shortly after Hurricane Maria, the Contingency Emergency

Response Component (CERC) of the ongoing World Bank-supported (US$38 million) Disaster Vulnerability Reduction Project (DVRP) was triggered, channeling US$10 million to unconditional cash transfer programs to provide immediate support to commercial and small farmers and aid in the recovery of small and microenterprises. The proposed Emergency Agricultural Livelihoods and Climate Resilience Project complements the role of partners in addressing the first phase of agricultural sector's recovery and leverages the World Bank's global experiences in post-disaster recovery and reconstruction in the Caribbean (for example, Haiti, Grenada), as well as post-hurricane emergency recovery loans in small island states. This proposed Emergency Agricultural Livelihoods and Climate Resilience Project is being prepared as part of an overall development partner initiative to support medium- and long-term recovery in Dominica. Based on the urgent need for assistance, the proposed operation meets the requirements of the World Bank Operations Manual, of Operational Policy 10.00 on "Projects in Situations of Urgent Need of Assistance or Capacity Constraints". The additional flexibility and condensed procedures for preparation will help contribute to the timely restoration of agricultural livelihoods.

Dominica is given the assignment of preparing an Environmental and Social Management Framework (ESMF) as a prerequisite for World Bank funding. For this the Ministry of Agriculture, Food and Fisheries has form an initial task force prior to the establishment of the Project Implementation Unit (PIU). The initial task force is expeditiously working on the ESMF document to include, report of stakeholder's consultation, indigenous People Plan (Kalinago People), Environmental Health and Safety Plan (EHSP), Forest Management Plan (FMP) and Integrated Pest Management Plan (IPMP).

3.0 Rationale

The Pest Management Plan (PMP) addresses relevant stakeholder concerns about pests and pesticides. It stresses the need to monitor and mitigate negative environmental and social impacts of the Project (which includes the use of pesticides) and promote ecosystem management with the human health risk being the underlying principle from seed usage, through planting and growth stage and also post-harvest issues including safe crops for consumption. It emphasizes the need for an integrated approach to the management of pests in line with the Dominica`s policy on Integrated Pest Management (IPM) as well as World Bank requirements on pest management and

makes provision for adequate measures to enable the Project sustain the adoption of IPM techniques.

4.0 Purpose

The purpose of the Integrated Pest Management Plan is to provide a strategic direction for the management of pests in Dominica under the implementation of the Emergency Agricultural Livelihoods and Climate Resilience Project (DEALRCP). The plan, therefore, outlines the various Acts that guides the management of pests in Dominica. It also sets out strategies and actions aimed at minimizing the environmental, economic and social impacts of pests in Dominica. The plan also creates a framework for pests of economic importance to Dominica from which detailed implementation plans can be prepared to deal with the full range of pests at specific sites or for specific pests on a more widespread scale.

The IPM Plan addresses environmental best practices (primarily in the agricultural sector) by providing a guide for the use sensitive pest management strategies and least-toxic control measures in the implementation of the Emergency Agriculture Livelihood and Climate Resilience Project (DEALCRP). It also seeks to ensure that resources are strategically invested in pest management activities in order to achieve effective outcomes by incorporating mechanisms for monitoring, evaluating and reporting on the effectiveness of the strategic actions implemented.

5.0 Scope

The IPM Plan applies to all lands owned or controlled by the Government of Dominica, private companies and individuals. The plan provides management strategies for locally significant pest species. For the purpose of this plan, 'pest specie' includes all plants and animals. However, the plan does not consider the management of domestic animals, non-declared animals, public health pests, marine pests and native nuisance animals and plants. Nor does it take into consideration pathogens of humans and domestic animals.

6.0 Objectives of the Pest Management Plan

- To promote and invest in the use of environmental sound measures (hygienic, cultural biological or natural control) in the control of pest;
- To effectively monitor pesticide use and pest affecting agricultural productivity;
- Develop an integrated pest management plan that will be able to combat any outbreak of

pest infestation;

- To comply with local and regional standards, laws and regulations of pesticides.

7.0 Regulatory and Policy Framework for Pest Management in Dominica

Dominica does not have a Pest Management Plan and therefore an approached has been developed using different regulatory bodies together with the World Bank OP4.09 Pest Management. A range of statutory and planning guidelines have been included in the development of this Integrated Pest Management Approach. The table below highlights the various acts that govern the management of pest in Dominica and the responsible agencies.

Table 1: A Table showing Regulatory Framework on Pesticides

Policy Document	Description	Relevance to Project	Responsible Agency
Pesticide Control Act (1974)	This act provide for the control of the importation, sale, storage and use of pesticides.	Any pesticide to be used for agricultural and food production must be in compliance with this act.	Pesticides Control Board
Plant Protection and Quarantine Act (1986)	This act deals with the protection of Agricultural resources from dangerous plant and animal pest and diseases. The act stipulates the monitoring of sanitary and phytosanitary (SPS) measures which sets out the basic rules for food safety and animal and plant health standards.	The importation of improved and new plant species for the increase in food production must comply with this act.	Plant Protection and Quarantine Unit
Water Catchment Rules (1995)	All water catchment area hereby declared to be protected forest. Prohibited from the protected forest are anyone who applies	Water is one of the most important resources and its source must be protected from contaminants. The	Forestry Division MAFF

	or stores pesticides; builds any hunt tor living places or livestock enclosure; burns, cut, fells removes, takes any forest produce; capture, hunts or kills any bird unless he is a holder of a license to do so; carries out any planting other than reforestation on slopes over twenty degrees.	sustainability of catchment areas has to be maintained to provide for the flora and fauna and promote biodiversity.	
Forestry Act	This act provides for the protection, conservation and management of wild mammals, freshwater fishes, amphibian, crustaceans and reptiles.	This is critical especially where forest land (reserves) is bordering with agricultural lands. Care must be taken to avoid the harvesting of timber, or land clearing activities or hunting of wildlife.	Forestry Division
Animal Disease Act	An Act to control the importation of animals, birds, reptiles and insects and to regulate the treatment and disposal of animals which are suffering or suspected to be suffering from disease	In the biological control of insect pest beneficial insects may be imported these insects must be free of disease and or parasites.	Plant protection and quarantine
Solid Waste Management Act (2002)	The outlines the organizational structure and core functions of the Solid Waste Management Corporation, whose functions are inter alia:	All pesticides products has to dispose of after usage, this act will provide guidance. There will be waste generated at any developmental activity. Therefore this Act will inform	Dominica Solid Waste Management Corporation (DSWMC)

	(a) provided storage facilities for solid waste; (b) procure equipment for the collection, transportation and disposal of solid waste; (j) prepare plans and programmes to address the problems of solid waste management in the State;	the procedures to be followed or can serve as a guide to the development of litter and waste management plan for the project.	
Environmental Health Services Act 1997	An act to make provision for the conversation and maintenance of the environment in the interest of health generally and in relation to places frequented by the public.	The conservation and maintenance of the environment in the interest of health must be taking into consideration when doing any housing development.	The Environmental Health Unit
Environmental Health Services Act 1997 Montreal Protocol (Substances that Deplete the Ozone Layer) Regulations, 2010	International treaty designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion. The Protocol sets out a mandatory timetable for the phase out of ozone depleting substances. This timetable has been reviewed regularly, with phase out dates accelerated in accordance with scientific	Pesticides containing ozone depleting substances should be in a process of phasing out. This pesticide management plan will work in accordance with such	Ministry of the Environment, Climate Resilience, Disaster Management and Urban Renewal

	understanding and technological advances. It sets binding progressive phase out obligations for developed and developing countries for all the major ozone depleting substances, including CFCs, halons and less damaging transitional chemicals such as HCFCs		

8.0 World Bank Safeguard Policy (OP 4.09) Pest Management

In Bank-financed agricultural operations pest population are normally controlled through Integrated Pest Management (IPM) approaches such as biological control, cultural practices, and the development and use of crop varieties that are resistant or tolerant to the pest. The Plant Protection and Quarantine Unit of the Ministry of Agriculture has developed a plant protection approach geared to strengthen the plant so that it would not be significantly stressed by pest or disease infestation. The World Bank can finance the acquisition of pesticides when their use is justified in within the framework of integrated management approach and the below mentioned pesticide selection criteria met:

• The purchase of a pesticide in a World Bank funded project is subject to an evaluation of the nature and degree of the associated risk.

• The pesticide selection and use criteria:

a) The unimportant negative impact on human health.

b) To have demonstrated their efficiency when used against target species;

c) To have a minimal effect on non-target species and the natural environment.

d) Their use must take into account the need to prevent the development of the ability to develop resistance to pesticides;

• Pesticides must be prepared, packed, handled, stored, disposed of and used according to standards acceptable to the World Bank.

