

## **EXECUTIVE SUMMARY**

### **1. REORGANISATION OF WORK PROGRAMMES**

*Following a retreat that was held and inputs from stakeholders, the Institute's work programme was reorganized to reflect the current focus of the Ministry of Agriculture. The three research Departments in operation are:*

- a) Crop Development*
- b) Livestock Production and Breed Enhancement*
- c) Postharvest and Agroprocessing*

*A special unit, Climate Change and Agricultural Adaptation was established to transfer appropriate technologies related to climate change adaptation to farming communities through on-farm demonstration and training. A Special Projects Unit was created to monitor all special projects (ADP, READ, Spices, EMBRAPA Projects, Greenfield Farms, Neal & Massy Farms, Coconut Revitalisation, Mangrove Project, Musa Project, Training, etc.). The Office of the Director has specific responsibilities for library and documentation and IT services.*

### **2. ENHANCEMENT/REORGANISATION OF OPERATIONS AT TIMEHRI AND ST. IGNATIUS**

#### ***Timehri***

*Timehri was designated as a Research and Training Facility. Apart from functioning as a nursery, the facilities would be used to demonstrate/train farmers on climate change adaptation strategies.*

#### ***St. Ignatius***

*The Centre at St. Ignatius has been re-designated the NARI Research and Development Centre. Considerable rehabilitative work was done on the existing structures and additional personnel posted to this location.*

*The basic functions of the Centre at St. Ignatius are as follows:*

- 1. Liaising with EMBRAPA, Boa Vista on the identification of appropriate technologies for transfer to farming communities in Region 9.*
- 2. Provision of basic soil testing facilities.*
- 3. Making appropriate fertilizer recommendations.*
- 4. Diagnosis of pest and disease problems.*

*Additionally, model/demonstration farms have been established at Moco Moco & St. Ignatius.*

### **3. NEW ACTIVITIES INITIATED**

#### **(a) Coconut Revitalisation Programme**

*Following a stakeholder's consultation, organized by the Ministry of Agriculture, a programme was developed for the revitalization of the coconut industry in Guyana. The formation of a Coconut Coordinating Committee to guide/advise on the activities proposed is fully operational. A coconut programme was also finalized. This programme would be ongoing.*

#### **(b) Musa Disease Management Unit (MDMU)**

*The MDMU was established in October 2009 to deal specifically with the management of plantain/banana diseases nationally. Training programmes were conducted for all personnel to be involved in related activities. Surveys were initiated to determine the extent of the problems as well as demonstrations established to investigate methods of control/management. Significant work would be undertaken in 2010 and beyond.*

**(c) Mangrove Rehabilitation**

*In November, NARI was given the mandate to be the Lead Agency for the mangrove rehabilitation project to be funded by the EU for the next three years. Studies are currently being done to identify the areas for rehabilitation and nursery development, and identify public awareness activities to be conducted. The Mangrove Action Plan is also targeted for review.*

**(d) New Livestock Breed**

*Major emphasis was placed on breed enhancement, especially with the Texel and the Crossbreds (Texanas). These animals have adapted well to local conditions. The Texanas were branded and were made available for sale to farmers in August. The pure bred Texel have also been crossed with the Texanas to produce a 75% cross. The second phase of the project would commence in February 2010.*

*Crosses were also made with the Dorper and the Barbados Black Belly. The offspring's are currently being monitored.*

**(e) Utilization of cassava on ingredient in poultry feed**

*Research was conducted in collaboration with Bounty Farm on the use of cassava as an ingredient in poultry feed mix. The results of the investigation indicated that between 5% and 10% cassava could be included in the mix as a substitute for corn/rice. This will be fully explored in collaboration with farmers in 2010.*

**(f) Other agroprocessing activities**

*The Institute was the beneficiary of a Japanese agroprocessing expert for a three month period. Rice-based products including pasta, noodles and instant rice were produced. The private sector is currently engaged in activities related to commercialization of these products.*

*Discussions were held with members of the PSC and the GMSA on promoting the value-added products made. A 'Compendium of Process Flow Technology in Fruits and Vegetables' was presented to the GMSA.*

***(g) Rice/Beans Project***

*In collaboration with the GRDB, a three acres bean project was established at Moco Moco. Farmers were trained in all aspects of production. This is to be expanded to 15 acres in 2010.*

***(h) MOU with Stine Seed Company***

*An MOU was inked with the Stine Seed Company of IOWA, USA to promote hybrid seed production at Ebini. A visit was subsequently made by official of Syngenta. Discussions are ongoing.*

***4. CLIMATE CHANGE AND AGRICULTURAL ADAPTATION***

*A programme was finalized and adopted for the Unit. Major emphasis during the year was placed on shade/house production, irrigation systems and training. Additional shadehouse facilities were constructed at Fort Wellington, Kuru Kuru, Kairuni, Timehri, Hope Estate and the GDF Farm at Garden of Eden. These complemented those existing at BBP, Mon Repos, Linden, Anna Regina and Bartica.*

*A hydroponics facility was also constructed at Mon Repos and is currently in operation.*

***5. TRAINING***

*Formal training sessions were identified for farmers in Regions 2, 3, 4, 5, 6 and 10. Specific sessions were also held in Regions 1 and 9. Training was conducted in the following areas:*

- 1. Soil and Fertilizer Management*
- 2. Pest and Disease Management*
- 3. Organic Production*
- 4. Agroprocessing*
- 5. Post Harvest Handling*

*In excess of 1000 persons were the beneficiaries of those training session.*

## **6. SPICES**

*Major emphasis was placed on turmeric. Planting materials were obtained for Region 1. Four plots were established in farmers' fields in the area to generate seed material. Additional plots were also established at Mon Repos, Benabs and Parika. The seed materials generated would be used to expand acreages, projected to between 15 and 20 acres in 2010. It is expected that local turmeric would be in the market by December 2010.*

## **7. SUPPORT TO THE PRIVATE SECTOR**

*Technical support was ongoing with the private sector on their current enterprises. These included N & M Farms, Greenfield Farm, Boer Goat Ranch, etc.*

## **8. ANNUAL RESEARCH CONFERENCE**

*The Annual Research Conference was conducted from October 12-13, 2009 under the theme "Agricultural Production in a Changing Climate – Towards Lower Greenhouse Gas Emissions". The conference was wide ranging and attracted participants from NARI, UG, GUYSUCO, GRDB amongst other agencies.*

## DEPARTMENTAL REPORTS, 2009

### I. OFFICE OF THE DIRECTOR

#### STAFF:

1.	Dr. O. Homenauth	-	Director
2.	Ms. M. Pooran	-	Confidential Secretary
3.	Ms. D. Conway	-	Special Projects Coordinator
4.	Ms. M. Sookdeo	-	Research Assistant
5.	Ms S. Roopnaraine	-	Research Assistant
6.	Mr R. Sukhna	-	Research Assistant
7.	Ms. N. Hutson	-	Information Technology Technician
8.	Ms. N. Henry	-	Senior Library Assistant
9.	Mr. K. Singh	-	Research Technician, Black Bush Polder
10.	Mr. J. Gonsalves	-	Farm Manager, St. Ignatius
11.	Mr. F. Benjamin	-	Senior Research Technician, Ebini
12.	Ms. M. Motielall	-	Research Assistant
13.	Dr. Y. Ishikawa	-	Japanese Consultant
14.	Ms. C. Rupnarain	-	Research Technician
15.	Ms. N. Rambarran	-	Research Technician

#### (A) SPECIAL PROJECTS 2009

##### (i) Coconut Revitalization 2009

In Guyana, a number of constraints have been identified which impact negatively on the coconut sector and these include: poor drainage, high and rising costs of production, marketing, labour shortage, inadequate crop husbandry practices, lack of fertilization and limited local manufacturing processing facilities. The Ministry of Agriculture has identified the coconut sector as one of the sectors for further development. Against this backdrop, a document was prepared on the coconut industry in Guyana based on information available and a workshop was conducted in August 2009 with various stakeholders to discuss the way forward. A Coconut Coordinating Committee (CCC) was then formulated to provide guidance for the development of the industry.

Work in progress:

- Establishment of a nursery at the Hope Estate.
- A coconut de-husker is being imported from India.
- Exploring suitable production of Value Added Coconut Products.
- Research the possibility of developing a Coconut Water Processing Plant in Guyana.

## ii. Spice Project

The development of Spices in Guyana is a project that was initiated with three goals:

- To build up germplasm, develop planting material of spices and layout field trials.
- To train manpower in spices research and development.
- To make Guyana a spice producing country (long term).

Four spices, black pepper, turmeric, ginger and nutmeg were targeted under the project.

### (a) Germplasm collection and conservation

Seven black pepper accessions, seven turmeric and 14 ginger accessions were collected from different parts of Guyana and conserved in the ex-situ germplasm conservatory at NARI, Mon Repos. One elite nutmeg tree was identified at Region #1 and the scions collected from this mother tree were used in grafting.

Lack of variability was observed in the black pepper germplasm collections while good variability for rhizome features and dormancy was noticed in the turmeric germplasm.

#### ➤ Black pepper

Two black pepper nurseries were established at NARI and Region #1, using the '**bamboo method**' of multiplication. '**Serpentine method**' of multiplication was also adopted in the nurseries. One hundred and twenty five rooted cuttings are now available between the two nurseries. Twenty rooted cuttings were distributed to farmers in Region #1.

### Breeding Black pepper for Guyana

In developing a black pepper variety, open pollinated seedling selection was adopted and seeds that were collected from a farmer's plot were germinated, the vigorous seedling selected and cloned. Two pilot plots were established at NARI and Region #1. At NARI, 50 cuttings were planted on dead wood standards. At Region #1, 52 cuttings are planted on *Glyricidia* and these vines are now growing vigorously.

Foot rot caused by *Phytophthora capsici*, shoot mealy bug and aphids are the major pests noticed on black pepper at NARI.

#### ➤ Turmeric

A total of 511, three /six meter square beds were planted at farmers plots in Region #1 and Parika and NARI (Mon Repos and Benab). Leaf blotch (*Taphrina maculans*) was the major disease observed in turmeric especially at St. Anslem (Region#1) while 'Leucoderma leaf spot' disease affected plants at NARI, Mon Repos.

A dust free turmeric polisher will be imported from India to assist in polishing the final product.

➤ **Ginger**

Fourteen, three metre square beds were planted at NARI, Mon Repos and one at Parika (Farmer's plot) with the nucleus rhizomes produced during 2008-09 at NARI. The crop is free from any major pests. The crop will be ready for harvest by March, about nine months after planting.

➤ **Epicotyl grafting in Nutmeg**

Nutmeg has sexual dichotomy so only the female trees bear fruits, thus, epicotyl grafting is adopted. A total of three grafts were produced using the scion of the elite mother tree from Region #1.

**Human Resources Development**

- Two Research Assistants were trained in post harvest processing of turmeric and ginger.
- Two staff members from Mon Repos and Hosororo were trained on Epicotyl grafting of nutmeg.
- The Research Assistant attached with the project is being trained on all aspects of spices production and processing.

**iii. St. Ignatius Research and Demonstration Facility**

The facility was rehabilitated in 2009 to provide basic services for farming communities in Region nine. A summary of the activities conducted at this facility are given below:

**(a) Rice and Beans project**

This was established in the Moco Moco Community in August 2009. 1.4 ha of Minica IV was cultivated. However, the weather conditions were extremely dry with only three significant rainfall events. Harvesting was completed.

**(b) Cashew project**

A three hectare plot for this project was fenced. Four varieties of cashew obtained from EMBRAPA and one local variety were established. A shallow well and trestle for water storage were constructed for field irrigation.

**(c) Moco Moco Demonstration Farm**

In July 2009, an area of 0.5 ha was fenced and subsequently thirty beds were prepared. Pipe line for irrigation was installed. Tomato, watermelon, bora, poi, cucumber, chive and pakchoy were planted on 25% of the land space.



A small shade house is currently being constructed and this activity is being led by a Senior Councillor who is the Headmaster of the Primary School.

**(d) Shulinab Cashew Project**

An area of approximately 3.2 ha was fenced and in December 2009, one thousand cashew seedlings were acquired and transplanted. This project undertaken by Shulinab village seeks to commercially produce cashew and other crops.

**(e) Maintenance of Crop Depositories**

The crop depositories consist of over 40 entries of mango established on 5.2 ha, three entries of cashew on 1.6 ha and over thirty entries of coconut established on 4 ha. Routine maintenance of weeding and application of fertilizer were done.

**(f) Nursery**

By December 2009, 4,019 plants were produced in the Nursery.

**(g) Texana Sheep Project**

This activity commenced in August 2009. Two farms – the Point Ranch in the North Savannahs and Santa Cruz in the south were initially selected for Artificial Insemination.

**(h) Livestock Herds**

Small herds of cattle, sheep and goats that were inherited from the Ministry of Agriculture are being maintained. There was a negligible increase in cattle numbers from 72 heads at the beginning of the year to 75 at the end. In December, a herd round-up was done and 61 heads of cattle were counted. It is felt that the remaining animals still exist but could not be located at the time. Grazing conditions have been extremely dry and poor over the latter part of the year.

For sheep and goats there was an increase in the total herd of sheep from 72 to 92 animals while goats showed an increase from 27 to 30.

**iv. Greenfield Farms Ltd**

**(a) Work Completed/ in progress**

Since 2007 Greenfield Farms have been working to develop greenhouses to promote agricultural exports and utilize advanced agricultural technologies.

As proposed, the farm was intended to fulfill several objectives including: serving as a demonstration facility for farmers; to cultivate the land leased in an agreed timeframe; to develop 20 greenhouses over an agreed period of time; be responsible for all

developmental works to be carried out at the farm; be responsible for all operational costs of the farm; produce crops that it have export markets.

**Up to January 2010:**

- Ten acres of land have been cultivated. Papaws, peppers (sweet and wiri wiri) broccoli, cauliflower, cantaloupe, celery and tomatoes have been planted.
- One greenhouse has been established and in use and another is currently being constructed.
- A fish pond is being constructed.

**(B) Musa Disease Management Unit**

- |                  |   |                                  |
|------------------|---|----------------------------------|
| 1. Mr R. Persaud | - | Head of Unit                     |
| 2. Ms B. Khan    | - | Secretary/Training Lab Assistant |

*Musa* spp. (Plantain and Banana) is widely cultivated throughout the world. In Guyana *Musa* spp. contribute significant to the daily food needs of citizens and is cultivated by households in all ten regions of the country. However, the cultivation of plantain and banana has been affected by a disease which is known to be very aggressive causing serious damage to the foliage of the plants resulting in stunted growth, death, and severe reduction in quality and yields. This disease (which has destroyed *Musa* in other Caribbean countries) has been preliminarily diagnosed as Black Sigatoka, *Mycosphaerella fijiensis* Morelet.

In view of the above, the Government of Guyana through the Ministry of Agriculture (MOA) formulates the “Musa Disease Management Unit” which comprises of 13-15 staff of the MOA, Guyana Rice Development Board (GRDB) and National Agricultural Research Institute (NARI) and was established within NARI in October, 2009.

The Musa Disease Management Unit (MDMU) has five Projects which started in October 2009 and will continue in 2010. These are as follows:

**1.0 Disease Identification**

**Objective:** To identify the diseases that is affecting the *Musa* spp. in Guyana (with special reference to the Sigatoka disease).

**Justification:** There are many diseases affecting *Musa* spp. (plantain and banana) in all countries of the world. Guyana is no different since preliminary reports indicate that there is a problem of an unknown disease that threatens to wipe out the plantain and banana industry in this country.

However, the proper identification of disease is one of most importance criteria for the planning, decision making and implementation of any management /control strategies.

**Achievements:**

- Collection and preliminary analysis of samples was done at NARI. The causative agent identified under microscope show morphological features resembling the pathogen that caused sigatoka disease, *Mycosphaerella spp.*
- The protocol for sending disease sample abroad was prepared by the unit and disease samples were sent for confirmation by an Independent International Laboratory (e.g. CABI etc.).
- The unit awaits the conformation report.

**2.0 Disease Assessment within the country**

**Objective:** To conduct disease surveillance programme/ survey in the ten (10) Administrative Regions of Guyana to identify and map all infected/affected areas and disease free areas.

**Justification:** In order to determine the status of the disease in an area, a survey must be conducted. The survey provides information on the presence or absence of the disease and the level of infection if it is present in an area. The information obtained will guide decision-making on whether any action should be taken, the type of action, and extent of the action to be taken as well as providing a basis for an efficient control programme to be implement.

**Achievements:**

- The disease surveys (delimiting, detecting and monitoring) in all the region of the country commence in 2009 and will continue in 2010.
- The aim is to identify and map all the infected and disease free areas that may be present and advice farmers on management strategies to be taken.
- Data received are being placed in format for further analysis of the situation.

**3.0 Disease Management Strategies**

**Objective:** To formulate and implement strategies to manage, control, quarantine and possible eradication of plantain and banana diseases.

**Justification:** Musa diseases are widely distributed in various parts of the world where ever this crop is been cultivated. A package/workable tools need to be developed (cultural practices, disease management etc.) with the strategies for managing this disease so as to revitalize this cultivation and regain the farmer's confidence in these crops.

