NATIONAL AGRICULTURAL RESEARCH INSTITUTE

ANNUAL REPORT 2006

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LIST OF ABBREVIATIONS

BrCA	-	Brown Citrus Aphid
CARDI	-	Caribbean Agricultural Research and Development Institute
CTA	-	Technical Centre for Agriculture and Rural Development
CTV	-	Citrus Tristeza Virus
ELISA	-	Enzyme Linked Immuno Sorbent Assay
FAO	-	Food and Agriculture Organisation
FFS	-	Farmers Field School
GGMC	-	Guyana Geology & Mines Commission
GIS	-	Geographic Information System
GLSC	-	Guyana Lands and Surveys Commission
GPS	-	Global Positioning System
GRDB	-	Guyana Rice Development Board
GTIS	-	Guyana Trade & Investment Support
GUYSUCO	-	Guyana Sugar Corporation
IFAD	-	International Fund for Agricultural Development
IICA	-	International Institute for Cooperation in Agriculture
IITA	-	International Institute for Tropical Agriculture
IPM	-	Integrated Pest Management
MOA	-	Ministry of Agriculture
NARI	-	National Agricultural Research Institute
NDDP	-	National Dairy Development Programme
NDS	-	National Development Strategy
NGMC	-	'New' Guyana Marketing Corporation
PGR	-	Plant Genetic Resources
PRA	-	Participatory Rural Appraisal
PRCSSP	-	Poor Rural Communities Support Services Project
UG	-	University of Guyana
USAID	-	United States Agency for International Development

EXECUTIVE SUMMARY

1.0 INTRODUCTION

During 2006, the Institute was involved in synthesizing its long-term Research and Development Strategy (2006-2015) by utilizing a holistic approach to agricultural development in Guyana. This approach included:

a) *Considering the agricultural sector as a strategic one in the Guyanese economy;*
b) *Emerging issues in the international economy;*
c) *Recognition of the rural milieu;*
d) *Promoting sustainable development;*
e) *Identifying current and future development of the sector where NARI's role would be integral;*
f) *Focusing on a renewed and competitive agricultural sector; and*
g) *Promotion and incorporation of new technologies.*

Consequently, the programmes/projects embarked upon had to satisfy any of the following criteria:

(i) *Demonstrate improved production practices;*
(ii) *Impact positively on food security and poverty alleviation;*
(iii) *Disseminate improved technology;*
(iv) *Cater for the rural milieu;*
(v) *Market demand driven and guided by responses from the private sector; and*
(vi) *Sustainability*

The Institute conducted activities based on the above. A summary is provided below

2.0. RESEARCH & DEVELOPMENT

Research and Development activities focused on crops, soils, plant genetic resources, pest management, postharvest technology, agroprocessing and livestock production.

A. CROPS

(a) Cow pea

(i) Varietal Evaluation

This cowpea trial consisted of 20 lines obtained from the International Institute for Tropical Agriculture (IITA). The trial was conducted at field #19, Mon Repos and the earliest maturing lines were IT00K – 1217 and IT98K – 1111-1, which matured in 59 days. The highest yielding line was IT 97K – 1069-6, which matured in 69 days.

(b) Plant Density and Cowpea Yield

One trial was completed to examine the influence of the density on the yield of ten cowpea lines. These cowpea lines were selected from a total of 20 that were evaluated in 2005. The trial was recently harvested but data analysis has not been completed. On completion of the analysis the most promising line will be tested on farms prior to release into production.

(ii) Soybean evaluation

Ten soyabean lines from IITA were evaluated at Kairuni. From visual observation some of the lines seem promising. The trial was harvested but yield data collection has not been completed.

(iii) Acclimatization of New Sweet Potato Varieties to White Sand Agro-ecologies of the Soesdyke –Linden Highway.

This sub-project was successfully concluded with the recommendation of four sweet potato varieties to be released into commercial production on white sands along the Soesyke-Linden Highway. Agronomic packages for Professor #1, Amjad Pumpkin Potato, Little and Scientist have been compiled and generation of planting material of these four varieties would commence during the third week of December, 2006.

(iv) Exploring various vegetative propagation techniques (budding, air layering, grafting) on several tropical fruit crops such as:

cashew, soursop, avocado, golden apple, sapodilla, and bread fruit.

Current Status:

Air layering

Sapodilla	–	*50%*
Hybrid soursop	–	*50%*
Dwarf Golden Apple	–	*80%*

Work on this project started in May 2006. Vegetative propagation such as air layering was performed on sapodilla, soursop, breadfruit and dwarf golden apple trees. The result was successful for soursop and dwarf golden apple. The severed air layered stems, of the dwarf golden apple plant, fruited one month they were potted, which is five months earlier than a seedling dwarf plant. No positive result was obtained from the bread fruit and sapodilla. These exercises are to be repeated.

Grafting of the cashew is expected to commence after a Brazilian training activity which is scheduled for the 4^{th}-9^{th} of February, 2007. Top working on cashew and avocado trees will begin at the Kairuni Horticultural Station after the rainy season and when suitable cashew scions can be allocated.

(v) Multi-location trials of carrot on farmer's fields

Multi-location trials were conducted at two hinterland-farming communities, St. Cuthbert's Mission and Long Creek during 2006. New Kuroda, a tropical carrot variety was introduced in the areas where the soil type is predominantly sandy. The crop was planted on raised

cambered beds on brown sandy soil and evaluated for its yield. Data collection is in progress.

(vi) Organic Pineapple Production

(a) Evaluation of different organic manures on the yield, pest spectrum and quality of organic pineapple (var. Sugarloaf)

In the tri-lake communities, pineapple is grown on white sandy soil containing little or no organic matter. The soil type comprises of coarse sands that dry out rapidly and are difficult to maintain for good productivity because of low fertility.

Recognizing that the emerging organic pineapple industry is important to the tri-lake farmers, the communities requested assistance in the development of a system of cultivation that would extend "life of the soil" beyond one cropping season and provide an increased income to the farming community.

A randomized complete block design trial was established on November 2, 2006 at Mainstay. There were six levels of organic manure and bio fertilizers.

The objective is to compare the performance of compost, cow and poultry manures, bio fertilizer (Bio Nature) and mixtures of bio nature and cow manure and bio nature and poultry manure in pineapple production in the tri lake communities. This trial is ongoing.

(b) Effects of intercropping pineapple (with short cycle crops) on pest infestation

The control of insect pests has been more successful where an integrated approach in the application of control strategies has been followed rather than a single method approach. An intercropping trial was set up at Mainstay during the month of

November, 2006 to demonstrate the concept of intercropping with pineapple. The use of trap crops around pineapple fields or even among the pineapple may be useful in attracting insect pests to them and thus leaving the intended crops intact. Sorrel and pigeon pea were planted in double rows around the fields.

Data collection has commenced on:

i. Level of pest and disease infestation on the main and trap crops; and
ii. Level of predators and parasitoids on the crop

(c) Evaluation of biopesticides and plant extracts for the control of pineapple pests in farmers' fields.

In certified organic pineapple production the key pest is the mealybug, Dysmicoccus brevipes. The mealybug attacks during the crop's entire life cycle, sucking the sap from the roots, foliage, and floral cavities. This pest is capable of transmitting the pineapple wilt virus. Organic producers currently use few preventive controls against mealybug and no organic curative controls. The research objective of this study was to determine the efficacy of various products for mealybug and ant control in field situations. It is currently on-going.

(vii) Edible Mushroom Cultivation

Cultivation of edible mushroom was incorporated into the work of the Post Harvest and Agroprocessing Department as a research project in support of the Government's Agricultural Diversification Programme to explore and analyse the developmental characteristics of new and untried non-traditional crop types in Guyana.

In 2005 a mushroom house was constructed to facilitate the activities and different steps in the cultivation process. The success of the project was

impeded by a high level of microbial contamination of the substrate material in the final stage of the cultivation process. During 2006 a strategy was implemented using a double sterilization process instead of the normal single application to counter or suppress the growth of the unwanted organisms. This strategy proved to be a success as 60 % of the bags holding the substrate material showed good and complete mycelial growth with no contamination at the end of three weeks in storage. These good results motivated the Department to supply and distribute a few bags to two private stakeholders to test and report on the success rate. About two weeks after distribution the reports from the two stakeholders were favourable with the production of very large and healthy fruiting bodies. The remaining bags in the Department's storage area also produced excellent quality fruiting bodies. Some of the bags are presently producing their second batch of mushroom.

(viii) Papaya:

Studies have been initiated to determine the influence of organic and inorganic fertilizers on the growth and yield of papaya (Red lady). The objectives were to compare the effects of the fertilizers on plant growth and yield and more specifically the shelf life of the harvested product. The plants started to fruit at the four month stage. Better growth parameters have been recorded with plants treated with inorganic fertilizers.

