NATIONAL AGRICULTURAL RESEARCH AND EXTENSION INSTITUTE

Mon Repos, East Coast Demerara

ANNUAL REPORT 2022

Office of the Chief Executive Officer

Research

Crop Development and Support Services

Plant Nurseries

National Plant Protection Organisation

VISION

To ensure food security and the empowerment of farming communities and to enhance their livelihoods through improved and environmentally friendly technologies

MISSION STATEMENT

To advise, develop and transfer appropriate systems to promote balanced, diversified and sustained agricultural production through adaptive and investigative research using a market-driven approach and a range of regulatory services to the sector.

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ACRONYMS

AHFSA	Agricultural Health and Food Safety Agency
AIEP	Agriculture Innovation and Entrepreneurship Programme
CAHFSA	Europe-Africa-Caribbean-Pacific Liaison Committee
CARDI	Caribbean Agricultural Research and Development Institute
CARICOM	Caribbean Community and Common Market.
CEO	Chief Executive Officer
COLEACP	Europe-Africa-Caribbean-Pacific Liaison Committee
CTV	Citrus Tristeza Virus
DNA	Deoxyribonucleic acid
FAO	Food and Agriculture Organization of the United Nations
GAP	Good Agricultural Practices
GLSC	Guyana Lands and Surveys Commission
GNBS	Guyana National Bureau of Standards
HCIL	Hope Coconut Industries Limited
IDB	Inter-American Development Bank
ISPMs	International Standards for Phytosanitary Measures
ITC	International Trade Centre
NAREI	National Agricultural Research and Extension Institute
PGR	Plant Genetic Resources
PISLM	Partnership Initiative for Sustainable Land Management
UN	United Nations
USA/APHIS	United States Department of Agriculture/Animal and Plant Health Inspection Service
USAID	U.S. Agency for International Development
WTO/SPS	World Trade Organization/ Sanitary & Phytosanitary Measures
WUSC	World University Service of Canada

CHIEF EXECUTIVE OFFICER'S STATEMENT

"Our mission over the next 10 years is to secure an expanded, diversified and modernized, resilient and competitive agriculture sector," is a quotation from a speech delivered by His Excellency Dr. Mohamed Irfaan Ali, President of the Co-operative Republic of Guyana.

As we embrace the charge of the Government of Guyana, the directive of the Board of Directors is to ensure that we continue to provide essential services to farmers for improvement in production and productivity. Further, to ensure that we continue the production drive as we support the Government and CARICOM Leaders in reducing imports into the Region by 25% by 2025.

2022 was a successful year for NAREI. We started with an approved budget of $1.328 billion and closed with a revised amount of $2.360 billion as a result of government's request to NAREI to undertake additional projects, that we listed as Special Projects.

One of the Special Projects is the Agriculture Innovation and Entrepreneurship Programme (AIEP) or the 'Shade House Project.' We were tasked with the construction of 54 shade houses within three months. They were to be completed for the Agriculture Investment Seminar in May 2022. This I can attest was completed and was greatly appreciated by all the Heads of State and other special guests, who visited on May 20, 2022.

During 2022, the Ministry of Agriculture successfully hosted an Investment Seminar, where we would have observed an improved relationship between Guyana and its CARICOM partners. Being a resolute partner, Guyana had committed to some Member States, to support their agriculture drive with the overarching theme of 25% by 2025. NAREI is actively participating in this support programme for Barbados and Trinidad and Tobago.

We would have also seen the conclusion of the 2021 flood relief programmes, where NAREI would have distributed relief packages to 37,137 farmers and households to the value of $2.6 billion.

NAREI continued to assist farmers in all the Regions of Guyana through the provision of inputs, technical support, training, farm certification etc. NAREI would have also started the distribution of fertilizer with 16,310 farmers receiving various quantities to a value of $96 million.

The Institute will continue to partner with all stakeholders committed to developing the “other crops” sector. Farming is a profitable venture and farmers should be able to earn a comfortable living standard from their investments. As such, NAREI will continue to provide technical and other necessary support to theensure that this is achieved.

MESSAGE FROM THE CHAIRMAN OF THE BOARD OF DIRECTORS

I am honoured to contribute this message on behalf of the Board of Directors of NAREI to this Annual Report of the Institute for 2022. One of the important functions of the Board is to ensure that the activities of the Institute are consistent with the policy and objectives of the Government, and the national priorities relating to agriculture, agricultural research, extension and crop protection.

In this regard, the Board is cognizant of the benchmarking activities which are the drivers of Guyana's agricultural strategy: Advancing the Caricom Agri-Food System Agenda; Prioritising Regional Food and Nutrition Security; and, addressing the Rising Food Import Bill by facilitating investment in agriculture and food production.

The Agri Investment Forum and Expo hosted by Guyana in 2022, provided an opportunity to review the pace of implementation of Guyana's agricultural strategy and identify measures to hasten the achievement of outcomes that are integral to climate-resilient and environmentally sustainable agricultural development. NAREI therefore has a pivotal role to play in the thrust towards: achievement of food and nutrition security; access to food throughout the ten Regions of Guyana; the efficacy of the agriculture value-chain; the economic viability and environmental sustainability of Guyana's non-traditional crops; attracting young persons and women's groups to the agriculture sector through capacity building in innovative agricultural practices and use of appropriate technologies; streamlining the administrative, logistics and financial systems through information technology and digitization processes and protocols; promoting inter-agency cooperation and collaboration; and, sustained monitoring and evaluation.

The Board, through its three Programme Advisory Committees - Research, Extension, and Crop Protection, as well as its Administration and Finance Committee, works closely with the CEO and Management Team of NAREI to ensure alignment of the Institute's strategy and activities with the national priorities. I wish to commend the CEO and Staff of the Institute for working in many instances beyond the call of duty throughout 2022, to execute the originally planned annual programme of work, along with unplanned but nationally important assignments such as the

Agriculture Innovation and Entrepreneurship Programme, the Cut-Flower Project, increase in inspections at Ports of Entry, introduction of new vegetables such broccoli and cauliflower, and coping with increasing demands for quality planting material, soil testing, soil enhancement, and crop protection.

Much appreciation is due to our pro-active Minister and the staff of the Ministry of Agriculture, who have been consistent in providing guidance and support to the Board and the Institute. My colleague Directors of the Board have shouldered their responsibilities and have brought to bear on the deliberations and decisions of the Board, their wealth of knowledge and hands-on experiences. To them, to our partner organisations - local, regional and international, and to our competent Corporate Secretary and staff, I am most grateful.

Joseph G Singh
Major General (retd)
Chairman of the Board
May 15, 2023

INTRODUCTION

Guyana currently holds lead responsibility for Agriculture, Agricultural Diversification, and Food Security in CARICOM and is spearheading the regional body's quest of reducing its US$5b food import bill. The target of 25% by 2025 is attainable through a cohesive unit.

National Agricultural Research and Extension Institute (NAREI) has a major role to play in promoting greater efficiency in the produce and agricultural product industry; and providing enhanced services in Agricultural Research, Technology Transfer and Crop Protection locally.

In spite of challenges posed by the Covid-19 pandemic, the war between Russia and Ukraine, and climate change (more specifically the 2021 flooding, which was deemed a national disaster) the other crops sector performed well. The sector had an overall production of 814,839 metric tons, of which coconut was outstanding with a total of 49,138 metric tons. A total of 1,000 hectares of soya beans were cultivated in the Intermediate Savannah with a target of making Guyana self-sufficient by 2025. Meanwhile, high-value crops including Cole crops and sweet pepper production totaled 21,788 metric tons.

Of course, efforts to achieve the 25% by 2025 goal of His Excellency, Dr. Mohamed Irfaan Ali, President of the Cooperative Republic of Guyana has positively impacted the performance of the other crops sector. We have seen renewed enthusiasm and vigour, by farmers in increasing production and productivity. The staff of NAREI worked assiduously to assist farmers to develop cost effective and sustainable agricultural production systems through the use of appropriate and market-driven technologies.

The Institute continued to transfer technology and conduct extension and plant protection services in all 10 Administrative Regions to over 20,000 farmers. Our plant nurseries located at Mon Repos, Hosororo, Pouderoyen, Benab, Charity, St. Ignatius, Timheri, Fort Wellington, and Bartica continued to supply quality citrus and other permanent crops to farmers at affordable prices.

NAREI also engaged in activities to protect our coastline by ensuring the restoration and preservation of our mangrove forests. One such activity was the installation of infrastructure on the East Coast Demerara, Region 4, and Essequibo, Region 2. The work being done with mangroves cannot be understated and its contribution to improving sea defense along the coastline is noticeable.