• The World Bank does not finance formulated products belonging to the World Health Organisation IA Classes (Extremely Hazardous) and IB Classes (Highly Hazardous) or Classes II formulations if:

a) When the country has no (regulatory or legal) provisions imposing restrictions to their distribution and use or

b) If they might be used by or accessible to the people applying them, agricultural or other workers with no adequate training, equipment and infrastructure for handling, storing and properly applying these products.

9.0 Other Regulatory Bodies

9.01 Pesticide Control Board

Pesticide management in Dominica is handled by the Pesticide Control Board.
What is the Pesticide Control Board?
The Pesticide Control Board of Dominica was established in 1974 under the Pesticide Control Act No. 15 of 1974.
The Act stipulates the function of the board as follows:

- To advise the minister on matters relevant to the making of regulations under the Pesticides Control Act.
- To carry out the provisions of the Act and of the regulations

The Membership of the Board is fixed by the Act as follows:

- Chief Agricultural officer
- Chief Medical Officer
- The Government Analyst
- Two other persons, one of whom should not be employed in the public service.

Members of the Board:

- Mr. Ricky Brummant — Director of Agriculture (Ag)
- Mr Amos Wiltshire — Farmer's Representative (Member)
- Ms Anna Mary Seraphine — Member
- Dr. David Johnson — Chief Medical Officer (Member)
- Ms Theodora Anthony — DEXIA's Representative (Member)

Pesticides Technical Committee

What Is the Technical Committee?

The technical Committee is a group of specialized individuals armed with the responsibility of advising and assisting the Pesticide Control Board on matters related to pesticide licensing and registration.

Members of the Technical Committee:

- Mr. Ryan Anselm Plant Protection Officer
- Mr. Kent Coipel IICA
- Mr. Lloyd Pascal Environmental Coordinating Unit
- Mr. Joseph Blanford Pesticide Inspector.
-

Functions of the Technical Committee:

- To review new applications for registration of Pesticides in Dominica and to make appropriate recommendations to the Pesticides Control Board for approval or non-approval.
- To review the current list of registered Pesticides in Dominica with a view to advising on the future status of these pesticides based on international pesticides conventions and current research findings.

9.02 The Coordinating Group of Pesticides Control Boards of the Caribbean (CGPC)

The Coordinating Group of Pesticides Control Boards of the Caribbean (CGPC) was created as a forward thinking group to promote sustainable agriculture and to protect human health and the environment through effective management of pesticides and toxic chemicals in the Caribbean. This is achieved through the steadfast interaction of like-minded institutional bodies of the CARICOM.

The relationship is primarily, but not exclusively, with respect to the formation of regional policy positions, programmes and projects in the area of pesticides and toxic chemicals in the context of agricultural health and food safety and preservation of the Region's environment and natural bio-diversity. The CGPC also is to collaborate with existing laboratories engaged in pesticides and toxic chemical analyses. The Vision of the CGPC is for a Caribbean Region promoting the effective use of pesticides and toxic chemicals and minimizing risks to human health and the environment.

The CGPC was established in 1994. The CGPC has three types of membership: Core Members; Associate Members; and Observers. The Core Members are member countries, while the Associate

Members are the private sector and the Observers are international organisations that are active in the Region. The composition of the CGPC is as follows:

CORE MEMBERS

Anguilla
Antigua and Barbuda
The Bahamas
Barbados
Belize
British Virgin Islands
The Cayman Islands
Dominica
Grenada
Guyana
Haiti
Jamaica
Montserrat
Saint Lucia
St. Kitts and Nevis
St. Vincent & Grenadines
Suriname
Trinidad & Tobago

ASSOCIATE MEMBERS

Caribbean Chemicals Limited
Marketing Arm International
Renwick DuWest
SC Johnson
McBride Caribbean Limited
UniVar USA
FDL Pest Control
MAFAS Limited
Agrochemical Incorporated
FASA

SECRETARIAT

Inter-American Institute for Cooperation on Agriculture (IICA)

OBSERVERS

University of the West Indies
Organisation of Eastern Caribbean States
Food and Agricultural Organisation
CARICOM Secretariat

Pan American Health Organization (PAHO)
Inter-American Institute for Cooperation on Agriculture (IICA)
Caribbean Agricultural Research and Development Institute (CARDI)

10.0 Agricultural Pests of Importance in Dominica

Dominica supports a range of agricultural enterprises which provides a variety of fresh produce to both domestic and international markets. However, the agricultural industry is plagued by a range of pest species that have the potential to cause significant economic loss. Therefore, management actions must be coordinated across the relevant departments/ responsible agencies to ensure that actions taken eradicate or minimize the prevalence of these pests are the most effective and environmentally friendly.

10.1 Crop and Vegetable Pest and Diseases

Common crops and vegetable pest and diseases in Dominica include the tannia root rot/leaf burning disease, viral diseases in vegetables, tuber weevils and grubs in sweet potato, anthracnose on yams, white fly, fruit fly on perennials, Lepidoptera on cucurbits, tristeza virus on citrus etc.). Most vegetable diseases are managed through the use of non-pesticide intervention. Fungicides and bactericides are used as last resort. Vegetable pest are dependent on the use of insecticides for effective control. This is an area of the plan that requires strict supervision and monitoring due to the short life of vegetables and the direct consumption habit. Farmers are being encouraged to use environmentally friendly control measures (bacillius thriugensis, biofungicdes). One of the contributing factors to the high insecticide use in vegetable is due to the labor shortage and the effective of insecticides versus cultural practice. Though costly, new resistant varieties of vegetable are being explored and use on farm has shown remarkable results. This plan will put mechanism for incentives for farmers who practice environmentally friendly solutions towards pest management.

Management practices include the following:

- Providing proper drainage
- Manual weed removal
- Planting of resistant varieties

- Moisture control
- Control insect pest
- Fungicide and bactericide application

Herbicides are also widely used in Dominica because of its wide covered and saving the farmer labor cost. Both systemic and contact herbicides are used.

10.2 Black Sigatoka Diseases (BSD)

10.2a History

Black Sigatoka first identified in Fiji and made its ways across the world in to Latin America. First identified in Jamaica in 1995. It stayed in Cuba for over 25 years. It has slowly moved through the islands. Black sigatoka is a fungal infection affecting the leaves and vegetative parts of bananas and plantain primarily. Black sigatoka was intercepted 2012 and has spread island-wide. After the first year of interception there was more than 60% loss in banana and plantain productivity due to early ripening of matured fruits. The management of the disease took a combined effort by Food Agriculture Organisation (FAO) and interventions from the Banana Accompanying Measures (BAM).

Black Sigatoka was identified in Dominica in 2012. Causal agent, a fungus, ***Mycosphaerella fijiensis.*** Closely related but more aggressive than its relative, M. musicola which causes Yellow Sigatoka. It produces four times more inoculum than M. musicola under the same environmental conditions. The fungus attacks the leaves of Banana and plantain. Members of the Musa species are known to be hosts of the fungus. It produces two types of spores, Conidia (asexual stage) and ascospores (sexual stage). Incubation period is shorter and symptom development is faster when leaves receive high charges of spores. Systematic pruning of BSD infected leaves and removal of bits of the leaf lamina with necrotic (dead) spots is important to reduce M. fijiensis.

10.2b Symptoms of Black Sigatoka

Stage 1 Small yellow speck visible on underside of the leaf.

Stage 2. Reddish brown streak under leaf

Stage 3. Streak gets longer and wider. Still visible on underside of leaf. At this stage fungus can start producing conidia. These can spread the disease when rain falls, to neighboring leaves or suckers.

Stage 4. Streak appears brown on underside and blackish on the upper surface of the leaf. Ascospores are produced at this stage and are available to be dispersed by wind.

Stage 5. Dark spots has a dark brown ring border and the center is dry and grey. Spot surrounded by yellow halo

Stage 6. Leaf tissue completely black with grey centres where ascospores are present.

10.2c Management of Black Sigatoka

This management is pesticide heavy compared to other pest issues. The agro chemical used for management, most are organic based. Management included the use of pesticides, both systematic, contact and preventatives measures. A combination of the following is required for successful management of the disease.

10.2d Cultural Practices

1. De leafing. Removing disease leaves or parts thereof, reduces the risk of early fruit ripening and aid the chemical control strategy. Leaves are removed if more than 50% is diseased. If only the tips are diseased, then only that part is removed. They are then placed upside down, one on top the other. This reduces the chances of ascospores being disseminated by wind. This practice reduces by several weeks the availability of ascospores for further infection.
2. Decrease humidity by managing the density of suckers and weed control, to reduced humidity in the fields as fungus thrives in high humid conditions.
3. Sanitation: use of clean boots, and tools and clothing before entering a field
4. Nutrition. Good plant nutrition through proper and timely fertilizer application.
5. Proper Drainage. Again ensures management of humidity in the field.