(ix) Jatropha (physic nut):

Jatropha (physic nut) is a crop which has been successfully cultivated for biodiesel production in a number of countries. Very little information is currently available in Guyana on the growth, fertilizer requirements, etc. of this species. Consequently, studies were initiated to determine the effect of fertilizers (inorganic and organic) on the growth and yield of Jatropha. Currently, plants treated with inorganic fertilizers have fruited (in about six months).

(x) Cauliflower:

An experiment was conducted to determine the optimum potassium requirement for cauliflower on a pegasse soil at Parika. Rates of potassium used were 0, 50, 100, 150, 200 and 250 kg/ha. Nitrogen was

applied as urea at 250 kg/ha. Heads are currently being harvested from this trial.

(xi) ***Edaphic climatic and geographic adaptability of Scotch Bonnet ('Bullnose') hot peppers***.

A Scotch Bonnet variety of hot peppers, referred to locally as the 'Bullnose' variety (believed to be a landrace) was identified for the export market. Seeds for propagation were obtained from an isolated location on the Soesdyke/Linden Highway.

Initial trials to determine production parameters were established at Mon Repos, Parika, West Coast Berbice, Black Bush Polder and Crabwood Creek. This project is being done in collaboration with NGMC and GTIS.

Results have shown that the plants commenced flowering within 35-40 days after transplanting. Harvesting can commence about 80 days after transplanting. A continuous harvest could then be made five weeks after. The average numbers of fruits/plants in the first three weeks of harvesting were 16, 21 and 7, respectively. The corresponding fruit weights were 12.5g, 14.1g and 11.8g respectively. This corresponds to approximately 15 fruits/plants with an average weight of 12.8g/fruit.

B. PLANT GENETIC RESOURCES (PGR)

(i) Establishment of Mango Germplasm Depositories at Ebini and St. Ignatius

Twenty seven mango accessions/varieties were established at St Ignatius and Ebini. The area of each nursery is approximately 3.5 acres. Additional mango accessions would be added to these depositories during the coming wet seasons. One cassava accession has been inter-cropped in the Ebini Nursery, and during the next wet seasons more would be added to both depositories.

(ii) ***Establishment of On-farm and Out-station Depositories of Targeted Crop Species***

Coconut*: In addition to mango, coconut has also been targeted for establishment at the Ebini and St. Ignatius out-stations. These nursery sites would be surveyed and laid-out during December-January, 2006-2007. These coconut depositories would initially accommodate approximately 120 accessions each.*

Hot Pepper*: Arrangements are underway to establish community field gene banks of hot pepper at St. Monica-Kariwab Village District in the Upper Pomeroon River and at Hauraruni along the Soesdyke-Linden Highway. About 45 accessions would be duplicated at these locations.*

(iii) ***PGR Collection of Targeted Landrace Varieties***

Collecting expeditions have been made to the Pomeroon River District, and the Moruca-Shell Beach Sub Region of Region 1. Additional collecting has been done in a section of West Berbice in Region 5. These expeditions which are continuing, have so far yielded 37 accessions of coconut from the Pomeroon-Moruca-Shell Beach Region; 32 accessions of hot pepper, 8 accessions of sweet potato, one accession of black potato, two accessions of cunami, and 16 accessions of cassava. Passport data of these accessions are currently being digitized in the PGR database.

C. POST HARVEST TECHNOLOGY AND AGROPROCESSING

(i) Pectin Production

This substance is a key ingredient in the manufacture of jams, jellies, marmalade and yogurt. It provides the end product with good qualitative features such as stability and texture. The Guyanese manufacturers of these products obtain pectin from neighbouring Brazil at an extremely high cost which is consequently reflected in the final cost of those products on the market. This substance is a normal derivative of fruit skins, fruit pulp and other fruit waste products.

The Department developed a research proposal and initiated work on the extraction of this substance from the skins, pulp and waste of locally grown fruit crops such as grapefruit, passion fruit, orange, golden apple, carambola and watermelon. The process of extraction was executed and the results indicate that the skins of golden apple, grapefruit, passion fruit and orange in descending order had good levels of pectin in the skins and pulp.

(ii) Dehydration of Hot Pepper

A trial was conducted on the dehydration of hot pepper varieties Wiri-wiri and Scotch Bonnet. Two methodologies were tested which included drying through mechanical means and indirect solar drying. Evaluation was done on colour retention, fresh weight to dry weight ratio, aroma retention and rate of moisture loss. The results are presently being analysed and processed.

(iii) Dehydration of Perishable Crop Produce

In an attempt to develop new and variable processed products for the benefit of the industry the Department was engaged in production and promotional work. A number of products were developed. These include candied papaw, candied pineapple, candied carambola, dehydrated jackfruit, dehydrated sweetpepper, dehydrated pumpkin seeds, banana chips, banana flour, banana raisins, yam chips, yam flour, sweet potato chips, sweet potato flour, pumpkin chips, pumpkin flour, celery powder, thyme powder, garlic powder, sorrel powder, papaw and grapefruit jam, banana and grapefruit jam, banana jam, papaw jam, papaw and lemon jam, papaw all purpose sauce, carambola all purpose sauce, pineapple all purpose sauce, ginger flavoured pepper sauce and fruit and nut snack mix.

D. SOIL AND WATER MANAGEMENT

(i) Characterising the Physical and Chemical Properties of the Soils in Administrative Regions 2 and 3 in Guyana.

The objective of the study is to produce information that could lead to improved soil productivity, in Regions 2 and 3, through the generation of data on physical and chemical properties of soils, the agricultural and land use potential of the area. The current status of this project are as follows:

Land Use Surveys

Region 3

A land use questionnaire was prepared in July 2006. It was tested and administered in several farming communities in Region 3. These communities included villages in the West Bank Demerara, West Coast Demerara, East Bank Essequibo, Kumuni-Potosi, Lanaballi, Bonasika, Aliki, Hogg Island, Morashi, Maripa and La Harmony. All data collected were entered into the computer to be used subsequently in a structured land use database. This activity will continue in Leguan and Wakenaam in 2007.

Soil Surveys

Soil fertility samples were collected at all locations where the land use questionnaire was administered. These soils were visually characterized to determine the zones of fluctuating water table and the acidic regions horizons of the soils. These data were used to assist PRCSSP field staff in preparing field workshops on farm layout in these communities. This activity will continue in Leguan and Wakenaam in 2007.

Region 2

In December, a meeting of NARI officials and Ministry of Agriculture Extension Officers of Region 2 was held in Charity. The extension officers were sensitized on the nature of their involvement in the NARI-PRCSSP Soil Characterization Project. The major discussion points were the logistics of locations within Region 2.

(ii) Revegetation of mined out areas

General Objective

This is to re-vegetate four hectares of ground subjacent to the spoil piles in North East Kara-Kara with appropriate tree or crop species of economic importance and pasture grass to support small ruminants, while simultaneously reducing runoff and erosion by promoting vegetative growth at the base of the spoil pile.

The current status of the project is as follows:

Silt Fences:

The silt fences established at this site have reached or are approaching their capacities. Maintenance of established fences is continuous. The process of establishing new silt fences has commenced.

Establishment of Plants:

The lime, Paulownia spp., Brachiara humidicola grass, Vetiver grass and Glyricidia spp are all established at the site. However there is need to plant Brachiara humidicola grass and vetiver in some gullies. Some plants were destroyed by eroded material overtopping the silt fences. The process of fertilizing and other crop husbandry practices and replanting of destroyed trees has recommenced.

Fat pork:

Several interviews were conducted with schools and community groups as part of the Participatory Rural Appraisal (PRA) for this project. These schools included the Mc Kenzie High School, Wismar Hill Primary School and the Wismar Christianburg Multilateral School. All have expressed an interest in participating in the creation of 'green areas' and using the fruit to create value added products.

The PRA also revealed the potential of the fat pork fruit to make a number of food products (wine, cake, ice-cream, nuts and pickles). These products

were made for exhibition purposes and won first prizes at Caribbean Science Fairs.

Site selection for 'green areas' for the planting of 'fat pork' on mined spoils in Linden are ongoing. The layout of a site at Kara-Kara (contiguous with the re-vegetation site) commenced in December 2006. Another site in the vicinity of the Wismar-Christianburg Multilateral School was selected and 100 'fat pork' seedlings planted.

Fencing

The fence at the Kara-Kara Revegetation Site was erected in November. This has retarded the invasion of cows and the destruction of plants. Even though dumping within the site has ceased, dumping of domestic and construction waste in the vicinity of the 'Site' continues to be an eyesore. The assistance of Linden Town Clerk was sought, and a promise made to write the known offenders.

(iii) Irrigated Vegetable and Fruit Production

This project is a component of the Regional FAO Project entitled "Promoting CARICOM/CARIFORUM Food Security", funded by the Government of Italy.

