



# NATIONAL AGRICULTURAL RESEARCH AND EXTENSION INSTITUTE

Mon Repos, East Coast, Demerara

# ANNUAL REPORT 2021



Office of the Chief Executive Officer

Research

Crop Development and Support Services

Plant Nurseries

National Plant Protection Organisation



# NAREI'S ANNUAL REPORT 2021



**NATIONAL AGRICULTURAL RESEARCH AND EXTENSION INSTITUTE  
(NAREI)**

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## **CEO'S STATEMENT**

The work at NAREI with the “Other Crops” sector has been progressing steadily despite the many challenges. The ongoing COVID-19 pandemic resulted in an almost “lockdown” with very few field activities and was compounded by unusual weather patterns, which led to severe flooding and high input cost. NAREI’S staff worked diligently to support our farmers during this period. They conducted numerous “outreaches” for the registration of farmers and households that suffered and the subsequent distribution of flood relief packages. Despite these challenges, we have seen positive growth in this sector. This is a result of sound agriculture policies and programmes that target all facets of Agriculture. We have seen significant Government support in the following areas: tax concessions, emphasis on drainage and irrigation, direct support for farmers affected by impacts of adverse weather, scientific research and farmers’ education. NAREI distributed to farmers, seeds and seedlings, and tissue culture plantlets of plantain, banana, pineapple and breadfruits. In addition, farm equipment, insecticides, weedicides, fertilizers and other supplies were requested to “get back” to the fields as quickly as possible. I would like to single out the farmers for commendation. They have demonstrated remarkable resilience in the face of the challenges referred to earlier. They have exemplified dedication and commitment to ensuring that our food supply needs are met. Promoting climate change adaptation measures to reduce the impact of repeated flooding along coastal regions, NAREI assisted farmers in the construction of 100 shade houses for vegetable cultivation. These measures were supported by the investment of \$50M to restore coastal mangrove ecosystems to reduce flooding and saline intrusion onto farmlands. NAREI’s technical staff have been working with farmers and the private sector in the production of corn, soya bean, broccoli, cauliflower and carrots in keeping with the national strategy of reducing the need for the importation of commodities that can be produced in Guyana. In addition, NAREI continued to conduct research and provide advice to farmers in the areas of soil fertility and pest and disease management. The staff of the Extension Department continued to work in transforming the lives of farmers and other stakeholders through the implementation of agricultural innovation systems. These required extensive and sustained efforts in the areas of training, technology transfer, data collection and special activities that assisted in strengthening the capabilities of farmers to become better and more efficient producers. Finally, in the implementation of the various policies of the Government, we have stayed true to our mission and continue to work diligently to improve livelihoods nationally and to enhance food and nutrition security for Guyana.

**JAGNARINE SINGH**  
**Chief Executive Officer**

## **MESSAGE FROM THE CHAIRMAN OF THE BOARD OF DIRECTORS**

The National Agricultural Research and Extension Institute, NAREI, is required to advise on and develop appropriate systems to promote balanced, diversified and sustained agricultural development and optimise agricultural production through adaptive and investigative research.

The Research component has a parallel, applied component – the Extension Services, to ensure that knowledge of improved production technology, phytosanitary and crop protection services to develop cost effective and sustainable agricultural production systems, is transferred to the farming community.

This Annual Report 2021 provides a synthesis of the work done by the staff of NAREI in research and extension throughout the country, during the year under review. This should be assessed in the context of the challenges posed by the Pandemic and the increasing incidence of unseasonal rainfall leading to extensive flooding of farmlands.

Nevertheless, there has been significant, incremental progress aligned with the requirements of Guyana's Low Carbon Development Strategy and the need for Climate Resilient agricultural methodologies to ensure food and nutrition security.

On behalf of the Board of Directors, I commend the management and staff of NAREI and express appreciation for the support and collaboration received from the Ministry of Agriculture, our partner organisations, and our farming communities.

Joseph G Singh

Major General (retd)

Chairman

# INTRODUCTION

In 2021, the National Agricultural Research and Extension Institute (NAREI) had a successful year with its three arms: Research, Extension Services and Training, and Plant Protection/ Surveillance achieving, and often surpassing their Work Programme targets. This is commendable, given the unusual challenges of the COVID – 19 Pandemic, and Guyana’s unprecedented country-wide flooding. The Institute received a budgetary allocation of \$1.2B and earned revenue from services, and sales at its various plant nursery locations. Resources were expended to equip laboratories, rehabilitate derelict infrastructure, conduct research and production trials, donate agriculture inputs and planting materials to farmers, and build capacities of staff and farmers, among other interventions. NAREI’s Extension and Research arms were the nucleus of the Ministry of Agriculture's national flood relief efforts for farmers and other homesteads. This activity channelled staff away from their regular duties for several months as they collected homestead data from flood-affected farmers for efficient distribution of the relief. Though not a target for 2021, NAREI processed 36,565 relief payments to farmers and householders. This exercise will continue in 2022 to complete outstanding claims. The Research Department focused on seven thematic areas: Increased Production and Productivity; Climate-Smart Practices; Plantation Crops; Guyana Government’s Priority Commodities; Promotion of Import Substitution; Management of Pests and Diseases; and Crucial Extension Services. Projects successfully implemented include seed multiplication, mangroves restoration, in-vitro storage of certain crops, completion of infrastructure works on the Plant Biotechnology and Genetic Resources DNA Laboratory, and preparation and submission of the Third Country Report on the Status of Plant Genetic Resources for Food and Agriculture (PGRFA) in Guyana (2014 to 2019). The staff of Extension Services and Plant Protection/ Surveillance departments performed exceptionally considering the Covid-19 restrictions. Farmers benefited from technical support, agri-inputs, issuance of 76 Farm Certificates, and the Government’s cash grants. Importantly, surveillance carried out at Ports of Entry helped to keep the ‘Other Crops’ sector safe from quarantined pests. Completed projects have added to NAREI’s capacity to transfer technology to farming communities. Technical Packages are now ready for dissemination to farmers. Several ongoing projects will be continued in NAREI’s 2022 Work Programme.