10.2e Fungicide Control

Fungicides used are generally determined by the marketing agent. Fungicides used are of two types. Contacts / Protectants used mainly in the dry season. They are applied in pure water and therefore reduce the risk of oil phytotoxicity.

1. Serenade (QST 713 strain of Bacillus subtils) is a Biofungicides are formulations of living organisms that are used to control the activity of plant pathogenic fungi and bacteria. The concept of biofungicides is based upon observations of natural processes where beneficial microorganisms, usually isolated from soil, hinder the activity of plant pathogens.
2. Pests—arthropods, weeds, and pathogens—have been, are, and will continue to be major constraints to agricultural production, forestry and related sector. Many consumers, therefore, believe that trace residues of synthetic chemicals in food are undesirable and represent a significant food safety risk and hence, use bio-pesticides and ecologically-based pest management (see also 10.3c).
3. Mancozeb is a broad spectrum protectant fungicide
4. Volley is a highly effective fungicide it considered a protectant, but can be classed as a systemic, entering the leaf tissue and attack the pathogen within the tissue.
5. Timorex gold spray a (T tree oil), this is a broad spectrum preventative biofungicide active ingredient being Tea Tree Oil.

Tilt is used four times per year and Bankit is used twice annually

10.3 Citrus Tristeza Virus (CTV)

Citrus Tristeza Virus is one of Dominica's most destructive diseases affecting the citrus industry. This disease has caused total destruction of the lime industry in Soufriere. The Division of Agriculture has confirmed the presence of the disease in other citrus growing areas in Dominica. The Brown Citrus Aphid (BrCA) was discovered in Dominica in 1980 and is the most efficient vector of the Citrus Tristeza Virus. Surveys conducted in 2007 have indicated the BrCA can be found in all citrus growing areas in Dominica.

10.3a Control

Most of Dominica citrus varieties are budded into sour orange rootstock, which is resistant to CTV. Dominica has developed a Citrus Certification Program with guidelines for nurseries and the selection of plants for an effective management of Citrus Trizera Virus.

10.3b Management of the Brown Citrus Aphids

Fortunately Dominica has many natural enemy of the aphis which helps lower the population of the pest. Citrus growers rely on these natural enemies. One of these natural enemies is a tiny

black wasp called Lysiphlebus testaceipes which kills the aphids after the pupa of the wasp after the pupa of the wasp has fed and developed inside the aphid. Another natural enemy of the Brown Citrus Aphid is the lady bird beetle. The adult and larvae of the beetle feeds on the aphid. These natural enemies must be maintained because citrus aphids are difficult to control by other means. Pesticides use may disrupt the natural enemies and the Aphids population may increase.

10.3c Bio-pesticides and ecologically-based pest management

Many synthetic chemical pesticides are broad-spectrum, killing not only arthropod and pathogen pests but also beneficial organisms that serve as natural pest-control systems. Without benefit of the natural controls that keep pest populations in check, farmers become increasingly dependent on chemical pesticides to which pests eventually develop resistance. Thus there is an urgent need for an alternative approach to pest management that can complement and partially replace current chemically based pest-management practices.

Pest-management strategies can be viewed in context of whole-farming systems. In whole-farming systems, pest-management methods are integrated into other management components of agronomic systems such as crop fertilization, cultivation, cropping patterns, and farm economics. Such alternative farm-management strategies that promote soil and plant health, and water quality were recommended.

Ecologically based pest management (EBPM) is recommended as a profitable, safe, and durable approach to controlling pests in managed ecosystems. The advanced biological technologies now available, are the most logical approach to developing a profitable, safe, and durable (long-lasting and self-maintaining) approach to pest management. The systems, hereafter identified as ecologically based pest management (EBPM), rely primarily on inputs of pest biological knowledge and secondarily on physical, chemical, and biological supplements for pest management. The EBPM systems are built on an underlying knowledge of the managed ecosystem, including the natural processes that suppress pest populations. It is based on the recognition that many standard agricultural practices disrupt natural processes that suppress pests. In contrast to standard practices that disrupt and destabilize the agroecosystem, agricultural practices recommended by EBPM will augment natural processes. These practices will be

supplemented by biological-control organisms and products, resistant plants, and narrow-spectrum pesticides.

10.4 Citrus greening disease (Huanglongbing)

Citrus greening disease is caused by bacteria which are transmitted by the Asian Citrus Psyllid vector. Management of rootstock change is not the preferred management practice. Therefore, the management is focused on the vector (citrus psyllid) through the use of parasitoids. The use of harsh pesticides is not encouraged in citrus orchards as it depletes the natural enemy population.

10.5 Croton scales (*Phalacrococcus howertoni)*

Croton scale is managed biologically by the Lady bird beetles. In areas with high infestation heavy pruning followed by burning is encouraged.

10.6 Giant African snail (*Lissachatina fulica)*

Giant African snails entered Dominica in 2007. Management practice is the destruction of habitats though cleaning, community involvement and manual collection Pesticides treatment includes met aldehydes solutions and pellets.

10.7 Seychelles scales (*Icerya seychellarum(* (

This pest is of more economic importance than black sigatoka because it affects all plant species and hinders the exportation of produce affected by Seychelles scale. The scale is controlled through the use of natural enemies and the use of bay oil extracts. They are found in pockets across the island.

10.8 Red palm mite (Raioella indica Hirst)

Red palm mite was recently introduced to Dominica in 2008. The preferred host of the red palm mite is the coconut plant thus impacting the coconut water industry. The red pam mite causes yellowing and leaf necrosis and sometimes death to young plants. Coconut production fell sharply in Dominica after the introduction of the mite affecting the coconut oil and water.

10.8a Biological Control

The predatory mite A. largoensis is widely distributed in the tropical regions and is often associated with red palm mite. Studies have indicated that that predatory mite used the R indica as a source of food and can be considered as a potential control agent of this pest. The use of the entomopathogenic fungi Beauveria bassiana and Metarhizium anisopliae for the biological control for mites is a promising management strategy. Increasing the natural predators such as lace wings, lady bird beetle has showed some results.

Table 1 Management Category of Pest Species

Management Category	Definition	Management Objectives
Under Surveillance Pest Species	Species that are not yet established in the region.	To monitor and detect any new pest before they become established.
Eradication Pest Species	Species with a restricted distribution and low abundance that have the potential to be eradicated from the region.	To eradicate all known pest species infestations.
Containment Pest Species	Species that are abundant Island wide and must be prevented from spreading further. Existing infestations must be controlled where possible.	To contain pest species and manage their impacts on and their risk to surrounding land uses.
Local Control Pest Species	Species that are abundant throughout Dominica but are not a priority for management and are only controlled where a significant impact or risk is identified.	To limit the impact of the pest species upon local sensitive areas.
Other Pest Species	Species that are widespread Island - wide	To provide advice to stakeholders when requested

11.0 Surveillance Pest Species

Management Objectives - To monitor and detect any pest incursions in Dominica before they become established.

Table 2. Strategic Program for Under Surveillance Pest Species

Strategic Actions	Success Indicators	Agency
Identify and eradicate Under Surveillance Pest Species in major transport corridors before becoming established.	Monthly surveys of all major transport routes for Under Surveillance Pest Species are conducted in accordance	Plant Protection and Quarantine Unit PPQ

Identify and control Under Surveillance Pest Species infestations before becoming established in Dominica	Quarterly Pest Survey Programs are conducted	Plant Protection and Quarantine Unit (PPQ)
	Under Surveillance Pest Species Protocol is developed and adopted by stakeholders	Plant Protection and Quarantine Unit (PPQ), MOFA
	Emergence of Under Surveillance Pest Species are identified and mapped before becoming established	All Stakeholders
Increase stakeholder awareness and capacity to identify and report infestations of Under Surveillance Pest Species	Under Surveillance Pest Species are included into the Pest Species Awareness and Extension Program	All Stakeholders
Ensure Under Surveillance Pest Species do not become established	Newly detected Under Surveillance Pest Species are immediately elevated to the Eradication Pest Species Program	Plant Protection and Quarantine Unit

11.1 Under Surveillance Pest Species in Dominica

- Citrus leprosius
- Citrus Cankar
- Fusarium wilt (tropical race 4)
- Frosty pod
- Strain II of coffee rust
- Coffee berry borer
- Xyella fastiodios
- Medeterrian fruitfly
- Lethal yellowing
- Laurel wilt
- Red ring disease

12.0 Challenges to Effective Pest Management

Farmers face a number of challenges in implementing effective pest management strategies. The major challenge to effective pest management is the cost and effort to deliver effective long-term pest control activities. Other barriers to effective pest management in Dominica are poor stakeholder knowledge, incorrect spraying techniques which can result poor results and thus deter future follow-up actions.