BOARD OF DIRECTORS' ACTIVITIES

A number of activities were successfully executed within the past year albeit under restricted conditions due to the COVID-19 pandemic. The activities of the Corporate Secretary in 2022 are as follows:

- Coordinate and implement the Statutory Meeting of the Board of Directors for the period January 2022 - November 2022.
- Carry out secretarial functions during the Board of Directors meetings.
- Organize activities on behalf of the Board of Directors.
- Coordinate visits by the Chairman of the Board to NAREI's various locations across the country.
- Notify the respective Heads of the Department of various decisions emanating from the Board of Directors and the Sub Committees of the Board.
- Draft internal reports on behalf of Management and provide legal guidance for the day-to-day activities of the Institute.
- Prepare and review contracts between NAREI and stakeholders.

Directors

The following persons were appointed to serve on NAREI's Board as Directors from December 8, 2021- December 7, 2022:

1. Major General (retd), Joseph G. Singh, Chairman
2. Mr. Ricky Roopchand
3. Dr. Dindyal Permaul
4. Mr. Jainarine Narine
5. Ms. Natasha Beerjit-Deonarine
6. Mr. Chris Persaud
7. Mr. Porandatt Narine
8. Ms. Anjanie Narine nee Seebaran
9. Dr. Garvin Cummings

10. Mr. Suresh Amichand
11. Mr. Christopher Vandeyar
12. Ms. Bibi Shadick
13. Mr. Raymond Ramsaroop
14. Mr. Jagnarine Singh, CEO / Ex-Officio Member

The Board of Directors' work began on May 25, 2022 but would have suffered a tragic loss with the passing of Director Ms. Bibi Shadick on August 14, 2022.

Committees of the Board

As of 2022, the following Committees operated under the supervision of the Board:

1. Appointments Committee

- Major General (retd), Joseph G. Singh, Chairman
- Dr. Dindyal Permaul - Director
- Mr. Ricky Roopchand - Director
- Mr. Suresh Amichand - Director
- Mr. Christopher Vandeyar - Director
- Mr. Jagnarine Singh - CEO

2. Research Programme Advisory Committee

- Dr. Dindyal Permaul - Chairman
- Dr. Garvin Cummings - Director
- Mr. Ricky Roopchand - Director
- Mr. Jagnarine Singh - CEO

3. Crop Protection Programme Advisory Committee

- Mr. Suresh Amichand - Chairman
- Mr. Jainarine Narine - Director
- Mr. Chris Persaud - Director
- Mr. Jagnarine Singh - CEO

4. Extension Programme Advisory Committee
    - Mr. Ricky Roopchand - Chairman
    - Mr. Porandatt Narine - Director
    - Ms. Anjanie Narine nee Seebaran - Director
    - Ms. Natasha Beerjit-Deonarine - Director
    - Mr. Jagnarine Singh - CEO

5. Finance and Administrative Programme Advisory Committee
    - Mr. Christopher Vandeyar - Chairman
    - Ms. Bibi Shadick - Director
    - Mr. Ricky Roopchand - Director
    - Mr. Jagnarine Singh - CEO

The following must be noted:

- With the passing of Ms. Shadick, the Board of Directors unanimously agreed to appoint Ms. Anjanie Narine- Seebaran to the Finance and Administrative Committee on October 26, 2022.

- The life of the Board of Directors came to an end on December 7, 2022.

RESEARCH

Together with the Extension arm of NAREI, the Research Department worked to advance the role of NAREI as the premier agricultural research and technology transfer organization in Guyana. Staff exhibited enthusiasm for service to farmers, and supported Government's and the Ministry of Agriculture's policy for research-informed crop cultivation. A summary of works conducted based on the policy priority directive of the Government follows.

I: Soil Management and Farm Mechanisation (SM&FM)

This department gave technical support for optimal soil health for vegetable production in shade houses and open field production. It provided Soil Chemical Testing Services for fertilizers, limestone and organic matter recommendations; Soil microbiological services with rhizobia bacteria formulations to enhance legume crop production, and mycorrhiza formulations to produce indigenous S-SOWMIX for vegetable seedling production; Hydroponic systems services for enhanced water and fertilizer use efficiency in the production of leafy and fruit type vegetables; Advised on nutrient balance for optimum cherry and soursop production; Crop evaluation services for onion and strawberry varieties under shaded and open field conditions; Geographic Information System services for available soil data and information; and provided sterilized potting soil for vegetable and citrus seedling production.

Achievements

- Analyzed 2,362 soil samples and provided limestone and fertilizer recommendations for judicious fertilizer use in crop production.
- Produced 3,533 L/1,215 kg and provided 420 liters (147 kg) of S-SOWMIX for seedling production on the AIEP farm.
- Identified four soil mixes for evaluation in shade house vegetable production.
- Produced 15 kg of rhizobia inoculant for distribution to legume farmers.
- NAREI's digital soil database now includes 10 soil maps (parts of Regions 3, 4, and 10). Access to comprehensive soil information for Guyana will be realized through established partnerships with GLSC, FAO, and PISLM through a Soil-care Project, and with Morocco on a Soil Fertility Mapping Project.

- Evaluated varieties, trained farmers, and established 0.4 ha onion cultivation in Regions 2, 3, 5, 6 & 9.
- Trained cherry farmers of Laluni, Kuru Kururu, Garden of Eden, Canal #2 Polder and East Bank Essequibo in Good Fertilizer Practices for optimum economic returns**.**

II: INTERMEDIATE SAVANNAHS FIELD RESEARCH UNIT (ISFRU- EBINI)

The ISFRU-EBINI provided crop extension and laboratory services (CTV testing, pH testing and threshing of peas for farmers and stakeholders in the Intermediate Savannahs.

Solar lights were installed at the guesthouse and laboratory buildings. The buildings were pressure washed and maintained. The store room area was reorganized, and shelves were installed and painted, among other improvements.

Repairs were done to the tractor and trailer, and the ATV was serviced. The generator which is the main supply of electricity to the community was serviced and electrical problems rectified. Works have commenced to install an electric fence.

General maintenance and monitoring of Plant Genetic Resources (PGR) established in field gene banks for conservation purposes were some of the interventions during the year apart from routine activities of the Unit.

Achievements

- Data collection was done for coconut and avocado germplasm established in field gene banks. Agronomical practices such as fertilization and germplasm maintenance were done to all crops in field gene banks.
- Four crop types (breadfruit, saijan, banana and plantains) were introduced and established in field gene banks.
- A total of four accessions were regenerated yielding 419 kg of maize (CARDI 001), 529.6 kg of peanuts (GN-92A 75.5 kg and 454.1 kg AK62) and 73.5 kg of red pea during the first

cropping season. Meanwhile, five accessions were regenerated during the second cropping season yielding 1,306 cobs and 54.8 kg grain of maize, 71.2 kg red pea, 0.9536 kg pigeon pea and 26.1 kg of peanuts.

- Conserved five red pea accessions obtained from five farmers in the Intermediate Savannahs, and one red pea accession and one pigeon pea accession from NAREI's regeneration plot.
- Conducted capacity building on Citrus Tristeza Virus (CTV) testing using ImmunoStrip®, soil sampling and soil testing.
- Sixteen farmers received technical advice on cultivation practices, pest and disease management, and threshing of peas, among other services.
- 7,619 kg of pea threshed for farmers in the Intermediate Savannahs, and 14 packs of ant baits (weighing 3.5 kg) were distributed.

III: BIOTECHNOLOGY and PLANT GENETIC RESOURCES

The Plant Biotechnology and Genetic Resources Department was created to "enhance crop productivity through innovative research in Plant Biotechnology and on Plant Genetic Resources along with devising new strategies for the conservation of Plant Genetic Resources for Food and Agriculture Security."

The department's key focus is on micropropagation of different crop species, (cassava, sweet potato, breadfruit, coconuts, plantain/banana, strawberry and pineapples) currently *in vitro* for conservation, research and production purposes. Projects undertaken in 2022 focused on import substitution and increase production and productivity. During the year, the department started looking at "cut flowers" tissue culture.

A germplasm collection of plantain accessions was established at NAREI's Commercial Farm and farmers' plots at Lusignan and Nabacalis to provide foundation stock for cyclic multiplication of

disease–free Musa spp. The collection was also established to provide data on the growth parameters of the tissue culture plantlets for traceability purposes.

Achievements

Tissue culture seedling production.