The objective of this project is to promote year round vegetable and food production for improved food security and income generation. The specific objectives are:

1. *Demonstration of the benefits of drip irrigation on crop production;*

2. *Upgrading water management and irrigation technologies on farmers' holdings;*

3. *Improving production and productivity of fruits and vegetables;*

4. *Transferring technology and building capacity in improved irrigation techniques among farmers;*

5. *Stabilization of supply of vegetables by increasing the number of crop cycles, and*

6. *Demonstration of technologies to improve the moisture holding capacity of the soil.*

Research/demonstration plots were established at Mon Repos and Naamryck. Drip irrigation was used in combination with mulch for the production of pepper. Initial results have indicated that drip irrigation in combination with plastic mulch look very promising.

E. LIVESTOCK

(i) A comparison of live weight and carcass gain of Pekin, Kunshan and Muscovy ducks on a commercial ration.

This study compared the production parameters of three breeds of duck, the Pekin, Kunshan and Muscovy on a commercial duck ration under local conditions. Fifty ducklings representing each breed (half males and half females) were used in a completely randomized design. All birds were fed the same starter and grower ration during this study. The ducklings were weighed individually and body weight recorded on a weekly basis.

Based on overall breed comparisons at eight weeks of age, the mean body weights for both sexes were Pekin (2.52 kg) > Kunshan (2.31 kg) > Muscovy (2.04 kg). The feed conversion ratios did not vary significantly between the Pekin and Kunshan, however, the Muscovy ducks were more efficient in converting feed to live weight gain. There were no major differences among breeds or between sexes within breeds in most carcass traits, the exception being body fat which was lowest in the Muscovy. The mortality for Muscovy ducks was zero with the Pekin and Kunshan breeds recording a similar mortality rate of 4%.

The highest profit margin was obtained from the Muscovy ducks.

(ii) ***Restricted feeding of Pekin ducks: A comparison of three levels of quantitative feed restriction and full feed on the growth, carcass and economic indices.***

This experiment was conducted to evaluate the performance of Pekin ducks on three levels of restricted feeding as against full feed. Feed utilization accounted for approximately 72% of the total cost of production for Pekin ducks reared intensively on commercial feed in Guyana.

Sixty F_2 Pekin ducklings of male sex were selected and used in conducting this experiment. Five ducklings were randomly selected and placed in a treatment unit with three units representing a treatment in a completely randomized designed study.

Ducklings were weighed individually and body weight recorded on a weekly basis. The mean of the birds' body weight was taken to represent each treatment unit throughout the duration of the experiment.

The data recorded during this investigation for each treatment unit were analyzed using the General Linear Models (GLM) procedures of SAS Institute (1985) with significance set at ($P<0.05$).

There were no significant differences between treatment I and 2 for mean live weight at 56 days old however, treatment 3 recorded significantly lower mean live weight at 56 days than T4, TI and T2 respectively ($P<0.05$).

There were no significant differences in feed conversion rates for birds under the four treatments ($P<0.05$).

In relation to carcass index, differences and similarities were observed among the four treatments.

Treatment 4 had the highest profit margin followed by treatment 1, 2 and 3 respectively.

(iii) The production parameters of the Barbados Belly and crossbred sheep in a controlled semi-intensive system.

A study was conducted at the Livestock Farm of the National Agricultural Research Institute, Mon Repos, East Coast Demerara, Guyana, between January 2000 and July 2003, to evaluate the production parameters of the Barbados Blackbelly and Crossbred sheep in a controlled semi-intensive production system. The data were obtained from a comprehensive record keeping system used during the study.

The animals were separated into two groups as according to breed. The dams were placed into groups based on their age 1-2 years, 2-3, 3-4, 4-5 and >5 years of age, to evaluate the birth weight of lambs born to dams within these age ranges. Young lambs were evaluated on their birth weight and weaning weight to yearlings. Other parameters evaluated were average daily gains, at the pre and post weaning stages of growth for the two breed types, birth types expressed as a percentage of total lambs born as well as pre and post weaned mortality.

There were no differences in live weight, (P<0.05), between the two breed types when comparisons were made separately for sex at the different intervals. These include birth weight, weaning weight at 90 days and weights at both 180 and 270 days. There were no differences in birth weights among sexes at the different age ranges. Female lambs, however, had lower birth weights in the 3-4 years and >5 years age ranges when compared to the 1-2 year, 2-3 and 4-5 year ranges. Based on the LSD test, no differences (P. < 0.05) could be detected between the two breed types for males in relation to the average daily gains of the animals at pre and post-weaning stages. The percent single births were significantly higher for the crossbred sheep when compared to the Barbados Blackbelly; this trend was, however, reversed when comparisons were made for twin births.

F ***PRODUCTION:***

The following were produced for sale to the farming community:

1. *Ducklings*
2. *Breeding rams*
3. *Plants - 95,000 (up to October, 2006)*
4. *Ant Bait - 7,906 packets*
5. *Seed of selected crops:*

Peanut	-	*636kg*
Red Peas	-	*5100 kg*
Bora	-	*14 kg*
Boulanger	-	*6 kg*
Black eye	-	*21 kg*
Sorrel	-	*2kg*
Sorghum	-	*2kg*
Corn	-	*13 kg*
Pepper	-	*1.6 kg*

G. TECHNOLOGY TRANSFER

Technology transfer was done through on-farm demonstrations, training and production of information products.

On-farm demonstrations were conducted to show the importance of liming for enhanced vegetable production in the Parika area. Another demonstration was done to compare the costs of production for two production systems. This involved the practice of farmers applying limestone and fertilizers on the surface as against incorporation in the soil. Using the Farmers Field School (FFS) approach, it was demonstrated that the better practice was soil incorporation instead of surface application.

A number of training activities were conducted. These included:

1. *Training of livestock farmers in Rupununi and Jawalla.*

2. *Several training activities were conducted using the mobile agro-processing facility. This was intended as a training exercise to acquaint stakeholders on the operation of the various equipment and the range of*

products that can be produced using this facility. The areas visited, included Crabwood Creek, Benab, Bush Lot, Bengal, Lesbeholden, Yakasari, Mara and Adventure. A number of products produced by the Institute were on display in the unit. Samples of some of the products were distributed to the trainees during the exercise. In addition, a number of leaflets, handouts and brochures, produced by NARI, on production and processing technologies and technical information were distributed to the participants.

3. *A number of training activities undertaken by NARI and PRCSSP in a collaborative approach were conducted in Regions 2 and 3. The areas included Hog Island, Essequibo Coast, Charity, Lanaballi, Berisaballi and Parika. Presentations were made on post harvest management principles, agroprocessing technology, management of pests and diseases and soil management. These training activities were intended to acquaint participants on the use of appropriate technology and appropriate skills for the improvement of quality produce in the farming communities.*

4. *Training of farmers at Bath, W.C.B. on managing tomato diseases.*

5. *Training of farmers at Morukabai on crop husbandry and pest management practices for pumpkin, pineapple, plantain and pepper.*

6. *Visit to Kato, Region 8 and surrounding communities to train farmers on the management of whiteflies.*

7. *Seminar at Orealla on crop husbandry and pest management practices for pumpkin, cashew, pineapple and beans.*

8. *Information products were disseminated through both the print and electronic media. The focus was on improved production practices for crops and livestock.*

H. HUMAN RESOURCES:

Twenty two persons were recruited and eleven left NARI during 2006 bringing the total number of persons on staff to 479.

Staff members benefited from training both locally and overseas.

DEPARTMENTAL REPORTS, 2006

I. OFFICE OF THE DIRECTOR

1.	Dr. O. Homenauth	-	Director
2.	Ms. M. Pooran	-	Confidential Secretary
3.	Dr. L. Munroe	-	Head of Unit
4.	Mr. R. Adrian	-	Research Assistant
5.	Ms. S. Pooran	-	Research Assistant
6.	Ms M. Lutchman	-	Research Assistant*
7.	Ms. M. Sookdeo	-	Research Assistant
8.	Ms. L. Badal	-	Communication Officer
9.	Mr. R. Chan	-	Communication Specialist
10.	Ms. N. Hutson	-	Information Technology Technician
11.	Ms. N. Henry	-	Senior Library Assistant
12.	Mr. K. Singh	-	Research Technician, Black Bush Polder
13.	Mr. J. Gonsalves	-	Farm Manager, St. Ignatius
14.	Mr. F. Benjamin	-	Senior Research Technician, Ebini

The Office of the Director had responsibility for the following:

1. Horticulture
2. Organic agriculture
3. Communications
4. Intermediate Savannahs
5. Irrigated Vegetable production
6. Jatropha cultivation

* Resigned 2006-10-19

7. Training

A. HORTICULTURE

(i) Evaluating the efficacy of four chemical treatments on citrus leaf miner.

The data recorded using the four treatments indicated different levels of success. Initially all the plants showed an average leaf miner damage of 51.6%. This was however, reduced after the first chemical application. The table below shows average percentage of new leaf damage in treatments.