Another challenge in executing effective pest management activities in Dominica is the availability of community groups. Traditionally, community groups provide an opportunity for long-term pest management programs, however, due to limited access to such groups, it is difficult to implement long-term pest management strategies within agricultural communities across Dominica.

Communication between stakeholders can also be a barrier to effective pest management strategies. Without a strong communication linkage among government departments, private sector and the farmers, it is difficult to plan and coordinate effective pest management activities across Dominica.

Additionally, knowledge gaps in the population dynamics and distribution of pest species infestation across the island is of concern when it comes to effectively delivering pest management activities. Without detailed knowledge of the true distribution and impact of agricultural pest species across Dominica it is difficult to both plan and deliver effective pest management programs.

Another challenge in controlling pest, particularly invasive species are the presence of illegal vessel entry. Collectively, these challenges affect the implementation of effective pest management activities across Dominica. Therefore, this IPM plan seeks to focus upon managing these challenges to help pave the way for the implementation of effective long-term pest management in the agricultural sector across Dominica.

13.0 Approach towards an Integrated Pest Management Plan in Dominica

Pest Management in the agricultural sector is currently headed by the Plant Protection and Quarantine Unit (PPQ). The Pesticide Control Board guides the use of pesticides to include the issuing of licence and the registration of pesticides. The Agricultural Integrated Pest Management Plans is currently being developed and will identify the overall vision and approach to pest management in Dominica's agricultural sector. It will promote the use of a range of preventative and non-chemical approaches to control pest populations. If an infestation with unacceptable impacts occurs, thereby warranting additional treatment the plan will favour the use of least-toxic pesticides. The targeted application of a toxic pesticide will only be allowed after all other reasonable non-toxic options are exhausted. Thus, this pest management approach will outline preventative best practices and pest control strategies approved for use in a farming environment taking into consideration of farmers' health and safety as well as the environment.

The Emergency Agriculture Livelihood and Climate Resilience Project will adopt the following specific strategies to achieve an effective pest and pesticide management process:

13.1 Formation of a Safeguard Team

The Project Coordinators/Project Implementation Unit will form a Safeguard Team to oversee and ensure that the project complies with relevant safeguard policy documents prepared for the Project including this Pest Management Approach. The Project will organize an orientation workshop for all registered pesticide distributors / resellers under the Project.

13.2 Education and awareness

The Project safeguard team will communicate the content of the Pest Management approach to all up stream project actors or participants such as the Ministry of Agriculture , Food and Fisheries, Environmental Coordinating Unit, Ministry of Health and the Environment, Ministry of Public Works, Ports, Water Resources and Forestry Division. The Project will create awareness among downstream project actors or participants to include pesticide distributors/resellers, farmers and farm assistants of the importance of pest and pesticide management. The approach will establish on-going communication with both the national and relevant regional level pest and pesticide management representatives such as the Coordinating Group of Pesticides Control Boards of the Caribbean (CGPC). The Project will organize workshop on Pest Management techniques for farmers and workers in the management of Black Sigatoka disease and those that are more likely to be expose to hazards due to frequent spray applications.

13.3 Capacity Building

Capacity building has to set a new tone in educating farmers on environmentally friendly approaches to pest management. Outreach programs will focus on educating farmers on the benefits of using non pesticides methods of pest control. Farmers will be provided with the knowledge of cultural practices, enhancing natural enemy population, selection of resistant varieties, crop rotation so that they can make inform decision on pest management. Many farmers do not distinguish between the various pesticides (believing that any product is good for any pest in any crop), nor do they recognize the importance of using the correct dose at the right time. Capacity building will focus on these key areas to create change and impacts in pest management. Pesticides will be used as an alternative option and in this case Extension workers together with the Project Implementation Unit responsible staff will be equipped and prepared to advice farmers

on the proper handling and use of pesticides, and on the hazards they pose to the farmers and to their families and livestock.

Training should therefore include a thorough understanding of pesticides: their effects and limitations, their associated health and environmental hazards, and requirements for safe and effective use and handling. In addition to conventional extension channels, a variety of methods and media should be used (e.g., radio, television, illustrated pamphlets and comic books, etc.) to circumvent illiteracy and get the widest possible dispersion of information. Special training, information and educational materials relating to IPM and pesticides will be provided:

(a) Shopkeepers, vendors, farmers' groups or agricultural cooperatives involved in sale or distribution of pesticides, to ensure that all understand the toxic nature of the pesticides they are dispensing.

(b) Doctors, community health clinics and women's groups (particularly on symptoms and treatment of pesticide poisoning).

(c) Staff of credit institutions, to help them understand the economic advantages of IPM and to encourage them not to impose loan conditions that promote dependence on chemical pesticides or the use of very hazardous materials.

(d) School teachers and pupils (and their parents) in rural areas.

13.4 Encourage Bio Pesticides and Ecologically Base Pest Management

Incentive will be provided for farmers who use biopesticides or ecologically friendly pest management measures. Farmers should fetch a higher price for their commodity when they don't use pesticides. Ba*ccillus thuringiensis (Bt)* is a microbe naturally found in soil. It makes proteins that are toxic to immature insects (larvae). There are many types of *Bt*. Each targets different insect groups. Target insects include beetles, black flies, caterpillars, and moths. *Bt* makes toxins that target insect larvae when eaten. In their gut, the toxins are activated. The activated toxin breaks down their gut, and the insects die of infection and starvation. Death can occur within a few hours or weeks. The different types of *Bt* create toxins that can only be activated by the target insect larvae. In contrast, when people eat the same toxins, the toxins are not activated and no harm occurs. Bt is widley use in Dominica for control of insect pest mainly on vegetable. Farmers who

do crop rotation and enrich the soil with pen manures needs to be encourage through incentive programs.

13.5 Enhancing Natural Enemies

Since Dominica is focusing on a crop management approach and the use of natural enemies to combat pest and diseases it is important that the role of natural enemies in controlling pest populations be emphasized. Many farmers have little understanding of this concept nor of its underlying principles (e.g., not distinguished between beneficial and harmful insects). The following can be used to enhance natural Enemy Population:

- One of the most important ways to increase the amount of natural enemies is by the reduction of the use of pesticides. Pesticides do not discriminate against beneficial or harmful insects.
- Aartificial structures that serve as shelters or as nesting sites for natural enemies. Such as mulching this provides nesting area for ants, spider and some beetles.
- Supplemental food for adult of natural enemies can be supplied. Some predatory ants are attracted to sugar water.
- Alternate hosts may be supplied for beneficial insects or their phytophagous hosts may be offered alternate host plants.
- Artificially supplying suitable host stages when these are unavailable in the field, and eliminating honeydew-feeding ants may also be effective.
- The habitat may be modified to eliminate or reduce the adverse effects of cultural practices, pesticides, dust deposits, etc.

13.6 Principles of Personal Protection

In the application of this Pest Management Approach there are certain measures which should always be undertaken by pesticide operators to help protect against contamination during the handling and application of pesticides. Farmers or farm assistants are the primary users of pesticides. The protection of farmers and farm assistants against any type of contamination by pesticides is not guaranteed. Farmers use various types of applications and in most cases the appropriate personal protective equipment (PPEs) such as hand gloves, overalls etc. are not worn. The time of spray during the day is sometimes not appropriate. Farmers have been observed

spraying during hot afternoons when sunshine is at its peak and such farmers who are usually not in appropriate PPEs are exposed through inhalation and skin contacts.

13.6a *Reading and Understanding Labels*

The first principle is to always read and follow the label recommendations on the pesticide container. If the label information cannot be read or understood for any reason, then the operator should find someone who can explain the instructions. Apart from the written instructions, the operator should also look for pictorial information on the label which will indicate the degree of hazard presented by the pesticide formulation.

13.6b *Avoiding Contamination*

If direct exposure of the skin, nose, mouth or eyes can be avoided or minimised when working with pesticide products, then this greatly reduces the chances of personal contamination.
When pouring and mixing the concentrated product, every effort should be made to avoid splashing or spilling onto skin or clothing.

13.6c Personal Hygiene

Another basic principle of personal protection is good hygiene when working with pesticides.
Operators should not eat, drink or smoke during work and should not touch their face or other bare skin with soiled hands or gloves. They should always wash their hands and face after handling pesticides and before eating, drinking, smoking or going to the toilet. When they have finished work for the day they should then wash themselves thoroughly. Their work clothes should also be washed after work, separately from other clothing, and then dried.