Crops	Status	Production	Distribution
Plantain	Protocol is 100% completed and is in the production phase	4,022	2,959
Breadfruit	Protocol is 100% completed and is in the production phase, supplying to NAREI plant nursery for sale	1,594	564
Strawberry	Field monitoring and evaluation	92	90
Pineapple	Protocol is 100% completed and is in the production phase	6,965	7,005
Total		12,673	10,618

- A conservation protocol was developed to conserve Musa accessions for short to medium-term storage *in vitro*.
- Strawberry seed germination protocol was completed to establish clean cultures of White Alpine and Red Climbing. The varieties are currently in the multiplication phase.
- *In vitro* grape production, the best technique for cleaning cuttings for *in vitro* propagation of grapes with a 75-80% survivability was proven.
- A total of 337 coconut embryos were initiated *in vitro* of which 111 plantlets were produced and transferred to the greenhouse.
- Callus formation was not observed on explants placed on different concentrations of two 4D using the somatic embryogenesis protocol.
- **Embryo incision technique**: 92 half embryos were generated with 43 being responsive and sub-cultured.
- Eleven explants responded with shoot and root formation using the split embryo technique and were further weaned.
- A total of 75 coconut plantlets were transferred to Moblissa for field establishment.

Molecular Biology/DNA

The Molecular Biology/DNA laboratory is yet to be operationalized. Nonetheless, activities conducted were in preparation for the laboratory being operationalized in 2023.

Achievements

- Two AC units were repositioned in the laboratory to facilitate proper air circulation.
- Fifteen single-channel micropipettes were serviced and calibrated by GNBS.
- PCR workstation base and chair fabricated by FIBERTEC.
- Printing of safety signs for the laboratory.
- Preparation of tags for laboratory equipment.
- Servicing and calibration of 15 laboratory equipment were completed by Environmental Engineering Solutions.
- Organized area for DNA extraction at the Plant Pathology Entomology and Weed Science Department.

IV: PLANT PATHOLOGY, ENTOMOLOGY AND WEED SCIENCES (PPEWS)

The department provided technical assistance on pest and disease management to Extension Officers, farmers, the AIEP shade house project and other agricultural stakeholders. It also provided academic instruction to students of the University of Guyana and the Guyana School of Agriculture. Additionally, it would have participated in several exhibitions and conducted several training programmes in collaboration with CDSS. The department also keeps records of pests and diseases found on several crops as a reference for future use.

Achievements

- **Acoushi Ant Bait produced**: 15,244 packs (weighing 3,811 kg) were produced, and 16,540 packs (weighing 4,135 kg) were distributed to farmers and other agricultural stakeholders.
- **Laboratory Services**: 217 pest and disease samples were submitted for identification and recommendations for their management.

- **Red Ring Disease *(Rhynchophorus palmarium):*** 116 traps were established. Twenty were placed at La Harmony in Region Three and 96 in various locations in Region Four namely: East Coast Demerara, East Bank Demerara and Linden-Soesdyke Highway.
- Successfully produced four technological packages that were distributed to farmers.
- Trained 80+ Guyana School of Agriculture students in pest and disease identification and management.

V: FRUITS VEGETABLES OTHER CROPS (FVOC)

The overall objective of the department is to develop and adapt appropriate agronomic technologies for farmers and other stakeholders. Specific activities conducted included the conservation of germplasm of important crops; the development of quality seeds of locally adapted varieties; the development of technological packages for sustainable agriculture; and the development of efficient production technology for fruits and vegetables.

Achievements

- Evaluated bell pepper production under various shade houses.
- Evaluated various potting media for the growth and development of tomato seedlings.
- Morphological characterization of pineapple accessions was conducted at Kairuni. Evaluated post-harvest factors that influence internal browning in pineapples.
- Germplasm collection of pineapple accessions at Kairuni Horticulture Station, 1,733 were planted of the following accession Sugarloaf E, Sugarloaf K, English E, English K, and Montserrat. Harvested 936.47 kg.
- Collected leaf samples from 45 cocoa accessions growing in Region 1; these were sent to the Cocoa Research Centre in Trinidad for analysis. Farmers of Bumbury, Region 1 were trained on the pruning of cocoa.
- NAREI Coconut Nursery produced 412 seedlings.
- Evaluated the growth of Flying Dragon Trifoliate Orange (*Citrus trifoliata* L. var. *monstrosa* T.) for rootstock purposes. There are currently 30 plants growing at NAREI's demonstration farm and three at Kairuni Horticulture Station.

- Established a mushroom research facility and the virtual training of one officer was completed.
- Seven sweet potato accessions, (Bob 1, Bob 2, Bob 3, Bob 4, Isacks, Sherry, and Moore) were collected from West Coast Berbice. Characterization was done for all seven accessions while tuber characterization was done for one accession (Bob 3).
- Kale - harvested 70 kg, Carrots - harvested 87 kg, Beetroot ‑ harvested 15 kg.
- Compost: Vermicompost - harvested 890 kg, Thermophilic compost - harvested 721 kg
- Number of seeds produced ‑ 62.154 kg
- Seeds packaged ‑ 53,835 packs
- Seeds distributed ‑ 383.064 kg

VI: **COCONUT UNIT**

The Government of Guyana, through the Ministry of Agriculture, imported 2,000 Brazilian Green Dwarf Coconut Variety seed nuts through funding from CARDI and IDB. 1,500 seed nuts were sown at HCIL's seedling nursery at Hope Estate, and 500 at NAREI's seedling nursery at Mon Repos. 91% germination was recorded at the NAREI location.

Three new coconut seedling nurseries were established at NAREI's facilities at Kairuni, Fort Wellington, and Lethem; 36,000 coconut (*Cocos nucifera*) seedlings were produced and sold to farmers across the Regions; and 1,127.5 ha were put under cultivation. Many new farmers have emerged under this programme.

NAREI embarked on a National Coconut Pest and Disease Surveillance and Management Programme; Extension Officers of the various Regions were trained and continue to assist in the surveillance aspect of the programme, which commenced in Administrative Regions 3 and 4 where 106 locally made traps were installed in coconut farms.

NAREI engaged in collaborative projects with various regional and international agencies. Farmers from Regions 2, 3, 4, 5, 6, and 10 participated in the Coconuts II Project funded by the International Trade Center (ITC) and benefitted from climate-smart agriculture interventions (shade houses), coconut seedling nurseries, inter-cropping in coconut cultivations, Integrated Pest Management (IPM) in coconuts, etc.

VII: MANGROVE

The Mangrove Restoration and Management Department (MRMD) completed capital projects to support the creation of a suitable mangrove habitat along sections of the coast. These included the completion of a 120m rock groyne at LBI, ECD, and 160m rock groyne at Perth Eliza, Essequibo Coast. Baseline surveys, topographic and geotechnical, were also completed as part of the capital programme to provide critical data for the monitoring of shoreline changes and design of restoration interventions. The updated National Mangrove Action Plan was completed with support from Conservation International-Guyana through a consultancy with the University of Guyana, Faculty of Earth and Environmental Science.

The department continued to advance its use of technology through the ongoing collaboration with SERVIR Amazonia to leverage remote sensing for the systematic monitoring of mangroves in Guyana. This was complemented by the *in-situ* restoration site monitoring and the use of UAVs.

The mangrove public awareness and education programme was boosted by support from Iwokrama/Exxon Foundation 'Guyana Conservation Initiative' which provided support for the production of a range of public awareness materials.

Achievements

- Completion of 120 m rock groyne at LBI, East Coast Demerara.
- Completion of 2.9 km of topographic surveys in Regions 2 and 6.
- Completion of Geotechnical surveys in Region 2.
- Commence of works on 160 m rock groyne at Perth/Eliza Region 2.

- Completion of in-situ site monitoring of restoration sites in Region 2.
- Mangrove Management Action Plan 2022-2032 completed.
- Continued implementation of Mangrove Monitoring System in collaboration with SERVIR Amazonia.
- Production of public awareness materials: Mural painted on seawall at Turkeyen; 4,000 posters; 2,000 brochures; 900 pcs of tokens.
- Nine community sensitization sessions were held in Regions 2 to 6.

VIII: HORTICULTURE

The Horticulture Department is dedicated to the study and application of various vegetative propagation techniques of high-value perennial plants, specifically fruit trees, catering for local farmers. This department is responsible for the preservation, maintenance, propagation, and improvement of the fruit trees germplasm collection at the Institute. Simultaneously, it is tasked with the functioning and production performance of the Institute's 10 plant nurseries tasked with producing planting materials for the needs of farmers.

This department is also responsible for the establishment of mother plant blocks of scion and rootstock in order to replenish, and manage the availability and accessibility of new plant genetic materials, to sustain the supply of high quality and disease-free genetic materials to the nurseries as required for production. This is done by establishing central orchards and replicating these in the other nurseries, also, these mother blocks have an additional function to serve as germplasm repositories for the preservation of the fruit trees diversity in the country.

Achievements

- A total of 45 trees were marked for characterization. Samples were collected from 16 trees. Some of the parameters being measured are; tree (crown shape), leaf (leaf blade shape, leaf apex shape, leaf margin, colour, length and width of leaf) and fruit (shape, weight, length, skin, colour, and pulp colour of ripe fruits).