	PERCENTAGE OF DAMAGE LEAVES			
APPLICATION	RELEVO	CAPRID	NEEMAZAL	CONTROL
0	54.6	52.0	54.3	45.4
1	29.1	35.3	32.1	40.2
2	22.3	15.2	37.6	43.7
3	15.9	10.0	37.6	45.0
4	10.0	8.5	37.6	70.6

Statistically, Caprid had the least mean damage to new leaves, followed by Relvo, Neemazal, and the control. Neemazal showed a decrease of leaf damage (32.1%) after the first application. This however was followed by an increase of 5.5% which stabilized over the next two applications. The Caprid-active ingredient Acetamiprid and Relevo-active ingredient Imidacloprid are both systemic and contact insecticides that are used in the eradication of chewing, sucking and piercing insects. The Imidacloprid acts as a stomach poison for insects, whereas Acetamiprid has ovicidal activity, and since the eggs are also eradicated, the leaf damage will therefore be minimal. Neemazal on the other hand is a biological repellant and an insect growth regulator. This explains the results, since the active ingredient for Neemazal is Azadirachitin and it does not eradicate the pest on contact but disrupts its life cycle. In this instance the chemical seemed to have had some effect. Since the active ingredient is a growth regulator and not a systemic poison, the on-going rains might have influenced the results. Evidence gathered from the data indicated that the three chemical treatments were able to control citrus leaf miner. The most effective being Caprid, followed by Relevo, and Neemazal.

(ii) Exploring various vegetative propagation techniques (budding, air layering, grafting) on several tropical fruit crops such as: cashew, soursop, avocado, golden apple, sapodilla, and bread fruit.

Current Status:

Air layering

Sapodilla	–	50%
Hybrid soursop	–	50%
Dwarf Golden Apple	–	80%

Work on this project started in May 2006. Vegetative propagation such as air layering was performed on sapodilla, soursop, breadfruit and dwarf golden apple trees. The result was successful for soursop and dwarf golden apple. The severed air layered stems of the dwarf golden apple plant, fruited one month after it was potted, which is five months earlier than a seedling dwarf plant. No positive result was gathered from the bread fruit and sapodilla. These exercises are to be repeated.

(iii) Plant Production

Table 1: Plant Production at NARI's Nurseries January – December, 2006

Nursery	Plant Type	Quantity	Total Production
Mon Repos	Citrus	5,608	
	Avocado	6,379	
	Mango	3,312	
	Other	20,063	
			35,362
Timehri	Citrus	2,128	
	Avocado	348	
	Mango	0	
	Other	5,916	
			8,392
Pouderoyen	Citrus	11,489	
	Avocado	3,601	
	Mango	4,055	
	Other	18,164	
			37,309
Charity	Citrus	14,228	
	Avocado	2,227	
	Mango	1,304	
	Others	6,000	**23,759**
Benab	Citrus	5,018	
	Other	711	
			5,729
Hosororo	Citrus	0	
	Cocoa	3,470	
	Other	103	
			3,573
St Ignatius	Citrus	888	
	Other	544	
			1,432
Bartica	Citrus	82	
	Other	111	**193**
TOTAL			**115,749**

B. ORGANIC AGRICULTURE:

(a) Effect of different organic manures on the yield, pest spectrum and quality of organic pineapple (var. Sugarloaf)

In the tri-lake communities in Essequibo pineapple is grown on white sandy soil containing little or no organic matter. The soil type comprises of coarse, sandy soils that dry out rapidly and are difficult to maintain for good productivity due to low levels of fertility.

Recognizing that the emerging organic pineapple industry is important to the tri-lake farmers, the communities requested assistance in the development of a system of cultivation that would extend "life of the soil" beyond one cropping season and provide an increased income to the farming community.

A randomized complete block design trial comprising of six levels of organic manure and bio fertilizers was established on November 2nd, 2006 at Mainstay.

The objective is to compare the performance of compost, cow and poultry manures, bio fertilizers (Bio Nature) and mixtures of bio nature and cow manure and bio nature and poultry manure in pineapple production in the tri lake communities. This trial is ongoing.

(b) Effects of intercropping pineapple (with short cycle crops) on pest infestation

The control of insect pests has been most successful where a more integrated approach in the application of control strategies has been followed rather than a single method approach. An intercropping trial was set up at Mainstay during the month of November, 2006 to demonstrate the concept of intercropping with pineapple. The use of trap crops around pine fields or even among the pines may

be useful in attracting insect pests to them and thus leaving the intended crops intact. Sorrel and pigeon pea were planted in double rows around the fields.

Data collection has commenced on:

i. Level of pest and disease infestation on the main and trap crops; and
ii. Level of predators and parasitoids on the crop

(c) Evaluation of biopesticides and plant extracts for the control of pineapple pests in farmers' fields.

In certified organic pineapple production the key pest is the mealybug, *Dysmicoccus brevipes.* The mealybug attacks during the crop's entire life cycle, sucking the sap from the roots, foliage, and floral cavities. This pest is capable of transmitting the pineapple wilt virus. Organic producers currently use few preventive controls against mealybug and no organic curative controls. The research objective of this study was to determine the efficacy of various products for mealybug and ant control in field situations. It is currently on-going.

C. COMMUNICATIONS

Information was provided to the public through videos, newspaper articles, school tours, booklets and exhibitions.

The following articles appeared in the Sunday Chronicle Newspaper:-

Guide to hot pepper cultivation, Administering drugs to your animal, Recovering after the flood, Celery disease, Ovine foot rot, Pink eye in sheep, Bacterial fruit blotch in watermelon, Acoushi ant bait production, Post harvest management and solar drying, Plantain cultivation, Tomato pruning, Liming of soil, Restrictive feeding for improved growth of ducks, Types of pastures found in Guyana, Southern blight in tomato, Requirements of a good pasture species, Growing hot

pepper in Parika, Growing cauliflower, Improving the small cottage industry on Essequibo Coast.

Agri Digest was aired on NCN television. Programmes included growing pepper, marcotting, seedling production, improved varieties of tomato and artificial insemination.

Five hundred and five students from ten schools visited NARI in 2006. The main areas of interest were budding and grafting, tissue culture, pest and disease management, livestock production and agro-processing.

D. INTERMEDIATE SAVANNAHS

Orchard Crops:

The orchard crops area was cleaned, the plants pruned and fertilized during the reporting period. In addition to maintaining the fruit orchard, fruits were harvested] and sold to the communities along the Berbice River. Surplus fruit mainly of the citrus varieties were also harvested and sent to Mon Repos for sale. Dried sorrel was also produced by this programme and sold at Mon Repos. Revenue from the sale of these products was approximately $20,000.00

The following is a listing of the plant types in the orchards and the work done.

Plant Type	Area	Location	Work Done
Rough lemon	8700 m^2	Crop Station	Maintenance
Guava	1800 m^2	Crop Station	Maintenance
Pineapple	11130 m^2	Crop Station	Maintenance
Passion fruit	7788 m^2	Crop Station	Maintenance
Cashew	5000 m^2	Crop Station	Maintenance
Dwarf Golden Apple		Vegetable Garden	Maintenance
Mango (Old)	3 ha	Crop Station	Maintenance (Scion material was collected from these plants for the PGR germplasm collections)
Oil Palm	3 ha	Crop Station	None
West Indian cherry		Crop Station	Maintenance

Sweet cherry		Crop Station	Maintenance
Orange	0.25 ha	Citrus orchard	Maintenance
Grapefruit	0.25 ha	Citrus orchard	Maintenance

The orchard nursery area was enlarged as part of the work programme of the Plant Genetic Resource Programme (PGR); this programme is funded by the USAID. As a consequence of the PGR work programme, an area of approximately 3 ha was fenced with chain link mesh, to establish a new mango, cashew and coconut collection. Root stock and scion material for 31 varieties of mango were collected and taken to Ebini and grafted in January 2006. Twenty five varieties of five mango plants each were subsequently planted at the new orchard crop germplasm collection site.

The following are the mango varieties in the collection.

Variety	**Source**	**Variety**	**Source**
MR-15	Mon Repos	MR-17	Mon Repos
Hayden Fl	Ebini	SE1520222	Ebini
MR-6	Mon Repos	MR-10	Mon Repos
Graham	Ebini	MR-11	Mon Repos
Vangra	Ebini	MR-14	Mon Repos
MR-2	Mon Repos	MR-9	Mon Repos
Colonial Bank	Ebini	MR-7	Mon Repos
Kent	Ebini	Langra	Ebini
Vandyke	Ebini	Tommy Atkins	Ebini
Dor	Ebini	Bombay	Ebini
Dor Dia	Ebini	MR-3	Mon Repos
Zil	Ebini	MR-12	Mon Repos
MR-5	Mon Repos		

The orchard crop programme also planted cashew seeds (*Var*. CP 1001) which were obtained from the Sunshine Farm, Tacama Savannahs, a farm that is owned by Mr. Gobin Dwarka. The seeds were planted in nursery bags prior to being planted in the new orchard crop germplasm area.