## **BOARD OF DIRECTORS' ACTIVITIES**

The Board of Directors was appointed on December 8, 2020, to serve for one year:

1. Mr. Joseph Singh, Major General (retd), Chairman
2. Dr. Oudho Homenauth, CEO / Ex-Officio Member
3. Mr. Ricky Roopchand Director
4. Dr. Dindyal Permaul Director
5. Mr. Jainarine Narine Director
6. Ms. Natasha Beerjit-Deonarine Director
7. Mr. Albert Andrew Forsythe Director
8. Mr. Porandatt Narine Director
9. Ms. Anjanie Narine nee Seebaran Director
10. Dr. Garvin Cummings Director
11. Mr. Suresh Amichand Director
12. Mr. Christopher Vandeyar Director
13. Ms. Bibi Shadick Director
14. Mr. Raymond Ramsaroop Director
15. Mr. Pooran Seeraj Director

It must be noted, that there were some changes made at the level of management and the Board of Directors during the reporting period. These are as follows:

1. Mr. Pooran Seeraj was appointed Deputy Chief Executive Officer- Extension (ag) resulting in him no longer being a member of the Board of Directors.
2. Mr. Jagnarine Singh was appointed Chief Executive Officer of NAREI on March 1, 2021, and became the new Ex-Officio Member of the Board. Committees of the Board

As of 2020-2021, the following Committees operated under the supervision of the Board:

### 1.Appointments Committee

- Mr. Joseph Singh, Major General (retd), Chairman
- Dr. Dindyal Permaul- Member
- Mr. Ricky Roopchand- Member
- Mr. Suresh Amichand- Member
- Mr. Christopher Vandeyar- Member
- Mr. Jagnarine Singh- CEO / Ex-Officio Member

### 2.Research Programme Advisory Committee

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

### 3.Crop Protection Programme Advisory Committee

- Mr. Suresh Amichand- Chairman
- Mr. Jainarine Narine- Member
- Mr. Raymond Ramsaroop- Member
- Mr. Jagnarine Singh- CEO

### 4.Extension Programme Advisory Committee

- Mr. Ricky Roopchand - Chairman
- Mr. Porandatt Narine - Member
- Ms. Anjanie Narine nee Seebaran- Member
- Ms. Natasha Beerjit-Deonarine - Member
- Mr. Jagnarine Singh- CEO

### 5.Finance and Administrative Programme Advisory Committee

- Mr. Christopher Vandeyar- Chairman
- Ms. Bibi Shadick- Member
- Mr. Albert Andrew Forsythe- Member
- Mr. Jagnarine Singh- CEO

It must be noted that the life of the Board of Directors came to an end on December 8, 2021.



## RESEARCH

In 2021, NAREI continued to advance its role as the premier agricultural research organization in Guyana. Staff exhibited a renewed enthusiasm for service to farmers and supported the government and the Ministry of Agriculture's policy for research-informed crop cultivation with an effort of commercializing the same. Research work at NAREI was conducted under several thematic headings. These thematic areas were:

### **PRIORITY 1: INCREASED PRODUCTION AND PRODUCTIVITY**

Multiplication of seeds at the Mon Repos and Ebini locations has seen farmers benefitting from increased availability of peanut, corn, and vegetable seeds. Stored seeds are regularly tested to ensure viability before distribution to farmers.

In support of seedling production, farmers have benefitted from the production of 3,718 litres of NAREI's potting mixture, (SSOWMix). 494 kg of vermicompost and 142 kg of thermophilic. 12.6kg of rhizobia inoculants distributed for use in legume crop production. Farmers benefited from the distribution of California red worms for vermicompost production for their farming systems. NAREI- IICA collaboration presented a webinar on using food waste to produce compost for vegetable production. The Institute also launched a booklet on the Safety Profile of Fruits and Vegetables. Additionally, 43,770 packs of seeds, 11,290 vegetable seedlings and 28,342 orchard seedlings were produced, and 280 kg of seeds and 195,121 seedlings were distributed. In preparation for the Third Country Report on the Status of Plant Genetic Resources for Food and Agriculture (PGRFA) in Guyana, a summative narrative of the progress made between 2014 and 2019. The remaining gaps and constraints were elaborated on and submitted to the Food and Agriculture Organization of the United Nations (FAO). The summative narrative addressed 18 priority activities that covered four areas of interest: In Situ Conservation and Management, Ex Situ Conservation, Sustainable Use, and Building Sustainable Institutional and Human Capacities.

The projects done in this area were:

1. The use of Mycorrhiza as a Bio-Stimulant for Crop Production in Marginal Soil
2. The effect of Mycorrhiza in combination with Rhizobium Inoculum on the growth and yield of Minica (*Vigna unguiculata*)
3. Management and operation of the soil sterilizer machine
4. Land Resource Assessment for Agricultural Production in Guyana
5. Purification of seed stocks of red beans and peanuts (at Ebini)

### **PRIORITY 2: CLIMATE SMART PRACTICES**

NAREI supported the construction of more than 140 shade houses for vegetable cultivation with the shade net and shade plastic at low cost to the farmer. Also, to optimize vegetable production in these small spaces, four vertical garden models (pocket barrel, trellis net, stack stand, and bottle wall) were tested and are available for adoption by farmers.

The monitoring of the coastal mangrove ecosystems to support restoration and planning of sea defences continued. Some 33,000 seedlings were produced in community nurseries and planted along the foreshores of Aberdeen and Colombia, Region Two. Other successes include - a mangrove monitoring platform utilizing remote sensing and Google Earth Engine that was developed in collaboration with the International Center for Agriculture Research (CIAT) SERVIR Amazonia project; the establishment of a new 2020 baseline of mangrove extent; and a completed topographic survey to monitor shoreline changes along the foreshore of Taymont Manor to Anna Regina Region Two; Ogle to Kitty and Enmore to Melanie, Region Four respectively. Also, a contract was signed between NAREI, Conservation International-Guyana and Consultants University of Guyana Faculty of Earth and Environmental Science for the Development of Mangrove Action Plan 2021-2030.

THE PROJECTS DONE IN THIS AREA WERE:

1. Response of lettuce (*Lactuca sativa* L.) inoculated with *Rhizophagus irregularis* to charcoal amended Tabela Sand for shade house cultivation
2. Production of Leafy Vegetables Using Hydroponics
3. Restoration of Coastal Mangrove Ecosystems
4. Mangrove Monitoring: Shoreline monitoring Topographic surveys Regions Two, Four & Six; Development of Mangrove Monitoring System; Rapid Assessment of mangroves along the coast
5. Increase Capacity of Mangrove Management: Development of Mangrove Action Plan 2021-2030
6. Public Awareness and Education Campaign
7. Productive intercropping of Coconuts through Climate-Smart Agriculture on the Coastal Clay Belt and Near Upland Sandy Soils.
8. Evaluating the cost and productivity of various vertical Farming models.