**Achievements:**

- Quarantine officers, farmers and other key stakeholders were provided with some initial recommendation for the implementation / strengthening of internal quarantine measures.
- Development of control measures to manage the Musa disease has started and will continue significantly in 2010. Some of the strategies will include destruction and

removal of disease plants and plant parts, develop a well planned spray program to combat the problem and screening of available chemicals (fungicides) etc.

#### **4.0 Training of staffs and farmers**

**Objective:** To train / build the capacity of the local professionals/ technical staff within the MDMU, MOA and/or farmers etc. in the identification and management strategies for the sigatoka disease in plantain and banana.

**Justification:** In order to effectively control/eradicate this new developing disease, capacity building of various individual within the industry is essential.

**Achievements:**

- Training of relevant staff, farmers and other key stakeholders (e.g. Quarantine Staff, Extension Officers and other Technical Staff etc.) across the country has started and will continue in 2010.

#### **5.0 Public awareness and sensitization.**

**Objective:** To conduct seminars /workshop /public sessions on black sigatoka aimed at sensitizing all the relevant groups about the disease.

**Justification:** The success of the programme would depend on the voluntary support, cooperation and understanding of the various stakeholders: General Public, Farmers, Extension officers, Students, News media, Commercial Interest and Technicians etc.

**Achievements:**

- Stakeholder awareness programme through all available means of communication (e.g. television, radio, news papers, flyers, brochures, facts sheets, posters etc) has commenced and will continue significantly in 2010.

## **(C) POST HARVEST AND AGROPROCESSING**

### **1. The production of composite flours for use in the food industry**

**Abstract:** *This study was undertaken to explore the development of composite flours using roots crops that can be utilized in the food industry. The root crops included cassava, eddoes and sweet potatoes in different combinations. The mixtures included cassava and sweet potatoes, cassava and eddoes, sweet potatoes and eddoes (40-56%; 56-40% respectively) with 4% of wheaten flour added to all mixtures. Numerous products were prepared from these composite flours, such as cookies, bread and roti. These products were tested among the staff at NARI for colour, aroma, cooking quality and taste. The results obtained indicated that the combination of 40% cassava, 56% sweet potato and 4 % wheaten flour were highly acceptable. Various suggestions were made on more food types that the cassava-sweet potato composite flour can be used to prepare. This project provides alternative uses for root crops in the food industry.*

### **2. The production of rice based products**

**Abstract:** *Preliminary studies were done on the production of rice based products. These products included instant rice, rice pasta and noodles.*

*A trial was initiated to produce instant rice using local rice. Work was done on different types of rice such as Karibee Brown rice and White rice. Rice was pre-cooked using two methods: steaming and boiling. Samples were pre-cooked for 20 minutes by both methods. Rice was then subjected to dehydration (10% moisture). The final product was analyzed for weight loss, moisture content, shrinkage, product quality (colour, aroma, and texture) and rehydration. The sampling of the product was done among the staff of NARI. The results showed that the steaming method was more efficient than the boiling method. The quality of the rice after dehydration in terms of colour, aroma and texture was good and more acceptable for the steamed brown rice and steamed Karibee rice. Highly favourable results were obtained for the steamed brown rice with rehydration time of 10 minutes. The results indicated that this trial was very successful.*

Two studies were conducted on pasta and noodles made from rice flour. In both studies 100% rice flour was used in the production of rice pasta and noodles. The dough was gelatinized by steaming which was subjected to extrusion prior to drying. These products were tested among NARI's staff for

brittleness, cooking quality, taste and storage. Favourable results in terms of eating quality and taste was determined. The results obtained during storage showed that the quality of the pasta and noodles were maintained for six months. Results on brittle products were not favourable and various suggestions were made by the private sector on ways to improve this aspect of these products. More work will be attempted in the following year on improving quality for private sector commercialization.

### **3. The utilization of cassava as an ingredient in poultry feed**

**Abstract:** *This project was initiated to determine the best ratio at which cassava meal could be incorporated in the diets of broiler chicks and to determine the economic benefits of feeding cassava meal to broilers. Fresh cassava was sun dried, powdered and incorporated as a component of poultry feed. Eight hundred one day old, Cobb breed chicks were selected for this trial and placed in four treatments (0%, 5%, 10% & 15% Cassava meal) with two replicates. There were two hundred birds per treatment. The completely randomized design was used. All the chicks were given feed and water ad lib. The trial lasted for a period of six weeks. Body weights were taken weekly, mortality was recorded daily and the feed conversion ratio (FCR) was determined. The results of this study indicated that cassava root meal can be used as substitute for the rice or corn in conventional feed for poultry, provided that the cassava-based rations are balanced properly for all nutrients. Good results were obtained for all the treatments with the best ration of 5% and 10% cassava meal inclusion. Considering the price for rice and corn, cassava feed for poultry supplement is economical provided that maximum yield can be obtained and the farm gate price does not exceed ten dollars/pound.*

### **4. Post harvest studies on the control of internal browning in Montserrat pineapples**

**Abstract:** *Work was initiated on the control of internal browning in Montserrat pineapple in the Canal # 1 Polder. Meetings were held with pineapple farmers and some exporters that utilize the New Guyana Marketing Corporation (NGMC) facility at Sophia, to discuss the issues on internal browning in pineapple. Through a survey, questionnaires were distributed and approximately 80% of the farmers indicated that their crops were affected by this physiological condition. Field visits were made to farmers' plots and samples of pineapple were randomly selected and cut into halves for observation. The observations showed that less than 2 % of farmers' plots were affected. These farms were highly infested by pests. Other observations indicated that some of the farmers that cultivate pineapple in these areas are unaware of the physical appearance of this physiological condition "internal browning". The exporters were more knowledgeable about this problem than the farmers.*

*This survey showed that exporters that obtained their pineapple from certified farms and followed proper post harvest handling techniques and did not encounter problems with internal browning of pineapples.*

**(D) Intermediate Savannahs – Ebini**

- 1. Floyd Benjamin - Officer in Charge
- 2. Kevin Gonsalves - Technician
- 3. N. Cumberbatch - Coordinator

**Programme:** Special Project under the direct supervision of the Deputy Director

During the reporting year the Ebini Station was instrumental in providing a number of services to ensure the integrity of the programmes of the Institute. These include seed production, germplasm evaluation and observation studies, managing plant genetic resources of coconut, mango and sweet potato, as well as maintaining breeding stock for sheep and cattle. The station was successful in fulfilling its mandate although the prevailing weather in 2009 was not favourable for crop production; the station experienced 1602.9 mm of rain during the reporting year. The rainfall data for the Ebini location is highlighted in Table 1.

**Table 1: Rainfall Data for the Ebini Station, 2009**

Months	J	F	M	A	M	J	J	A	S	O	N	D
<b>Rainfall (mm)</b>	178	103	79.1	140	64.3	251	213	184	59.5	160	45	126
<b>Rainfall days</b>	21	20	17	21	13	21	20	17	8	13	12	21

**Agricultural Systems at the Ebini Unit**

The Ebini Unit is a special project and during the reporting year the programme was transferred to the Office of the Deputy Director. The Unit serves as a site for a number of projects that are conducted by the different Departments of the Institute. These include:

- 1. The Agronomy Department
- 2. The Horticulture Department
- 3. The Department of Plant Genetic Resources and Biotechnology, and
- 4. The Department of Livestock and Pasture Production

In addition to working with the above mentioned Departments of the Institute, the Ebini Unit has developed a Cooperation Agreement with the Guyana Sugar Cooperation to test sugar cane varieties and produce legume seeds for the Cooperation and a Memorandum of Understanding with the Rising Sun Farm for a livestock breed improvement programme.

### **The Agronomy Department**

The goal of the Agronomy Department of NARI is to test improved varieties and promote the productivity of these crops mainly, vegetables and root and tuber crops through improved production systems and enhanced seed quality.

The specific objectives of the seed programme of the Agronomy Department are to:

1. Maintain the genetic purity of seed material.
2. Produce high quality seed material of selected crops.
3. Make available to farmers good quality seed at a reasonable price, and
4. Provide a sustainable seed supply system.

### **Seed and grain production of soybean**

The highlight of this programme was the success attained both in the multiplication as well as the germplasm evaluation of the ten soybean varieties from Brazil. Table 2 shows the agronomic data from the evaluation studied as well as the results from the seed multiplication efforts at Ebini. The outstanding varieties included BRS Babacu, BRS MA Serido, BRS Pirarara and BRS Cornauba.

**Table 2: Agronomic characteristics and available seed of 10 Brazilian Soybean Varieties in the Intermediate Savannahs**

<b>Variety</b>	<b>Days to Maturity</b>	<b>Plant height (cms)</b>	<b>Height of lowest pod (cms)</b>	<b>Yield Kg/ha</b>	<b>Seed available (kg)</b>
BRS Babacu	131	92	13	4000	54.8
BRS 291 Boa Vista	121	45	4	3000	7.2
BRS MA Serido RHC	121	52	17	4000	15.6
BRS Sambaiba	121	41	11	2400	8.1
BRS Tracaja	121	40	2	3850	7.2
BRS Candeia	131	52	5	3000	6.6
BRS Cornauba	121	42	10	3900	9.5



BRS Pirarara	121	65	15	4000	7.0
BRS Jucara	131	37	9	3700	10.5
BRS MA Pati	121	45	5	2090	4.4

Figure 1 below show some soybean seed multiplication trial in the Intermediate Savannas.



**Figure 1: Soybean seed multiplication trial in the Intermediate Savannas, 2009**

Seed material available from the soybean varieties and stored at the Seed Storage Facility at Mon Repos are as follows:

Crop type	Variety	Seed available (kg)
Soybean	BRS Babacu	54.8
Soybean	BRS 291 Boa Vista	7.2
Soybean	BRS MA Serido RHC	15.6
Soybean	BRS Sambaiba	8.1
Soybean	BRS Tracaja	7.2
Soybean	BRS Candeia	6.6
Soybean	BRS Cornauba	9.5
Soybean	BRS Pirarara	7.0
Soybean	BRS Jucara	10.5
Soybean	BRS MA Pati	4.4

During 2009 the Ebini Unit tested for the Agronomy Department a number of cowpea seeds, the yield component data are presented in Table 3.

**Table 3: Yield Components of Cowpea Lines Acquired and Tested at Ebini, 2009**

<b>Accession No</b>	<b>Time of emergence</b>	<b>Days to 50% flowering</b>	<b>Days to maturity</b>	<b>Average pod length (cm)</b>	<b>Seeds/pod</b>
IT97K-461-4	4 days	47 days	67 days	15.08	9
IT98K-128-4	„	47 days	70 days	14.7	12.6
IT98K-491-4	„	39 days	70 days	13.14	8.8
IT99K-11122	„	44 days	74 days	11.67	13.8
IT99K-316-2	„	39 days	78 days	12.9	8.8
IT00K-1236	„	48 days	72 days	15.36	8.4
IT99K-529-1	„	44 days	76 days	13.44	11.2
IT99 K-491-7	„	48 days	72 days	14.02	13.2
IT99K-429-2	„	40 days	74 days	13.34	10.4
IT96D-610	„	44 days	75 days	12.74	10.4

The seed yield for the lines were good and all lines are being maintained. However, there were greater demand for peas of the black-eye and red pea type from the buying public, therefore, the decision to increase seed material of the black-eye types of cowpea lines, as well as, those seeds more closely resembling phenotypically the red peas or Minica 4 was made.

A number of other plant types were planted at Ebini as part of the work undertaken by the Unit for the Agronomy Department, the objective being to maintain and multiply seed material. The bulk of the seed material maintained at the Ebini location had to be transferred to the Mon Repos Unit for safe storage mainly as a result of the unseasonal dry conditions experienced during the reporting year. Table 4 shows all of the seed material that was planted by the Unit during 2009 and which material was transferred to the Mon Repos Unit for safe storage.

**Table 4: Commercial Seeds and Seed Lines Produced by the Ebini Station and Stored at Mon Repos, 2009**

<b>Crop type</b>	<b>Variety</b>	<b>Seed available (kg)</b>	<b>Storage area</b>
Soybean	BRS Babacu 2009-11-06	54.8	Main building
Soybean	BRS 291 Boa Vista 2009-11-06	7.2	Main building
Soybean	BRS MA Serido RHC 2009-11-06	15.6	Main building
Soybean	BRS Sambaiba 2009-11-06	8.1	Main building
Soybean	BRS Tracaja 2009-11-06	7.2	Main building
Soybean	BRS Candeia 2009-11-06	6.6	Main building
Soybean	BRS Cornauba 2009-11-06	9.5	Main building
Soybean	BRS Pirarara 2009-11-06	7.0	Main building
Soybean	BRS Jucara 2009-11-06	10.5	Main building
Soybean	BRS MA Pati 2009-11-06	4.4	Main building
Soybean	BRS Babacu 2009-07-06		Annex
Soybean	BRS 291 Boa Vista 2009-07-06		Annex
Soybean	BRS MA Serido RHC 2009-07-06		Annex
Soybean	BRS Sambaiba 2009-07-06		Annex
Soybean	BRS Tracaja 2009-07-07		Annex

Soybean	BRS Candela 2009-07-07		Annex
Soybean	BRS Cornauba 2009-07-07		Annex
Soybean	BRS Pirarara 2009-07-07		Annex
Soybean	BRS Jucara 2009-07-07		Annex
Soybean	BRS MA Pati 2009-07-07		Annex
Cow pea seed	Minica 4 Red peas 2009-09-28	150 kg	Main building
Cowpea seed	Minica 4 Red peas 2009-09-28	350 kg	Agronomy seed storage
Peanut	Florunner 2009-11-27	240 kg	Agronomy Seed storage
Peanut	GN-94-A2 2009-11-27	1 kg	Agronomy Seed storage
Sorghum	3D 2009-11-27	500g	Agronomy Seed storage
Sorghum	Be hary 2009-11-27	500g	Agronomy Seed storage
Sorghum	4001 2009-11-27	500g	Agronomy Seed storage
Corn	M-92-B2 2009-11-27	200 kg	Agronomy Seed storage
Cowpea seeds	IT99K-429-2 2009-11-27		Agronomy Seed storage
“	IT99K-491-7	49.5 kg	Agronomy Seed storage
“	IT98K-128-4	32 kg	Agronomy Seed storage
“	IT98K-491-4	24.3 kg	Agronomy Seed storage
“	IT99K-316-2		Agronomy Seed storage
“	IT99K 529-1		Agronomy Seed storage

“	IT99K-461-4		Agronomy Seed storage
“	IT96D 610		Agronomy Seed storage
“	IT 98-K-128-4		Agronomy Seed storage
“	IT99K-429-2	20.5 kg	Agronomy Seed storage
“	IT99K 11-22		Agronomy Seed storage
“	IT-99K316-2		Agronomy Seed storage
Mung bean	Mung bean 2009-11-27		Agronomy Seed storage
Cowpea Black-eye pea	Cal 5 2009-11-27		Agronomy Seed storage

## **ORCHARD CROP PROGRAMME**

### **The Department of Plant Genetic Resources and Biotechnology**

The orchard crop programme was enlarged to cater for some of the activities under the Plant Genetic Resources Department (PGR). As a consequence of the PGR programme, a project was developed to establish on-farm and out-station depositories of some specific crops. These include coconut, mango, cashew, sweet potato and cassava.

The objectives of the programme are:

1. To establish basal collections of local mango varieties to serve as the national basal gene pool.
2. To establish basal collections of local coconut varieties representing the diversity of riverain and coastal ecologies.
3. To establish basal collections of local cassava and sweet potato varieties, and
4. To evaluate the growth and production of dwarf cashew varieties. As part of the Orchard Crop programme, the PGR activities in the Intermediate Savannahs are highlighted and these include the establishment and maintenance of the repositories for the economic crops, namely mango, coconut and sweet potato.

## Mango

There are two blocks of mangoes planted at Ebini. There are 24 rows (varieties) in block 1 and 23 rows (varieties) in block 2; each mango row should have 5 plants of the same variety. In Table 5, the number in the mango row represents the number of plants in each row.

**Table 5: Field Plan for the Ebini Mango Germplasm Plot, 2009**

R	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
B1	5	1	4	5	4	4	5	5	5	5	5	3	1	1	2	1	1	1	1	0	0	0	3	1
B2	4	2	3	3	5	4	4	5	4	4	5	4	4	3	5	4	3	5	3	4	4	3	3	

## Coconut

Approximately 100 coconut varieties were collected from the area formerly occupied by the Guyana National Service, Kimbia. These varieties formed the nucleus of the coconut germplasm which is located in the (No-till field) in the Kasarama Savannahs. In addition, approximately 50 coconut varieties were collected from the Pomeroun and were taken to Ebini to be part of the germplasm collection. The coconut field has four plots. As shown in Table 6, there are 22 rows per plot and in each plot there are supposed to be 5 plants. The number in the coconut row represents the coconut plant in the collection.