Plants and seeds from approximately 100 varieties of coconut were collected from the Kimbia location, an area formerly occupied by the Guyana National Service. In addition, a number of seeds and plants of different varieties which were collected in the Pomeroon area, were taken to the Ebini location to be planted in the germplasm collection. The

coconut germplasm area is situated in the Kasarama Savannahs of the Ebini Unit in an area that was formerly used as the no-till site.

Seed and grain production

The seed and grain production programme is perhaps the main activity of the Ebini Unit; this programme produces seed for the farming communities of the Berbice River and beyond. The seed produced include cowpea, for example Minica 4 (red pea) and black-eye pea, corn, sorghum, peanut, sorrel, citrus (rough lemon) as well as forage seed. The excess seed is sold as grain.

This activity has always been hindered by the lack of inputs; the untimely supply of inputs, the lack of fertilizer, fuel, chemicals and the unavailability of machinery to effect land preparation. In-spite of the numerous problems the following was achieved by this programme during the reporting year (Table 2).

Table 2: Seed and Grain Production at the Ebini Unit, 2006

Crop type	Location sent	Quantity Harvested	Quantities sent to Mon Repos	Revenue from sale
Peanut	Berbice River, M of A, and Mon Repos	1400 lbs	1054 lb	$167,500
Red pea	Berbice River, Essequibo (M of A), Rupununi, Mon Repos	11, 000 lbs	10,000 lb	$1,000,000
Sorrel seeds	Mon Repos		2 kg	
Leucaena seeds (Forage seed)	Kibilibiri and Essequibo (Three lakes community)		6 kg	
Corn	Mon Repos, Berbice River		3 kg	
Rough lemon	Mon Repos			

The revenue accrued from the sale of seed and grain in 2006 was in excess of G$1M. This was a commendable effort when the state of the tractors and implements and the difficulty involved in servicing this remote location are taken into consideration.

Other crop types:

A number of other crops were also maintained at the Ebini location in germplasm collections during the reporting year. The crops planted in the collection included mung bean, sorghum, maize, cowpea, pigeon pea and peanut. In addition the unit also received 16 sweet potato accessions as part of the PGR programme. These were planted at a new germplasm site.

Table 3 shows the crops planted in the germplasm collection in the 2006 planting season.

Table 3: Maintenance of other crop germplasm material, Ebini 2006

Crop type	Number of accessions	Variety
Sweet potato	16	
Maize	1	M-92-B-2
Pigeon pea	2	
Mung bean	3	
Peanut	2	Jumbo, Basanti and AK-62
Cowpea	6	Black eye, CP-91-A6, CP-91-X1, CP-91-B11, CP-95-A4, Iron and Clay (forage seed)

Livestock programme

The small ruminant programme particularly the sheep programme continued to use the multiple sire breeding system instituted a year ago. In addition, the animals were allowed to graze extensively, rather than being restricted to grazing the enclosed pastures.

In an effort to wean lambs earlier, the programme instituted the concept of creep feeding the lambs, as well as bottle feeding those lambs whose mothers do not have enough milk to provide for their lambs. The feeding regime consists of ground peas and peanut shells mixed with either a commercial beef or dairy ration. The programme has also reinstituted the monthly weighing programme and has reorganized the record keeping system.

The records revealed that 102 lambs were born during the reporting year; the lamb mortality was 12 percent. The average daily gains for the pre-weaned lambs were 81.49 g/day and the post- weaned lambs 59.1g/day. In an effort to increase the post weaning weights of the lambs a research project was conceptualized. The project is as follows.

Number of Paddocks:	4
Paddock Size:	(3) 3094 M^2 & 3808 M^2
Forage Species:	*Brachiaria humidicola*
Fertilizer Rate:	N 100kg/ha, P 50 kg/ha and K 50 kg/ha.
Animal Units:	1.2 AU/HA
Animal Weight Per Paddock:	148.5 KG and 182.7 KG
Experimental Design:	Latin square, cross over design
Experimental Arrangement:	Fixed stocking rate, where the number of animals/area will be fixed for a period of 28 days. Generally in a fixed stocking rate study the pasture may be undergrazed or overgrazed at some point of the growing season. The stocking rate of 1.2 Au/ha is being used because this was recommended as the optimum stocking rate for *B. humidicola* in the Intermediate Savannahs.
Pasture Treatment:	1. Fertilized pasture only at recommended rate and beef ration at 150g/day.

	2. Unfertilized pasture and beef ration at 300g /animal /day 3.Unfertilized pasture and beef ration at 150g/ animal/day. 4. Unfertilized pasture and no supplement
Duration of Study:	84 days

MEASUREMENTS

1. **Average daily gains:-** animals will be weighed at beginning of every trial period and at the end of the trial period.

2. **Pasture yields:-** dry matter on offer will be measured using a $0.25M^2$ quadrant. Two cuts would be taken from the pasture at the beginning of the study period, day 14 and at the end of the trial period. Forage samples will be oven dried to ascertain dry matter yield. One of the samples will be air dried and used to ascertain the nutrient status of the pasture.

3. **Pasture nutrient status**:- samples will be saved and analyzed for protein concentration etc

4. Cost/gain

5. Cross-over, weight and harvest dates

The sheep programme also supplied 43 rams to the Mon Repos Unit for sale to farmers, 32 of the rams supplied were sold to farmers in Region 6. The revenue collected from this sale was approximately $300,000.00. The flock count showed the following.

Animal Class	Opening Stock	Closing Stock
Breeding males	02	03
Breeding females	102	86
Weaned males	30	11
Weaned females	25	20
Male lambs	-	35
Female lambs	-	21
Total	**159**	**161**

The rehabilitation of the goat unit continued during the reporting year, all of the young males were castrated to prevent further inbreeding of the animals of this unit. The goat

unit did not have a breeding buck and the unit had to borrow a breeding buck from Mr. Kevin Gonsalves. The unit was able to acquire a Boer breeding male courtesy of Mr. Mahandra Persaud, who has a goat breeding and production unit in the Intermediate Savannahs. The Institute is extremely grateful to both Mr. Gonsalves and Mr. Persaud for their fine gesture of assistance.

The goat programme also had some level of success during the reporting year. This programme is in dire need of a breeding buck. The flock count reflects the following.

Animal Class	**Opening Stock**	**Closing Stock**
Breeding males	-	-
Breeding females	23	20
Weaned males	5	5
Weaned females	-	8
Male kids	3	1
Female kids	3	1
Total	**32**	**35**

The beef cattle, which were **rescued/acquired** by the livestock programme from the Livestock Development Company, continued to do well and the flock has increased. A holding pen and a corral have been constructed to better handle the animals. The calves have been ear tagged and all male calves have been castrated. The animals were also tested for both brucellosis and tuberculosis during the year and all animals were found negative for both diseases.

E. IRRIGATED VEGETABLE PRODUCTION

This project is a component of the Regional FAO Project entitled "Promoting CARICOM/ CARIFORUM Food Security", funded by the Government of Italy.

The objective of this project is to promote year round vegetable and food production for improved food security and income generation. The specific objectives are:

7. Demonstration of the benefits of drip irrigation on crop production;

8. Upgrading water management and irrigation technologies on farmers holdings;
9. Improving production and productivity of fruits and vegetables;
10. Transferring technology and building capacity in improved irrigation techniques among farmers;
11. Stabilization of supply of vegetables by increasing the number of crop cycles, and
12. Demonstrate of technologies to improve the moisture holding capacity of the soil.

Research/demonstration plots were established at Mon Repos and Naamryck. Drip irrigation was used in combination with mulch for the production of pepper. Initial results have indicated that drip irrigation in combination with plastic mulch look very promising.

F. JATROPHA CULITVATION

Jatropha (physic nut) is crop which has been successfully cultivated for biodiesel production in a number of countries. Very little information is currently available in Guyana on the growth, fertilizer requirements, etc. of this species. Consequently, studies were initiated to determine effect of fertilizers (inorganic and organic) on the growth and yields of Jatropha. Currently, plants treated with inorganic fertilizers have fruited (in about six months).

G. TRAINING

In collaboration with the Guyana Rice Development Board (GRDB) training was initiated in Region 3 using the Farmer Field School (FFS) approach for technology transfer. The following is a summary of the activities undertaken.

(i) The Effect of fertiliser rate and application method on the yield and growth of cabbage

Cabbage is a vegetable that is rich in minerals and vitamins and is widely grown in Guyana with Tropicana and Salvation being the most common varieties planted. This trial was conducted to determine the effects of different rates and methods of fertiliser application on cabbage growth and yield. Fertilizer rates recommended by NARI were split applications of Urea at 220 kg/ha; TSP at 90

kg/ha and MoP at 140 kg/ha incorporated into the soil. The farmer used two application of 15g of 15:15:15 per/plant placed on the surface of the soil and sprayed two application of Miracle Gro, a commercial foliar fertiliser. Average yield of the varieties for all treatments were not significantly different with Tropicana having an average yield of 0.74 kg and Salvation 0.66 kg. Salvation however, had greater budworm damage compared to Tropicana and the farmers plot was also heavily infested with budworm damage compared to NARI's plot. This may be due to the high rate of nitrogen fertiliser applied by the farmer. It is recommended that both varieties be planted in the Parika area using the NARI fertilizer recommendation as was demonstrated in this experiment.