- 2,000 avocado seedlings were evaluated for their resistance/tolerance to phytophthora root rot disease.
- A total of 13,600 citrus rootstocks were produced via stem-cutting methods at Timehri in a brown sand potting mixture.
- The cocoa plot at Timehri was cleaned and fertilized and seeds were collected and set for sapling production to expand the plot.
- A total of 1,300 cocoa seeds were sowed for rootstock at the Hosororo Nursery and a selection of plants for scion collection was done. Fifty-two farmers were trained in Mabaruma Sub-district, Region One in vegetative cocoa production using the grafting technique.
- The first batch of roses (164 plants) was received and planted under the tunnel house in NAREI compound in March, this plot was tagged for research.
- Four greenhouses were assembled in field 17 in July for cut rose cultivation. The first two houses were planted in July, while the last 2 were planted in September, where 600 plants were established in each house. A total of 24 different colour variations of roses were acquired.
- Harvesting began in April, and 3,093 cut roses were harvested at the end of 2022, where majority of these cut flowers were used for research observation and key identification and documentation.
- A total of 212,015 seedlings (a mixture of fruit crops and ornamentals) were produced in 2022 across the 10 plant nurseries.
- A total of 10,617 seedlings (a mixture of fruit crops and ornamentals) were distributed to farmers, schools, state buildings, and other stakeholders at no cost.

AIEP Shade House Project

DIAGNOSTICS AND IPM



PLANT PROTECTION



TISSUE CULTURE



TRAINING



Donation to farmers



Soil Management & Farm Mechanization



Open Day






MANGROVE

Section of the completed 160m rubble mound groyne constructed at Perth/Eliza, Region 2

Natural regeneration along Beterverwagting foreshore resulting from rubble mound groyne constructed under the mangrove restoration programme

IX: **SPECIAL PROJECTS UNIT**

SPU - Cassava

This department provides the farming communities and other stakeholders with technical services in addressing inefficiencies in cassava production and productivity. It also provides appropriate agricultural knowledge through short-term training via establishing field trials on research stations and on farmers' fields. Importantly it facilitates access to improved varieties, and supports agricultural extension services.

Achievements

- Cassava accessions were characterized morphologically using 18 morphological descriptors (eight qualitative and 10 quantitative).
- Variability percentages for qualitative and quantitative parameters for cassava accessions were determined.
- Average yield of cassava increased from 19.5 to 36 t ha-1) due to improved farm practices and utilization of improved varieties.
- Cassava yield increased by over 30% when improved agronomic practices, phytosanitary control measures and the use of healthy planting material were used in the field trial.
- Multiplication and distribution of elite cassava sticks to farmers enhanced.

SPU - Quinoa

Quinoa has been introduced for the first time in Guyana during the 2019 growing season. Various studies were conducted by NAREI with the objectives to determine the adaptability of quinoa to local conditions as well as determine the morpho-agronomic characteristics of various accessions grown in Guyana. Key project outputs will include a selection of appropriate accessions that can grow well in different agro-ecological zones. Overall, the project will contribute to increased food and nutrition security for resource poor farmers in Guyana.

Quinoa trials for varietal adaptability in Guyana's condition:

- Ten quinoa accessions were evaluated to determine adaptability to local environmental conditions.
- Results obtained on grain yield (550 to 785 kg ha^{-1}) and other parameters were encouraging.

SPU - Corn

Morphological and agronomical characterization of field corn (*Zea mays* L.) accessions and variety at NAREI Mon Repos were evaluated. The yield performance of three field corn accessions (Mara, Sand Hill, Pomeroon) and one variety Pioneer (Belize) (CARDI 001) were evaluated during the period February to July 2022 in Field 17 NAREI Compound, using plant spacing 30 cm by 30 cm. Forty sticky insect traps were set in the field, and 10 fall armyworms *Spodoptera frugiperda* were collected during the cropping cycle. The results indicated that:

- Time of flowering after emergence: Mara: 74 days, Sand Hill 73 days, Pomeroon 75 days, and Pioneer (Belize) (CARDI 001) 71 days;
- Time to maturity: Mara: 122 days, Sand Hill 120 days, Pomeroon 124 days, and Pioneer (Belize) (CARDI 001) 127 days after emergence;
- The number of grains per cob: Mara 394 grains, Sand Hill 374, Pomeroon 360 and Pioneer (Belize) (CARDI 001) 436;
- The weight of 1,000 grains: Pioneer (Belize) (CARDI 001) 0.36367 kg, Mara 0.23959 kg, Sand Hill 0.22337 kg and Pomeroon: 0.27385 kg; and
- Yield range: 5.89t/ha-1 (CARDI 001) to 2.79 t/ha (Sand Hill).

SPU Spices

Turmeric (*Curcuma longa* L.)

- Turmeric *(Curcuma longa L.):* A total of 5,669.90 kg of turmeric planting materials were distributed to 100 farmers of Region One. This will expand turmeric cultivation by at least 30 acres.

Ginger (*Zingiber officinale*)

- Ginger *(Zingiber officinale):* A total of 19,050.87 kg of ginger planting materials were distributed to 215 farmers of Region 1. This will expand ginger cultivation by at least 70 acres.

Black pepper (*Piper nigrum* L.)

- Black pepper *(Piper nigrum L.):* A total of 1,275 and 3,438 black pepper cuttings were generated in the nurseries at NAREI, Mon Repos and Hosororo respectively using the serpentine method of multiplication. Over 2,600 black pepper cuttings were sold and distributed to farmers of Regions 1, 4, 6 & 10. These black pepper cuttings were used for expanding black pepper cultivation in Guyana.

Nutmeg (*Myristica fragrans*)

- Nutmeg *(Myristica fragrans):* At Hosororo Nursery, 1,300 nutmeg seedlings were generated and 360 were distributed to farmers of Regions 1, 4, and 10 to expand cultivation. At NAREI's demonstration plot located at Hosororo, six acres of nutmeg seedlings were planted.

Spice facility at Hosororo, Region One

At this facility, a number of activities were carried out such as:

- Upgrades were completed at the Spices' Facility located in Hosororo, Region One

- The ginger facility at this factory was commissioned by the Hon. Minister of Agriculture, Zulfikar Mustapha on October 10, 2022.

AIEP's SHADE HOUSE PROJECT

- Under the One Guyana Shade House Project a total of 132 shade houses were constructed, of which 54 are located at NAREI, each with a dimension of 30 m x 13 m. These are in support of the Agriculture Innovation Entrepreneurship Programme (AIEP), producing high-value crops.

- Seedling Nursery: A total of 558 trays of seedlings were sown on various shade houses. These included high-value crops such as broccoli, cauliflower, celery, lettuce, bell pepper, parsley, tomatoes and kale. Students were integrally involved in all aspects of seedling production and management of the nursery.

- Harvesting and Marketing: A total of $7,778,590.00 was generated from the AIEP as at December 2022.

EXTENSION AND TRAINING

Apart from the daily routine activities, 2022 commenced with the continuation of the processing and distribution of flood relief packages for farmers. This exercise spanned almost the entire year. There was an increase in the frequency of visits to farming communities by government officials including the President of the Co-operative Republic of Guyana, His Excellency Dr. Mohamed Irfaan Ali, the Hon Vice-President Dr. Bharrat Jagdeo, Ministers of all Ministries, Heads of Government Agencies, etc. These engagements resulted in assistance being provided to farmers in support of their farming activities.

The year also saw many international donor agencies coming on board to support our farmers. FAO was very passionate in their effort by providing two rounds of agro-inputs to the more vulnerable farmers, while the UN Women's Organization afforded 10 women farming groups the construction of shade houses. Other notable contributions included those from WUSC and USAID. By the end of 2022, CDSS commenced the distribution of fertilizer to farmers. Importantly, CDSS distributed $104.9M in inputs for the period under review.

The year 2022 can be considered as being wetter than the last few years. This phenomenon resulted in an increase in crop issues for farmers. To this effect, special visits and assessment activities to bring relief to farmers had increased. Farmers are continuously being encouraged to adopt climate-smart agricultural practices. To support this initiative, NAREI continued to provide shade house materials at cost price to farmers.

With regard to our farmers' database, officers have been registering farmers via electronic devices in order to digitize this database. There has been some loss of farmers' data in the system. USAID has supported this venture through the provision of overseas consultants visiting Guyana to observe and assist in the implementation.

Achievements

1) **Crop Extension Services**

As outlined below (*Table 1*), most of the targets for the year were achieved.

Table 1: Crop Extension targets and achievements of the CDSS Department of NAREI for 2022.