**Table 6: Field plan for the Ebini coconut germplasm plot, 2009**

<b>Rows</b>	<b>Plot 1</b>	<b>Plot 2</b>	<b>Plot 3</b>	<b>Plot 4</b>
Plants /plot				
1	5	5	1	4
2	3	Nil	4	Nil
3	5	1	Nil	5
4	5	4	5	4
5	4	5	5	3
6	5	5	Nil	Nil
7	2	4	4	5
8	3	1	4	4
9	5	4	Nil	1
10	Nil	5	5	5
11	5	5	5	5
12	4	5	5	Nil
13	5	5	4	5
14	2	5	4	4
15	1	5	Nil	Nil
16	4	5	2	2
17	2	5	1	5
18	Nil	5	Nil	4
19	2	5	5	5
20	5	5	4	Nil
21	5	5	5	5
22	5	5	5	5

### **Sweet potato**

The sweet potato germplasm collection which is a part of the PGR activity at Ebini was maintained during the reporting period. The lines were transplanted to ridge and furrow plots during the reporting quarter as shown in Figure 2. There are 22 lines in the sweet potato germplasm.



**Figure 2: Sweet Potato Varieties at Ebini, 2009**

### **The Horticulture Department**

The orchard crops, such as the citrus, mango, guava, pineapple, cherry, golden apple and rambuttan all form part of the orchard crop programme of the Ebini Unit. One of the main activities of this programme activity is to provide propagation material to the tissue culture as well as the nursery programme of the Institute. In addition to the overall maintenance of the orchards, the programme embarked on two pineapple projects.

Pineapple is perhaps the third most important export crop type and the demand for organically produced pineapple is expanding. The pineapple niches well in the Intermediate Savannahs, hence the need to investigate its production potential using organic production techniques is being explored.

### **Pineapple Germplasm and Museum**

The Ebini pineapple germplasm collection has plants mainly of the Montserrat variety. This collection supplied pineapple slips for the tissue culture programme. The pineapple programme has expanded and is in the process of establishing a pineapple museum plot in an attempt to acquire and store most of the commercial pineapple varieties grown in Guyana

### **Organic Pineapple Study**

An organic pineapple experiment was planted at the Ebini Location, using pineapple of the Montserrat variety. The experiment has five plots of three treatments per plot. As shown in Table 7, the treatments are cow manure, sheep/goat manure and the control is no organic treatment. As shown in Figure 3, all plots are planted in an alley with *Gliricida sepium* as the alley plant.





**Figure 3: Organic Pineapple Study**

**Table 7: Mean plant height (cm) of organic pineapple plants at Ebini 2009**

<b>Control</b>	<b>Plot 1</b>	<b>Plot 2</b>	<b>Plot 3</b>	<b>Plot 4</b>	<b>Plot 5</b>
July	19.3	19.3	23.8	22.25	23.6
August	39.7	46.1	49.3	50.6	50.05
September	45.7	53.2	57.4	55.3	56.9
October	45.8	56.7	46.5	57.7	56.5
November	44.5	55.8	56.9	55.1	57.5
December					
January					
February					
March					
April					
May					
June					
<b>Cow manure</b>	<b>Plot 1</b>	<b>Plot 2</b>	<b>Plot 3</b>	<b>Plot 4</b>	<b>Plot 5</b>
July	19.85	19.4	20.4	23.4	23.05
August	51.6	46.7	56.7	57.7	58.1
September	56.3	54.7	59.9	61.6	65.9
October	60.9	58.4	63.1	55.1	67.0
November	56.9	56.3	59.3	65.1	64
December					
January					
February					

March					
April					
May					
June					
<b>Sheep manure</b>	<b>Plot 1</b>	<b>Plot 2</b>	<b>Plot 3</b>	<b>Plot 4</b>	<b>Plot 5</b>
July	19.7	19.9	20.5	22.5	23.1
August	59.5	54.2	59.2	62.7	66.6
September	69.2	63.7	64.5	67.05	69.5
October	62.5	75.2	63.3	65.5	60.1
November	67.7	63.02	64.9	67.75	76
December					
January					
February					
March					
April					
May					
June					

### Rambutan in the Savannahs

Forty rambutan plants were planted at the Ebini location on January 22, 2009. All of the plants have adapted to the condition, however it was observed that leaf cutting insects are damaging the plants. Sevin dust was placed around the plants in an effort to reduce the damage. The plants are being monitored and have been fertilized with organic manure regularly.

In addition, 15 Persian lime plants were also planted on January 22, 2010 at the Ebini location. These plants are not being affected by the leaf cutting insects. Both sets of plants are planted in the same area.

## **The Department of Livestock and Pasture Production**

### **Livestock programme**

The livestock programme of NARI was implemented to investigate and develop improved production systems for cattle, sheep and goats. This programme over the years has been instrumental in ensuring that the national livestock programme is enhanced by providing quality breeding animals to the farming community, but more importantly ensuring that the production parameters for sheep in particular in the Intermediate Savannahs continue to improve.

During the ensuing year, the programme concentrated its efforts on reducing the supplemental feeding cost of the ruminant animals in the savannahs. Plant by-products were therefore used to manufacture feeds for the animals. The by-products used include sugar cane which was used to make silage, reject cowpea; shells, corn stover and other such feed material were used as additives in commercial feeds as well as in molasses blocks for the ruminants.

The Ebini Sheep programme made one of the more significant contributions to the sustainability of the small ruminant sector, food security and the Grow More campaign, by transferring 30 breeding rams to the Mon Repos Unit for sale to the farming community. The rams were sold to selected farmers throughout Guyana. The contribution of the Ebini Unit was significant because of the shortfall in the availability of Barbados Blackbelly breeding males from the Mon Repos Unit. The shortfall in breeding males from the Mon Repos Unit was as a result of the breeding females from the Mon Repos Unit being used in the embryo transfer and artificial insemination programme for the introduction of the Texel breed of sheep.

The stock number of sheep at the Ebini Unit is shown in Table 8.

**Table 8: Stock Number of the Sheep at the Ebini Unit at December 31, 2009**

<b>Sheep</b>	<b>Opening Stock</b>	<b>Closing stock</b>
<b>Animal class</b>	<b>Number</b>	<b>Number</b>
Breeding males	3	2
Breeding females	92	104
Weaned males	5	10
Weaned females	23	32
Male lambs	18	26
Female lambs	30	46
Total	171	220
Transfers(breeding males to Mon Repos)	48	30

There were 117 lambs born at the Ebini Unit during 2009, the lambing seasons were March –June and November –December.

The production parameters for the March-June 2009 lambing crop are presented in Table 9.

**Table 9: Production Parameters for the March-June 2009 Lambing Crop**

	<b>Parameters</b>	<b>Units</b>
1	Number of lambs born	77
2	Number of lambs died	5
3	Dams giving birth to twins	12
4	Dams giving birth to single lambs	53
5	Number of male lambs	29
6	Number of female lambs	48
7	Average birth weight (male) g	3.31
8	Average birth weight (female) g	2.96
9	Number of lambs being assisted (fed with milk)	10

The overall mortality for the lambs and weaned animals for 2009 was still too high and renewed and sustained efforts would have to be made to ensure the survival of the lambs. To this end the personnel responsible for the small ruminant programme has been changed.

## The Goat Unit

The flock of goat has increased during the reporting period.

The stock of goats is presented in Table 10.

**Table 10: Stock Number of Goats at the Ebini Unit at December 2009**

<b>Animal class</b>	<b>Opening stock</b>	<b>Closing Stock</b>
Breeding male	1	1
Breeding females	16	26
Weaned males	7	4
Weaned females	4	16
Male kids	6	10
Female kids	10	10
Wethers	2	0
<b>Total</b>	<b>46</b>	<b>66</b>

## Supplemental feed (Silage)

The small ruminant pastures are mainly of the forage species *Brachiaria humidicola*, this forage species is of relatively poor nutritional value, therefore, to provide for the nutrient requirements for the animals, supplemental feed is generally provided.

In order to provide the required supplement for the animals it was decided to utilize the harvested sugar cane to make silage and use it as the feed supplement for the sheep.

Correct supplementation is the key to animal productivity on sugarcane. The principles are well established and are based on satisfying the needs of rumen microbes for fermentable nitrogen (ammonia), trace nutrients (peptides, amino acids, minerals and vitamins) and the physical attributes of an efficient rumen ecosystem (small quantities of readily fermentable fibre).

Sources of protein, glucose precursors and long chain fatty acids able to bypass (or escape) the rumen fermentation so that the end products of fermentative digestion can be balanced according to the needs of the particular production function.

Therefore in making the silage from sugar cane at Ebini, the sugar cane was chopped using a mechanical chopper. The chopped sugar cane was enhanced by using molasses, gliricida leaves and wheat middling as a feed by-product. The chopped cane was then stored in a large garbage bag in the silo for 28 days. Approximately 50 kg of silage was placed in each silo. Ninety bags of silage were made. The silage produced in the plastic bag silo was of an excellent quality and was readily accepted by the sheep in particular. There is limited acceptance from the goats. The silage is being fed as the feed supplement during the evening period when the animals are confined to the pens.

Figures 4 and 5 showed the silage made from sugar cane at Ebini.



**Figure 4: Sugar Cane for Silage**



**Figure 5: Sugar Cane Silage Made at Ebini,  
2009**

In the tropics protein and energy are the elements most lacking in the feeding of livestock, and certainly at Ebini, the lack of protein in the forage on offer to the animals has been well documented. This lack of protein as well as energy could have a negative effect on the growth rate of animals in the savannahs. In order therefore to correct this deficiency, it was determined to produce molasses blocks as a feed supplement for the grazing animals (Figure 6).



**Figure 6: Molasses Blocks Made at Ebini, 2009**

As shown in Table 11, the formulation used to manufacture the molasses blocks. This formulation was very effective when fed to the sheep, but proved too soft when fed to the cows, and therefore for the cows the formulation was adjusted by increasing the level of cement to 20%.

**Table 11: Ingredients for Formulation of Molasses Blocks**

<b>INGREDIENTS</b>	
Wheat middling %	30
Molasses %	35
Minerals %	15
Urea %	0
Salt %	5
Cement %	15

### **The Beef Cattle Unit**

The NARI herd was without a breeding bull for the greater part of the year hence the reduced number of births during the reporting year, with the acquisition of a breeding bull most of the animals are pregnant and the stock number should show some improvements during 2010.

The programme rescued the animals abandoned by the Livestock Development Company (LIDCO). A number of these animals were in excess of 15 years old, however the strategy adopted was to attempt

to acquire a calf from each animal; however there has been a number of deaths among the adult animals mainly as a result of the age of the animals.

Routine maintenance and monitoring of the animals continued during the reporting period. All animals were dewormed during the reporting period. In addition, an improved mineral supplement, which is the recommended mineral supplement for the Intermediate Savannahs has been acquired and is being used by the Ebini herd. The supplement is available at the Bounty Farms Ltd, at a cost of \$6000/bag. Table 12 compares the recommended mineral mix and the recently acquired mineral mix.

**Table 12: Mineral Mix Recommended for the Intermediate Savannahs/Bounty Farm Mix**

<b>Ingredients/Elements</b>	<b>Unit</b>	<b>Desired minimum level (1)</b>	<b>Bounty Farm Mix (%)</b>
Phosphorus	%	8.4	9
Calcium	%	18.8	15-17
Salt	%	33.3	20-22
Potassium	%		1.5
Iron	%	0.3	1.0
Magnesium	%	1.0	1.0
Manganese	ppm	1,500	0.25
Zinc	ppm	750	0.5
Copper	ppm	300	0.1
Iodine	ppm	200	0.02
Selenium			0.001
Flourine			0.08
Cobalt	ppm	100	0.001
Molybdenum	ppm	75	
Vitamin A	i.u./g		
Vitamin B	i.u./g		

Source: (1). Livestock Development Company, Performance Report 1980.

Additionally, NARI and Rising Sun Farm have signed a Memorandum of Understanding (MOU) for the improvement of the beef industry. The MOU, among other activities requires that a structured breeding programme be developed using both embryo transfer as well as artificial insemination on the



cattle at Ebini. Additionally, Rising Sun Farm would transfer to Ebini approximately 500 head of cattle to ensure sustainability of the programme..

The stock number for cattle at Ebini is presented in Table 13.

**Table 13: Stock Number of Cattle at the Ebini Unit at December, 2009**

<b>Animal class</b>	<b>Opening stock</b>	<b>Closing stock</b>
Breeding bulls	Nil	1
Breeding cows	41	35
Weaned bulls	nil	01
Heifers	30	21
Male calves	3	7
Female calves	4	5
Steers	2	0
<b>Total</b>	<b>80</b>	<b>70</b>

## **GUYSUCO**

The GUYSUCO sugar cane nursery plots were harvested during the reporting year. The GUYSUCO personnel were responsible for harvesting all of the experimental canes, taking brix readings as well as weighing and recording the weight of the cane on each plot.

Because of the amount of cane that was to be harvested and the time constraint involved, some members of the NARI Ebini staff were contracted to remove the harvested cane from the field and dispose of same, as well as harvest the non-experimental fields.

The Guysuco personnel were also responsible for the removal of trash from the fields and fertilizing the cane after the removal of the trash, these tasks were effected after the NARI staff had harvested all remaining cane as well as removing the cane from the fields.

The harvested cane was used to make silage for the NARI animals. In addition, some of the cane was used to feed the animals belonging to the Rising Sun Farm. The acceptance of the sugar cane by the animals from the Rising Sun Farm was good. The feeding of whole cane to these animals was

necessary because the pastures occupied by this group of animals were burnt as a result of the prolonged dry period.

### **Guysuco legume seed production**

A plot of *Carnavalina ensiformis* (jack bean, lima bean) was planted at NARI Ebini for use by Guysuco in their field fallow experiments on the coastal estates. Harvesting of the plot is being undertaken and the yield for Jack Bean in the Intermediate Savannas has been estimated to be 10,370 kg/ha. It is expected that the planted plot at Ebini would yield 1800 kg of seed. The seed is to be sold to Guysuco.

## **11. CLIMATE CHANGE AND AGRICULTURAL ADAPTATION UNIT**

### **STAFFING:**

- |                             |   |                           |
|-----------------------------|---|---------------------------|
| <b>1. Mr B. Chintamanie</b> | - | <b>Head of Unit</b>       |
| <b>2. Mr R. Sullivan</b>    | - | <b>Research Assistant</b> |
| <b>3. Mr Q. Scotland</b>    | - | <b>Research Assistant</b> |

### **Introduction**

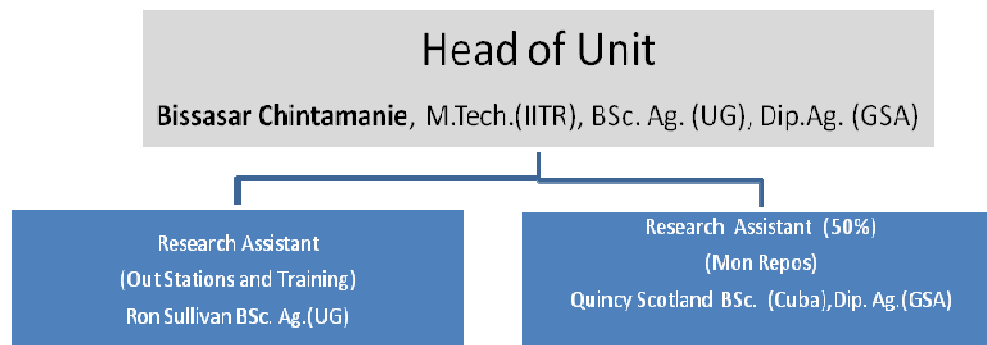
Climate is the long-term statistical expression of short-term weather. The overall distribution of climatological parameters, bounded by weather extremes, defines the climatic variability. Changes in climate can be defined by the differences between average conditions at two separate times. Climate may vary in different ways and over different time scales. In Guyana, agriculture is the dominant economic sector, both as a foreign exchange earner and contribution to employment. Agriculture will continue to be important to national and regional development since it does not only provide food, but also its role in socioeconomic stability and integrity to the environment. However, despite technological advances, such as improved varieties, drainage and irrigation systems, weather is still a key factor in agricultural productivity, as well as soil properties and natural communities. While the international aspect of trade and security in terms of food implies that there is need to consider the effects of climate change on a global scale, the effect of climate on agriculture will affect agricultural practices, cause environmental problems and pressure on rural space among other areas. As such, effective agricultural mitigations strategies will have to be formulated and adapted.

The Ministry of Agriculture (MoA), through the National Agricultural Research Institute in an effort to address this problem has set up a “Climate Change and Agricultural Adaptation Unit”. This unit is based at NARI, Mon Repos, East Coast Demerara. The General Objectives of the Unit are:

- ❖ To transfer technologies for climate change adaptation and mitigation in the agricultural sector of Guyana.
- ❖ To train farmers and other stakeholders to use the technologies adopted/formulated, and
- ❖ To collaborate with National and International agencies working on the frontline of climate change.