**PRIORITY 3: PLANTATION CROPS – citrus, plantains, breadfruit, etc.**

The provision of quality planting materials continued with in-vitro-storage of pineapple, yam, cassava and sweet potato accessions, and in-field storage of five pineapple accessions (Sugarloaf – 1000, English – 500 and Montserrat – 500) at Kairuni. Farmers benefited from the production and distribution of 46,32 plantain and banana plantlets, 1,150 pineapples and 663 breadfruit tissue cultured plantlets. Bio-technological protocols were developed for micropropagation of breadfruit and virus-free Citrus. Sixty Ma'afala breadfruit shoots were successfully established and stored in-vitro. To ensure local sweet potato varieties are conserved and new varieties are developed, 31 local sweet potato accessions were characterized and evaluated and are being maintained in Field 17 of NAREI. Also, in storage are 80 sweet potato seeds for 10 local sweet potato accessions: Amjad, Cogle, Beauregard, Strongman, Vanilla, Zebra, Professor, PB 12, 19 and 21. Five (5) newly developed accessions (Amjad -5, Cogle-5, PB 12-5, PB 21 and Beauregard-5) were evaluated on a farmer's plot at Parika Backdam. To support citrus production, 970 citrus plantlets were successfully acclimatized for distribution to farmers. Successful in-vitro testing for the most economically important - Citrus tristeza virus (CTV) - was conducted on seven varieties of citrus. Also, successes were achieved in the vegetative propagation of citrus rootstock with the production of 5163 new cuttings of Volkameriana lemons. At Ebini, nine horticultural crops -Breadfruit, Citrus, Passion fruit, Cherry, Saijan, Star fruit, Pomegranate, Sapodilla and Pond apple) were introduced to add to the existing gene pool that has 640 plants of mangoes, citrus, avocados, pomegranate, gooseberry, golden apple, and soursop. Works were completed for tech packs on passion fruit, sweet potato, hot pepper, sweet pepper, cauliflower and broccoli; a brochure on mother palm selection; an advisory on coconut spacing requirement and intercropping; commodity profiles on pineapple and hot pepper.

THE PROJECTS DONE IN THIS AREA WERE:

1. Effects of biopesticides on Black Sigatoka Disease
  2. The effectiveness of newer fungicides in combating Black Sigatoka Disease (*Mycosphaerella fijiensis*) on plantain suckers
  3. Establishing an efficient protocol for micropropagation of virus-free citrus SPP in vitro
  4. In vitro propagation of coconut *cocos nucifera* (L)
  5. Establishing an efficient protocol for micropropagation of breadfruit (*ARTOCARPUS ALTILIS*) in vitro
  6. Acquisition, Conservation, Production and Cyclic in vitro propagation of pineapple (*ANANAS COMOSUS*)
  7. Acquisition, Conservation, Production and Cyclic in vitro propagation of Plantain (*MUSA SPP*)
- 
1. The establishment of LTER for horticultural (avocado, breadfruit, carambola, cherry, soursop, etc.) alley-cropped with annuals and bi-annuals to study their commercial compatibilities (at Ebini)

#### **PRIORITY 4: GUYANA GOVERNMENT'S PRIORITY COMMODITIES – COCONUT, CORN, SOYABEAN, etc.**

To support the government's targeted crop commodities, maintenance of the Coconut Safe Depository at Ebini continued for 83 accessions. In the biotechnology laboratory, 120 coconut tissue cultured plantlets were produced and weaned in the greenhouse. Works continued on the morphological and molecular characterization of Guyana's coconut germplasm. To this end, infrastructure works were completed on the Plant Biotechnology and Genetic Resources DNA Laboratory. Servicing and subsequent calibration of all equipment within this laboratory will render the laboratory functional. In the coconut nursery, large and medium-sized quality seed nuts purchased from farmers were sprouted and 310 quality seedlings were produced for distribution. NAREI - CARDI - ITC collaborated on Project Alliances for Coconut Industry Development, Expansion and Enhanced Support for the Caribbean. This project demonstrated avenues for additional income from coconut intercropping trials. At Dalgin, Soesdyke-Linden Highway, sandy marginal soil was amended with biochar and chicken litter and produced peanuts (1500kg/ha), minica iv (222 kg/ha) and onions (30,000kg/ha); at Victoria, ECD on clay soil, ochro (2332kg/ha), and hot pepper (3538kg/ha); and at Friendship, ECD, sweet potato (2627 kg/ha) and hot pepper (1493 kg/ha) were obtained at Friendship, E.C.D.

To support the conservation of cassava germplasm, genebanks were strengthened at Kairuni with 37 improved accessions, at Ebini with 120 plots containing 50 cassava accessions duplicated from Kairuni, and at Parika Backdam with five improved sweet cassava varieties evaluated on farmer's field.

#### **THE PROJECTS DONE IN THIS AREA WERE:**

1. Conservational Biological Control: Enhancing Floral Resources as Food Source for Lacewings in Guyana Agroecosystems
2. Identification and management of major pest affecting sweetcorn in Guyana.

1. Effects of a resilient cassava seed bank for increased production and productivity at Parika Backdam East Bank Essequibo.
2. Morphological and agronomical characterization of four field corn (*Zea mays* L.) accessions at NAREI Demonstration Farm and Parika backdam.
3. Sustainable Management Coconut of an isolated safe depository of Coconut (at Ebini)
4. Cyclic characterization of Morpho-attributes of new accessions in core gene bank at Kairuni and duplicated (at Ebini)

#### **PRIORITY 5: PROMOTION OF IMPORT SUBSTITUTION – corn, soyabean, onions, Irish potato, etc.**

Corn: NAREI's support towards the local stockfeed production was manifested through varietal trials of three local and one Belizian corn variety. They were conducted at Parika Backdam on a farmers' plot. Production levels varied from 1,650 to 2,950 kg/ha. Also, varietal trials were conducted at Ebini with CARDI 001 yielding 616 kg/ha. Nine pests were collected from the field and identified, and a list of major pests and diseases associated with the crop was documented.