Activities	Target	Actual	% Ach
Visit to Remote/Riverain Communities	770	950	123.4%
Field Visits	19,000	23,738	124.9%
Farmers Visited	37,488	42,988	114.7%
Farmers' Open Days	688	855	124.3%
Meetings/Outreach Programs	500	700	140.0%
Farmers' Field Schools	34	45	132.4%
Demonstration Plots	47	43	91.5%
Soil Sample Collection	235	411	174.9%
Water Sample Collection	205	181	88.3%
Pest and Disease Sample Collection	45	90	200.0%
Acoushi Ant Management	20,000	16,540	82.7%
Number of farmers benefitting from non-cash assistance	4,400	6,739	153.2%
Number of new shade house constructed	105	128	121.9%
Seeds distributed to farmers (kg)	40	61	153.2%

2) Farmers' Training

The number of training sessions with farmers conducted year-to-date is 359 which is representative of a target accomplishment rate of 141 percent of the annual target.

3) Support to Farmers' Group

A total of 44 new farmers' groups were formed. Together with the new groups, old farmers' groups are also engaged in meetings to address their concerns and issues as well. A total of 43 meetings were conducted for 2022.

NATIONAL PLANT PROTECTION ORGANIZATION (NPPO)

All the objectives, programmes and activities that formed part of the work programme were achieved and some had even surpassed expectations. Surveillance and survey activities were carried out in almost all the Administrative Regions of Guyana, a first-time achievement for the department. This enables the department to have a clear picture of the pest status of the various quarantine pests and non-regulated pests of the different Regions.

The Quarantine department continued with the execution of its duties at the various ports and points of entry and facilities. Now that the COVID-19 restrictions have been to a greater extent removed, the staff of the department has significantly increased their inspection and monitoring of all imported and exported agricultural commodities that fall under the purview of the NPPO.

The department successfully participated in the discussions involving the Governments of Guyana and Barbados to develop a new trade agreement or Mutual Recognition Agreement (MRA) for Trade in Products of Plant and Animal Origin between the two (2) countries.

The department participated in the development of several standards, guidelines, and pest protocols by directly assisting in the drafting of standards or by way of review and comments. This will ensure a holistic approach to the standardization process.

QUARANTINE SERVICES

Services	2022 Reported	Comments
Inspection of Imports	11,216	Some of the major commodities that were imported included: cut flowers, exotic fruits and vegetables, potatoes, onion, garlic, and spices. All the commodities that met Guyana's import requirements were allowed entry.
Import Permits Issuance	981	Exotic fruits (apples, grapes, berries, etc.), vegetables, potatoes, onions, seeds, garlic, wooden furniture, etc.

Inspection of Ships	1,116	All the vessels examined were allowed to enter or operate inside Guyana.
Inspection of Flights (Passenger, Cargo, etc.)	2,865	Both domestic and international flights were inspected
Inspections of vehicles at Ports of entry	49,076	Vehicles entering and leaving Guyana
Inspection of Rice Fumigation (Containers, etc.)	5,320	Containers, etc. No non-compliance report was received from Trading Partners.
Inspection of exports	14,535	Both commercial and non-commercial items to more than 40 countries
Phytosanitary certificates issued	4,403	
Farm Visits	451	
Farm Certification	151	
Trade Negotiation		The Governments of Guyana and Barbados completed a draft Mutual Recognition Agreement for Trade in Products of Plant and Animal Origin. These discussions to finalize a new agreement will continue in the year 2023.
WTO/IPPC Enquiry and Notification Points	18	Draft ISPMs, Pest Diagnostic Protocols and Questionnaires were received by Guyana for review and comments

FARM CERTIFICATION

Farms Inspected

The number of farms visited in 2022 to ensure compliance with GAP and NPPO's certification criteria were four hundred fifty-one (451). During these visits NPPO's Inspectors work with farmers to incorporate systems that would minimize microbial contamination in the production of fresh fruits and vegetables.

Farms certified in 2022

One hundred and fifty-one (151) farms were approved for the export of fruits and vegetables during the reporting year. In comparison to the prior year, this result demonstrates a twofold increase in

overall accomplishments and one hundred percent (100%) compliance with certification requirements among farmers.

Trade negotiation

The Governments of Guyana and Barbados completed a draft Mutual Recognition Agreement for Trade in Products of Plant and Animal Origin. This document is expected to remove many of the trade barriers that presently exist. The document was reviewed by the technical team representing Guyana and is ready for signing by the Ministers of Agriculture of the two countries. Guyana has initiated discussions to review and renew of the Trade Protocol for Trade in Fresh Agricultural Products (signed in 2001). These discussions to finalize a new agreement will continue in the year 2023.

WTO/ IPPC Enquiry and Notification Points

Involvement in the work of the WTO/ SPS Committee and the International Plant Protection Convention (IPPC) is integral for effective implementation and ultimate benefits for the provisions contained. During the period under review, a total of 18 draft ISPMs, Pest Diagnostic Protocols and Questionnaires were received by Guyana for review and comments. These were completed and submitted to IPPC, as well as, numerous inquiries answered by varying levels of stakeholders (including WTO Member States).

Pest Risk Analysis (PRAs)

There was one PRA for the importation of ginger from St. Vincent during the reporting period.

PRA Data/ Information sheets provided to countries to initiate trade Market Access or PRA Data Sheets offer a structure for the PRA procedure to begin trading that is closely in line with international norms. There were 14 PRA Data/ Information sheets provided to countries to initiate trade. Commodities included: coconut seedlings, coconuts, cherry, tangerine, oranges, sweet potato, eddo, golden apple, breadfruit, ginger, plantain, banana, cassava, yam. Market Access dossiers were submitted to Barbados, Trinidad and Tobago, Antigua and Barbuda, Dominican Republic, and Suriname.

SURVEY AND SURVEILLANCE

Carambola Fruit Fly (CFF) (*Bactrocera carambola*)

During the period under review, nine of the 10 Administrative Regions were monitored namely Regions 1, 2, 3, 4, 5, 6, 8, 9 and 10. Based on results obtained through the monitoring component of the programme, the Unit recognized the need to implement control measures in all the areas where CFF was detected with the aim of reducing the prevalence of the pest.

Three focus areas chosen in 2021 for intense CFF management intervention were visited in 2022. The areas included: Canal # 2, Region 3, St. Cuthbert Mission, Region 4, and Karasabai and Lethem, Region 9. With the acquisition of additional staff and resources during 2022, the focus areas were expanded to include other areas such as Orealla/Siparuta, Mahdia, Linden and North Pakaraimas.

Red Palm Weevil (RPW) and South American Palm Weevil (APW)

Surveillance activities for *Rhychophorus palmarum*, commonly referred to as the South American Palm Weevil were initiated because of a recently developed coconut project. The significance of this pest to the unit is linked to its recognition as a vector for a destructive disease of coconut palms referred to as red ring disease. The traps used in the surveillance were initially established on functional estates suspected to contain palms infected by the red ring disease. However, most traps were readjusted and placed within proximity of the farms to propel the pests away.

Red Palm Mite (RPM) (*Raoiella indica*) Quarantine Activities

The NPPO in 2022 focused on containment of the quarantine pest through internal monitoring and the implementation of quarantine measures on the Island of Wakenaam.

Technology Transfer: Meetings, Workshops, In-services staff sessions

One hundred and twenty (120) meetings were attended by NPPO Staff and included meetings with other organizations/ Ministries such as the Ministry of Foreign Affairs, Ministry of Home Affairs, GNBS, CAHFSA, AHFSA, Commission on Phytosanitary Measures (CPM), Caribbean Plant Health Directors Forum (CPHD), COLEACP, WTO/SPS Committee, United Nations Conference on Trade and Development (UNCTAD), National Committee on Trade Facilitation (NCTF),

Ministries of Agriculture of Brazil (MAPA), Trinidad and Tobago, Suriname, United Kingdom, Canada, Dominican Republic, Antigua and Barbuda, and USA/APHIS.

TRAININGS/WORKSHOPS/ IN-SERVICE TRAINING

Main Objective:

NPPO staff participated in 21 capacity building training sessions. There were six in-house training sessions for the reporting period.