(ii) Bora varietal evaluation

Bora is a popular crop that is grown throughout the farming communities of Guyana especially in the Parika Backdam and Ruby areas. Unknown varieties are cultivated from seeds saved from previous cropping seasons by farmers. Four varieties namely: Long Leader, NARI's Yard Long, Yard Long Bean and the farmer's variety were evaluated for their yield potential in a randomized complete block design (RCBD) with two replicates. Fertiliser was applied twice with the first application at 10-14 days after planting and the second application at flowering. The rates used at 10-14 days after planting were: Urea- 25 kg/ha; Triple Super Phosphate - 100 kg/ha; Muriate of Potash - 100 kg/ha and at flowering: Urea - 25 kg/ha; Muriate of Potash - 50 kg/ha. Yields obtained from the trial showed that the high yielding varieties were Long Leader, Yard Long Bean and the Farmer's variety. There was a 70% difference in fresh pod production between the varieties Yard Long and Long Leader. The yields of the other varieties were not significantly different. Based on agronomic characters, morphological traits, cooking qualities and marketability, the variety Yard Long Bean was recommended as the most suitable variety for production in Parika.

A number of other training sessions were conducted. These included:

1. Training of livestock farmers in the Rupununi and Jawalla, Region 8.

2. A number of training activities undertaken by NARI and PRCSSP in a collaborative approach were conducted in Regions 2 and 3. The areas included Hog Island, Essequibo Coast, Charity, Lanaballi, Berisabalti and Parika. Presentations were made on Post Harvest management principles, agroprocessing technology, management of pests and disease and soil management to the participants. These training activities were intended to acquaint participants on the use of proper technology and appropriate technology and appropriate skills for the improvement of quality produce in the farming communities.

3. Training of farmers at Bath, W.C.B. on managing tomato diseases.

4. Training of farmers at Morukabai on crop husbandry and pest management practices for pumpkin, pineapple plantain and pepper.

5. Visit to Kato, Region 8 and surrounding communities to train farmers on the management of whiteflies.

6. Seminar at Orealla on crop husbandry and pest management practices for pumpkin, cashews, pineapple and beans.

II. SOIL AND WATER MANAGEMENT DEPARTMENT

STAFF:	Mr. D. B. Fredericks	-	Head of Department
	Ms. G. Easton	-	Senior Research Technician
	Mr. S. Hollingsworth	-	Research Technician II
	Ms. M. Goopcharran	-	Research Technician II
	Ms. M. Joseph	-	Research Technician I
	Mr. Y. Dhanpaul	-	Research Technician I
	Mr. D. Benjamin	-	Research Technician I
	Mr. C. Nunes	-	Research Technician I
	Ms. S. Singh	-	Laboratory Attendant

GENERAL

This Department has experienced a number of personnel and structural changes during 2006. The former Head of Department – Mr. M. A. Livan retired in September after more than 20 years service to NARI. The Department thanked him for his invaluable contribution and stewardship and wished him all the best in his future endeavours.

Structurally, the Soil Chemistry Division joined the Soil and Land Use Surveys Division as part of the Soil and Water Management Department in September 2006. Unfortunately Mrs. M. Lutchman, Research Assistant in the Soil Chemistry Division resigned in October 2006. The loss of two senior personnel and the magnitude of the service required from the Department continue to challenge the human resource base of the Department.

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

Sub- Project: **Sub-Project: Characterising the physical and chemical properties of the soils in Administrative Regions 2 and 3 in Guyana.**

Introduction:

The National Agricultural Research Institute (NARI) has entered into an agreement with PRCSSP-IFAD to characterize the physical and chemical properties of the soils in Administrative Regions 2 and 3 of Guyana. This agreement will be executed in accordance with the recommendations of the NDS for research and development to be concentrated in geographically delineated zones. This project will cost US$59136.00 and should be executed within two years. NARI will contribute personnel and indirect costs to the success of this project.

Fieldwork for the project began in July 2006 in Region 3 with soil fertility sampling and questionnaire testing for participatory rural appraisal. Questionnaires were finalized and administered by staff of NARI. Liaisons were developed with extension staff of the Ministry of Agriculture who participated in the field visits.

Justification

There is a concern for the appropriate and sustained use of land resources in Guyana. Land use conflicts resulting from multiple land use threaten to reduce the availability of land for agriculture. To optimize the use of land resources, mechanisms to reduce degradation and loss of productivity must be implemented. This project will offer approaches to optimize and preserve the physical and chemical properties of the soils.

It is also recognized that knowledge on the characteristics of soils is a prerequisite to planning and developing efforts in agriculture. This project, therefore, will generate data

to fill the information gap presently existing in our knowledge of the chemical and physical properties of our soils.

Benefits

This project will provide to farmers means of optimizing 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 optimized to produce better quality commodities increasing the demand and optimizing the market prices.

3. with the increase of production and quality of produce the export potential of the commodities will be realized leading to enhanced earning power of farmers and investors in non-traditional crop exports.

Objective:

To produce information that could lead to improved soil productivity in Regions 2 and 3 through the generation of data on physical and chemical properties of soils and the agricultural and land use potential of the area.

Specific objectives:

i. To evaluate the suitability of the various potential farming areas for crop production.
ii. To create a digital database of the soils and land use in the regions.
iii. To provide physical and chemical data on the soils in the regions.
iv. To facilitate easy access to soil and land use information.

Outputs:

a. Reliable and easy access to soil and land use data with coordinate specific information.

b. Efficient storage of data with diminished threat through loss by fire or theft as presented by paper storage.

c. The ability to easily upgrade and update databases.

d. An agricultural land use map of Regions 2 and 3.

e. An agricultural land use vulnerability map of Regions 2 and 3.

f. A map of proposed agricultural land use zones in Regions 2 and 3.

g. Soil maps of Regions 2 and 3.

h. Information on the physical, chemical and morphological properties of the soils in Regions 2 and 3.

The Strategy

The project team will consist of researchers from NARI, the lead agency for this activity in collaboration with the Ministry of Fisheries Crops and Livestock.

Activity I: Digitising of maps in soil and land use.

i. To create digital database on soils and land use for Regions 2 and 3.

ii. The use of Global Positioning System (GPS) to adequately geo-reference points on maps during field surveys.

iii. The use of Arc Info/Arc View software to create database on soil and land use maps.

Activity II: Computerizing existing soil and land use survey reports of Regions 2 and 3.

In the first instance, soil and land use reports will be inventoried and inputted into a computer. Reports will be stored in Microsoft Word and maps in a Geographic Information System (GIS) software (Arc Info/Arc View). Digital copies of reports will be checked for accuracy before being published. Maps will be upgraded through fieldwork using a GPS to add geographic coordinates. These maps will then be digitized to form part of the GIS database.

Activity III: The Assessment of agricultural land use potential of Regions 2 and 3.

Agricultural land use areas will be documented for Regions 2 and 3 of Guyana. These areas will then be mapped using GPS technology during fieldwork for input into a digital database. At each location, data will be collected on the ecological, social and economic aspects of the land use to obtain an adequate description and classification of the agricultural land use system. The methodological approaches to be adapted will be:

1: The participatory rural appraisal approach to elaborate the agricultural land use systems

2: The use of soil surveys methodologies to identify and describe the different "kinds of soils" in the regions.

The areas will then be assessed for vulnerabilities, conflicts and opportunities within the land use and recommendations made for agricultural land uses in these areas.

Activity IV: Characterising the physical and chemical properties of the soils of Regions 2 and 3.

At suitable sites, soil pits will be dug to a depth of 120 cm. From each horizon of the pit samples will taken to the laboratory for physical and chemical analyses.

The physical analyses will include: bulk density, moisture retention, plasticity, texture, porosity, shrinkage data, saturated hydraulic conductivity. *In situ* hydraulic conductivity and infiltration rates will be determined in the field as close as possible to the soil pits.

Chemical analyses will include: soil pH, total exchangeable bases, exchangeable acidity and cation exchange capacity of the soil.

Project Status:

i. **Financing**

Funding for this project was provided in February 2006. Several pieces of equipment were purchased to facilitate these projects' objectives. These pieces of equipment include: two computers (with electrical protection accessories), one plotter and one printer. Equipment to support work in the Soil Chemistry Division is presently being sourced.

ii. Land Use Surveys

Region 3

A land use questionnaire was prepared in July 2006. It was tested and administered in several farming communities in Region 3. These communities included villages in the West Bank Demerara, West Coast Demerara, East Bank Essequibo, Kumuni-Potosi, Lanaballi, Bonasika, Aliki, Hog Island, Morashi, Maripa and La Harmony. All data collected were entered to the computer to be used subsequently in a structured land use database. This activity will continue in Leguan and Wakenaam in 2007.

iii. Soil Surveys

Soil fertility samples were collected at all locations where the land use questionnaire was administered. These soils were visually characterized to determine the zones of fluctuating water table and the acidic regions horizons of soils. These data were used to assist PRCSSP field staff in preparing field workshops on farm layout in these communities. All samples collected were transferred to the Soil Chemistry Division of NARI for chemical analysis. This activity will continue in Leguan and Wakenaam in 2007.