During the reporting period, the unit was involved in the activities listed below:

- (1) The structure and programme of the Unit was developed. A long term programme for the unit was developed in keeping with the goals and objective of the Ministry of Agriculture and in line with Low Carbon Development Strategy (LCDS). This programme was subsequently sent for approval and initial funding from the Ministry of Agriculture. A sum of twelve million, five hundred thousand dollars (12,500,000. GYD) was received and is currently being utilized for the day to day activities of the Unit. Figure 7 represent the organizational structure of the unit.



**Figure 7: Organisational Structure of the Climate Change and Agricultural Adaptation Unit**

This structure will be supplemented with the staff from the different locations across the country which will help in the delivery of the Unit's programme.

- (2) **Preparation of Proposals for Funding under UNESCO:** Three proposals were prepared and sent to UNESCO via internet for funding. The titles of the three proposal were:
- a. Low Cost Drip Irrigation System - "Towards Environmental Sustainability and Production Efficiency"
  - b. Intensive Production of Vegetables under Semi-Protected Conditions in the Rupununi Savannah, Region 9, and
  - c. Promoting Sustainable Agriculture in Hinterland for Environmental Sustainability and Food Security in Guyana

The Department was unable to access funding from this programme due to limited number being offered.

- (3) **Preparation of Cost Estimates for Shade House/Green Houses:** Cost Estimates for Shade Houses and Green Houses were prepared to give farmers and other investors an idea of what will be the cost of setting up a structure and what is the

likely returns on such investment. The cost of putting up a shade house/green house is approximately 800-1000 GYD per square foot. Farmers can expect to payback their investment within a year if managed properly. A 20-30 % Yield increased can be expected with better fruit quality and shorter time to harvest.

- (4) **Preparation of Brochures on Climate Change and Agricultural Productivity:** A brochure on climate change and agricultural productivity was prepared. The focus of the brochure was to discuss the impacts of climate change on agricultural productivity and to outline NARI's programme on climate change. Two (2) other brochures previously prepared by FAO on Protected Cultivation were updated. These included brochures on Organoponics and Protected Seedling House.
- (5) **Preparation of Proposal for EU funding:** A proposal for funding under EU was prepared in Collaboration with Pro-Natura International, Pro-Natura UK and the University of Edinburgh. The title of the proposal was: The Production of Vegetables with the use of Biochar in Low Fertility Soils of Guyana. Funding was not secured for this project. This proposal will be updated and funding will be sought in 2010.
- (6) **Participation in the national consultation on the LCDS:** The Unit participated in the national consultation on the Low Carbon Development Strategy which was held country wide. Specific contribution was made to discussions in regions 2 and 6.
- (7) **Participation in Workshops, seminars and meetings:** The unit participated in several workshops, seminars, discussions and meetings during the reported period. This included the monthly National Climate Committee meetings, Workshops and meetings hosted by the Second National Communication Project, several workshops hosted by GFC and CI and other participatory meetings at the MoA.
- (8) **Coordination of National Exhibitions:** The several exhibitions nationally. This included; the Berbice Expo 2009, the scout exhibition and the GUYEXPO 2009. All these events were successfully coordinated as was evident by the feedback from the minister and other dignitaries who attended. NARI's focus this year was to showcase climate change and to highlight programmes and innovation by the Ministry and NARI to combat climate change. Over 1000 plants were given to persons who visited the boot and answer questions on climate change. This was highly appreciated and will go a far way in helping the revegetation and carbon sequestration drive of the LCDS. Brochures on climate change and agriculture were also distributed along with flyers from the Ministry of Agriculture and GMC.
- (9) **Establishment of Hydroponics Facility:** An experimental Hydroponics Facility was established in September 2009. This facility will focus on experimental hydroponics. Currently, three nutrient solutions are being tested along with different growth medium and different crops. In November 2009, one such experiment was completed. The results are presented in Table 14. The initial results showed that of the three nutrients solution tested the locally made (ICAG) gave the best results in terms of yield and time to harvest with both crops.

**Table 14: Hydroponic Experiment Using Three Nutrient Solutions on Different Growth Medium and Crops**

Substrate	Nutrient Solution	Crop	Days to harvest	Yield (kg/m <sup>2</sup> )
Paddy shell/sand	ECAG	Pakchoy	21	2.5
Paddy shell/sand	ECAG	Lettuce	28	2.3
Paddy shell/sand	La Molina	Pakchoy	42	1.8
Paddy shell/sand	La Molina	Lettuce	35	2.3
Paddy shell/sand	Vege Nutrient	Pakchoy	42	0.14
Paddy shell/sand	Vege Nutrient	Lettuce	42	0.08
Coconut fibre/coal	ECAG	Pakchoy	42	0.4
Coconut fibre/coal	ECAG	Lettuce	42	2.1
Coconut fibre/coal	La Molina	Pakchoy	42	1.5
Coconut fibre/coal	La Molina	Lettuce	42	2.4
Coconut fibre/coal	Vege Nutrient	Pakchoy	42	0.07
Coconut fibre/coal	Vege Nutrient	Lettuce	42	0.05

- (10) **Establishment of UDP trials at Burma Rice Research Station:** A UREA deep placement trial was established and coordinated at the GRDB's Rice Research Station Burma. Three (3) sets of trials were conducted. The rates of UDP used were 67 kg N ha<sup>-1</sup>, 89 kg N ha<sup>-1</sup> and 130 kg N ha<sup>-1</sup>. All these trials have been harvested.
- (11) **Rehabilitation of the Shade House at Mon Repos:** The shade house demonstration facility was rehabilitated to accommodate more space and improved housing. This will allow for more diversity of crops as well as new testing innovation.
- (12) **Establishment of New Demonstration facility with partnership with the private/ government sector:** Three (3) new demonstration facilities were established and are fully functional. These include Shade House at Hope Estate, East Coast Demerara (in collaboration with hope estate), Shade house and seedling house at Kuru – Kuru, Linden Highway (In collaboration with private sector) and Shade house at GDF Garden of Eden on the East Bank of Demerara. These facilities will serve as demonstration sites for visiting farmers as well as providing food security to the neighboring community. So far, no major problems have been reported.
- (13) **Renovation of Forth Wellington Shade House:** The Forth Wellington Shade house was rehabilitated with the placement of boxes for cultivation. Several crops were grown and harvested. This facility will provide interested farmers with the “know how” in protected cultivation. Several visits were made by farmers from Region 5 based on the feedback from the staff of the Forth Wellington substation.
- (14) **Participation in the training of Extension Personnel:** The Unit was involved in the one-week training of extension officers at GSA. The unit conducted training in the area of Climate Change and Agricultural Production. Officers were exposed to

both theory and practical aspect of adaptation strategies for agriculture. A tour was also conducted at NARI's Facilities where they were exposed to the shade house, drip irrigation, hydroponics and seedling houses. Officers were encouraged to set up similar facilities in their area where farmers can be exposed to similar type facilities.

- (15) **Micro Irrigation Demonstration:** A micro sprinkler demonstration system has been established at Mon Repos. The aim of this system is to expose participating farmers to the Micro Irrigation Technology with emphasis on water saving and improved production. It is expected that this system will increase production as well as quality and also reduce the time to harvest.
- (16) **Visits to Farmers Field:** Over 50 farms were visited during the reporting period. These farms included those under partnership with NARI as well as special request by the Ministry of Agriculture. Farms in Regions 2, 3, 4, 5 and 6 visited were given advices on Climate Change Adaptation as well as other relevant areas. Farmer's feedback was also solicited with respect to NARI's programme on climate change.
- (17) **Preparation of Training Materials for Farmers:** Several training materials were prepared for farmers training. This activity commenced in November 2009 and it is expected to continue throughout 2010. These materials are in respect to climate change and agricultural production. These materials will be used throughout the training sessions and will be updated regularly. Some of these materials will be posted on NARI's Web site in the year 2010.
- (18) **Timehri Research and Demonstration Facility:** This facility is being managed partially by the unit. Three (3) demonstration protected houses is currently under construction and is expected to be fully operational by January 15, 2010.
- (19) **The Mangrove Revegetation Project:** The Unit is task with coordinating the implementation of the mangrove action plan. Currently, the mangrove action plan is being updated and the unit is fully involved in its formulation and update. Several visits were made to different parts of the country to assess and identify possible area for revegetation. This project is expected to begin work by February 10, 2010.

### **III. CROP DEVELOPMENT DEPARTMENT**

#### **(i) SOIL AND WATER MANAGEMENT**

##### **STAFFING:**

1. Mr. D. Fredericks	-	Head of Division
2. Ms T. Persaud	-	Research Assistant
3. Ms S. Hollingsworth	-	Research Assistant 111
4. Ms D. Singh	-	Research Assistant 11
5. Ms S. Singh	-	Laboratory Attendant

##### **GENERAL**

The Soils Division consists of Chemistry Laboratory Services, Soil Microbiology Services and Soil and Land Use Surveys.

##### **Project 1: SOIL AND LAND USE SURVEYS**

This division was engaged in several activities during 2009. These included: Soil and Land Use Surveys of Belmont to Recess, Region 5 of Guyana, Revegetation of Mined-Out Areas in North East Kara-Kara Linden, Improving Cherry Production through Appropriate Fertilizer Usage, and Soil and Land Use Surveys to support the implementation of an irrigation system for agricultural crop production in Kato, West Central Rupununi of Guyana.

In addition, the Division facilitated:

- i. The Region 10 Farmers Association with Acoushi ant bait and citrus for sale to members;
- ii. Conducted tour to cherry farm at Coverden, and NARI's facilities at Timehri, Kiruni and Mon Repos for St. Rose's High School students; and to farmers' holdings in Regions 2, 3, 4, 5 and 10 for 16 members of Tobago Farmers Association (guests of RTFA);
- iii. Site selection and layout for Farm Emerald Tower, Soesdyke - Linden Highway; and Characterised soil for entrepreneur at Caledonia for: corn, coconuts, citrus, vegetables and bananas.
- iv. Farm visits and recommendations on land use at Georgetown, Chateau Margot and Le Ressouvenir and Enterprise, ECD; Supply, Covent Gardens EBD, Region 4; Canals #1 and 2, WBD, and Hague, Region 3; Bomboo Landing, Arawai and Richmond Hill, 58 miles and Great Falls Region 10;
- v. Preparation and presentation of training on 'Soil Sampling and Testing for Regional Extension Agents';
- vi. Preparation of Report on 'Suggested Crops for Various Locations in Guyana' for Ministry of Agriculture - ADP project;
- vii. Review and preparation of documentation on 'Location, Soils and Associated Crops for Bananas and Plantain Cultivations in Guyana – in support of NARI's Musa Project.

A Summary of the projects undertaken is given below:



## **SOIL AND LAND USE SURVEYS BELMONT TO RECESS REGIONS 5, GUYANA**

Soil and Land Use Surveys was conducted to collect coordinate specific data on soil fertility, agronomic practices, and the socio-economic profile of the area between Belmont and Recess, Region 5 of Guyana. The ecological system is defined through the elaboration of soil properties and land utilization types. The area has undergone significant crop changes over the last five years. Owing to attractive prices, pepper, tomatoes and celery became the major crops grown in the area. These crops replaced cabbage and eggplant owing to falling productivity through demanding pest, disease and water management. The soils types in the area are Onverwagt Clays (41d and 41s), Novar Loamy Sand (70) and Ithaca Sandy Loam (72). Soil pH ranges from 5.5 – 7.5, and TSP and limestone is seldom used. However, varying combinations of urea, 12:12:17:2 and 15:15:15 are applied in their crop production systems.

This project provided farmers an opportunity to optimize their land resources. It is expected therefore that:

1. Farmers will become knowledgeable of methods to preserve and optimize the land resources in their production systems;
2. The land use potential of soils will be optimize to produce better quality commodities increasing the demand and optimizing the market prices; and
3. Increases in the production and quality of produce result in improved export potential of commodities and enhanced earning power of farmers and investors in non traditional crop exports.

**Objective:** To produce information that could lead to improved soil productivity in selected areas of Region 5 through the generation of data on soil and land use, and the agricultural land use potential of the area.

### **Specific objectives:**

- a. To evaluate the suitability of the various areas in Region 5 for crop production.
- b. To create a digital database of the soils and land use in the region.
- c. To facilitate easy access to soil and land use information.

### **Outputs**

- a. Reliable and easy access to soil and land use data with co-ordinate specific information.
- b. Efficient storage of data with diminished threat through loss of fire, theft as presented by storage on paper.
- c. The ability to easily upgrade and update databases.
- d. Agriculture Land Use Maps.
- e. Agricultural Land Use Vulnerability Maps.
- f. Soil Maps.

## **The Strategy**

The project team consisted of Researchers from NARI, the lead agency for this activity in collaboration with the Ministry of Agriculture. The activities included:

- a) The creation of a digital database on soils and land use for the study area with geo-reference datasets, and
- b) The assessment of land use vulnerabilities, conflicts and opportunities, using Soil Surveys and Participatory Rural Appraisal approaches.

## **Project Results**

### **i. Land Use Surveys**

A land use questionnaire was prepared and administered in the farming areas between Belmont and Recess of Region 5. Farming communities were selected with the help of the respective Regional Development Councils, extension agents, the Ministry of Agriculture (regional) Extension Officers and farmers' representative. Additionally, these entities gave logistical support within the limits of their capabilities. All data collected forms parts of a Land Use Database.

In the past, the major crops growing in the area were bora, eggplant, cabbage and eschallot and celery. However, since 2005, farmers have recorded reduced productivity form this cropping system. At present, the dominant crops are pepper, celery and tomato. Also, 15:15:15 and limestone is broadcasted in large quantities and in each cropping season; and many crops show abnormality, a symptom of trace element deficiency.

### **ii. Soil Surveys**

Soil fertility samples were collected at all locations where the Land Use Questionnaires were administered. Soils were characterized and examined to determine the zones of fluctuating water table and the acidic horizons. All samples collected were analyzed by the Soil Chemistry Division of NARI and forms part of the Soil's database for these regions. The dominant soils of the study area are:

- a. Soil Unit 70 – Novar Loamy Sand (Dark brown fine sand over yellowish brown sandy loam)
- b. Soil Unit 72 – Ithaca Sandy Loam (Dark brown acid fine sand over yellowish brown Sandy Loam with greenish grey clay substratum).
- c. Soil Unit 41s - Onverwagt Clay (Dark grey clay over grey clay with sandy substratum).
- d. Soil Unit 42s - Lichfield clay (Thick, very dark grey clay over brownish yellow clay).

These soils all have pH values above 6.0, and adequate levels of available phosphorus (above 16 ppm).

### iii. Conclusions

- a. **Comparative Advantage:** This area has a functional drainage and irrigation system and soils of high phosphorus and pH status. This makes it highly suitable for crop production.
- b. **Ecological Vulnerability:** This consists of its susceptibility to inundation, owing to its location on the low coastal zone, and trace elements (e.g. Boron) deficiency. This deficiency was probably occasioned by farmers consistent use of 15:15:15 fertilizers (which contains no trace elements), and farmers irrational use of large treatments of limestone on soils with pH 6.5 – 7.0.
- c. **Socioeconomic vulnerability:** Readily available, costly and inefficient use of agrochemicals on cabbage, eggplant and bora has skyrocketed production costs. This has forced a change in cropping patterns to pepper, celery and tomato.

### iv. Recommendations

- a. Given the ready availability, easy accessibility and inefficient use of agrochemicals by farmers, a regulatory agricultural controlling mechanism should be activated for this area. This should serve to supplement NARI's training efforts of good pest and disease management practices.
- b. Given that trace elements becomes increasing unavailable in soils with pH values above 6.5; it is recommended that farmers use 12:12:17:2 instead of 15:15:15 to supplement trace elements availability in the soil. Also, limestone should only be applied based on soil tests and technical recommendations.
- c. Farmers should avoid applying complete fertilizers by broadcasting. Application by placement will result in greater effectiveness on crop.

## **ESTABLISHING THE YIELD POTENTIAL FOR ECONOMIC CROPS ON MINESPOILS IN NORTH EAST KARA KARA – LINDEN**

From April 2003 to December 2008, NARI and GGMC have successfully collaborated on remedial studies at the Kara Kara site. During this period, a number of specific objectives were achieved. These included, improvement of soil quality; control runoff and encourage infiltration; establish ground cover using *B. humidicola*; establish limes as an economic crop; establish fatpork (*Chrysobalanus icao*) over part of Kara-Kara.; establish cashew (*Anacardium spp.*) over part of Kara-Kara; establish fatpork as an environmental and economic crop in Linden and environs; establishing community liaison within Linden and its environs. The activities of this year, therefore, sought to build on these successes by focusing on possible economic benefits to be realized from the revegetated mine spoils.

This project has the potential to change the face of the landscape in areas where mine-spoils exists. As economic crop production progresses, no longer would communities tolerate rugged degraded landscapes. Instead, they would be empowered to bring these sites in productive uses through cultivations for human, animal or industrial purposes.

### **OBJECTIVE:**

1. To determine the yield potential of cashew nuts and Minica IV on the mine spoils of Northeast Kara Kara mined out area of Linden.