13.7 Personal Protective Equipment

Protective equipment for these purposes may include coveralls, respirators, gloves, googles, aprons, boots, face masks, and hats. These protective clothing must only be used during handling and application of pesticides and should not be worn on other occasions or for other purposes.

- ***Respirators -*** Protection against the inhalation of fumes or fine droplets and particles into the lungs is provided by full face respirators. These respirators are only used for certain specialized operations which give rise to this type of exposure, for example, spraying against black sigatoka. However, if they are recommended for an operation then they must be worn, and they should be cleaned and maintained as directed by the manufacturer. Respirators used under the Black sigatoka management comprises of three part; filters, retainers and cartridge which has to changed routinely.
- ***Protective Gloves -*** When pouring, mixing or loading pesticide formulations the wearing of protective gloves is advised. Gloves made of materials such as nitrile rubber, neoprene, PVC

and butyl rubber offer good protection to a range of pesticide products and are particularly appropriate for those containing organic solvents.

- ***Eye and Face Protection -*** A simple face shield made from clear transparent material is a comfortable form of eye and face protection when mixing and loading pesticide formulations in tropical field conditions.
- ***Coveralls -*** Use coveralls to cover the entire body to avoid skin contact during pesticides application.
- ***Rubber boot -*** Rubber boot are recommended during normal farming operation for safety against puncture or contact with the soil or manures. Rubbers boot should be worn with a pair of socks.
- ***Hat -*** A hat of any covering protecting the head from exposure to chemical is important.

13.8 Stakeholder Involvement and Participation

There is a diverse range of stakeholders involved in pest management in Dominica. They include government agencies, industry, community groups and private land owners. To ensure that the Integrated Pest Management approach is effectively implemented, all stakeholders need to cooperate and coordinate their efforts towards the strategic actions outlined in this Document.

The Pest Management approach implementers will coordinate the pest management process with all relevant stakeholders including water resource, environmental, forestry and fisheries organization. Contacts will be established with significant neighbouring land managers and consult with them when appropriate and co-ordinate management activities with representatives of the identified government agencies.

13.9 Pests Inventory and Monitoring Measures

The project safeguard team in collaboration with the Plant Protection and quarantine Unit will track and document all pest cases, be it minor or major in a pest inventory register. It will identify the types, abundance, location of pest plants, date of first spotted or seen and date reported. This information will be gathered from surveillance or monitoring system to be put in place, periodic surveys to be conducted and feedback from farmers/farm assistants. The data will be managed in a standardized way so that trends can be established.

Monitoring the effectiveness of the Pest Management Approach over time requires diligent traceability and accountability. Recording pest populations and locations; management strategies

employed; quantities and types of chemicals and products used; and the outcome of pest management activities must be documented prior to each application.

13.9a Pertinent Information when monitoring and evaluating:

1. location of pesticide application
2. Target pest
3. Prevention measures applied
4. Alternatives explored and/ non-chemical methods of control
5. Type, dosage and quantity of pesticide used, including trade name and active ingredient
6. Summary of results
7. Name of the pesticide applicator
8. Application equipment used

13.9b Indicators for IPM

Additional monitoring indicators that provide information on the effectiveness of the proposed IPMP approach should be captured periodically. This data includes: Number of farmers engaged in IPM capacity building in the project locations; number of women as a percentage of total participating in IPM and successfully trained; improvement in farm production due to adoption of IPM as a percent of production without IPM; and improvement in the health status of farmers.

14.0 Pest Management Approach and Outcome

Table 3. Desirable Outcomes

Desired Outcomes	Issues	Action Required
Awareness and Education		
Stakeholders are well informed, knowledgeable and have ownership of pest species management	Availability of information	Make information accessible to all stakeholders
	Public awareness	Increase community, industry, agribusiness and government awareness of pests and their impacts
	Education and Training	Improve stakeholder knowledge and skills in pest identification and management
Informed decision making		
	Data collection and assessment	Collect, utilize and make available data relevant to pest management

Reliable information is available as a basis for decision-making	Biology and impacts	Further the understanding of the biology, ecology and impacts of weeds and insect pest
	Community attitudes	Further the understanding of community attitudes to weed and insect pest management
Strategic directions are established, maintained and owned by all stakeholders	Planning	Create and maintain a regional planning framework for weed and insect pest management and identify priority sites for management
	Holistic management	Integrate pest management planning with other planning processes
	Resources	Efficiently and adequately resource weed and insect pest management
	Strategic management and coordination	Plan, implement, monitor, evaluate and review integrated weed and insect pest management
Prevention, eradication and containment		
Introduction, spread and establishment of weeds and insect pest is prevented	Prevention of introduction	Prevent the introduction of new weeds and insect pest
	Early detection and eradication	Prevent the local establishment of new weeds and insect pest
	Containment	Minimize the spread of weeds and insect pest to new areas
Integrated Management		
Integrated systems for managing the impacts of established weeds and insect pest are developed and widely implemented	Development of management practices	Develop new and improve existing management practices
	Adoption of management practices	Adopt and promote best practice management
	Population and impact management	Reduce pest populations and impacts
	Management incentives	Offer incentives for implementing environmentally pest management practices
	Environmentally significant areas	Protect sensitive areas such as water ways from impacts of pests
Commitment and partnerships		
All stakeholders are committed to and undertake	Long term commitment	Establish long term shared stakeholder commitment to address weed and insect pest issues

coordinated management of weeds and insect pest	Roles and responsibilities	Establish roles and responsibilities for pest management that are accepted by stakeholders
	Compliance and enforcement	Ensure compliance with legislative requirements for control of weeds and insect pest

15.0 Management of Pesticides

The Dominica Emergency Agriculture Livelihood and Climate Resilience Project (DEALCRP) will comply with the criteria set forth by the World Bank under the Pest Management OP 4.09. The Bank may refer to the World Health Organization (WHO) for recommendation on the classification of pesticides by their hazards. The following criteria apply to the selection and use of pesticides in Bank-financed projects:

(a) They must have negligible adverse human health effects.

(b) They must be shown to be effective against the target species.

(c) They must have minimal effect on non-target species and the natural environment. The methods, timing, and frequency of pesticide application are aimed to minimize damage to natural enemies. Pesticides used in public health programs must be demonstrated to be safe for inhabitants and domestic animals in the treated areas, as well as for personnel applying them.

(d) Their use must take into account the need to prevent the development of resistance in pests.

15.1 Procurement of Pesticides

The procurement of any pesticides in a Bank –financed project is contingent on an assessment of the nature and degree of associated risk, taking into account the proposed use and intended users. The pesticide procurement guidelines under this project will address the following:

- types of pesticides for which procurement should be prohibited or restricted;
- specifications for product quality, packaging and labelling;
- preparation of bidding documents;
- d .qualification of bidders and after-sales service; and
- evaluation of bids taking into account effectiveness, cost and human and environmental hazards.

15.2 Importation of pesticides

All chemical –based pesticides used in Dominica are imported. It is therefore very important the Pesticide Control Board guided by the Pesticide Control Act of 1974 only permit pesticides that has minimal impacts on the environment and human health, (see annex 1) for a list of approved pesticides in Dominica.

a. Registration Process for pesticides includes:

- Completion of an application form to include all technical information on the pesticide. Technical information would include but not limited to active ingredient, biological or chemical in nature, dosage, target pest, plant species and method of application.
- The pesticide will be assessed by the Pesticide Control Board of Dominica. The Board decides whether to approve or disapprove pesticides.
- Pesticide may be registered with restriction or for general use.
- After successful registration of the pesticide, merchants can seek a license to import.
- The pesticide is registered for three years after which time registration must be renewed.

b. Licensing of Pesticides

    - Any company wishing to import a registered pesticide into Dominica must obtain a license by the Pesticide Control Board
    - The license must be accompanied with all the necessary custom documents
    - Ensure that the pesticide to be imported is registered for use in Dominica
    - A license is granted for one shipment of pesticide and is valid for three months.
    - A license must be obtained for every shipment of pesticide imported.

c. The Project safe guard team will require the following before engagement of pesticide importers:

    - Certificate of registration of Business
    - License or permit to sell pesticides
    - Locations of Business
    - Type of activities or services or products to be provided.

15.3 Selling and distribution

The distribution of pesticides is done by the importers / merchants, However the Ministry of Agriculture imports pesticides for specific projects. The few private importers of pesticide also

retail their pesticides products. Retail pesticide selling points are generally well kept and pesticides are properly displayed on the shelves. Some retailers may decant or repackaging of pesticides, mainly pelleted pesticides (slug-bait) into smaller containers to meet farmers' purchasing ability, usually without proper labels, which should describe active ingredients and concentration, dosage, handling instructions and hazards, batch and date of expiry.