Region 2

In December, a meeting of NARI officials and Ministry of Agriculture Extension Officers of Region 2 was held at Charity. The extension officers were sensitized on the nature of their involvement in the NARI-PRCSSP Soil Characterization Project. The major discussion points were the logistics of locations within Region 2.

iv. Training

Eight technicians (NARI - 4, PRCSSP – 2, Ministry of Agriculture – 2) were trained in administering questionnaire, methods of soil fertility sample collection and identifying soil characteristics important for farm layout. These were all practical field sessions. During this period, the Guyana School of Agriculture Corporation Diploma Students benefited from two 2-hour lectures on soil surveys through an initiative of the Ministry of

Agriculture. The Ministry of Agriculture and PRCSSP field staff in Leguan and Wakenaam will benefit similarly when activities commence at these locations.

v. Future Work

Soil morphological works, which includes 'digging soil pits' and 'collection of soil samples for chemical and physical analyses', will form part of 2007 activities.

Project 2: Revegetation of mined out areas in North East Kara – Kara and its environs

Introduction

Bauxite mining activities in the Linden area have resulted in landscapes characterized by mine spoils. Three such areas are readily accessible at East Montgomery, Dorabece and Kara Kara. The Memorandum of Understanding between GGMC and NARI signed in March 2003 recognized that:

1. Abandoned bauxite mining lands (mine spoils) were a challenge to revegetate.
2. Mine spoils remain outside economic use by nearby communities.
3. Mine spoils have a negative environmental effect on surrounding communities.
4. GGMC has a responsibility for remedial studies to reduce negative impacts of mining.
5. There is need for projects to determine ways of beneficial reclamation of mine spoils.
6. NARI's competence, technical experience, and willingness to conduct such works.

From April 2003 to present NARI and GGMC have successfully collaborated on remedial studies at the Kara Kara site. In October 2004 a decision was taken to plant fat pork and cashew at the Kara Kara re-vegetation site. Some cashew nuts were planted and

established at selected locations but fat pork was deemed incompatible with the established grasses at the site.

In March 2005 the decision was taken to plant 3000 fat pork trees in 'other' barren areas of Linden. Linkages with schools and environmental groups around Linden were to be established to facilitate planting of fat pork, as weekend exercises, with an environmental focus.

General Objective

This is to re-vegetate mine spoil piles in North East Kara-Kara and other areas with appropriate tree or crop species of economic importance and pasture grass to support small ruminants, while simultaneously reducing runoff and erosion by promoting vegetative growth at the base of the spoil pile.

Specific objectives

i. To improve the soil quality (pH, structure and nutrient content) by addition of ameliorants and manipulation of soil characteristics to produce an improved medium for growth. This will include addition of organic matter to improve soil structure through establishment of *Glyricidia spp* and *Brachiara humidicola* grass as ground cover. The *Glyricidia spp*, which will be used as mulch, will also enhance the soil's nitrogen content.

ii. To control runoff and erosion from the spoil piles and encourage infiltration on the slopes by: establishing lines of *Vetiver* grass along the contours, contour harrowing, and establishing ground cover over the entire project area by planting *Brachiara humidicola* grass.

iii. Out of *Brachiara humidicola* grass ground cover, to initially establish 1.3 ha of pasture for grazing by small ruminants. As the limes and *Paulownia* grow to a certain height, it will be possible to graze small ruminants over the entire area.

iv. To establish 1.3 ha of *Paulownia spp* this is rapid growing forest specie that can be used for plywood manufacture.

v. To establish 1.3 ha of limes as an economic crop.
vi. To establish fat pork (*Chrysobalanus icao*) over part of the project area, and
vii. To establish cashew over part of the project area.
viii. To establish fat pork as an environmental and economic crop in Linden.

Description of Project Area

The project area is east of the Linden Highway and south of Kara Kara Creek, at the beginning of the road leading to the Kara Kara mines. It is bounded to the north by the mine road, to the east by the western spoil pile of the North East Kara Kara mine, and to the west by an embankment that extends along the eastern edge of the Linden Highway. The land slopes from south to north towards the Kara Kara Creek and there are two major erosion gullies in the spoil pile, one to the southeast and another to the southwest of the project area. E-W contours were established across the slope.

The area is divided into three 1.3 hectare plots oriented North to South running down the slope: the easternmost plot is for the establishment of *B. humidicola* grass for pasture for small ruminant livestock; the middle plot is for the establishment of *Paulownia* plants, and the westernmost plot is for the establishment of lime plants. A small area further west of the lime plants is for the establishment of a fat pork plot.

Strategy

The strategy used was to improve soil pH, nutrient and organic matter status by the periodic addition of lime, organic and inorganic fertilizers, and to improve soil structure by addition of organic matter through establishment of ground cover grass (B. *humidicola)* and *Glyricidia* shrubs that would be used as mulch. Lime and fertilizers were applied directly to planting areas for grass and planting holes for plants. By fixing nitrogen, *Glyricidia* would enhance the soil nitrogen content. Improved soil nutrient, organic matter content and structure will promote growth of the *B. humidicola* and *Vetiver* grasses and lateral spread of the *B. humidicola* grass would enhance ground cover.

Erosion of the spoil pile has the dual effect of moving large quantities of sand and progressively spreading it over, and creating disruptive erosion channels in the subjacent ground resulting in the progressive covering and disruption of the area that is being vegetated, close to and away from the base of the spoil pile. Erosion control was effected by planting of rows of 'fences' of *Vetiver* grass along the contours established over the project area and across the lower to middle reaches of the two major erosion gullies in the spoil pile, in the north eastern and south eastern borders of the project area. As the establishment of the *Vetiver* grass fences were affected by spoil pile erosion, it became necessary to install rows of silt fences, made of fabric, across the two major erosion gullies. The establishment of the *B. humidicola* grass as ground cover over the entire project area was used as a measure of erosion control by reducing runoff and increasing infiltration.

Water management was effected by the erosion control measures to promote infiltration and reduce runoff, and by increasing the organic matter content of the soil and establishing ground cover.
In the northern third of the area, the *B. humidicola* grass was established as pasture for small ruminants in a part of the project area. When the lime and *Paulownia* trees grow to a certain height, the ground cover *B. humidicola* grass throughout the project area will be used as pasture.

Cashew (*Anacardium spp.)* seedlings were planted in 2004 as an economic crop to test its viability at the location. Seedlings were planted as opposed to seeds to enhance the success of establishment.

Work Done

Work done during 2006 was as follows:

- Under Objective 1: Effective planting using organic material and crop husbandry practices including liming and fertilizing were applied to all crops at the site.
- Under Objective 2: New Silt Fence was erected and old ones repaired.
- Under Objective 3: Fertilized and maintained *B. humidicola* ground cover and pasture grass.
- Under Objective 4: Maintained *Paulownia.*
- Under Objective 5: Maintained limes.
- Under Objective 6: Started tree selection for the establishment of plot at Kara- Kara.
- Under Objective 7: Maintained cashew plants.
- Under Objective 8: Planted fat pork seedlings at Wismar Multilateral School Holdings.

Problems and Constraints to Work

Owing to lack of funding during the period January to May 2006 very few visits were made to the project area. This combined with the absence of a fence around the site resulted in:

1. Over grazing of the *B. humidicola* by cattle
2. Destruction of the silt fences
3. Severe erosion
4. All the plants (*Paulownia*, limes and cashew) showing severe signs of nutrient deficiency
5. Infestation of the lime plants by citrus leaf miner

In May 2006, a meeting was held between the GGMC and NARI. Here, the budget for the year 2006 and funding for the period October – December. 2005 were approved. For the period June to December 2006 vehicles and drivers for trips to the sites were made available by GGMC and NARI.

Project Status

General

Most of the sand particles covering the spoil pile at the Kara-Kara site have eroded exposing the clays beneath. This has resulted in a low level of infiltration on top of the spoil pile with more runoff and erosion. Efforts will be concentrated on re-vegetation of areas on top/side of the spoil pile to reduce the runoff.

The clay size particles in the flowing water had a sealing effect on the surface of the 'soil'. This restricted infiltration, resulting in water logging of depressions and planting holes, creating anaerobic conditions which caused the death of some lime and *Paulownia* plants.

There is also a proliferation of fat pork seedlings/trees at the site. This is most observed in areas in the vicinity of *vetiver* lines (which were fertilized). Thus, fat pork is using the improved conditions for plant growth at the site to create lines/clumps along the contours.