NAREI has entered an MOU with a business consortium to offer technical support and monitor corn (0.4ha each of five varieties) and soyabean (46.5 ha of three varieties) plots at Dubulay Ranch. Indicative data suggests that soyabean 4866 has a significantly higher number of pods per plant – 89 and 100 seed weight - 35g than the other planted varieties in this trial.

Onion and Irish Potato: Twenty-five (25) varieties of onions were secured from CARDI and IICA for on-farm trials under shaded and open-field conditions in Regions One and Four. Irish potato planting material was secured for evaluation at Dora and Kairuni (Soesdyke Linden Highway); Little Baiboo (Mahaica), Region One (Mabaruma, Wauna, White Carbie and St. Anslyn) and Waikin Ranch (Rupununi, Region Nine). Acquisition of a stacker and humidifier are earmarked for the strengthening of this value chain. At Ebini 26 types of onions were introduced in the latter half of the reporting year 2021. Among the 26 variants, one was an OPV (Cebola lola). All seed varieties were sown in trays and subsequently transplanted in December. To date, all types

have received the same number of agronomic procedures, including an application of 12:12:17+2 as basal fertilizer. Additionally, only 12 of the 26 types were adequately acclimated to their habitat. Granex, Yellow F1 Granex, Duster, Neptune, Red Wave, White Dawn, Hornet, Nomad, Mercedes, White Album, Red Sensation, and Santamara are among them. Monitoring and data collection are ongoing. Strawberry: Four methods (seeds, bareroots, stolons, and explants) were used to propagate plants. The most successful was stolons with an average survival rate of 80% and multiplication (production of daughter plants via stolons) rate of 10%. A seed germination protocol for in-vitro propagation was developed, and 590 strawberry plantlets were produced, 180 of which are stored in vitro. Three varieties (Tropical, Chandler, and Quinult) are being multiplied under shaded conditions. Indicative results suggest that Tropical Variety is showing superior adaptability to local conditions.

Quinoa: Ten accessions of Quinoa (*Chenopodium quinoa* Willd.) were evaluated for production potential at Fort Wellington, West Coast Berbice. All accessions were adaptable; however, their yields were low compared with other quinoa-growing countries. A quinoa group comprising NAREI, UG, and Quinoa growers' association of Guyana was formed.

#### THE PROJECTS DONE IN THIS AREA WERE:

1. Observational Yield Trial of Everbearing Strawberry Varieties Under Shaded Conditions
2. Evaluation of Onions and Increased Production in Open Field Conditions.
3. Evaluation of ten Quinoa (*Chenopodium quinoa* Willd) accessions for crop diversification on Saline soil in Guyana
4. Acquisition and evaluation of additional Irish potato varieties in Guyana.
5. Evaluation of three Irish Potato varieties under shaded and open field production system.
6. Producing Irish Potato in Small spaces

1. An evaluation of different potting substrates for the efficient acclimatization of in vitro strawberries
2. Establishing an efficient protocol for micropropagation of strawberry (*FRAGARIA ANANASSA*) seeds in vitro

#### **PRIORITY 6: MANAGEMENT OF PEST AND DISEASES**

This was one of the most challenging areas of work. But, based on the results it can be considered to be very successful. Acoushi Ants Bait production (18,740 packets) continued with the Ministry of Amerindian Affairs and NAREI extension Department being the main clients and distributors. Fusarium is a major disease affecting tomatoes and potatoes. The search to identify indigenous bio-agents to manage pathogens continued with *Trichoderma*.

Three suspected species of *Trichoderma* were used on infected samples of tomato and potato leaves.

These treatments had varying degrees of success in controlling *Fusarium* sp. Work will continue to optimize the treatment.

Anthrachnose is an economic disease of pepper and West Indian cherry. Several formulations were tested for their management in pepper, with varying degrees of efficacy. These include Xtrata Gold-98.9%, Coback - 76.8%, Acrobat 71.2% and Maximo 500 - 63.6%. In the case of anthrachnose on cherry, an Integrated Pest & Nutrient Management solution was found in the combined use of limestone and a copper-based fungicide. These recommendations are available for use by farmers.

The projects done in this area were:

1. In vitro Biocontrol of Pathogenic *Fusarium* species using *Trichoderma* species.
2. Management of Leaf Cutting Ants Using a Homeopathic Method.
3. Effect of three *Trichoderma* spp. on Anthrachnose disease of sweet pepper
4. The Management of Anthrachnose (*Colletotrichum* spp) under laboratory conditions
5. An Evaluation on the Use of Entomopathogenic Fungus (*Beauveria bassiana*) for the Management of the Mealybug Ant Complex in Pineapples

1. Evaluation of Entomopathogenic Fungi *Beauveria bassiana*, Botanical Extract on Acoushi Ant Activity in Guyana.
2. The Management of Anthracnose (*Colletotrichum* spp) in the laboratory, Infield trials and During Postharvest Storage on Sweet and Hot Pepper plants.
3. An Assessment of the Effects of Botanical Extracts on Insect Pests' Incidence and a Tomato (*Lycopersicon esculentum*) Production
4. Diamond Back Moth (BDM) Management
5. Management of Bacterial Fruit Blotch Disease on Watermelon (*Citrullus lantatus*)
6. Detection Survey for *Tuta absoluta* Adults
7. In vitro Biocontrol of Pathogenic *Fusarium* species using *Trichoderma* species.

### **PRIORITY 7: CRUCIAL EXTENSION SERVICES**

NAREI continued to improve on its delivery of soil chemical services to the more than 800 farmers who submitted 1,387 samples for analysis in 2021. This service was further enhanced with two pH meters secured to initiate soil services at NAREI's St. Ignatius and Ebini holdings to the benefit of farmers in those locations.

To facilitate optimal cropping on progress on a Land resource Assessment for Agricultural Production in Guyana continued with the digitization of 11 soil maps representing Adventure-Supernaam, Barima, Bartica, Good Hope-Lookout, Kalacoon, Maripa-Bonasika, Rupununi Savannahs, Tapakuma.

To satisfy the government's ambition to be self-sufficient in spices, trials continued for the improvement of responses to fertilizers for turmeric, ginger, black pepper and nutmeg. Processing and technical support to farmers continued in Region One.