15.4 Handling, Transportation and Storage of Pesticides

- Store pesticides in a locked, well ventilated cupboard or storeroom, away from water and food supplies
- Keep out of the reach of children or farm animals
- Container should be properly covered and labelled in intact bottles.
- Don't purchase pesticide in food or water containers
- Don't purchase pesticide in unlabeled bags or containers
- Don't transport pesticide with food items
- Always use the correct pesticide to control plant pest
- Read instruction before use
- Use the correct dosage base on the label
- Observe the safety precaution given on the labels
- Avoid contact with skin or inhalation
- Do not eat drink or smile while using pesticides
- Wear protective clothing at all times during pesticide use (gloves, eye shield, respirators, overalls boots.
- Use the proper application equipment
- Ensure that pesticide equipment are well maintained
- Do not spray pesticides to crop less than 7 days of harvest
- Mixed pesticides using a stick instead of bare hands
- Do not empty pesticide containers near water source

15.5 Disposal of pesticide containers

Following the recommendations of the WHO, all pesticides-used containers must be rinsed with water with the progressive triple-wash method and the resulting water should be either re-used the next day to dilute pesticides or, alternatively, disposed in a safely lined evaporation pond. As WHO indicates, should never be poured directly on the soil. Once cleaned, the used containers are considered as hazardous materials and should be managed in compliance with national regulations, if these are consistent and equivalent to good international practice; alternatively, used containers should be collected in a centralized facility, specific for that purpose, where they should be properly and safely stored until final disposal by incineration or burying under controlled method.

For labelling of pesticides, refer specifically to the use of The Globally Harmonized System of Classification and Labelling of Chemicals (GHS), an internationally agreed-upon standard managed by the UN. For classification of pesticides by hazard (for the purpose of procurement) the link to the WHO classification of pesticides by hazard, which is reviewed on a regular basis is: http://www.who.int/ipcs/publications/pesticides_hazard_2009.pdf?ua=1 .A traceability system may be put in place to ensure that the farmer accounts for all pesticides purchased.

16.0 Impacts of Pesticides on the Environmental

Dominica has over 365 waterways most of them are streams flowing through our agricultural lands. In Dominica pesticides are applied primarily with the use of a knapsack sprayer or Mist blower. The knapsack sprayer is commonly used for the control insect pest on vegetable or weeds and the mist blower Black sigatoka and diseases of tree crops. Pesticides may be carried away by wind and water especially in applied on a windy day and can affect the non-target species.

16.1 Pesticides in the soil

Once applied to crops, pesticides work their way into the soil, where it has devastating effects. Perhaps the most detrimental of these effects is that pesticide causes biodiversity loss in soil. This means the soil has a lower quality overall and is less fertile. Additionally, it removes a large percentage of organic matter. This lack of organic matter also allows pesticides to continue to build up in the soil instead of breaking down the chemicals. Less fertile soils mean less plant growth, which, in turn, means farmers must use increased quantities of fertilizer for successful crop yield.

16.2 Pesticides in the rivers

Pesticides seep into the soil and find their way into groundwater. They may be washed into nearby streams and rivers affecting aquatic life and changing the natural chemistry of the waterways. Pesticides residues may find their way to the coast and impair coral reef and marine ecosystem. Pesticides ingested by fish will accumulate in their system and when this moves up the food chain to the human level, the bioaccumulation will be higher affecting human health and well-being.

16.3 Pesticides in the Air

Pesticides drift is most common during the use of mist blower, where the pesticides are carried away to non-targeted areas. Herbicide drift can destroy vegetation that is food for wildlife,

depriving or in some cases causing death of wildlife due to lack of food source. A lot of wildlife such as the agouti which is a vegetarian eats and traverse through grassland may be impacted by ingesting sprayed grasses or direct fur contact. Pesticides are carried up the food chain when animals consume pesticide-contaminated foods.

17.0 Impacts of Pesticides on Human Health

Pesticides are poisons and can harm cause harm not only to the primary users but also consumer of produce. Pesticides exposure can cause a number of health effects and is linked to a range of serious illnesses and diseases in humans, from respiratory problems to cancer.

17.1 Acute toxicity

Pesticides can be harmful or lethal after one single episode of ingestion, inhalation or skin contact. The symptoms are evident shortly after exposure or can arise within 48 hours. The symptoms associated with acute toxicity includes:

- respiratory tract irritation, sore throat and/or cough
- allergic sensitisation
- eye and skin irritation
- nausea, vomiting, diarrhoea
- headache, loss of consciousness
- extreme weakness, seizures and/or death

17.2 Chronic toxicity

Pesticides can cause harmful effects over an extended period, usually following repeated or continuous exposure at low levels. Low doses don't always cause immediate effects, but over time, they can cause very serious illnesses. Long term pesticide exposure has been linked to the development of Parkinson's disease; asthma; depression and anxiety; cancer, including leukaemia and non-Hodgkin lymphoma; and attention deficit and hyperactivity disorder (ADHD).

Annex 1

LIST OF PESTICIDES REGISTERED

INTRODUCTION

The following list represents pesticides products currently registered for use in Dominica. Note that pesticides in red are those that are currently imported.

Product Name **:** **Name registered by manufacturer/applicant**

Active Ingredient **:** **Chemical name of active substances in product**

Formulation Codes:

WDG ***= Water Dispersible Granule***
EC ***= Emulsifiable Concentrate***
WP ***= Wettable Powder***
SC ***= Suspension Concentrate***
SP ***= Soluble Powder***
GR ***= Granule***
WE ***= Water Emulsion***
PLT ***= Pellets***
P ***= Powder***
D ***= Dust***

INSECTICIDES

TRADE NAME	ACTIVE INGREDIENT	FORMULATION	ACUTE TOXICITY CATEGORY	MANUFACTURER/ SUPPLIER
ABATE 1% SKEETER	TEMEPHOS	GRANULE	U	
ACTARA	THIAMETHOXAN 25%	WDG	111	SYNGENTA
ACTELLIC	PIRIMIPHOS-METHYL	EC	111	SYNGENTA
ADMIRE 2F	IMIDACLOPRID	EC	11	BAYER CORP.
AGACLIN 15 WG	ALPHACYPERMETHRIN	WDG	11	BASF
ANVIL	HEXACONAZOLE	SC	1V	SYNGENTA
AZA –DIRECT 1.2 EC	AZADIRACTIN	EC	111	RENWICK DUWEST
ARILON	INDOXACARB 20%	WP	111	FDL PEST CONTROL SOLUTIONS
BASUDIN	DIAZINON	WP	11	SYNGENTA
BELLIS	BOSCALID	WG	111	BASF CORPORATION USA
BIFENTHRIN	BIFENTHRIN	EC	11	
BUG DEFENCE	CEDAR WOOD OIL GERANIOL	LIQUID	111	
CAPRID 20 SL	ACETAMIPRID 20%	SC	111	WANGS LTD CHINA
CARATRAX 5EC	LAMBDA-CYHALOTHRIN	EC	11	AGROCARE CHEMICAL INDUSTRY GROUP LIMITED
CASCADE	FLUFENOXURON	DISPERSIBLE CONCENTRATE	111	AMERICAN CYANAMID
CURE1.8 EC	ABAMECTIN 1.8%	EC	111	HEBEI VIAN BIOCHEMICAL CO CHINA
CYMPERATOR	CYPERMETHRIN	WP	11	SYNGENTA
CYPER TC	CYPERMETHRIN 25.4 %	EC	11	CONTROL SOLUTIONS, INC.
CYPER WP	CYPERMETHRIN	WP	11	CONTROL SOLUTIONS INC.
CYPRO	CYPERMETHRIN PROFENOPHOS	EC	11	
DANITOL	FENPROPATHRIN	EC	1	SUMITOMO CHEM CO LTD
DECIS	DELTAMETHRIN	EC	11	PROCIDA
DELTA DUST INSECTICIDE	DELTAMETHRIN 0.05%	D	111	FDL PEST CONTROL SOLUTIONS
DEMON	CYPERMETHRIN	WP	11	SYNGENTA
DIAFENTHIURON	DIAFENTHIURON 50%	SC	111	AGRO-CARE CHEMICAL INDUSTRY GROUP LTD CHINA
DIAFENTHIURON 50 SC	DIAFENTHIURON 50 %	SC	111	
DIAZINON DAF	DIAZINON	EC	111	AGRO COSTA
DIPEL MVP	BACILLUS TH.	WP	111	CHEM. & AGRI. PRODUCTS DIV.