2. To nurture an active involvement of schools and other community stakeholders in activities of the site.
3. To maintain all established vegetation (e.g. grasses, cashew nuts, fatfork, citrus and *Glyricidia*), from the re-vegetation process.
4. To maintain all established soil conservation and fertility measures (e.g. silt fences) at the site.

## Output

1. Stabilized mine spoils (no mass movement down slope) at the revegetation site.
2. Established linkages with community stakeholders (Secondary Schools; Regional Democratic Council; Region 10 Farmers Association; Guyana Forestry Commission (GFC) and other groups).
3. An expected yield for economic crops identified for large scale cultivation at the site.

## Strategy

The strategies used were:

- a) To reduce the potential for mass movement of spoil materials down slope, by maintaining fabric silt fences across the base of the spoil pile. This action, coupled with the maintenance of established *B. humidicola* grass ground cover was used to reduce surface runoff and increase infiltration.
- b) To maintain and improve the soil fertility and organic matter at the site, by the use of liming material, pen manure and inorganic fertilizers. Additionally, establishment pasture grass (*B. humidicola*) was allowed to die and produce grass mats, and *Glyricidia* (a nitrogen fixing shrubs) was cut and used as mulch.
- c) Cashew (*Anacardium spp.*) and Minica IV seedlings were planted as economic crops to test their viability at the location. Seedlings were planted as opposed to seeds to enhance the success of establishment.

The activities included:

- i. The establishment of Minica iv plots (15 m X 20m), using seeds treated with inoculum (Tal 178) and planting three (3) week old seedlings in rows at the site. The land was prepared by cutting establishment grass (*B. humidicola*) and broadcasting Low Grade Rock Phosphate (LGRP) at 3000 kg/ha. Plants were mulched with cuttings from an established *Glycerida* plot. Plots were monitored by NARI, Ministry of Agriculture Extension staff and RTFA (Region 10 Farmers Association) personnel.
- ii. The establishing Cashew nut trees, using four (4) month old seedlings germinated and maintained at NARI, Mon Repos. Planting was done in rows 6 m apart and 6 m between holes using well-rotted pen manure and Low Grade Rock Phosphate. Planting was done with the involvement of NARI, Ministry of Agriculture Extension staff, Guyana Forestry Commission (Region 10) staff, and School Children and RTFA personnel. Monitoring was done by NARI, Ministry of Agriculture, Extension staff and RTFA personnel.

- iii. The establishment of a glyricidia plot (15 m X 20m) using seedlings developed at NARI's Mon Repos Nursery from cuttings of established glyricidia plants at the site. Planting was done with the involvement NARI, Ministry of Agriculture, Extension staff and RTFA personnel.
- iv. The maintenance and repair of the perimeter fencing after destruction by roaming animals and vandals was done using barbed wire and wood strips. Discussions were held with the REO of Region 10 on the security of the site. The RDC undertook to assist in facilitating the security of the site.
- v. Educational Tours by CXC students from St. Roses' High School, Mac Kenzie High, Linden Foundation, Linden School of Excellence and Tobago Farmers Association were facilitated at the site. In addition, schools from Linden and its environs participated in tree planting exercises during the year.
- vi. The involvement of community stakeholders in activities at the site was given the highest priority. Regular discussions were held and decisions made with the involvement of the RDC, Agricultural Extension Officers and RTFA. Discussions with the RDC proved instrumental in having the Regional Agricultural Extension Agent and Agricultural Officer sit on the Regional Agricultural Committee. The Guyana Forestry Commission was invited and participated in the cashew nut planting exercise and has expressed an interest in future activities at the site.
- vii. The maintenance of established crops (Cashew nuts, pasture grass (*B. humidicola*), fatpork, citrus and glyricidia) continued as scheduled. Citrus and glyricidia plants were pruned, however, in some areas, grasses and citrus suffered from fire damage, causing a set back to their development.

### **Project Status**

1. Mine spoils have stabilized – no mass movement down slope.
2. Teachers and students are benefiting from practical sessions in planting citrus and cow pea; and the use of inoculums in legume production.
3. The Regional Agricultural Extension Agent and Agricultural Officer are now members of the Regional Agricultural Committee.
4. The land is presently suitable for the cultivation of cashew nuts, pasture grass, citrus and legume production. Expected yields for crops are:
  - (i) Cashew nuts – 3300 kg fresh fruit/ha/yr and 460 kg nuts/ha/year.
  - (ii) Minica IV – 650 kg/ha/crop using *Rhizobium* inoculation (Tal 178).
  - iii. Stakeholders are coming on board to provide security and contribute to creating a productive enterprise in the region.

### **Recommendation**

- Notwithstanding the stabilized slopes, fabric silt fences should be maintained as spoil piles present at the site could become unstable during periods of prolonged and intense rainfall.

- A harvesting program should be implemented for the grasses especially during the dry season, as decaying grasses may fuel bush fires and cause damage to tree crops.
- Liaison with community groups and functionaries should be strengthened for greater support by community stakeholders.
- Economic Community Crop Production Activities should be encouraged on the minespoils at Kara – Kara Linden.

## **REPORT ON SOIL AND LAND USE SURVEYS TO SUPPORT THE IMPLEMENTATION OF AN IRRIGATION SYSTEM FOR AGRICULTURAL CROP PRODUCTION IN KATO, WEST CENTRAL RUPUNUNI, GUYANA**

The main task was to establish a rational for irrigation support to crop production activities in Kato. Special emphasis was placed on suitable soil type and present cropping patterns.

### **Project Results**

#### **Soils of Kato**

The survey recognized three (3) soil series units to differentiate between the two proposed sites and the homesteads. The dominant soil series are Site I - Emprensa Series, Site II – Ambrose Series and Homesteads – Kaput Series.

#### **Ecological Suitability for Vegetable Cultivation At Kato**

In support of vegetable production at selected sites in Kato, an ecological suitability was conducted. The results showed that the sites are moderately suitable for vegetable production. They have low susceptible to fires and flooding, consequently, crop losses from these factors are minimized. Also, sub-optimal conditions of temperature and water availability represent a risk factor that would negatively affect the crop production system. However, the presence of the all year round flowing Chiung River in the vicinity of Kato has the capability through hydropower to provide power for irrigation in crop production systems. If implemented, the suitability of these sites will be upgraded to highly suitable.

### **Recommendations**

The relatively high clay content of soils at Site II makes this area highly suitable for water tolerant crops such as rice and eddoes. Site I, with fine sandy loam soils is highly suitable for irrigated vegetable production, with a strong emphasis on crop rotation.

Programmes to introduce new crops to this area should not ignore the acidic nature of these soils (low pH values). Thus, preference should be given to acid tolerant species during crop selection. It must be noted, that these recommendations are only valid with the implementation of a reliable system of irrigation. It is, therefore, recommended that the development of a small hydropower to supply energy for irrigating farm land is diligently pursued.

## 5.2 CONCLUSION

In Kato, most households are engaged in the planting of kitchen-gardens. This activity is cultured by the reality of high vegetable prices in the region and the recognition of the need to have a balanced diet. However, their expressed ambition is to expand to larger acreages. This ambition is supported by the availability of suitable lands within the village as identified at Sites I (approx. 100 Ha) and II (approx. 10 Ha).

The proposal to expand crop lands at Kato is constrained by the absence of an accessible irrigation system. However, the use of energy derived from the proposed development of small hydropower facility will remove this constraint. Pumping water from shallow wells or distributing water from river sources requires energy, which if available, will enhance the irrigation of crop lands at Kato. Also, its implementation will ensure optimal, sustainable, and all year round crop production, providing a reliable and accessible food supply link for neighbouring villages.

The improvement of crop production in terms of scale and technology will bring questions of sustainable farming practices, land occupation (allotment and distribution). The answers to which could form the subject of another consultation.

### **THE RESPONSE OF MINICA (IV) TO INOCULATION ON A CLAY SOIL ON THE COAST OF GUYANA. (TRIAL 2)**

**Abstract:** *Due to the high cost and sometimes unavailability of nitrogen fertilizer coupled with the environmental effects of inorganic fertilizers, there is need to explore other forms of available nitrogen to plants. The ability of the plant-bacteria combination to 'fix' and utilize an otherwise unavailable form of nitrogen is of considerable economic importance to farmers. A second trial was conducted on soil type 41d – Onverwagt Clay to compare the response of Minica (IV) to inoculation by four strains of Rhizobium (Tal 173, Tal 178, Tal 169, 022) with Urea. Blocks of 32.6 m<sup>2</sup> were placed in units with four replications in a Randomized Complete Block Design (RCBD). Data were collected on plant height, number of branches, nodulation, days to flowering, pod length, 100 seed weight, number of seeds/10 pods, dry matter production, effectiveness of nodules, percentage strain recovery and grain yield. There were significant differences for nodulation at four, six and eight week stages of growth for inoculated plants. There was twice as much nodulation than the previous trial, however at eight weeks the nodules started to die. There were no significant differences between grain yield for urea applied at 100 kg/ha and Tal 178. There were significant differences between urea applied at 100 kg/ha and the other treatments except Tal 178. Tal 178 had the lowest percentage flowering and gave the highest yield among inoculated treatments. In both trials Tal 178 was the superior rhizobium strain and should to be used instead of urea fertilizer in the production of grain legumes by farmers.*

**Key words:** *Economic importance, inoculation, legumes, rhizobium bacteria*

## **Chemistry Laboratory Services**

### **Introduction**

The steep increase in fertilizer prices demands that fertilizer application be strategically to soil analysis. Thus, it is anticipated that farmers will increase their demands on this division this year. Farmers, students and researchers continue to make demands for a wide range of analysis, namely, N, K, P, Ca, Mg, Na, Fe, Mn, Zn, and Cu, pH, KCl-acidity and electrical conductivity.

### **Objectives**

- i. To provide technical support for research and the farming sector.
- ii. To undertake specific discipline-oriented research of universal practical applicability.
- iii. To generate baseline supporting technical information for the sector.

### **IMPACT AND BENEFICIARIES:**

In the absence of soil tests and appropriate fertilizer recommendations, the potential for overuse of fertilizers on farm abounds. On the other, many crops fail to realise their productive potential owing to nutrient deficiencies. This division therefore, will have its greatest impact in optimising crop yield and financial returns to farmers.

#### **Activity 1: Analysis of Samples – Soil Chemistry Services** **Sample Status:**

Six hundred and eighty seven (687) soil samples were analyzed in 2009. All samples received for 2009 were analyzed for the analyses requested. Two hundred and ninety four (294) samples were analyzed for organic carbon, moisture content and root volume for Guyana Forestry Commission (GFC). Other samples were received from – Farmers 253, Researchers 10, students 4, other agencies 126.

Equipment to analyze for Nitrogen has received and is in the process of becoming operational. The Atomic Absorption Spectrophotometer is still not operational due to the extractor fan.

#### **Activity 1.1: Maintenance of Digital Databases for Soils**

A database with the Results of Analyses was created (in 2007), and is regularly updated. It contains results from year 2000 to present. The database of soil samples entering the division continues to be maintained.



## **Soil Microbiology Services**

### **Introduction**

Enhancing legume production with reduced inputs of inorganic fertilizers is a priority of this division. Farmers and other producers are likely to make greater use of this product with rising prices of inorganic fertilizers continue to rise.

### **Objectives:**

- i. To develop biological systems for plant nutrient uptake
- ii. To reduce crop production dependence on chemical fertilizer.

### **Activity 2.1: Production of Inoculant**

During the year 86 acres equivalent of inoculant were produced of which 55 acres equivalent were distributed to Ebini, Guysuco and farmers. Inoculants (Tal 173, Tal 178, Tal 169 and 022) were also prepared for field trials at NARI's Mon Repos location. Presently, a 31 acres equivalent of inoculums is in storage at Mon Repos.

Laboratory work was very restricted owing to the shortage of Bacto agar and Yeast Extract. However, six (6) strains of Rhizobium is being subcultured and stored. Rhizobium strains Tal 173, Tal 179, Tal 169, 022, 086, Tha 301 and Tal 420 are being maintained. Rhizobium strains Tal 420 and Tha 301 are used in the recycling of inoculants at present. Sub-culturing of other Rhizobium strains will commence when outstanding orders for chemical arrive.

## (ii) BIOTECHNOLOGY, PLANT GENETIC RESOURCES & PLANT PROTECTION

### Staffing:

1. Mr C. R. Paul - Head of Department
2. Mr E. Willabus - Research Assistant

### **Project: Production of Tissue-cultured Plantlets of Targeted Crop Species to be used as Foundation 'seed' Stocks for Commercial Planting Material Production**

In order to provide a steady flow of clonally uniform and field-stable foundation 'seed' plantlets serving as a source of plantain and pineapple commercial 'seed' stock a strategy of farmer-managed commercial production of 'certified seed suckers' has been identified as a viable option to meet farmers' demands for planting materials. Towards this end, during the reporting period the following interventions were executed:

1. Two Research Technicians were trained in tissue culture protocols, inclusive of media preparation, excision and sterilization of *explant* tissues, tissue culture initiation, sub-culturing, plantlet transfer and weaning. These two Technicians have since been retained in the Tissue Culture Lab and continue to be engaged in daily tissue culture lab and screen-house routines.
2. Installation of a modified system to provide continuous air-conditioning in the lab, and especially in Culture Rooms. This intervention is meant to mitigate difficulties during power failure episodes.
3. Setup of a direct distilled water supply system to the Biotechnology Facility, specifically servicing the Tissue culture Lab.
4. The above interventions meaningfully supported the preparation of 70.5 liters of media used in tissue culture initiation, sub culturing, and *in vitro* rooting. Despite the shortage of media additives which were critically depleted in July of the reporting period, a total of 850 plantlets of bananas, plantains and sweet potatoes, and pine apples were successfully produced in the lab, and weaned in the Plant Tissue Culture Screen-house.
5. Towards the end of this reporting period 91, 33, and 30 containers of banana/plantain, pineapple, and sweet potato tissue cultures, respectively, were in maintenance condition.

## **PROJECT: Establishment of On-farm and Out-station Depositories of Targeted Crop Species**

**Cassava Depositories** at Karuni, St. Ignatius, and Ebini continue to be supported by collaborative undertaking of the GCDT (Global Crop Diversity Trust) and CARDI. The main activity undertaken was the replanting of accessions. During the reported period an additional of 27 accessions were added; bringing the total number of accessions to 50.

**Sweet Potato Field Depositories:** Seventeen accessions were maintained at Ebini and Kairuni. At Mon Repos 4 accessions were added bringing the total to 31.

**Avocado Depository:** Thirty four (34) accessions were maintained at Kairuni. Drought conditions reduced crop stand to 63% at last count.

**Coconut and Mango** accessions were maintained at St. Ignatius and Ebini. Logistics and drought conditions prevented the expansion and patch-planting of these depositories. Approximately 87 accessions were maintained at Ebini, while at St. Ignatius the latest count was 73.

## **PROJECT: Local and Joint Expedition to Sample the Diversity of Local Crop Species**

One collecting expedition was conducted in the Pomeroon River (Region 2) in November. The main target was bastard 'seed' coconuts.

### **'Bastard' Coconut Collection**

1. Exclusive 'bastard' coconut seed-plant germplasm was sampled in the Lower Pomeroon River between Hackney and Liberty River Districts; and especially along the Aberdeen Canal, all trees targeted in 2007, were re-sampled.
2. Seed-plants of 37 mother trees from 9 plantations were sampled. These plantations would have optimally met the *geographical criteria* (close cross-river plantations and distant along-river inter-plantations) for sampling.
3. Excluding the 9 trees re-sampled in the Aberdeen Canal community, the remaining 28 trees were selected from among more than 140 potential 'bastard' mother palms inspected/evaluated. These 28 trees would have met the criteria for, putatively, the widest variation in 'bastard' coconut 'nut-types'.
4. A total of 497 seed-plants were taken. About 30% of these 497 seed-plants were sourced from the Aberdeen Canal community.

5. Seed-plants were categorized into 5 groups based upon mature fruit characteristics and paint-labeled accordingly. Unlike in previous collecting, seed-plants were not labeled as to its tree-source and numerically sequenced. But trees were marked to signify their contribution to this 'bulked collection' of 'bastard' seed-nuts.
6. All seed-nuts are currently stored in the drainage depression inside the Seed Technology Compound at NARI.

### **Other Plant Germplasm Resources Collections**

Seven farms were earlier identified for sampling in the upper Pomeroon River between Jacklow and Warapana Creek. However, time restricted the team to acquiring only four scion accessions of mango, four varieties of cassava, one accession of sweet potato, and a sample of corn seeds. The four cassava accessions have since been added to the germplasm collection at Kairuni, and the sweet potato accession added to the tissue culture screen house collection at NARI; while the four mango scion accessions were grafted at the Plant Nursery at Mon Repos.