As part of NAREI's commitment to the Ebini agricultural community, farmers benefited from the threshing of 363.6 kg of red peas by NAREI. Also, farmers nationwide continued to benefit from fertilisers and limestone being available at NAREI at cost.

The projects done in this area were:

1. Soil Chemistry Laboratory
2. Plant Biotechnology and Genetic Resources

Biotechnology Laboratory

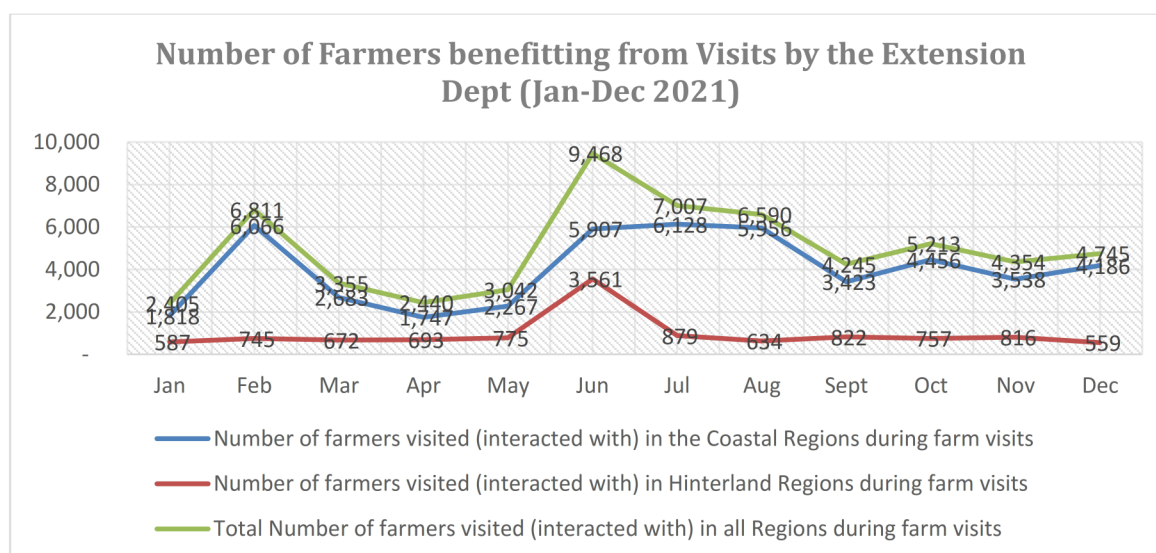
### Extension Services and Training

Many set targets in the 2021 Work Programme were surpassed owing to the strengthening of existing partnerships and the formation of new ones. Thousands of farmers and other stakeholders benefitted from technical support, training, and agri-inputs. Key to this were constant interactions between farmers and Extension Officers. The table below highlights these meetings:

#### Interaction with farmers:

Activities	Targets & Achievements 2021			Remarks
	Targets	Actual	% Ach	
Visits to Remote/Riverain Communities	664	1,597	241%	Communities located away from the mainland
Field Visits	19,975	46,202	231%	Visits conducted to farmers' fields
Farmers Benefiting	-----	57,906	-----	Target was not set for this indicator
Farmers' Open Days	838	1,079	129%	Farmers' clinics
Outreach Meetings	500	535	107%	Farmers' meetings with mainly external officers
Farmers' Field Schools	41	71	173%	Informal classroom sessions
Farmers' Group	----	53	-----	Regions Two, Three, Four, Five, Six, and 10

Table 1 shows the number of times NAREI's Extension and Training Arm met with farmers



### Promoting the Adoption of Climate-Smart Agricultural Practices and the Production of Import-Substitution Crops

**Promoting the Adoption of Climate-Smart Agricultural Practices and the Production of Import-Substitution Crops**

NAREI promoted climate-smart agricultural practices in crop production through the provision of technical support and inputs to farmers. The Institute sold materials to farmers at cost (without profit). Materials were also donated to other agencies, organizations, and schools. Many of the shade houses were used to cultivate crops targeting import-substitution. Farmers benefitted from training on the cultivation of import-substitution crops such as broccoli, cauliflower, bell peppers, carrots etc.

**Provision of Critical Extension Services**

Soil sampling and analysis was widely utilized by the farmers. Water sampling and analysis was affected due to the flooding of the farms by rainfall water. The targets and achievements for soil, water, pest and disease sampling and analysis are indicated in the table below:

Activities	Targets & Achievements 2021			Remarks
	Targets	Actual	% Ach	
Soil Sampling	330	356	108%	Samples collected and analyzed by NAREI and recommendations provided
Water Sampling	---	10	---	Samples collected and analyzed by

*Table 2 shows vital services farmers benefitted from thanks to extension services*