DIVERSIDE K	PETROLEUM DISTILLATES	L	111	DIVERSEY JCA LTD
DRAGNET	PERMETHRIN	EC	111	FMC CORP
DUPONT ADVION ANT GEL	INDOXACARB 0.05 %	GEL	111	DUPONT
DUPONT ADVION ROACH GEL	INDOXACARB 0.6 %	GEL	111	DUPONT
DURSBAN	CHLORPYRIFOS	WP	11	DOW CHEMICAL CO
ELSAN	PHENTHOATE	EC	11	NISSAN CHEMICAL INDUSTRY LTD
EXCITER	PYRTHRIN	EC	11	
FASTAC	ALPHACYPERMETHRIN	EC	11	SHELL
FENDONA	ALPHA CYPERMETHRIN	SC	11	BASF
FLIP 800 DF	PROPUXUR 80%	DF	11	
INVADER HPX	PROPUXUR 1.0 %	PRESSURED LIQUID	1A	
INVICT GOLD COCKROACH GEL	IMIDACLOPRID 2.15%	WP	111	FDL PEST CONTROL SOLUTIONS
In2 CARE MOSQUITO TRAP	PYRIPROXIFEM 70-80%	TRAP	111	FDL SOLUTIONS
HOT SHOT ULTRA ROACH & ANT GEL	DINOTEFURAN 0.05%	GEL	111	CHEMSICO
KARATE	LAMDACYHALO-THRIN	EC	1B	SYNGENTA
LANNATE	METHOMYL	WSL	1	DUPONT
MALATHION	MALATHION	EC	III	SYNGENTA
M-PEDE	POTASSIUM SALTS OF FATTY ACIDS	EC	11	MYCOGEN CORP
MAXFORCE	FIPRONIL	GEL	11	BAYER
MAXFORCE COMPLETE	HYDRAMETHYLNON	GRANULE	11	BAYER
MOLE CRICKET BAIT	CARBARYL	BAIT	11	
NEEM-X	NEEM EXTRACT 98% AZADIRACHTIN 0.4%	L	111	MARKETING ARM INTL
NEW BT 2X	BACILLUS THURINGIENSIS-KURSTASKI	WP 6.4% LIQUID SUSP. 3.5%	111	MARKETING ARM INTL
NEWMECTIN	ABAMECTIN 1.8%	EC	111	MARKETING ARM PANAMA
NOMOLT	TEFLUBENZURON	SC	1V	
ORTHENE	ACEPHATE	SP	111	VALENT
PADAN	CARTAP	SP	11	TAKEDA CHEM INDUSTRIES
PERFEKTHION	DIMETHOATE	EC	1	BASF
PERMASTAR AG INSECTICIDE	PERMETHRIN 38.0 %	EC	111	LG LIFE SCIENCES, LTD.
PIRATE	CHLORFENAPYR			

PHANTOM	CHLORFENAPYR-21.45 %	LIQUID	11	BASF CORPORATION
PHOENIX	FLUBENDIAMIDE	WG	111	BAYER
PRELUDE	PERMETHRIN	EC	11	SYNGENTA
PREMISE	IMIDACLOPRID 75%	LIQUID	11	
PREVAIL	CYPERMETHRIN 24.8%	WP	11	
PROGRAM	LUFENURON	EC	111	SYNGENTA
PRONTO 60	IMIDACLOPRID 73.68 %	WDG	11	
PROVADO 1.6F	IMIDACLOPRID	EC	11	BAYER CORP.
PT 565 AEROSOL	PYRETHRINS 0.5%	AEROSOL	11	
REGENT 200 SC	FIPRONIL	SC	11	RHONE POULENC
REGENT 5GR	FIPRONIL	WP	11	RHONE POULENC
SEVIN	CARBARYL	WP	III	UNION CARBIDE CHEMICAL CO
ROGOR	DIMETHOATE	EC	11	SYNGENTA
SNIP RB1	ALFACRON	WP	111	SYNGENTA
SPECKOZ AGRESSOR 75	IMIDACLOPRID 75 %	WATER SOLUBLE	11	SPECKOZ, INC.
SPECKOZ BIFENTHRIN	BIFENTHRIN 7.9 %	WE	11	SPECKOZ, INC.
SPECKOZ EVERCIDE	ESFENVALERATTE	EC	11	SPECKOZ, INC.
SPECKOZ TENGARD SFR ONE- SHOT	PERMETHRIN	EC	11	SPECKOZ, INC.
SPECKOZ UP-CYDE	CYPERMETHRIN 24 %	EC	11	UNITED PHOSPHORUS, INC.
STEDFAST	ALPHACYPERMETHRIN	EC	11	AMERICAN CYANAMID CO
SUSPEND SC	DELTAMETHRIN 4.75 %	LIQUID SUSPENSION CONC.	11	
SWIFT GEL	FIPRONIL	GEL	11	DUPONT
TAMBO	PROFENOFOS	EC	11	SYNGENTA
TEMPO SC	CYFLUTHRIN	EC	11	BAYER
TEMPRID	IMIDACLOPRID 21%	SP	11	
TEMPO ULTRA WP	CYFLUTHRIN	WP	11	BAYER
TENGARD SFR ONE-SHOT	PERMETHRIN 36.8 %	EC	111	
TERMIDOR	FIPRONIL	SC	11	BASF CORPORATION

TERBIBAM 25 EC	CYPERMETHRIN 25% ETHER 10% XYLENE 65%	EC		CARIBBEAN CHEMICALS
THERMINEX	FIPRONIL 2.5%	EC	11	SYNGENTA
TORPEDO	PERMETHRIN	EC	11	SYNGENTA
TRIGARD 75 WP	CYROMAZINE	WP	111	CIBA LTD
UNIVAR	IMIDACLOPRID 75%	WG	111	FDL PEST CONTROL SOLUTIONS
ULD BP100	PYRETHRIN	EC	11	BASF
ULD BP 300	PYRETHRIN	EC	11	BASF
VOLATON	PHOXIM	GR	11	BAYER AG
XENTARI	BACILLUS THURINGIENSIS SUB SPECIES AIZAWAI SEROTYPE HD-7	WDG	111	VALENT BIOSCIENCES

FUNGICIDES

TRADE NAME	ACTIVE INGREDIENT	FORMULATION	ACUTE TOXICITY CATEGORY	MANUFACTURER/SUPPLIER
ACROBAT	DIMETHOMORPH 9% MANCOZEB 60 %	WP	111	BASF QUIMICA COLOMBIA
ALIETTE	FOSETYL AL	WP	11	MAY & BAKER
BANKIT	AZOXYSTROBIN	EC	IV	SYNGENTA
BANKIT	AZOXYSTROBIN 250 g/L	SUSPENSION CONC (SC)	IV	SYNGENTA PHILS. INC.
BAYLETON	TRIADIMEFON	WP	11	BAYER AG
BENLATE	BENOMYL	WP	IV	DUPONT
BUMPER	PROPICONAZOLE	EC	11	CIBA GEIGY
CALIXIN	TRIDEMORPH	EC	III	BASF
CALIXIN 860	TRIDEMORPH	L	III	BASF
CARBENDAZIM 50% SC	CARBENDAZIM 75%, INERTS 25%	WP	U	
CHAMPION	CUPRIC HYDROXIDE	WP	11	
COBACK 77%	COPPER HYDROXIDE MANZATE MANCOZEB	WP	111	AGRO-CARE
CONSAN	BENZYL AMMONIUM CHLORIDE	EC	1	PARKWAY RESEARCH CORP.
CUPRAVIT	COPPER	WP	111	BAYER AG
CUPROSAN	COPPER OXYCHLORIDE	WP	111	RHONE POULENC
DACONIL	CHLOROTHALONIL	WP	1	FERMENTA ASC
DIFOLATAN	CAPTAFOL	WP	IV	CHEVRON CHEMICALS
DITHANE	MANCOZEB	WP	IV	RHONE POULENC
DURAZONE	INALAZIFLAM 0.006%	L	111	BAYER
IMAZALIL	FUNGAFLOR	EC	11	JANSSEN PHARMACEUTICA
IMPULSE	SPIROXAMINE	EC	11	BAYER
KARATHANE	DINOCAP	WP	11	ROHM HAAS CO
KOCIDE	COPPER HYDROXIDE	WP	111	GRIFFIN CORP.
LIQUID COPPER	COPPER SALTS	LIQUID	111	
MAGNATE SULPHATE	IMAZALIL	GRANULES	11	MAKHTESHIM CHEMICAL WORKS LTD
MANKOCIDE	COPPER HYDROXIDE & MANCOZEB	WP	IV	GRIFFIN CORP.
MANCOZEB	MANCOZEB	WP	IV	
MANZATE	MANEB	WP	IV	DUPONT
MANZATE 43 SC	MANCOZEB 34%, INERTS 66%	SC	IV	
MERTECT	THIABENDAZOLE	L	111	MSD AGVET
NEOZIL	IMAZALIL SULPHATE 75%	SOLUBLE POWDER	11	
OPUS 12.5 SC	EPOXICONAZOLE	L		CARIBBEAN CHEMICALS
ORTHOCIDE	CAPTAN	WP	1	CHEVRON CHEMICALS
PHYTON-27	COPPER SULPHATE	L	11	MARKETING ARM INTERNATIONAL
PUNCH	FLUSILAZOLE	WP	11	DUPONT
POLYRAM 80 WG	METIRAM 70%	WG/WD		CARIBBEN CHEMICAL