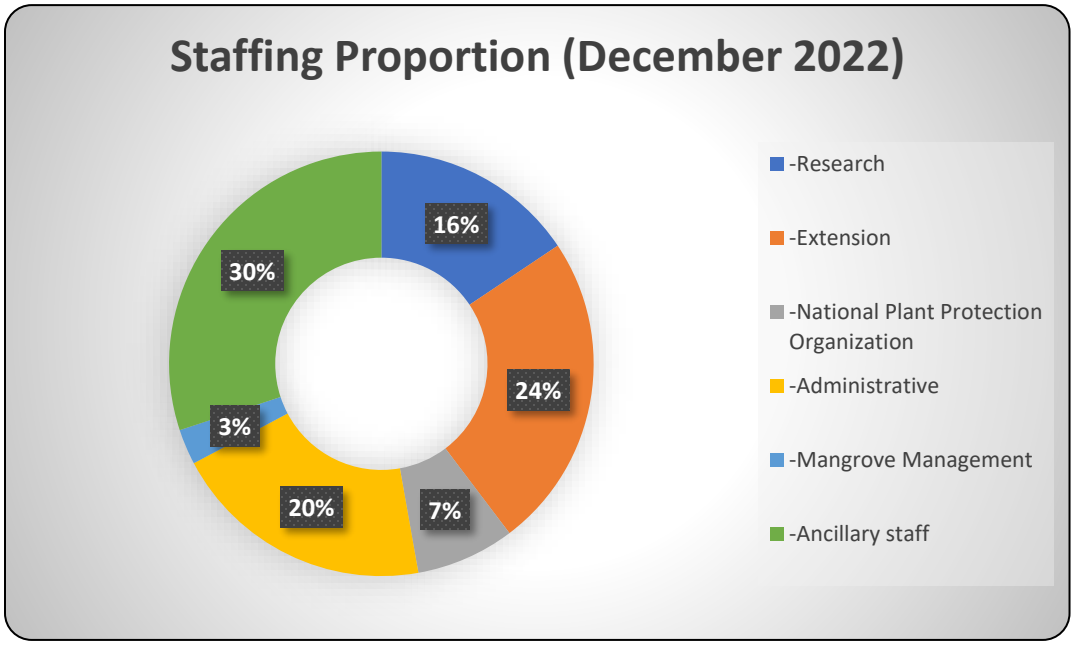
Trainings were undertaken in the following areas: -

- Export/ Import verification/ inspection procedures (e-phyto)
- Carambola Fruit Fly (CFF) Identification and Control Methods
- Red Palm Mite (RPM) Identification & Control Methods
- Farm, nursery and agricultural processing and export facilities verification and certification procedures
- Fumigation procedures
- Pest of Quarantine Importance (Mediterranean Fruit Fly, Red Ring Disease, South American Palm Weevil, TR4) Identification & Management
- Data Management
- Plant Quarantine Inspection
- Pest Risk Analysis Training
- Good Agriculture Practices (GAP) and Good Agriculture Health (GAHP) Training for farmers and Extension Staff, Importers/Exporters
- Change Management
- Project Management
- Bio-technology (use of PCR)

HUMAN RESOURCES REPORT

Staffing at the Institute has seen a steady increase throughout 2022. As of December 2022, the Institute had 519 employees.

Department	As at Dec 2022
Mangrove	14
Research	81
Extension	121
NPPO	39
Admin	104
General Worker	156
Contracted Employees	515
Extension Agents	4
Total	519



Actions	No. of Staff	Comments
Recruitment	75	
Resignation	9	
Dismissal	11	
Termination	3	
Non-renewal of contract	6	
Promotion	12	
Transfer	7	
Training of Staff	15	14 local and one overseas
Non-Contracted Employees	4	

During the year, NAREI conducted several activities in observance of religious and national holidays. The activities allowed staff members to become familiar with religious practices of the different religions in Guyana. They showcased the beauty of Guyanese through dances, songs, poetry and cuisines.

Agriculture Month also presented the opportunity for staff to collaborate and celebrate with each other. Cook-out competition, sports, and other social events have helped to build a stronger team. Staff have reportedly found these events relaxing and good for their mental wellbeing.

INTERNAL AUDIT DEPARTMENT

The Internal Audit Department is an independent and objective assurance unit that improves operation and governance through systematic, disciplined, modern and effective approaches and techniques which minimize risk, add value, improve internal controls, and accountability.

The department will provide assurance/advisory audits and services to determine whether established controls and processes are adequate and efficient. The verification work will include but not be limited to: -

Identify and assess potential risks and recommend possible approaches to reduce such risks; ensure financial, operational and managerial information is accurate, reliable and timely; review internal control systems, policies and procedures, to ensure efficiency and compliance with applicable laws, regulations, procedures, guidelines and circulars; ensuring legislative and regulatory issues and changes impacting the Institute are recognized and addressed accordingly; providing adequate reporting and follow-up to ensure recommendations are recognized and corrective actions are taken where applicable; carrying out special assignments, appraisals and investigations as requested by the Finance Committee/Board of Directors or Chief Executive Officer (CEO).

The department audited financial records mainly in the following areas of income/receivable, payment/expenses, payroll to ensure internal control systems, policies and procedures are followed. Examination of the Payroll to ensure applicable tax regulation and accurate calculation of statuary deductions. Reperformance of bank reconciliation to confirm that there is no misappropriation of the institute's funds. Among other tasks requested by the CEO as deemed relevant.

UNAUDITED FINANCIAL STATEMENT

Draft Accounts

NATIONAL AGRICULTURAL RESEARCH & EXTENSION INSTITUTE
STATEMENT OF FINANCIAL POSITION
AS AT 31 DECEMBER, 2022

	Note	31.12.2022	31.12.2021
			$
Assets			
Non Current Assets			
Property, Plant & Equipment	3	332,931,446	361,497,622
Total Non Current Assets		332,931,446	361,497,622
Current Assets			
Cash and Cash Equivalents		44,495,047	52,043,561
Accounts Receivables	4	11,704,005	8,267,615
Inventory	5	149,759,070	152,903,450
Total Current Assets		205,958,122	213,214,626
Total Assets		538,889,568	574,712,248
Equity & Liabilities			
Shareholders' Equity			
Grant from Foreign Sources		51,897,479	51,897,479
Government fo Guyana Contribution		728,408,000	767,902,000
Revaluation of Stock		341,781	341,781
General Reserves		7,646,564	7,612,974
Accumulative Surplus/(Deficit)		(282,088,978)	(288,717,149)
Total Shareholders' Equity		506,204,846	539,037,085
Non Current Liabilities			
Ministry of Public Works		5,606,815	5,606,815
Total Non Current Liabilities		5,606,815	5,606,815
Current Liabilities			
Payables	6	27,077,907	30,068,348
Total Current Liabilities		27,077,907	30,068,348
Total Equity & Liabilities		538,889,568	574,712,248
On Behalf of the Board of Directors			

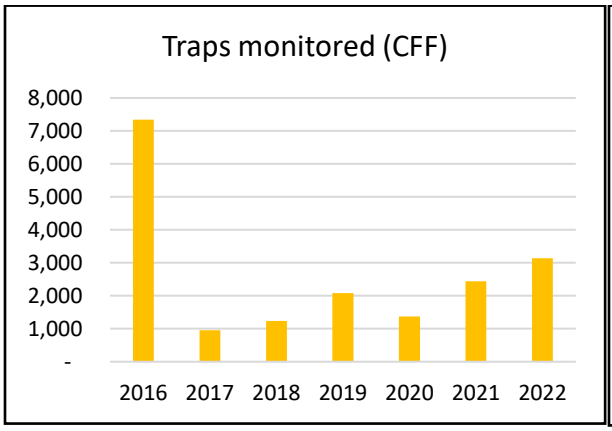
DRAFT ACCOUNTS

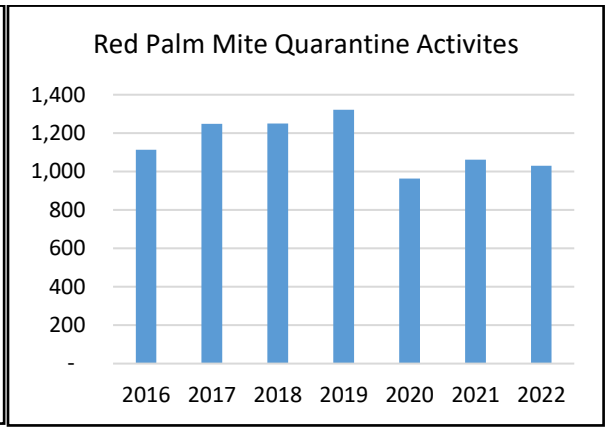
NATIONAL AGRICULTURAL RESEARCH & EXTENSION INSTITUTE
STATEMENT OF COMPREHENSIVE INCOME
FOR THE YEAR ENDED 31 DECEMBER, 2022