## Provision of Inputs

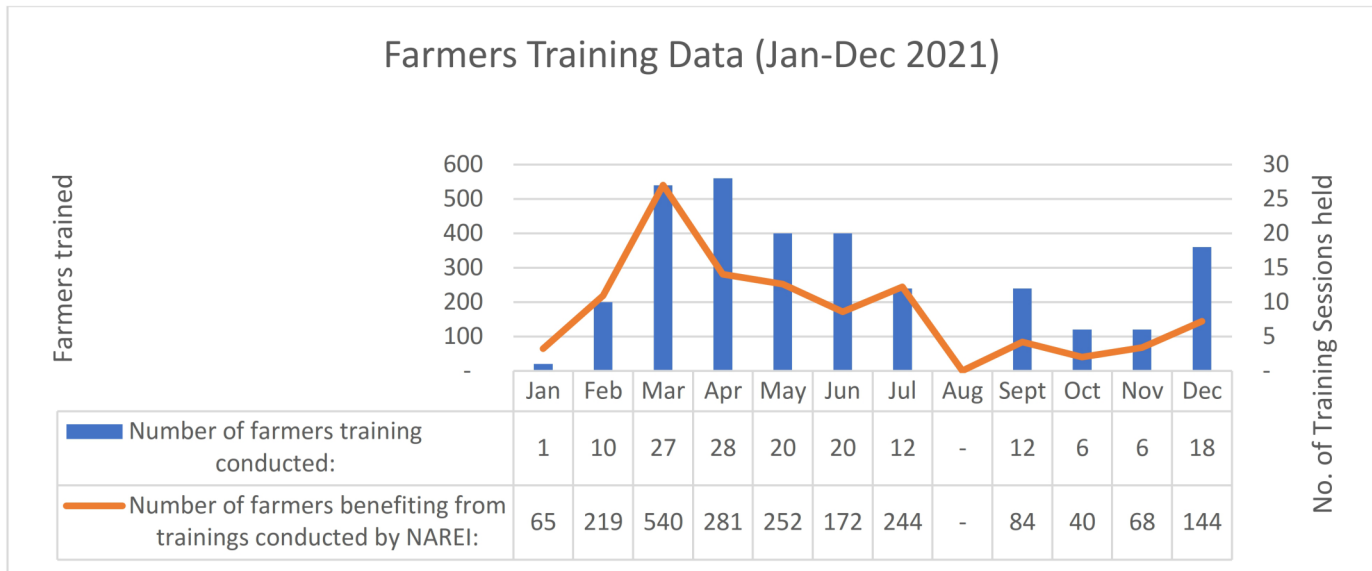
Farmers accessed 11,854 packets of ants' bait at no cost. In situations of heavy acoushi ants' infestations, extension staff conducted fogging exercises. These activities were hindered by the 2021 floods. After the floods, many farmers were very devastated and were unable to return to farming activities. Additionally, fruits and vegetables were limited in the local market. The government recognized this issue and responded to the farmers' needs through the Ministry of Agriculture. Some of the main inputs provided to farmers were vegetable seeds and seedlings, orchard seedlings, inorganic fertilizers, pesticides, gardening tools, rat baits etc. Listed below are the targets and achievements for the year 2021:

Activities	Targets & Achievements 2021			Remarks
	Targets	Actual	% Ach	
Acoushi Ant Management	20,000	11854	69%	Packets of ant bait
Tools, Fertilizers, Pesticides, Rat Bait	450	4,056	901%	Number of farmers benefiting
Fruit and Vegetable Seeds	5,000	13,923	278%	Packets of seeds

*Table 3 shows Targets and achievements of acoushi ant bait, tools, fertilizer, pesticides, and rat bait provided to farmers*



## Training



A total of 2,109 beneficiaries were trained during 160 training sessions conducted by the Training Unit. The number of farmers' pieces of training conducted thus far is representative of a target accomplishment rate of 137 percent while the number of beneficiaries reflects an accomplishment rate of 78 percent of the annual target. Training sessions conducted year-round include climate-smart agriculture, acoushi ant management, cultivation of Cole crops under shaded cultivation, etc.

### Flood Data Collection

To date, 35,040 (thirty-five thousand, and forty) farmers would have benefitted from the National Flood Relief who were affected by flood during the May – June rainy season in 2021 to the sum of \$2,487,600,000: (two billion, four hundred and eighty-seven million, six hundred thousand dollars).

Farmers from all 10 Regions of Guyana benefitted from this exercise in both cash and kind. Seedlings distribution, tools, fertilisers and technical assistance were amongst the non-cash items that were given to these farmers.

## National Plant Protection Organization

The year 2021 saw the execution of a work programme that was geared toward ensuring the protection of Guyana's agriculture from the introduction and spread of exotic plant pests and diseases across the 10 Administrative Regions. The department continued its trade facilitation responsibilities by engaging Guyana's trading partners to provide information and guidance on issues of trade and Sanitary and Phytosanitary (SPS), to ensure the smooth movement of agricultural goods and the provision of quality quarantine services in the process of trade.

### **Red Palm Mite:** *Raoiella indica*

The implementation of internal quarantine measures on the island of Wakenaam resulted in a total of **17,619** brooms and **2,217,747** dried coconuts being fumigated with Phostoxin tablets. While **17,874** water coconuts were washed in a bleach solution and **15,707** coconut palms were treated with Monocrotophos, Abamectin and Triazophos.

### **Red Palm Weevil (RPW) Survey**

A total of 101 traps were monitored of which zero RPW was captured.

### **South American Palm Weevil**

The importance of this pest as a vector for the very destructive Red Ring Disease caused by the nematode *Bursaphelenchus cocophilus* was the driving force for the initiation of surveillance in Region Three. The team established 16 traps on two estates within the Demerara River. The results from the traps are awaiting scientific confirmation.

### **Fruit Sampling Survey**

Surveys were conducted in Regions Three and Four resulting in 11 batches of samples being submitted. Examination of 190 individual fruit samples was done. Fruits that were examined include *Averrhoa bilimbi*, *Averrhoa carambola*, *Anacardium occidentale*, *Prunus avium*, *Chrysobalanus icaco*, *Aegle marmelos*, *Ribes uva-crispa*, *Psidium guajava*, *Citrus aurantifolia*, *Citrus limon*, *Mangifera indica*, *Citrus sinensis*, *Manilkara zapota*, and *Melicoccus bijugatus*. An analysis of the acquired data from the examination of fruit samples revealed the emergence of 748 pupa and the evolution of 711 fruit flies.

### **Carambola Fruit Fly (CFF):** *Bactrocera carambolae*

Seven of the 10 Administrative Regions were monitored, and control activities were conducted in Regions Two, Three, Four, Eight and Nine. Areas selected included Canal # 2, Region Three, St. Cuthbert's Mission, Region Four, and Karasabai and Lethem, Region Nine. The importance of the Brazil-Guyana Frontier as it pertains to trade in Agricultural commodities between the two countries and the recent CFF Outbreak within that Region was considered when selecting Region Nine. Farmers in Canal # 2 some of which are supplying TOPCO with fresh fruit were selected with the aim of reducing some of the losses experienced by these farmers.

### **Mediterranean fruit fly**

Surveillance activities for *Ceratitis capitata*, commonly referred to as Mediterranean fruit fly or Med fly commenced in 2017 with a total of 304 traps monitored and zero flies captured to date.

### **World Trade Organization/ Sanitary and Phytosanitary (WTO/SPS) Enquiry and Notification Point:**

A total of 60 enquires and correspondences were received from the WTO/IPPC (International Plant Protection Convention) and responses were provided where necessary. Correspondences specifically related to Guyana included the following:

- IPPC, a special invitation for Guyana to participate in an eCommerce working group.
- Request for information on the status of methyl bromide phase-out in Guyana

- India requesting verification of authentication of phytosanitary certificate No. 13388 issued for *Maclura tinctoria* round logs from Guyana. The certificate was authentic and valid.
- India Requesting verification of authentication of phytosanitary certificate for Purple Heart round logs.
- Invitation to participate in online regional Bacteriology workshop on Citrus Canker surveillance and Identification.