### **PROJECT: Upgrading of Existing Laboratory Facility in Main Building to Plant Biotechnology Research Lab Status**

1. During a USDA-NARI PGRFA Project review further collaboration activities were extended to NARI. One senior staff underwent training in DNA Molecular Typing and Laboratory Management at the USDA, USA. During this training course DNA molecular Analysis (RAPD) of NARI's current ex situ sweet potato accession was undertaken as a special project. The results of sweet potato 'molecular typing' were reported at the Annual Agriculture Conference.
2. During the above project review the LI-COR DNA Analyzer was initially installed and calibrated at the Biotechnology Lab. An additional critical 'Ultra-pure' water purification kit was also obtained. Meanwhile, following release of addition project funds, sourcing of additional start-up equipment and reagents is actively in process. Final payments on invoices, inclusive of shipping were done in December.
3. Sourcing of Laboratory orders are, to date, 90% committed. Shipping to Larparkan Trading, Inc. Ocean Freight in-transit point in Miami, Florida (USA) has begun, and it is expected that NARI's container would leave for Guyana the third week in February-2010.

### **(iii) CROP PROTECTION**

#### **STAFFING**

1. Dr. Raghunath Chandranauth - Head of Department
2. Ms. Kaye Mc Allister - Research Scientist
3. Ms. Sridevi Nanku - Research Assistant
4. Mr. Ramphal Mohabir - Senior Research Technician
5. Ms. Amanda Connell Chester - Research Technician II
6. Ms. Sharon Alexis Nicholson - Research Technician II
7. Ms. Noelle Moses - Laboratory Assistant
8. Ms. Shelia Kellman - Laboratory Attendant
9. Ms. Marcia Amanda Somerset - Laboratory Attendant

#### **THE DEPARTMENT OF CROP PROTECTION**

The goal of the department is to advise on, and develop appropriate systems in crop pest management to promote sustainable agricultural production through adaptive and investigative research, promote good agricultural practices, and provide efficient pest diagnostic and advisory services for the management of agricultural crops.

Research and development aspects of the Department encompass the following:

- Survey of pests, diseases and weeds;
- Integrated pest management;
- Use of indigenous materials for pest control; and
- Diagnostic and advisory services.

#### **PROJECT: 1**

**Strategic Objective:** Generate, develop and apply new knowledge and technology.

**Key Results Areas:** Increased agricultural production and productivity.

**Programmes:** Bio- control

**PROJECT TITLE:** Integrated management of weed in aquatic environment

**Abstract:** Aquatic weeds vegetation is causing numerous problems throughout the coastal areas of Guyana. The objective of this study was to determine the predominant aquatic weed species, and their biological life forms, distribution, growth and level of infestation in the irrigation canals.

Excessive growth of these plants can have detrimental effects on bodies of water and its inhabitants. It is therefore important to use a safe and effective method for the control of these weeds, in order to achieve balance between environmental impact and water use efficiency.

The National Agricultural Research Institute in collaboration with the Ministry of Agriculture (MOA), the Food and Agricultural Organization (FAO) and the US Army Research and Development Centre (ERDC) have developed capabilities for the release of insect biological control agents for the management of aquatic weeds in Guyana. Biological control is an environmentally friendly method of releasing natural enemies to manage invasive aquatic weeds. It is a safe and economical method for the control of these problematic vegetations and has been used successfully throughout the world.

Plants targeted for biological control include the floating plant *Eichhornia crassipes* (waterhyacinth), *Pista stratiotes* L. (waterlettuce), *Salvinia* spp. and submersed plant *Cabomba aquatica* (fanwort). Surveys along the coast of Guyana revealed the discovery of one species of waterhyacinth weevil; salvinia weevil, waterlettuce weevil and *Sameodes* sp. (*Lepidoptera*) that are capable of killing these plants. With the use of insects rearing methodology, these weevils were reared and periodically harvested and released when numbers are high to eradicate invading weeds in waterways. There has been no biological control insects on *Cabomba* identified as yet.

The release of waterhyacinth, waterlettuce, and salvinia weevils along the coast led to a sudden stunted growth, reductions in flowering, and leave curling among these plants. More than 65% of these invading weeds were destroyed at the released sites.

**Keywords:** *biological control, ecosystem, Eichhornia crassipes, Pista stratiotes* L., *Salvinia, Cabomba aquatica, Sameodes* sp., *Lepidoptera*.

## PROJECT: 2

**Strategic Objective:** Generate, develop and apply new knowledge and technology.

**Key Results Areas:** Increased agricultural production and productivity.

**Programmes:** Integrated Crop Protection

## PROJECT TITLE

Provision of information for improved management of crop pests and diseases

## OBJECTIVES

- To develop and maintain skills and laboratory capability.
- To provide support for the national quarantine system.
- To provide diagnostic and advisory service to the farming community in Guyana.
- To provide training for target groups.

The department processed a total of 78 plant specimens submitted by farmers for the year from Regions 2, 3, 4, 5, 6 and 10.

Table 15 gives the pathological and entomological problems on the crop specimens received. Routine health test for *Musa* sp. was done at the Plant Pathology Laboratory at Mon Repos. The necessary recommendations and advice were given to the farmers.

**Table 15: Showing Samples that were Diagnosed**

#	Crops Affected	Diseases Identified	Pests Identified
1.	Bora ( <i>Vigna sesquipedalis</i> )	*Mosaic virus	*Wasp *Aphids *Bean beetle *Leaf Miner
2.	Boulanger ( <i>Solanum melongena</i> )	* <i>Fusarium oxysporium</i> – <i>fusarium</i> wilt *Damping off	*Whitefly *Thrips *Aphids *Nematode
3.	Cabbage ( <i>Brassica oleracea</i> )	* <i>Erwinia carotoyora</i> – bacterial soft rot *Black rot	*Bud worm *Diamond back moth

4.	Cantaloupe	*Gummy stem blight – ( <i>Didymella bryoniae</i> )	
5.	Carambola ( <i>Averrhoa carambola</i> )		*Mealy bug *Scales *Mites
6.	Cauliflower ( <i>Brassica sp.</i> )	* <i>Erwinia carotoyora</i> – bacterial soft rot	
7.	Celery ( <i>Apium graveolens</i> )	* <i>Cercospora</i> leaf spot *Heart rot	*Nematode
8.	Cherries	*Moss *Sooty mold	*Scales *Leaf Miner
9.	Citrus ( <i>Citrus sp.</i> )	*Gummosis *Sooty mold *Anthracnose *Moss *Tristeza	*Aphids *Scales *Acoushi ant *Leaf Miner *Nematode
10.	Coconut ( <i>Cocos nucifera</i> )	* <i>Phytophthora palmivora</i> – bud rot	*Moth borer *Coconut caterpillar
11.	Corilla/ Bitter gourd ( <i>Momordica charantia</i> )	*Bacterial wilt	*Stink bug
12.	Cowpea ( <i>Vigna unguiculata</i> )	* <i>Fusarium oxysporium</i> – <i>fusarium</i> wilt *Mosaic virus	
13.	Cucumber ( <i>Cucumis sativus</i> )	* <i>Erysiphe cichoracearum</i> - powdery mildew	
14.	Guava ( <i>Psidium guajava</i> )	*Anthracnose	*Mite *Mealy bug *Scales
15.	Mango ( <i>Mangifera indica</i> )	* <i>Aspergillus sp.</i> *Sooty mold *Anthracnose	*Acoushi Ant
16.	Okra ( <i>Abelmoschus esculentus</i> )		*Aphids *Nematode
17.	Pak-choi ( <i>Brassica rapa</i> )	* <i>Alterinaria brassicae</i> -leaf	



		spot *Bacterial root rot	
18.	Papaw ( <i>Carica papaya</i> )	*Anthracnose * <i>Gloesporium papayae</i> - fruit rot	*Mealy bug *Scales
19.	Passion Fruit ( <i>Passiflora edulis</i> )	*Anthracnose	*Mite *Termite
20.	Pepper ( <i>Capsicum frutescens</i> )	* <i>Fusarium oxysporium</i> – fusarium wilt *Pepper Mottle Virus *Anthracnose	*Whitefly *Aphids *Mites
21.	Pineapple ( <i>Ananas comosus</i> )	* <i>Ceratostomella paradox</i> – fruit rot *Black rot	*Acoushi Ant *Mealy bug
22.	Poi ( <i>Basella sp.</i> )	* <i>Alterinaria brassicae</i> -leaf spot *Bacterial root rot	
23.	Plantain ( <i>Musa acuminata</i> ), banana ( <i>Musa sp.</i> )	*Moko disease, *Sigatoka (black and yellow)	*Scarring beetle *Pseudostem borer
24.	Rambutan ( <i>Nephelium lappaceum</i> )	*Leaf spot	
25.	Saime	*Angular leaf spots	
26.	Sour sop ( <i>Asimina muricata</i> )	*Anthracnose	*Mealy bug *Scales *Mites, *Wasp
27.	Sweet potatoe( <i>Ipomoea batatas</i> )	*Black rot- <i>Ceratocystis fimbriata</i>	*Sweet potato weevil
28.	Thyme ( <i>Thymus vulgaris</i> )	*Stem rot	
29.	Tomato ( <i>Lycopersicon esculentum</i> )	* <i>Fusarium oxysporium</i> – fusarium wilt *Tobacco Mosaic Virus *Anthracnose	*Whitefly *Thrips *Aphids *Mite *Flea beetle

			*Stem borer
30.	Watermelon ( <i>Citrullus vulgaris</i> )	* <i>Fusarium oxysporium</i> – fusarium wilt *Anthracnose *Powdery mildew *Pseudoperonospora cubensis – downy mildew	*Striped cucurbit beetle

## OTHER ACTIVITIES OF THE CROP PROTECTION DEPARTMENT

### Farmers Training

A total of 30 training sessions/ field schools were conducted by staff of the Crop Protection Department on the Integrated Management of Pest and Disease for farmers and other stakeholders in Regions 2, 3, 4, 5, 6, 7 and 10

## CESO INTERNATIONAL SERVICES - VOLUNTEER ADVISER'S REPORT OF ASSISTANCE RENDERED

**Start Date:** Nov. 7, 2009                      **Completion Date:** Nov. 20, 2009

**Purpose:** Assist vegetable and fruit disease management

Dr. Kalyan Basu a Canadian Executive Services Organisation - International Volunteer Advisers (CESO) scientist was solicited by NARI to assist in vegetable and fruit disease management, he held two training programs one at Bath West Coast Berbice and the other at Parika Backdam for farmers and other stakeholders. Dr. Kalyan Basu was on a two week mission in Guyana from Nov. 7-20, 2009.

Ministry of Agriculture, Guyana, has identified several agricultural commodities for the export market. Some of these important vegetable and fruit crops are peppers, pumpkins, pineapples and plantains. Increasing productivity of these commodities is vital to the agriculture industry of Guyana. Currently, the major problem of agricultural production is the proper management of pest and disease. Especially for peppers, the diseases locally known as 'wilt' and 'fine leaf' which are affecting pepper production. Technical assistance is requested for identification of the causal organism and recommendation of proper control measures for these diseases. These technology of disease and pest management needs to be provided to the farmers and agricultural extension officers via training sessions.

Immediate results of the assignment in terms of improvements realized, changes made.

Cause of the fine leaf disease problem of the pepper has been assessed as viral disease. Main cause of the disease spread is by insect vector.

Besides pepper diseases, causal organisms of other diseases were identified and control measures discussed with the farmers of Guyana. Some of the important diseases of Agricultural crops are listed below:

- Scarlet tip disease of pineapple caused by virus
- Leaf spot of celery and beans
- Diamondback moth infestation of cabbage
- Sagatoka disease of banana
- Fusarium wilt of banana
- Stem rot of eggplant
- Anthracnose disease of papaya
- Damping off of cabbage

Recommendations or plans are still to be carried out by the Client.

The staff at NARI was informed about the casual agents of several pest and diseases of agricultural crops and how to manage them. Emphasis was given particularly on pepper and pineapple diseases.

For fine leaf disease of pepper, the following recommendations were made:

- Control insect vector by applying specific chemicals.
- Rotate crops that are not in the pepper family, and not to plant seed from diseased plants.
- Farmers were also advised to use certified disease free seeds for their next planting.
- Confirm virus type by ELISA test using specific antibody.
- Confirm efficacy of recommended insecticides such as Regent and Pegasus by field trials of these chemicals.
- Use seed testing for disease free seeds.
- Continue doing research on new chemicals in the market which are environmentally friendly and have minimum impact on the health and safety of farmers and consumers.

### **Social benefit for the client, employees or the community**

The assignment resulted in public gathering of farmers for information and training sessions.

CESO advisor was the main speaker and trainer at these meetings. Interactions between CESO, farmers and government officials were very beneficial in terms of information transfer about pest and disease management practices.

### **Impact of this training on the client staff and on the individual farmer**

The client (NARI) is a government institution. The information transfer about casual agent of the fruits and vegetable diseases and their management practices will have a positive impact on the individual staff at NARI and the farmers at large.

Using the disease management practices which were discussed at these training sessions, farmers would be able to increase production of their crops for domestic and export markets.

### **Most satisfying aspect of this assignment**

Meeting friendly, hospitable and hard working people. Experience a rich culture and history of Guyana and an opportunity to share ideas of crop production with the growers and technical staff.

## **STAFF CAPACITY BUILDING**

### **Training/Seminars/Workshops**

1. Ms. Sridevi Nanku participated in a workshop on “*Rural Enterprise and Agricultural Development Project (READ)*” held in collaboration with the Ministry of Agriculture and the International Fund for Agricultural Development in Guyana, 2009.
2. Ms. Sridevi Nanku participated in a workshop on “**Strategy for Cassava Enterprise and Industry Development**” in collaboration with NARI and the Food and Agriculture Organization of the United Nations (FAO), European Development Fund, ACP States, and the International Trade Centre / UNCTAD/ WTO, Workshop in Guyana, 2009.

3. Ms. Sridevi Nanku participated in a workshop on “**Integrated Approach to Aquatic Weed Management in Guyana**” held in collaboration with NARI and the Food and Agriculture Organization of the United Nations (FAO) in Guyana, 2009.
4. Ms. Sridevi Nanku represented Guyana in a five-day Regional Workshop on the :“**Identification of Coleopteran Pests of Economic Importance to the Region**”, planned by the Inter- American Institute for Cooperation on Agriculture (IICA), in collaboration with the United States Department of Agriculture Animal and Plant Health Inspection Services (USDA-APHIS) and the Florida Association for Volunteer Action in the Caribbean and the Americas (FAVACA)" September 21-25, 2009 at the St. George’s University, Grenada.
5. Ms. Sridevi Nanku and Ms Sharon Nicholson participated in a capacity building workshop held by the Crops and Livestock Department, Ministry of Agriculture, in collaboration with the Food and Agricultural Organization – International Plant Protection Convention (FAO-IPPC) on “*International Standards for Phytosanitary Measures (ISPMs)*” Guyana, 2009.
6. Dr. Raghunath Chandranauth participated in FAO/ USDA study tour in the USA on “**Integrated Management of Weed in Aquatic Environment**” from September 7-20, 2009.

#### **IV. LIVESTOCK AND PASTURE PRODUCTION DEPARTMENT**

**Staff:**

Dr. Robin Austin	- Head of Department
Mr. R. N. Cumberbatch	- Senior Research Scientist
Mr. J. K. Q. Solomon	- Senior Research Assistant (on study leave)
Dr. Q. Joseph	- Research Assistant –(Veterinarian from Aug. 2008)
Dr. J. Despaigne Rodriguez	- F.A.O. Livestock Consultant
Ms. Z. Ali	- Research Technician

**Introduction**

N.A.R.I.'s Livestock and Pasture Production Department continued its mandate of contributing to Guyana's diversification of its agricultural sector by assisting the farming community, specifically in four disciplines, i.e. duck, sheep, forage and beef production.

Research, production and development, and technology transfer are the department's main focus.

There were three highlights of the department's activities in 2009. Firstly, there was the successful introduction into Guyana of a nucleus flock of purebred Texel sheep, using laproscopic embryo transplant techniques and the breeding of a crossbred animal referred to as the "Texana", using laproscopic artificial insemination (A.I.) techniques. These were accomplished through extensive collaboration between N.A.R.I., the British Texel Society and British High Commission in Guyana.

Secondly, we successfully introduced the "Texana" throughout a wide geographical area in Guyana and compared its performance against other local breed types.

Thirdly, we achieved a marked improvement in growth weight and meatiness of a large section of the local Muscovy duck population as a result of the use of imported French Muscovy genetics.

## DUCK SECTION

### Development and Production Activities

Work continued aimed at developing the following strains of local Muscovy ducks; Solowhite, Robinblue and Cumberblack. Strains of French Muscovy were used to improve the meatiness and egg producing capability of these local strains.

Table 16 gives an indication of the fertility of the locally adapted Pekin, Kunshan and Muscovy ducks over a four year period, as well as the performance of imported strains of Pekin and Muscovy and some of the local strains being developed.

**Table 16: Fertility Percentages of Several Breeds and Strains of Ducks at NARI Livestock Farm, 2006 - 2009**

PERIOD	PEKIN (fertility%)		KUNSHAN (fertility%)	MUSCOVY (fertility%)					
	Local adapted	Metzer (USA)		Local	French Local	French Solo white	French Cumber black	French Robin blue	French Pure Black
2006	81.75	-	80.97	81.25	-	-	-	-	-
2007	83.2	-	77.1	88.8	-	-	-	-	-
2008	88.0	87.2	87.1	87.2	91.8	79.6	62.4	65	62.6
2009	88.7	73.6	89.3	83.4	89.0	74.4	68.5	66	86.5

Hatchability percentages for several breeds and strains of ducks are presented in Table 17.