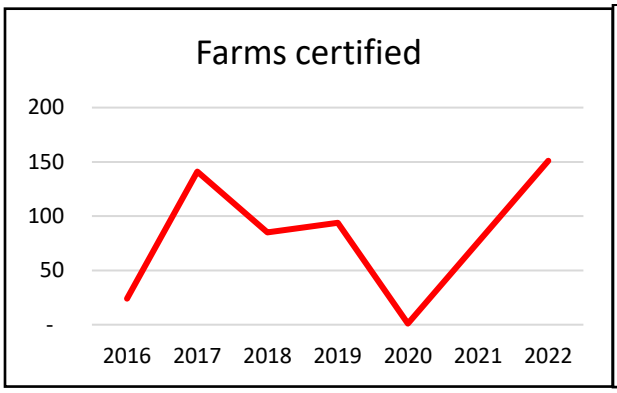
	Note	31.12.2022	31.12.2021
		$	$
REVENUE			
Government of Guyana Subvention		1,584,654,474	1,328,323,821
Income from Operations		33,468,536	50,334,181
Rental of houses		680,000	1,115,000
Other Income		152,154,654	56,359,190
Interest Earned		160,458	374,571
Income Adjustment under IAS 20		39,494,000	54,357,000
Total Revenue for the Year		1,810,612,122	1,490,863,763
Expenditure			
Benefits & allowances		48,336,676	46,436,331
Cleaning & extermination		1,429,844	1,032,772
Capital expenses		-	(47,755)
Depreciation	2	39,494,000	54,357,000
Drugs & Medical supplies		11,291,214	3,081,938
Equipment & Maintenance		4,845,058	5,333,999
Field materials & Supplies		36,599,933	43,718,757
Fuel & Lubricant		30,788,670	20,316,942
Local travelling & subsistence		13,116,163	12,189,614
Maintenance of Infrastructure		553,412	4,285,067
Mangrove Expenses		1,854,995	1,303,182
National Insurance Scheme (employers)		72,827,983	63,025,528
Office materials & supplies		12,090,432	11,872,819
Old Age Pension		980,332	1,054,007
Other direct labour costs		60,159,271	34,493,451
Other Goods & Services		17,934,667	12,061,586
Other Operating Expenses		35,805,491	16,824,949
Print & non print materials		11,435,996	12,973,624
Project Expenses		30,207,430	53,324,139
Rental & Maintenance of Buildings		41,536,707	75,955,106
Security services		22,673,155	15,912,566
Training		12,431,701	6,691,530
Transport, Travel & Postages		26,642,918	16,909,905
Utility Charges		40,778,594	35,298,122
Vehicle maintenance & service		24,166,251	20,937,344
Wages & Salaries		1,206,003,059	984,752,811
Total Expenditure for the year		1,803,983,951	1,554,095,334
(Deficit)/Surplus		6,628,170	(63,231,571)

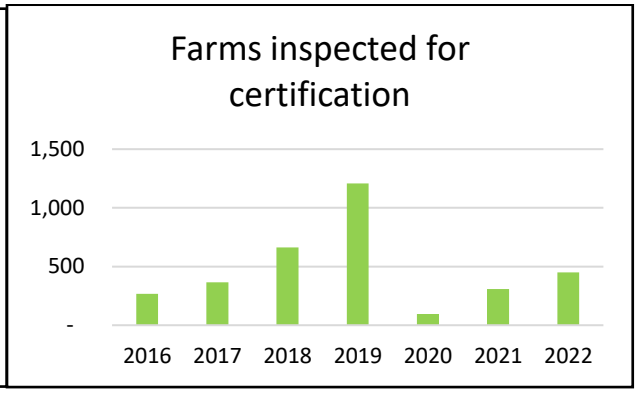
Appendix 1:

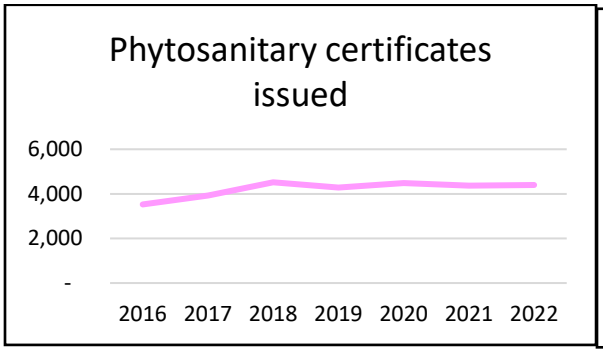
National Plant Protection Organization's Trends

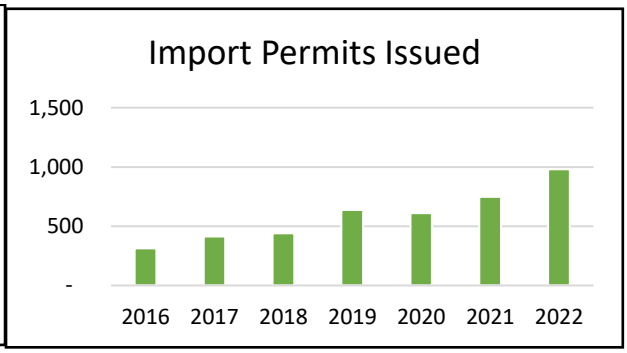


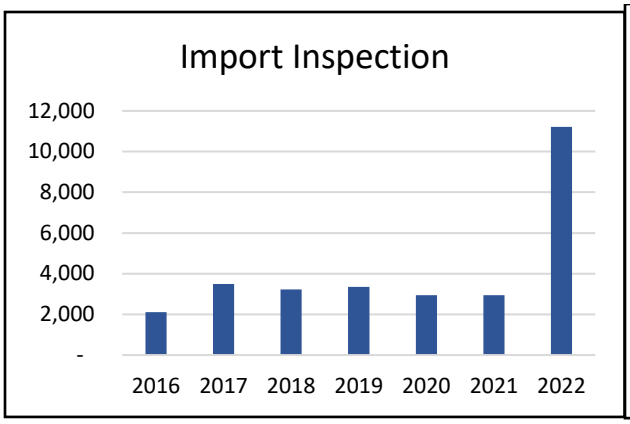


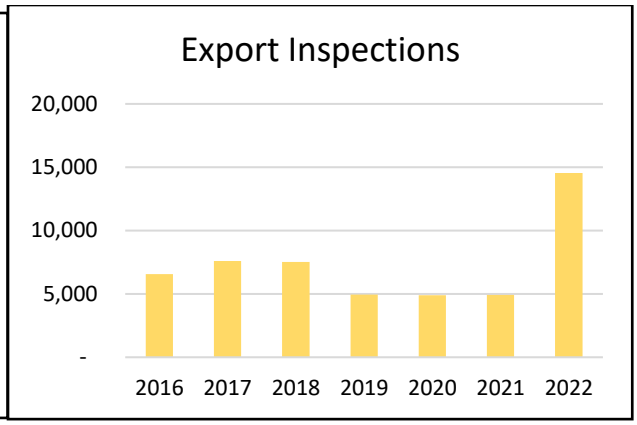


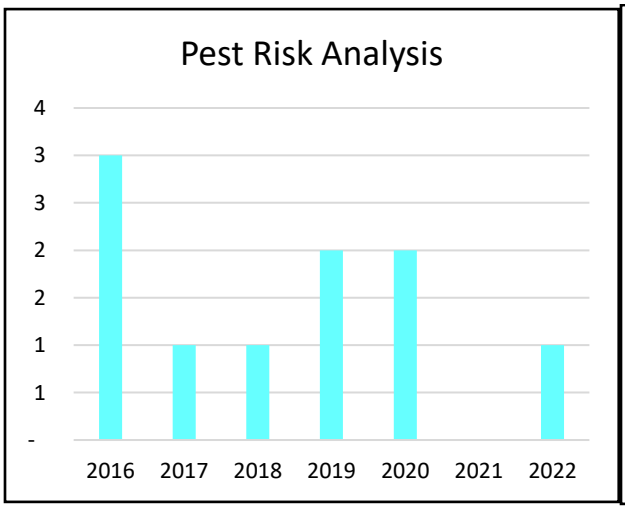


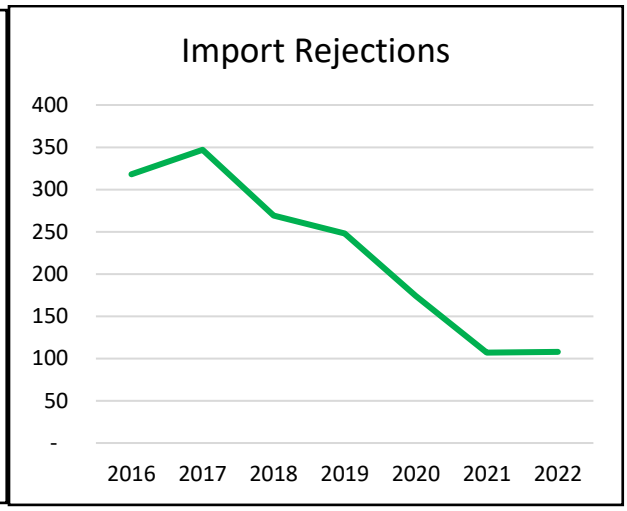





Import Inspection
12,000
10,000
8,000
6,000
4,000
2,000
-
2016 2017 2018 2019 2020 2021 2022