### Number of Visits by Trading Partners.

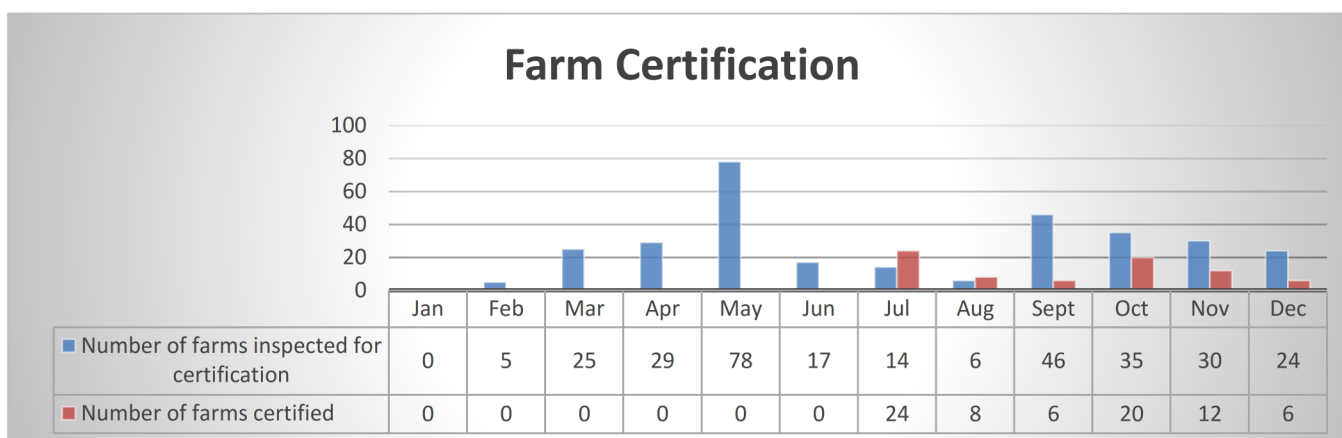
A five-member Brazilian delegation visited Guyana in the months of October and November. This team worked with the staff of NAREI in the bordering villages of regions 8 and 9, conducting Joint Carambola Fruit Fly Monitoring and control measures. The exercise was geared at enhancing collaboration and cooperation to curtail the spread of this dire quarantine pest.

### Quarantine Services

Services	# Of times offered	Comments
Inspection of imports	2,942	major imported commodities included: potatoes, onions, garlic, spices, exotic fruits, and vegetables.
Import Permits Issuance	749	Apples, grapes, berries, vegetables, potatoes, onion, seeds, garlic, wooden furniture, etc.
Inspection of vessels	1,193	All ocean-going and local vessels were given permission to enter
Inspection of Aircraft		Increased in # of inspections
Inspections of vehicles at Ports of entry	13,095	Prior to entering or leaving Guyana
Export Inspections	12,544	Commercial and non-commercial commodities
Inspection of Rice Fumigation	5,479	Containers and ocean-going vessels
Phytosanitary certificates issued	4,207	

### Farm Certification

A total of 76 farm certificates were issued throughout the year.



## HUMAN RESOURCES REPORT FOR YEAR ENDED DECEMBER 31, 2021

NAREI's human resources continues to be one of its most important assets. The Institute provides equal employment opportunities and seeks to select staff based on job suitability. Staffing at the Institute has seen a steady increase throughout 2021. Staffing as of December 2021 was reported at 474 employees, approximately 16% (64 staff) overall increase from January 2021. Employment peaked in September at 481.

Actions	No. of Staff	Comments
Recruitment	108	
Resignation	7	
Dismissal	12	
Termination	1	
Non-renewal of contract	5	
Promotion	5	
Transfer	1	
Training of staff	30	Mental Health (local)
Training of staff	1	PSM Change Management
Training of staff	1	PSM Personnel Principle and Procedures
Non- Contracted Employees	4	Extension Agents

### STAFFING AT NAREI

Categories	No. of Positions	Filled positions	Vacant Positions
Crop Development & Support Services	102	*108	14
General Administration & Finance	253	*224	37
National Plant Protection Organization	52	*38	29
Mangrove	18	14	4
Research and Development	94	86	16
<b>Total</b>	<b>519</b>	<b>470</b>	<b>100</b>

**\* Represents overlapping of fourteen (14) District Crop Extension Officers, six (6) Crop Extension Assistants, one Confidential Secretary, nine (9) General Workers, fifteen (15) Plant Quarantine Officers, one (1) Research Assistant and six (6) Research Technicians which is reflected under staffing at CDSS, General Administration and Finance, NPPO and Research and Development departments.**

### Net Change in Staffing (Jan-Dec 2021) by Department

Department	Net change in staff (Jan-Dec)
Ancillary/General Services	25
Administrative	20
Research	15

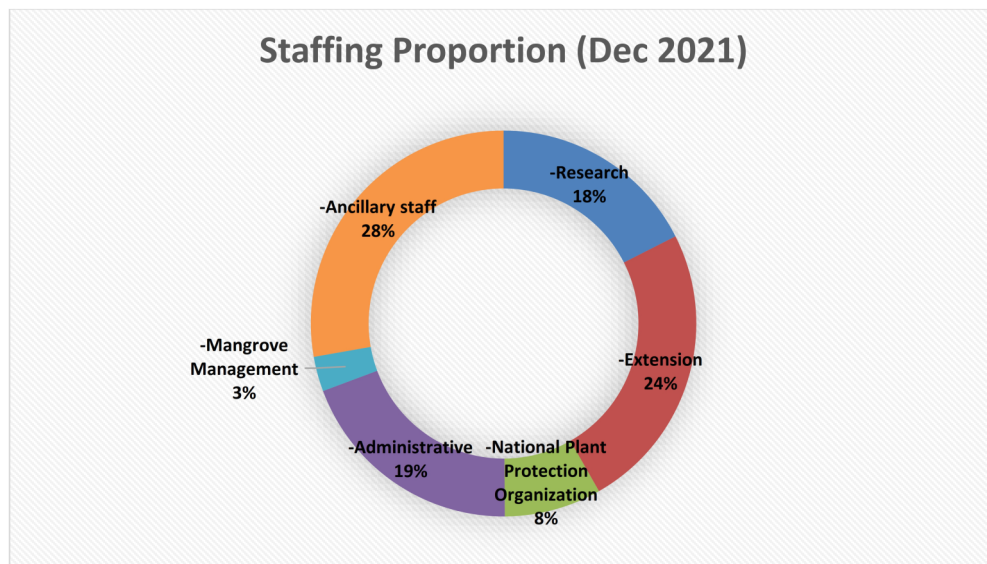
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Net Change in Staffing (Jan-Dec 2021) by Department