**Table 17: Hatchability Percentages of Several Breeds and Strains of Ducks at NARI Livestock Farm, 2006 - 2009**

PERIOD	PEKIN (hatchability%)		KUNSHAN (hatchability%)	MUSCOVY (hatchability%)					
	Local adapted	Metzer (USA)		Local	French Local	French Solo white	French Cumber black	French Robin blue	French Pure Black
2006	73.75	-	73.2	71.25	-	-	-	-	-
2007	69.5	-	64.3	53.4	-	-	-	-	-
2008	68.9	87.2	80.5	72.3	71.8	69.6	58.4	65	62.6
2009	64	73	70	67	66	59	52.7	51.9	58.5

In 2009, both fertility and hatchability compared to previous years declined due to constant power outages and the absence of standby power.

The introduction of imported strains of French Muscovy resulted in increased meatiness and growth rate. (Table 18 and 19).



**Table 18: Growth Rate Comparison of Several Strains of Imported French Muscovy at 56 days**

STRAIN OF MUSCOVY	EXPECTED	ACTUAL WT.	ACTUAL WT.
	WT.	2008	2009
	KG	KG	KG
Heavy Banded Grey Muscovy Canedins R31 (M)	4.8	5	5.2
Heavy Banded Grey Muscovy Canedins R31 (F)	2.8	2.7	-
Heavy Black Muscovy Canedins R41 (M)	5.1	5	-
Heavy Black Muscovy Canedins R41 (F)	2.75	2.9	3
Super Heavy White Canedins R71SL (M)	4.9	5.2	5.2
Super Heavy White Canedins R71SL (F)	2.9	2.6	2.8

**Table 19: Comparison of Selected Portions of Several Strains of Imported French Muscovy at 56 Days**

Characteristics	STRAIN OF MUSCOVY			
	R41(M) kg.	R41(F) kg.	R71SL(M) kg.	R71SL(F) kg.
Chest wgt.	0.5	0.4	0.49	0.4
Back wgt.	0.48	0.38	0.45	0.35
Neck wgt.	0.23	0.2	0.23	0.2
Drumstick wgt.	0.35	0.3	0.32	0.32

Table 20 shows the supply of ducklings for 2008 and 2009.

**Table 20: Supply of Ducklings for 2008 - 2009**

YEAR	PEKIN	KUNSHAN	MUSCOVY	TOTAL
2008	13 036	7 546	10 106	30 688
2009	24 221	13 603	31 306	69 130

Opening and closing stock for all breeders was 3412 and 4239. Duckling production from N.A.R.I.'s breeders was 65 593 in 2009, while a further 31 553 ducklings were hatched from eggs supplied by farmers.

## **SHEEP SECTION**

N.A.R.I.'s sheep section plays a vital role in the development of a commercially viable sheep industry in Guyana.

The successful introduction of Texel genetics was the main highlight of the programme.

## **Research**

In keeping with the Memorandum of Understanding between N.A.R.I., the Texel Sheep Society and the British High Commission in Guyana, the Department collaborated with these partners in three projects, which were conducted by its officers.

## **1. PRODUCTION PARAMETERS OF THE TEXANA: A NEW INTRODUCTION TO GUYANA**

**N. Cumberbatch, R. Austin, Q. Joseph and Z. Ali, NARI**

***Abstract:** The “Texana” is a cross between the Texel male and either/or the Barbados Blackbelly, Virgin Island White and Barbados Blackbelly crossed female. The name Texana originated from the words Texel and Guyana. The Texel breed of sheep was introduced in Guyana in 2008; the methods selected for the introduction of the breed were embryo transfer for the pure bred Texel animals and laparoscopic artificial insemination for the Texana. The objective of this programme was to improve the carcass quality and growth performance of crossed bred sheep in Guyana. A number of farms were selected to be the initial recipients of these animals. The farms were located in different geographic areas of Guyana; in addition, the management systems employed on each farm was different, the farms selected and the management systems used are highlighted. The paper also highlights the phenotypic characteristics of the different crosses, the growth parameters and the recommended feeding regime.*

**KEY WORDS:** growth, phenotypic, sheep, Texana

## **2. THE EFFECT OF LAPAROSCOPIC ARTIFICIAL INSEMINATION AND EMBRYO TRANSPLANT ON SHEEP IN GUYANA**

**N. Cumberbatch, R. Austin, Q. Joseph and Z. Ali, NARI**

***Abstract:** In February 2008, a Memorandum of Understanding was signed between the British Texel Sheep Society and the National Agricultural Research Institute, to introduce the Texel breed of sheep into Guyana. The methods selected for the introduction of the breed were embryo transplant and laparoscopic insemination; this was the first time these methods of breed improvements were undertaken in sheep in Guyana. The lambs from the embryo transplants are the pure bred Texel and those from the artificial insemination are the crossed bred Texel. A number of locations around Guyana were identified for the introduction of the breed and these include the Intermediate Savannahs, the Linden /Soesdyke Highway, the National Agricultural Research Institute and the Guyana School of Agriculture farms located on the Coastal Clay Soils, a farm located in the Essequibo Islands, and farms located in Region 5. The conception rates ranged from 17% for the*

animals selected from the farms in Region 5 to 75% for the animals selected from the farm on the Linden/Soesdyke Highway. The Texel females had an average birth weight of 4.7 kg and the males 4.6 kg, while the birth weight of the Texel crossed lambs ranged from 2.0 kg to 4.5 kg for the male and 2.1kg to 4.0 kg for the female lambs.

**KEY WORDS:** *embryo, insemination, Laparoscopic, transplant*

### **3. COMPARISON OF GROWTH PARAMETERS OF THE TEXEL, THE TEXEL CROSS AND BARBADOS BLACKBELLY SHEEP AT MON REPOS**

*N. Cumberbatch & R. Austin , NARI*

*Abstract: A comparison was made to ascertain the growth parameters of the Texel, the cross bred Texel and the Barbados Blackbelly sheep at the National Agricultural Research Institute, Livestock Farm, Mon Repos. The animals were all on the same feeding and management regimes. A pregnancy diet was fed for six weeks prior to lambing and a lactating diet was fed from lambing until weaning. Weaning was done approximately 12 weeks after lambing. The average birth weight of the Texel lambs was twice that of the Barbados Blackbelly lambs and the initial average daily gains of the Texel lambs was also superior to that of the Barbados Blackbelly. However, the Barbados Blackbelly lambs average daily gains compared favourably with the crossbred Texel lambs.*

**KEY WORDS:** *Barbados Blackbelly, Texel, Texel cross, weaning*

#### **Farm Locations**

A number of farms were selected to be the initial recipients of these animals. The farms were located in different geographic areas of Guyana; the areas where the selected farms were located were as follows:

- Intermediate Savannahs – Region 10.
- Linden/ Soesdyke highway (White Sands) – Region 4.
- Coastal Clay Soil – Region 4. (NARI and GSA, Mon Repos)
- Essequibo Islands – Region 3.

- Coastal Plains - Region 5.

### **Feeding regime for both the Texel and crossbred Texel lambs**

Animal production is a function of the genetic potential of the animal, the standard of animal management and the quality of the feed or the nutritional value of the feed /forage on offer to the animal. The selected animals were subjected to a strict feeding regime utilizing a balanced diet formulated from locally available feed ingredients. Table 21 gives the diet compositions of the recommended diets.

**Table 21: The feed compositions of the recommended diets for Texel and crossbred Texel sheep, 2008**

<b>Pregnancy/ Lactating Diet</b>		<b>Lamb diet</b>	
Ingredient	Percent	Ingredient	Percent
Broken rice	16.5	Broken rice	20.3
Ground corn	10.0	Ground corn	15.0
Wheat middling's	25.0	Wheat middling's	25.0
Soybean meal	10.0	Soybean meal	5.0
Coconut oil	1.0	Fish meal	6.0
Molasses	5.0	Coconut oil	1.0
Limestone	1.8	Molasses	5.0
Salt	0.5	Limestone	1.5
Sheep micronutrients	0.2	Salt	0.5
Rice bran	10.0	Ammonium Chloride	0.5
Copra meal	20.0	Sheep micronutrients	0.2
		Copra meal	20.0

The pregnancy/ lactating diet was fed for a six week period prior to lambing and until weaning. Weaning was done approximately 12 weeks after lambing.

## DORPER

Efforts to establish this breed, which was introduced in 2007, have been frustrated by the high incidence of mortality, morbidity and acclimatization problems.

Additionally, successful reproduction presents its own challenges. Twelve females exposed to the rams, produced only eight lambs, three of which subsequently died.

Table 22 shows the inventory of Dorper Sheep at the Livestock Farm in 2009.

While Dorper pure breeding continues to challenge the Technical Staff, six Barbados Black Belly ewes were crossed with a Dorper male. This tupping activity produced one quadruplet, one twin and four single births, with the average birth weight for males – 2.6 kg. and for females - 2.3 kg., while average daily gain and mortality were 105.4 g. and 0 %, respectively.

**Table 22: Inventory of U.S.A Dorper Sheep, Livestock Farm, Mon Repos, 2009**

	<b>Opening stock</b>	<b>Births</b>	<b>Transfer In</b>	<b>Transfer Out</b>	<b>Death</b>	<b>Sold</b>	<b>Closing Stock</b>
Breeding Males	2	-	0	-	-	-	2
Breeding Females	9	-	-	-	2	-	7
Weaned Males	1	-	0	-	-	-	1
Weaned Males	3	-	0	-	-	-	3
Lamb Male	0	2	-	0	2	-	0
Lamb Female	0	1	-	0	1	-	0
<b>TOTAL</b>	<b>15</b>						<b>13</b>

Production of the pure bred Black Belly and Cross bred sheep at Mon Repos and Ebini continued. Table 23 shows the flock inventory at Mon Repos in 2009. Table 24 highlights the production parameters of the Mon Repos, flock of Barbados Black Belly and Barbados Black Belly Crosses at Mon Repos for 2009 and compares the 2009 while Table 9 looks at parameters from 2004 to 2009.

**Table 23: Stock Inventory of the Mon Repos Flock of Barbados Black Belly Sheep, 2009**

<b>PARAMETERS</b>	<b>OPENING STOCK</b>	<b>CLOSING STOCK</b>
BREEDING MALES	8	8
BREEDING FEMALES	190	194
WEANED MALES	3	50
WEANED FEMALES	26	77
MALE LAMBS	42	28
FEMALE LAMBS	54	37
<b>TOTAL</b>	<b>323</b>	<b>394</b>

**Table 24: Comparison of Production Parameters of Barbados Black Belly Sheep at Mon Repos for 2004-2009.**

Parameters	2004	2005	2006 *	2007	2008	2009
Number of lambs born	272	175	48*	314	73	338
Number of ewes giving birth	84	119	33*	184	41	186
Average lambs/litter	1.543	1.47	1.45	1.71	1.78	1.82
Single births	35%	37.1%	48%	29.3%	19.1%	30.6%
Twin births	55.9%	56%	54%	50.6%	60.4%	57.52%
Triplets births	8.5%	6.9%	NA	17.5%	20.5%	11.2%
Quadruplet births	NA	NA	NA	2.6%	NA	0.53%
Male lambs	49.3%	50.2%	54.1%	50.95%	56.2%	51.47%
Female lambs	50.6%	49.8%	45.8%	49.05%	43.8%	48.52%
Male birth weights	2.7 kg	2.55 kg	2.7 kg	2.8kg	2.8kg	2.6kg
Female birth weights	2.4 kg	2.325 kg	2.4 kg	2.4kg	2.5kg	1.4kg
Average daily gains (Male) preweaning	102.49 g	102.125 g	103.6g	104.2g	104.4g	104.8g
Average daily gains (Females)	91.83 g	95.075 g	97.7g	101.g	101.2g	101.6g

The data for 2006 are incomplete because the computer system in the Department was non-functional for the greater part of the year.

Compared to 2008, the increased number of lambs (338) is as a result of a large breeding flock.

In 2009, 47 Barbados Black Belly and 11 Texana rams were sold to the farming community.

186 ewes lambed 338 BBB lambs - 174 males and 164 females

Types of births - 1 quadruplet, 21 triplets, 107 twins, 57 singles



Average Birth wgt. Male	- 2.6kg.
Average Birth wgt. Female	- 2.4kg.

## **FORAGE**

Forage production continued to suffer throughout 2009. The establishment of approximately 70 acres of pasture is crucial to the successful introduction of the Texel sheep and the sheep programme at the N.A.R.I. location. All the necessary resources must be provided as a matter of urgency, if we are to establish enough pasture by July 2010.

## V. HUMAN RESOURCES REPORT – 2009

### 1. RECRUITMENT OF STAFF

#### A. Senior Technical

1. Mr. Bissasar Chintamanie	Research Scientist	2009-07-01
2. Mr. Kevindra Tularam	Research Assistant	2009-05-09
3. Ms. Dinte Conway	Special Projects Coordinator	2009-11-23

#### Cubans Graduates to NARI

1. Mr Premdat Beechan	Research Assistant	2009-08-24
2. Ms Indira Persaud	Research Assistant	2009-08-24
3. Mr Kaimraj Kandhai	Research Assistant	2009-08-24
4. Mr Beesham Narine	Research Assistant	2009-08-24
5. Mr Quincy Scotland	Research Assistant	2009-08-24
6. Mr Keri Eleazer	Research Assistant	2009-08-24
7. Mr Ramdat Ancil	Research Assistant	2009-08-24

#### B. Other Technical and Craft Skilled

1. Ms. Rebecca Brehaspat	Research Technician	2009-01-12
2. Mr. Dork Bess	Research Technician II	2009-08-24
3. Ms. Erena Torres	Research Technician II	2009-08-28
4. Mr. Shurland Klass	Research Technician II	2009-09-01

#### C. Clerical and Office Support

1. Ms. Sarita Persaud	Accounts Clerk II	2009-01-12
2. Ms. Bibi Khan	Secretary/Lab. Assistant	2009-12-02

#### D. Semi -Skilled and Unskilled Operatives

1. Ms. Lestra Da Silva	General Worker	2009-08-02
2. Mr. Kevon Taylor	General Worker	2009-01-19
3. Mr. Terry Richmond	General Worker	2009-01-19
4. Ms. Sarajudai Ramkarran	General Worker	2009-01-19

### 2. RESIGNATION

#### A. Senior Technical

1. Mr. Gavin Mahadeo	Research Assistant	2009-01-12
2. Ms. Shri Devi Dhanpaul	Research assistant	2009-06-04
3. Ms. Kaye McAllister	Research Scientist	2009-12-26

#### B. Other Technical and Craft Skilled

1. Mr. Ishri Singh	Plant Nursery Supervisor	2009-02-13
2. Ms. Natasha Rambarran	Research Technician I	2009-09-01
3. Ms. Goldwyn Todd	Plant Nursery Supervisor	2009-11-05

4. Ms. Samantha Sheoprashad      Research Technician I      2009-11-05

**C. Clerical and Office Support**

1. Mr. Kurt Gouveia      Accounts Clerk II      2009-08-31

**D. Semi Skilled and Unskilled Operatives**

1. Mr. Adesh Teckchand      Assistant Foreman      2009-09-01  
2. Ms. Lestra DaSilva      General Worker      2009-08-31

**3 DISMISSAL**

**A. Senior Technical**

1. Ms. Monica Sookdeo      Research Assistant      2009-07-28

**B. Semi Skilled and Unskilled Operatives**

1. Ms. Bibi Rehana      Assistant Foreman      2009-02-07  
2. Mr. Deoram Sanchara      Mobile Equipment Operator      2009-05-06

**4 TERMINATION**

**A. Other Technical and Craft Skilled**

1. Mr. Yadesh Dhanpaul      Research Technician I      2009-02-17

**B. Clerical and Office Support**

1. Mr. Henry Melville      Office Assistant      2009-08-03

**5. RETIREMENT**

**A. Other Technical and Craft Skilled**

1. Ms. Grace Easton      Senior Research Technician      2009-03-22

**B. Semi Skilled and Unskilled Operatives**

1. Ms. Sarjudai Singh      Laboratory Attendant      2009-01-29  
2. Mr. Welton Griffith      Security Guard      2009-04-05  
3. Ms. Merlyn Hercules      Security Guard      2009-11-03  
4. Ms. Eva Rodrigues      Nurseryman I      2009-12-19

**6. PROMOTION**

**A. Semi Skilled & Unskilled Operatives**

1. Mr. Hameed Ibrahim      Equipment Operator      2009-08-01

**7. DEATH**

**A. Other Technical and Craft Skilled**

1. Ms. Amanda Connell-Chester      Research Technician I      2009-03-26

**B. Semi Skilled and Unskilled Operatives**

1. Mr. Nandram Persaud      Security Guard      2009-03-07

2. Mr. Nigel Crooke	General Worker	2009-11-28
3. Ms. Natasha Fraser	General Worker	2009-11-28

**Table 25: Staffing at NARI – 2009**

Categories	No. of Positions	Positions filled	Positions vacant
Administration	11	6	5
Senior Technical	43	28	15
Other Technical & Craft Skilled	40	27	13
Clerical & Office Support	20	9	11
Semi Skilled & Unskilled Operatives	174	131	43
<b>Total</b>	<b>288</b>	<b>201</b>	<b>87</b>