RIDOMIL 5G	METALAXYL	WP	111	CIBA GEIGY
RIDOMIL MZ	METALAXYL	WP	111	CIBA GEIGY
RIZOLEX	TOLCLOFOS	WP	11	SUMITOMO CHEM CO LTD
SIGANEX 60 SC	PYRIMETHANIL 60%	SC	1V	BAYER
SIGMA	THIOPHANATE	WP	111	NIPPON CO
TILT	PROPICONAZOLE	EC	11	SYNGENTA
TRI-MILTOX	BENOMYL & CU	WP	111	
VECTRA	BROMUCONAZOLE	EC	111	RHONE POULENC
VOLLEY	FENPROPIMORPH	EC	1V	TENKOZ INC
VERANGO 50 SC	FLUOPYRAM	EC	111	RENWICK DUWEST

HERBICIDES

TRADE NAME	ACTIVE INGREDIENT	FORMULATION	ACUTE TOXICITY CATEGORY	MANUFACTURER/SUPPLIER
ALLIGARE GLYPHOSATE 4 PLUS	GLYPHOSATE 41.0 %	EC	111	ALLIGARE, LLC
BASTA 200 LS	GLUFOSINATE AMMONIUM 20%	SC	111	BAYER CROP SCIENCE GERMANY
CARZONE 75% DF	METRIBUZIN 75%, INERTS 25%	GS	11	
DIUREX	DIURON	SC	111	AGRO COSTA
DIURON 80% DF	DIURON	DF	111	AGRO-CARE
EVIK	AMETRYN	WP	111	
FUSILADE	FLUAZIFOP	EC	1V	SYNGENTA
GESAPAX	AMETRYN	WP	111	SYNGENTA
GESATOP	SIMAZINE & AMETRYN	WP	111	SYNGENTA
GLIFOMAX	GLYPHOSATE	L		
GLYFOS	GLYPHOSATE	WSL		
GRAMINEX	PARAQUAT	SL	1	AGROCOSTA
GRAMOCIL	PARAQUAT & DIURON	SC	1B	SYNGENTA
GRAMOXONE	PARAQUAT	AC	1B	SYNGENTA
HERBADOX	PENDIMETHALIN	EC	II	AMERICAN CYANAMID
HYVAR	BROMACIL	WP	111	DUPONT
KARMEX	DIURON	WP	IV	DUPONT
KROVAR	BROMACIL	WP		DUPONT
LASSO	ALACHLOR	EC	1	MONSANTO
NABU	SETHOXYDIM	WP	111	NIPPON SODA CO LTD
PILLARXONE	PARAQUAT	EC	1	PILLAR INTERNATIONAL
PRINCEP	SIMAZINE	WP	111	SYNGENTA
REGLONE	DIQUAT	EC	II	SYNGENTA
RIVAL	GLYPHOSATE	WP	111	MONSANTO
ROUND UP	GLYPHOSATE	WSL	1V	MONSANTO
ROUND UP ULTRA	GLYPHOSATE 41%	WSL	III	MONSANTO
STOMP	PENDIMETHALIN	EC	II	AMERICAN CYANAMID
SUGARPAX 50 SC	AMETRYN	SC	111	AGRO COSTA
TALENT	PARAQUAT & ASULAM	AS	III	MONSANTO
TOUCHDOWN	GLYPHOSATE	SL	111	SYNGENTA
WEEDLESS	PARAQUAT	L	I	

NEMATICIDES

TRADE NAME	ACTIVE INGREDIENT	FORMULATION	ACUTE TOXICITY CATEGORY	MANUFACTURER/ SUPPLIER
MIRAL	ISAZOPHOS	GR	IB	SYNGENTA
MOCAP	ETHOPROPHOS	GR	II	RHONE POULENC
NEMACUR	FENAMIPHOS	EC	1B	BAYCHEM CORP
RUGBY	CADUSAFOS	WP	1B	FMC
SINCOCIN	PLANT EXTRACTS	LC	111	AG –SCI INC USA
VYDATE / OXATE	OXAMYL	EC	1B	DUPONT

RODENTICIDES

TRADE NAME	ACTIVE INGREDIENT	FORMULATION	ACUTE TOXICITY CATEGORY	MANUFACTURER/SUPPLIER
CONTRAC	BROMODIALONE	PLT	111	
DITRAC	DIPHACINONE	P	11	BELL LABS, INC
FASTRAC	BROMETHALIN 0.01%	BLOCKS	1A	
FINAL WEATHER BLOX	BRODIFACOUM	BLOCKS	1A	
GENERATION MINI BLOCKS	DIFENTHIALONE 0.0025 %	SOLID MINI BLOCKS	111	
HAVOC	BRODIFACOUM	BLOCKS	1A	
KLERAT	BRODIFACOUM	PLT	1A	SYNGENTA
MAKI MINI BLOCKS	BROMODIALONE 0.005%	BLOCKS	1A	
RAMIK	DIPHACINONE	PLT	111	
ROZOL TRACKING POWDER	CHLOROPHACINONE	P	1A	
STORM	FLOCOUMAFEN	PLT	1A	
TALON	BRODIFACOUM	BLOCK	111	
WARFARIN	WARFARIN	P	1B	

ACARICIDE

TRADE NAME	ACTIVE INGREDIENT	FORMULATION	ACUTE TOXICITY CATEGORY	MANUFACTURER/ SUPPLIER
DIFOCOL	KELTHANE	WP	II	SYNGENTA

MULLUSCICIDES

TRADE NAME	ACTIVE INGREDIENT	FORMULATION	ACUTE TOXICITY CATEGORY	MANUFACTURE/ SUPPLIER
CARRAXX	FERRIC PHOSPHATE 3% INERTS 97%	GRANULE		CARIBBEAN CHEMICALS
DEADLINE	METALDEHYDE	M-PELLETS	11	

MESUROL	METHIOCARB	WP	1B	BAYER AG
SLUG BAIT	METALDEHYDE	PLT	11	
SLUGIT	METALDEHYDE	AS	11	UNICORP

MICROBIOCIDE

TRADE NAME	ACTIVE INGREDIENT	FORMULATION	ACUTE TOXICITY CATEGORY	MANUFACTURER/SUPPLIER
SODIUM CHLORITE	SODIUM CHLORITE	GR	**1**	

GROWTH ENHANCERS

TRADE NAME	ACTIVE INGREDIENT	FORMULATION	ACUTE TOXICITY CATEGORY	MANUFACTURER/SUPPLIER
STRIKE	ORGANIC ACIDS	LIQUID		
GROW-CARE	ORGANIC ACIDS	LIQUID		
WHOLESOME	ORGANIC ACIDS	LIQUID		
I-SURGE	ORGANIC ACIDS	LIQUID		
D'NEMO	ORGANIC ACIDS	LIQUID		
INNOGRO-P	ORGANIC ACIDS	LIQUID		
ULTRALAC	MIXED MICROBIAL CULTURE	LIQUID		
AGUA CHIL	ORGANIC ACIDS	LIQUID		
RENUZYME	MICROBIAL CULTURE	LIQUID		
INNO-GRO	ORGANIC ACIDS	LIQUID		
ACTIVATOR	ORGANIC ACIDS	LIQUID		
I-BOOST	ORGANIC ACIDS	LIQUID		
CALBO	ORGANIC ACIDS	LIQUID		
BUILD-UP	ORGANIC ACIDS	LIQUID		
VITAZYME	ORGANIC ACIDS	LIQUID		

Annex 2 Prohibited List

Prohibited pesticides are listed below and include the WHO “dirty dozen” which are prohibited as well:

2,4,5,-T
aldicarb
Aldrin
binapacryl
captafol
chlordane
chlordecone
Chlordimeform chlorobenzilate
DDT
Dieldrin
Dinoseb and dinoseb salts
1,2-dibromoethane (EDB)
Endrin
fluoracetamide
HCH (mixed isomers)
heptachlor
hexachlorobenzene
lindane
Mercury compounds
mirex
paraquat
pentachlorophenol
toxaphene
monocrotophos
methamidophos
phosphamidon
Methyl parathion
parathion
alpha hexachlorocyclohexane
Beta-HCH
Pentachlorobenzene