Department	Net change in staff (Jan-Dec)
Ancillary/General Services	25
Administrative	20
Research	15
National Plant Protection Organization	3
Extension	0
Mangrove Management	0
<b>Total</b>	<b>63</b>

Data Source: Monthly Reports-Human Resources Dept, NAREI



NAREI's Financial Position (mandated) for 2021 is outlined below:

<b>DRAFT ACCOUNTS</b>			
<b>NATIONAL AGRICULTURAL RESEARCH &amp; EXTENSION INSTITUTE</b>			
<b>STATEMENT OF FINANCIAL POSITION</b>			
<b>AS AT 31 DECEMBER, 2021</b>			
	Note	31.12.2021	31.12.2020
		\$	\$
<b>Assets</b>			
<b>Non Current Assets</b>			
Property, Plant & Equipment	3	361,497,622	371,646,519
<b>Total Non Current Assets</b>		<b>361,497,622</b>	<b>371,646,519</b>
<b>Current Assets</b>			
Cash and Cash Equivalents		52,043,561	180,940,539
Accounts Receivables	4	8,267,615	6,795,036
Inventory	5	152,903,450	158,352,360
<b>Total Current Assets</b>		<b>213,214,626</b>	<b>346,087,935</b>
<b>Total Assets</b>		<b>574,712,248</b>	<b>717,734,454</b>
<b>Equity &amp; Liabilities</b>			
<b>Shareholders' Equity</b>			
Grant from Foreign Sources		51,897,479	51,897,479
Government fo Guyana Contribution		767,902,000	822,259,000
Revaluation of Stock		341,781	341,781
General Reserves		7,612,974	6,772,889
Accumulative Surplus/(Deficit)		(288,717,149)	(225,485,579)
<b>Total Shareholders' Equity</b>		<b>539,037,085</b>	<b>655,785,570</b>
<b>Non Current Liabilities</b>			
Ministry of Public Works		5,606,815	5,606,815
<b>Total Non Current Liabilities</b>		<b>5,606,815</b>	<b>5,606,815</b>
<b>Current Liabilities</b>			
Payables	6	30,068,348	56,342,069
<b>Total Current Liabilities</b>		<b>30,068,348</b>	<b>56,342,069</b>
<b>Total Equity &amp; Liabilities</b>		<b>574,712,248</b>	<b>717,734,454</b>
On Behalf of the Board of Directors			
Chairman		Director	

The accompanying notes form an integral part of these financial statements.

<b>DRAFT ACCOUNTS</b>			
<b>NATIONAL AGRICULTURAL RESEARCH &amp; EXTENSION INSTITUTE</b>			
<b>STATEMENT OF COMPREHENSIVE INCOME</b>			
<b>FOR THE YEAR ENDED 31 DECEMBER, 2021</b>			
	<b>Note</b>	31.12.2021	31.12.2020
		⚡	⚡
<b>REVENUE</b>			
Government of Guyana Subvention		1,328,323,821	1,195,387,000
Income from Operations		50,334,181	28,243,997
Rental of houses		1,115,000	2,564,000
Other Income		56,359,190	11,704,697
Interest Earned		374,571	302,276
Income Adjustment under IAS 20		54,357,000	64,073,000
<b>Total Revenue for the Year</b>		<b>1,490,863,763</b>	<b>1,302,274,970</b>
<b>Expenditure</b>			
Benefits & allowances		46,436,331	38,501,521
Cleaning & extermination		1,032,772	998,348
Capital expenses		(47,755)	15,751,596
Depreciation	2	54,357,000	64,073,000
Drugs & Medical supplies		3,081,938	1,756,015
Equipment & Maintenance		5,333,999	4,592,504
Field materials & Supplies		43,718,757	16,900,008
Fuel & Lubricant		20,316,942	9,938,119
Local travelling & subsistence		12,189,614	8,407,472
Maintenance of Infrastructure		4,285,067	5,251,638
Mangrove Expenses		1,303,182	-
National Insurance Scheme (employers)		63,025,528	50,750,267
Office materials & supplies		11,872,819	18,445,681
Old Age Pension		1,054,007	1,386,072
Other direct labour costs		34,493,451	27,325,065
Other Goods & Services		12,061,586	13,383,274
Other Operating Expenses		16,824,949	13,641,592
Print & non print materials		12,973,624	5,100,126
Project Expenses		53,324,139	1,392,385
Rental & Maintenance of Buildings		75,955,106	46,236,678
Security services		15,912,566	17,567,292
Training		6,691,530	201,365
Transport, Travel & Postages		16,909,905	7,584,815
Utility Charges		35,298,122	34,007,894
Vehicle maintenance & service		20,937,344	10,991,082
Wages & Salaries		984,752,811	817,211,148
<b>Total Expenditure for the year</b>		<b>1,554,095,334</b>	<b>1,231,394,957</b>
(Deficit)/Surplus		(63,231,571)	70,880,013

## Flood Relief: cash grants, seedlings, seeds and agri-inputs



## Providing Technical Support



## Mangroves providing coastal protection





# Nursery Operations



# Flood Relief: cash grants, seedlings, seeds and agri-inputs



## Activities of the Board of Directors



## Soil health is important for high yielding production



## 2021 Devastating Flood



# Responding to pests and diseases



# Fun time at NAREI



# Climate Smart Agriculture



## NAREI experimenting with strawberry, onions and potatoes to promote import substitution



## Disseminating vital information through training and public awareness



# Revitalizing our coconut industry



# Surveillance and Quarantine Services