**Table 26: Staffing in the Administrative Category, 2009**

Categories	Authorized positions	Positions filled	Vacant post
Finance Manager	1	1	0
Internal Auditor	1	0	1
Personnel & Industrial Relations Officer	1	0	1
Assistant Librarian	1	0	1
Senior Personnel Assistant	1	1	0
Chief Accountant	1	1	0
Superintendent, General Services	1	1	0
Communication Specialist	1	0	1
Communication Officer	1	0	1
Chief Security Officer	1	0	1
Deputy C.S.O	1	1	0
<b>Total</b>	<b>11</b>	<b>5</b>	<b>6</b>

**Table 27: Staffing in Senior Technical Category, 2009**

<b>Categories</b>	<b>Authorized positions</b>	<b>Positions filled</b>	<b>Vacant post</b>
Senior Research Scientist/Research Scientists	18	7	11
Senior Research Assistants/Research Assistants	22	19	3
Farm Manager	2	2	0
Field Superintendent	1	0	1
<b>Total</b>	<b>43</b>	<b>28</b>	<b>15</b>

**Table 28: Staffing in the Clerical & Office Support Category, 2009**

<b>Categories</b>	<b>Authorized positions</b>	<b>Positions filled</b>	<b>Vacant post</b>
Confidential Secretary	1	0	1
Registry Supervisor	1	0	1
Personnel Assistant	1	1	0
Secretary	1	1	0
Typist I/II	2	1	1
Assistant Accountant & Audit	2	1	1
Accounts Clerk II	3	1	2
General Clerk	3	1	2
Expediter I/II	1	1	0
Office Attendant	2	0	2
Records/Audit Clerks	3	2	1
<b>Total</b>	<b>20</b>	<b>9</b>	<b>11</b>

**Table 29: Staffing in the Other Technical and Craft Skilled Category, 2009**

<b>Categories</b>	<b>Authorized positions</b>	<b>Positions filled</b>	<b>Vacant post</b>
Senior Stores Keeper/Storekeeper	2	0	2
Senior Library Assistant	1	1	0
Library Assistant	1	1	0
Information Technology Technician	1	1	0
Senior Plumber/Plumber	1	1	0
Mechanical Supervisor	1	0	1
Senior Mechanic/Mechanic	1	0	1
Electrician	1	1	0
Carpenter	2	1	1
Welder	1	1	0
Plant Nursery Supervisor	6	2	4
Senior Research Technician/Research Technician II Research Technician I	22	18	4
<b>Total</b>	<b>40</b>	<b>27</b>	<b>13</b>

**Table 30: Staffing in the Semi Skilled and Unskilled Category, 2009**

<b>Categories</b>	<b>Authorized positions</b>	<b>Positions filled</b>	<b>Vacant post</b>
Caretaker	2	2	0
Senior Security Guard	6	6	0
Security Guard/Watchman	36	17	19
Heavy Duty Driver/Driver Mechanic/Driver	6	5	1
Equipment Operator	3	2	1
Mobile Equipment Operator	4	4	0
Foreman/Assistant Foreman	5	2	3
Assistant Plant Nursery Supervisor	4	1	3
General Worker	80	72	8
Porter	1	1	0
Sanitation Worker	4	4	0
Attendant (Laboratory, Livestock, Crop)	11	9	2
Assistant (Laboratory)	1	1	0
Nurseryman I	7	2	5
Nurseryman II	4	3	1
<b>Total</b>	<b>174</b>	<b>131</b>	<b>43</b>

## TRAINING

### A. OVERSEAS

Meetings /Workshops/Short Courses

## MEETINGS

1. Dr. Oudho Homenauth, Director participated in “**The Caricom Regional Working Group Meeting**” on GMOs, held in Barbados from March 17 to 18, 2009.
2. Mr. Raghunath Chandranauth, Research Scientist, participated in a Technical Meeting of Experts on “**Biotechnology and Climate Change in the Caribbean.**” held in Trinidad and Tobago on April 28, 2009.
3. Dr. Oudho Homenauth, Director participated in **Caricom/IICA/UNEP Consultative Meeting and workshop on Biosafety and Biotechnology**, held in St. Vincent, from September 28 to 29, 2009.
4. Dr. Oudho Homenauth, Director participated in a Meeting with the aim of discussing “**The Proposed areas of cooperation for the Improvement of Agriculture Sector**” held in China from November 02 to 13, 2009.

## WORKSHOPS

1. Mr. Ronn Sullivan, Research Assistant, participated in a **Regional Workshop on Rainwater Harvesting for Agriculture,**” held in Antigua from July 31, 2009 to August 17, 2009.
2. Ms. Sridevi Nanku, Research Assistant **participated in a workshop on “The Identification of Coleopteran Pest Economic Importance**”, held in Grenada from September 21, 2009 to September 25, 2009.
3. Dr. Robin Austin, Research Scientist participated in a a workshop on “**Incaribe Caribbean Large Marine Ecosystem (CLME)**” held in Colombia, from September 28, 2009 to September 30, 2009.

## SHORT COURSES

Ms. Kaye McAllister, Research Scientist participated in a Training Course on “The Borlong International Agricultural Science Technology Fellows for Guyana, held in the United states of America, from July 31, 2009 to August 17, 2009.

## LOCAL

### Programmes/Conferences/Workshops

Ms. Nathalie Woolford, Senior Library Assistant, participated in Training Programme on “**Information and Library Techniques**” – Module III, IV and V held at the National Library and Government Technical Institute from February 09, 2009 to April 13, 2009, April 27, 2009 to June 30, 2009 and August 11, 2009 to November 29, 2009 respectively.



## CONFERENCE

1. Messrs David Fredericks, Research Scientist and Sydney Hollingsworth Senior Research Technician, participated in the 18th Biennial Delegates Conference, held at the Guyana Public Service Union, Headquarters from September 30, 2009 to October 02, 2009.

## WORKSHOPS

1. Mr. Quincy Scotland, Agricultural Officer, participated in **Guyana Second National Communication (SNC) Project: Mitigation Assessment workshop**, held at the Ministry of Agriculture from November 10, 2009 to November 12, 2009.
2. Ms. Nathalie Woolford, Senior Library Assistant, Participated in a workshop on ***“GLA/IDCE Training Programme for Library Technician”***, Held at the University of Guyana from November 10, 2009 to November 12, 2009.

# VI. FINANCIAL REPORT

## NATIONAL AGRICULTURAL RESEARCH INSTITUTE

### BALANCE SHEET

AS AT DECEMBER 31, 2009

\$ 2008	NOTES	\$	\$
204,495,420	<b>FIXED ASSETS</b>	<b>5</b>	<b>215,088,259</b>
	<b>CURRENT ASSETS</b>		
18,045,390	Stocks	19,516,548	
8,323,958	Debtors	18,939,958	
5,191,396	Short Term Investment	5,226,104	
2,252,169	Cash at Bank and on Hand	35,517,573	
33,812,913		<u>79,200,183</u>	
	<b>CREDITOR AND ACCRUALS</b>		
(4,634,235)	Amount due within one (1) year		
(3,124,437)	Creditors	(4,181,965)	
26,054,241	Bank Overdraft		
<b>230,549,661</b>	<b>NET CURRENT ASSETS</b>		<u>75,018,218</u>
			290,106,477
	<b>PROVISION FOR LIABILITIES &amp; CHARGES</b>		
(5,606,815)	Ministry of Works	(5,606,815)	
<u>(5,606,815)</u>	Ministry of Finance	<u>-</u>	
			<u>(5,606,815)</u>
<u>224,942,846</u>	<b>NET TOTAL ASSETS</b>		<u>284,499,662</u>
	<b>FINANCED BY:</b>		
51,897,479	Grant Foreign Sources		51,897,479
310,858,647	Government Contribution	<b>7</b>	340,858,647
341,781	Revaluation of Stock		341,781
(138,155,061)	Accumulated Surplus (Deficit)		<u>(108,598,245)</u>
<u>224,942,846</u>			<u>284,499,662</u>

CHAIRMAN ( A. R. C.)

DATE

DIRECTOR

DATE

**NATIONAL AGRICULTURAL RESEARCH INSTITUTE**

**STATEMENT OF INCOME AND EXPENDITURE**

**FOR THE YEAR ENDED DECEMBER, 31, 2009**

<b>\$</b>	<b>OPERATING INCOME</b>	<b>NOTES</b>	<b>\$</b>	<b>\$</b>
<b>2008</b>				
18,310,870	Income from Agricultural Produce	<b>2</b>		26,310,156
22,759,809	Grant	<b>3</b>		47,483,146
237,619,993	Government Subvention			294,104,323
4,129,728	Miscellaneous Income	<b>4</b>		8,484,920
<u>282,820,400</u>				<u>376,382,545</u>
	<b>OPERATING EXPENDITURE</b>			
184,930,425	Employment		181,617,814	
12,546,049	Fuel and Lubricants		11,262,718	
18,270,167	Repairs and Maintenance		16,616,335	
22,967,425	Field Supplies and Services		33,851,390	
22,465,792	Depreciation		22,855,254	
57,876,968	Administrative Costs		<u>80,622,218</u>	
<u>319,056,826</u>				<u>346,825,729</u>
<u>(36,236,426)</u>	Net Surplus/(Deficit)			<u>29,556,816</u>

**STATEMENT OF ACCUMULATED SURPLUS/(DEFICIT)**

(101,918,635)	Accumulated Surplus/(Deficit) as at Jan. 1, 2009	(138,155,061)
(36,236,426)	Add Current Year Surplus / (Deficit)	29,556,816
<u>(138,155,061)</u>	Accumulated Surplus/(Deficit) as at Dec. 31, 2009	<u>(108,598,245)</u>

**NATIONAL AGRICULTURAL RESEARCH INSTITUTE**  
**STATEMENT OF SOURCE AND APPLICATION OF FUNDS**

**FOR THE YEAR ENDED DECEMBER, 31, 2009**

<b>\$</b>		<b>\$</b>	<b>\$</b>
<b>2008</b>			
	<b>SOURCE OF FUNDS</b>		
(36,236,426)	Surplus for the year		29,556,816
	Add : Adjustments for just items not involving The use of funds :-		
	Loss on Disposal of Fixed Assets	-	
22,465,792	Depreciation	22,855,254	
22,465,792			22,855,254
(13,770,634)			52,412,070
	<b>FUNDS FROM OTHER SOURCES</b>		
35,000,000	Government Contribution	30,000,000	
-	Grant Foreign Sources	-	
35,000,000			30,000,000
21,229,366	Total Funds From All Sources		82,412,070
	<b>APPLICATION OF FUNDS</b>		
-	Ministry of Finance	-	
594,015	Revaluation of Stock	-	
44,803,562	Purchase of Fixed Assets	33,448,093	
45,397,577			33,448,093
(24,168,211)			48,963,977
	<b>INCREASE/DECREASE IN WORKING CAPITAL</b>		
(1,731,683)	Increase/(Decrease) in Stock	1,471,158	
(13,387,454)	Increase/(Decrease) in Debtors	10,616,000	
459,251	(Increase)/Decrease in Creditors	452,270	
(14,659,886)			12,539,428
	<b>MOVEMENT IN NET LIQUID FUNDS</b>		
55,364	Increase/(Decrease) in Short Term Investment	34,708	
(3,124,437)	(Increase)/Decrease in Bank Overdraft	3,124,437	
(6,439,252)	Increase/(Decrease) in Cash at Bank & on Hand	33,265,404	
(9,508,325)			36,424,549
(24,168,211)			48,963,977

# NATIONAL AGRICULTURAL RESEARCH INSTITUTE

## NOTES TO THE ACCOUNTS

### 1 ACCOUNTING POLICIES

#### (a) Accounting Conventions:-

These statements have been prepared under the historical cost conventions as modified by the revaluation of assets taken from Central Agriculture Station and Guyana Rice Board; such assets being valued at the current market price prevailing as at March 01, 1985.

#### (b) Fixed Assets:-

Depreciation is calculated on the straight line basis to write off the assets over their useful lives as follows:-

Buildings	5%
Motor Vehicles	20%
Machinery and Equipment	20%
Laboratory Equipment	20%
Household Furniture and Fittings	20%
Library Books	15%

Depreciation is provided following the year of acquisition.

No depreciation is provided on freehold land, capital work-in-progress and livestock.

#### (c) Stock:-

Stocks are valued at lower of cost and net realizable value. In general, cost is determined on a first-in-first-out basis and includes all cost relating to freight, insurance, handling and finance charges.

#### (d) Loans:-

Loans are stated net of unearned and uncollected interest.

#### (e) Pension Plan:-

The Institute has established a contributory Pension Scheme for its monthly paid employees. The contributions are held in a trustee administered funds.

**( f ) Transferred to NARI:-**

At Cabinet Meeting held on 8th October, 1996 approval was granted with effect from 01st January, 1997 to transfer sections of the Ministry of Agriculture, Crops and Livestock Department to NARI. However, the valuation of the Assets taken over from the Mon Repos Livestock Station, Seed Technology Unit including Kairuni Agricultural Research Station and all Plant Nurseries is not included in the present report.

**2 INCOME FROM AGRICULTURAL PRODUCE**

**This figure is made up as follows:**

	\$
Sale of Plants	12,054,195
Sale of Organic Produce	61,940
Sale of Livestock Produce	13,850,190
Sale of Grain Legumes	177,180
Sale of Vegetables & Seeds	142,570
Sale of Papaw & Other Fruits	9,081
Sale of Cocoa Beans	15,000

26,310,156

**3 GRANTS**

**This figure is made up as follows:**

	\$
Guyana Rice Development Board	6,920,000
Guyana Sugar Corporation	101,400
FAO	4,046,041
CHF	1,527,600
United Nations Women's Guild of Rome	597,000
Khenmraj Narain	145,255
Ministry of Agriculture	23,697,000
Ministry of Finance	9,400,000
Ministry of Amerindians Affairs	400,000
New Guyana Marketing Corporation	300,000
Guyana School of Agriculture	186,500
CARDI	162,350

47,483,146

**4 MISCELLANEOUS INCOME**

**This figure is made up as follows:**

**\$**

Sale of Acoushi Ant Bait	1,445,480
Electricity Receivable	463,737
Interest Receivable	41,971
Other Income	142,502
Rental of House	575,000
Rental of Equipment	3,349,630
Sale of Printed Materials	5,500
Accommodation Guest House	1,681,100
Sale of Unservicable Items	<u>780,000</u>
	<u><u>8,484,920</u></u>

**6 SHORT TERM INVESTMENT**

**\$**

30-Oct-09	Certificate No. 394841	5,226,140
		<u>5,226,140</u>

**7 GOVERNMENT CONTRIBUTION**

This figures represents Inflows from Government for Capital Works

**\$**

Incorporated Reserves	12,454,472
Govt. Contribution Balance as at Jan. 1, 2009	298,404,175
Add Govt. Contribution during the Year	30,000,000
	<u>\$340,858,647</u>

**SCHEDULE OF FIXED ASSETS AS AT DECEMBER 31, 2003**

<b>COST</b>	<b>BUILDINGS ETC.</b>	<b>MACH. &amp; EQUIP. &amp; MOTOR VEHICLES</b>	<b>FURNITURE &amp; FITTINGS &amp; OFFICE EQUIPMENT</b>	<b>LABORATORY EQUIPMENT</b>	<b>LIBRARY BOOKS</b>	<b>ANIMALS</b>	<b>CONSTRUCTION WORK IN PROGRESS</b>	<b>GRAND TOTAL</b>
AT 2003 - 01 - 01	195,260,083	104,863,115	44,467,155	44,066,792	2,087,071	702,431	124,050	391,570,697
ADDITIONS / ACQUISITION	11,084,176	14,511,305	1,705,382	798,375	3,000	860,700	8,562,986	37,525,924
DISPOSAL / TRANSFERS							- 8,615,626	- 8,615,626
AT 2003 - 12 - 31	206,344,259	119,374,420	46,172,537	44,865,167	2,090,071	1,563,131	71,410	420,480,995
<b>DEPRECIATION</b>						-	-	
AT 2003 - 01 - 01	54,120,778	67,563,188	35,562,986	39,364,192	1,317,169	-	-	197,928,313
DISPOSAL / TRANSFERS								
CHARGED FOR THE YEAR	9,765,424	9,551,546	3,360,972	1,976,891	229,587		-	24,884,420
AT 2003 - 12 - 31	63,886,202	77,114,734	38,923,958	41,341,083	1,546,756	-	-	222,812,733
<b>NET BOOK VALUE</b>	142,458,057	42,259,686	7,248,579	3,524,084	543,315	1,563,131	71,410	197,668,262