Export Inspections
20,000
15,000
10,000
5,000
-
2016 2017 2018 2019 2020 2021 2022


Pest Risk Analysis
4
3
3
2
2
1
1
-
2016 2017 2018 2019 2020 2021 2022


Import Rejections
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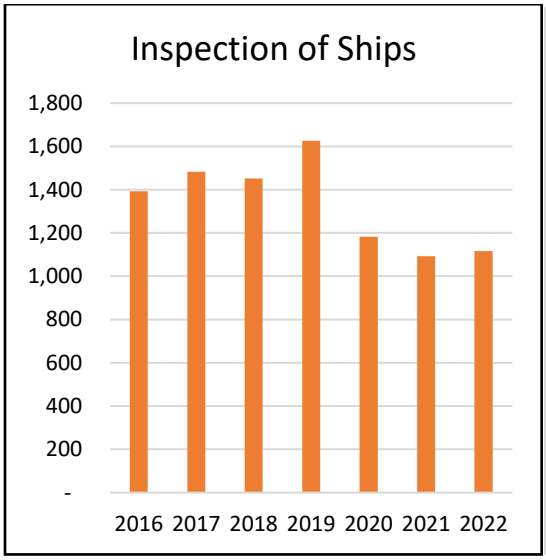
300
250
200
150
100
50
-
2016 2017 2018 2019 2020 2021 2022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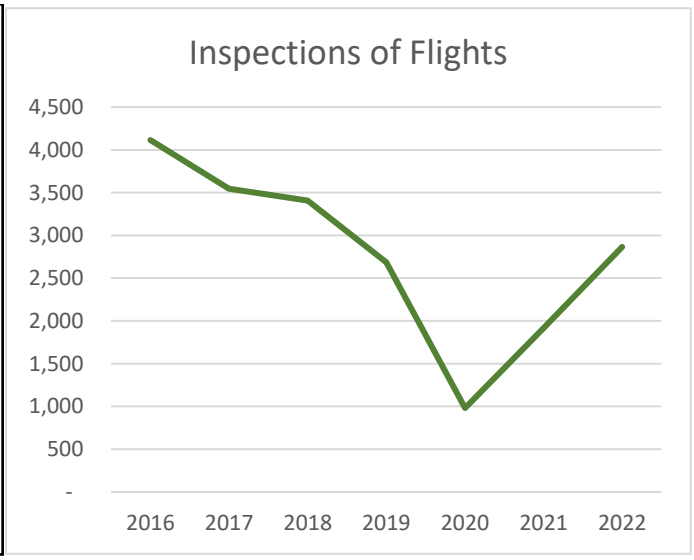
1,600
1,400
1,200
1,000
800
600
400
200
-
2016 2017 2018 2019 2020 2021 2022


Inspections of Flights
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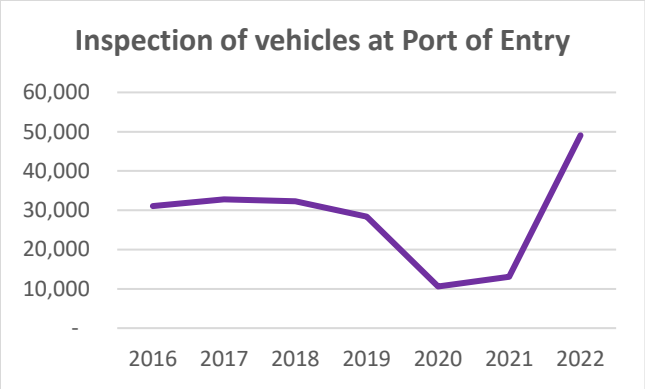
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
-
2016 2017 2018 2019 2020 2021 2022


Inspection of vehicles at Port of Entry
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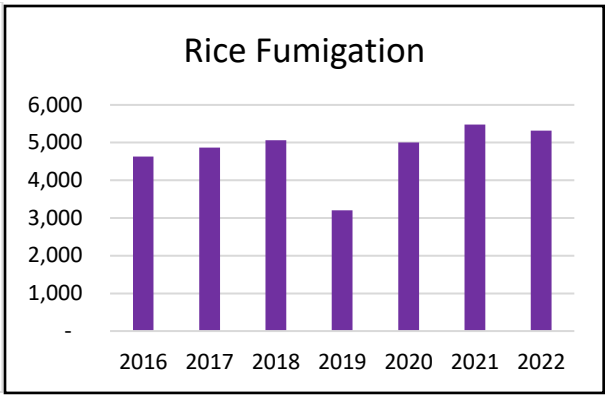
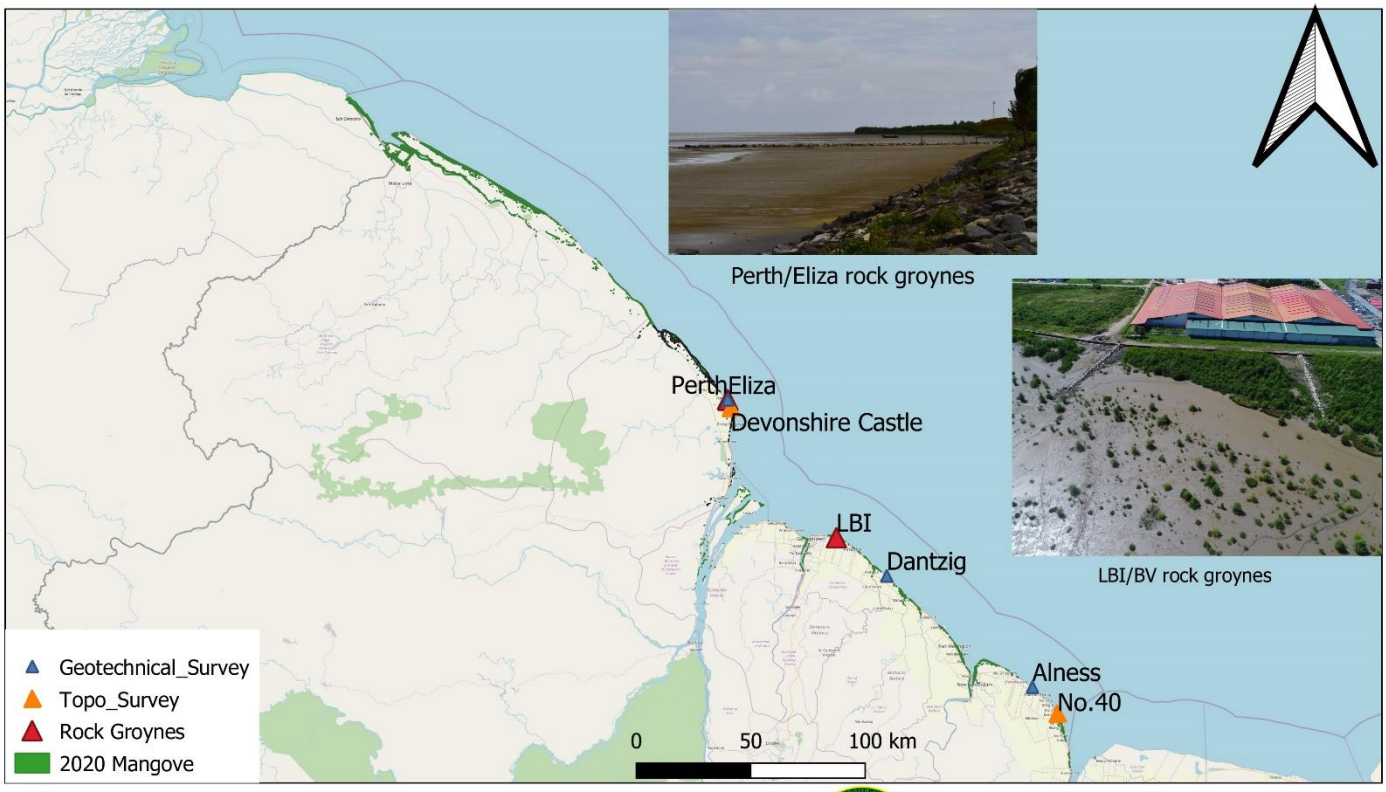
50,000
40,000
30,000
20,000
10,000
-
2016
2017
2018
2019
2020
2021
2022


Rice Fumigation
6,000
5,000
4,000
3,000
2,000
1,000
-
2016
2017
2018
2019
2020
2021
2022

Appendix 11:

National Agricultural Research & Extension Institute
Mangrove Restoration Captial Projects 2022



Prepared by: Mangove Deparment
Date: January 2023


4 Course
Healthy Meal
MAIN COURSE


KEVINING


Conducting a in-field
trial for the Aroushi
area project