Several interviews were conducted with schools and community groups as part of the Participatory Rural Appraisal (PRA) for this project. These schools included the Mc Kenzie High School, Wismar Hill Primary and the Wismar Christianburg Multilateral School. All have expressed an interest in participating in the creation of 'green areas' and using the fruit to create value added products.

The PRA also revealed the potential of the fat pork fruit to make a number of food products (wine, cake, ice-cream, nuts and pickles). These products were made for exhibition purposes and won first prizes at Caribbean Science Fairs.

Site selection for 'green areas' for the planting of 'fat pork' on mined spoils in Linden are ongoing. The layout of a site at Kara-Kara (contiguous with the re-vegetation site) commenced in December 2006. Another site in the vicinity of the Wismar-Christianburg Multilateral School was selected and 100 'fat pork' seedlings planted.

A fence was erected at the Kara-Kara revegetation site in November. This has effectively prevented the invasion of cows and the destruction of plants. Efforts of crop husbandry and other practices at the site are now protected. The fence has also prevented dumping within the site. However, dumping of domestic and construction waste in the vicinity of the 'Site' continues to be an eyesore. The assistance of the Linden Town Clerk was sought, and a promise made to write the known offenders. To date the practice continues.

Erosion Management – *Vetiver*

Erosion in the gullies to the southwest and southeast necessitated the use of mechanical barriers before the replanting of the *Vetiver* grass fences across the gullies as the *Vetiver* grass was continually being washed away before it was established. The erection of the silt fences across the gullies effectively curbed the erosion in the gullies. During the May-June period, however, the flowing water over topped most fences resulting in most of them being buried or washed away or approaching their capacities (Fig. 1). New silt fences were erected at closer distances in both gullies. The rains of the November – December period saw a repeat of the silt fence destruction. The process of establishing/repairing silt fences has commenced.

In the project area where *Vetiver* grass fences were established along the contours, a combined nitrogen, phosphorous and potassium fertilizer, 12:12:17:2, and urea were applied in June 2006.

Fig.1: Southwest Gully with Buried Silt Fences, East Kara Kara, 2006

Erosion Management - *B. humidicola* Ground Cover/Pasture

The hand planted *B. humidicola* located at the base of the spoil pile in the northeast suffered greatly from gully erosion. This resulted in the relatively dense patch of grass being dissected and its spread restricted. Thus, ground cover immediately below the spoil pile, in the area/plot designated for pasture, is improving more slowly than expected. The grass cover in the *Paulownia* and lime plots, which are further away from the base of the pile (thus less affected by erosion) is approximately one hundred percent.

The grass was fertilized in June 2006, with a mixture of 12:12:17:2 fertilizer and urea. However, overgrazing, erosion and lack of nutrients have led to it becoming patchy and showing signs of nutrient deficiency. In November 2006, a fence was erected around the site that is effectively preventing cattle from grazing and destroying plants. Planned fertilizer application and other crop husbandry practices will soon return its lush green colour and vigorous growth.

***Glyricida* in Pasture Area**

Of the 210 *Glyricida* plants established at the site (130 in 2005 and 80 in 2006), only 52 have survived. This high mortality was due to trampling by cattle and erosion. *Glyricida* plants established on slope of the spoil pile not subjected to erosion and cattle appear to

be doing better that those on lower slopes. This phenomenon needs to be further investigated. Four hundred cuttings were obtained and set to root in NARI's nursery for replanting now that a fence is in place around the site.

Establishment of Plants

Paulownia

Lack of maintenance, the water logging and cattle damage resulted in the death of all but one *Paulownia* plant (149 dead). *Paulownia* plants at this site exhibited severe signs of nutrient deficiency (especially calcium). They were fertilized with 12:12:17:2 and 30:30:30, Calmax and Agrigrow applied to the foliage twice/week for four weeks. This treatment was effective in removing the nutrient deficiency symptoms. Now that the site is protected replanting and other crop husbandry practices will recommence.

Limes

Forty five lime plants have survived (60 dead, stolen or destroyed by cattle). Limes at this site exhibited severe signs of nutrient deficiency (nitrogen, calcium, phosphorous, magnesium and potassium). In some instances die-back had commenced and there was infestation by citrus leaf miner. These plants were pruned and fertilized with 12:12:17:2 which was applied to the soil and with 30:30:30, Calmax and Agrigrow which were applied to the foliage twice/week for four weeks. The plants responded to this treatment and the symptoms disappeared. The citrus leaf miner was controlled by the insecticide Abemectin. Now that the site is protected replanting and other crop husbandry practices will recommence.

Cashew

The same fertilizer applied to the limes and Paulownia were applied to the cashew plants. The symptoms of nutrient deficiencies disappeared and new flushes are evident. Some of the plants were almost buried by the eroded material.

Fig. 2: View from the Southwest, East Kara Kara, 2006

Note the erosion Channels, and the Yellow Leaves of the Cashew Plants in the Foreground and the Brown grass (*B. humidicola*) in the Background (Fig. 2)

Fat pork

Site selection for 'green areas' for the planting of 'fat pork' on mined spoils in Linden are ongoing. The layout of a plot at Kara-Kara (contiguous with the re-vegetation site) commenced in December 2006. Tree selection for this plot is ongoing. Another plot in the vicinity of the Wismar-Christianburg Multilateral School was selected and 100 'fat pork' seedlings planted in December 2006.

Conclusions

- Erosion in the gullies to the southeast and southwest of the project area continues to be the major challenge to the success of the project. Silt fences erected across both of the gullies were successful in trapping the eroding sand but due to the lack of proper maintenance they were overtopped by the eroded material and buried
- The *B. humidicola* pasture and ground cover grass in the project areas abutting these gullies in the east and southeast are the most affected by erosion.
- In the *Paulownia* and lime plots, which were less affected by erosion, *B. humidicola* grass ground cover was approximately one hundred percent. However, the fat pork (*Chrysobalanus icao*) growing in the eastern part of the

project area is continuing to restrict the establishment of the *B. humidicola* grass ground cover in this area.

- Lime and *Paulownia* plants were severely affected by the waterlogged conditions caused by the sealing of the 'soil' surface in and around the planting holes

Recommendations

- Silt fence needs to be established across the gullies and at closer distances
- Transportation facilities to take personnel and material to the site in Linden must be made readily available.
- All fat pork (*Chrysobalanus icao*) not growing in the designated plot should be eliminated as soon as possible.
- Liaison with community groups and functionaries should be vigourously pursued to activate their involvement and participation in activities at the sites. This should include cattle farmers in the area.

Project 3: SOIL CHEMISTRY DIVISION

Introduction

This year saw increased activity in the laboratory as demands for soil chemical analyses increased significantly over 2005. Farmers, students and researchers obtained results for a wide range of analysis, namely, N, K, P, Ca, Mg, Na, Fe, Mn, Zn, 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.

Activity 1: Analysis of Samples – Soil Chemistry Division

A. Sample Status:

Five hundred and fifty soil samples were received for processing and analyses. These samples were received from: Farmers – 398, University of Guyana (UG) students - 36, Researchers - 52 and other agencies 64. Two hundred and seventy three samples were completed for the analyses requested.

B. Chemical and Equipment Status:

An inventory of laboratory chemicals, equipment and apparatus was prepared for this division. This inventory included:

a. A listing and quantification of chemicals, equipment and apparatus needed.

b. The source (s) in catalogues and a listing prepared for purchase.

Work is presently being done to rehabilitate the dysfunctional chemistry stores. Extractor fans and air conditioning units will be installed to assist in making this facility functional.

The distilled water system is also being refurbished. Repairs to the stills are complete and work on the replacement and rehabilitation of collection tanks is in progress.

All faulty electrical points within the laboratory were replaced and a voltage stabilizer installed on the atomic absorption spectrophotometer.

C. Staff Training

The competence of staff in this Division continues to improve. Two staff members (one Research Assistant and one Research Technician) benefited from training in feed analyses provided by GUYSUCO. The process of acquiring the necessary equipment and chemicals to do similar work at NARI has begun.

In 2007 more in-house training on methods of analyses will continue.

Activity 2: A digital database for all samples entering the Division.

A database for soil samples entering the Division was created in October 2006. It has ten fields and presently contains all samples (7530) that entered the Division between January 2000 and December 2006. The next step in this activity is to create a similar database with the corresponding results of analyses.

Project 4: SOIL AND LAND USE SURVEYS DIVISION

Introduction

This Division continues to offer valuable support to farmers, entrepreneurs and researchers in agricultural crop production and planning. At present the Division is collaborating in drip irrigation projects of NARI-FAO, NARI GGMC revegetation projects and NARI-PRCSSP soil characterization projects.

Objectives: Maintaining national inventories and classification of soil resources by:

1. Executing soil and land use surveys and describing the morphology, genesis and classification of soil resources.
2. Providing physical, chemical, mineralogical and biological information about different kinds of soils.
3. Interpreting the above characteristics for various land users for planning and management purposes and recommending the best possible use of soil resources.

Activity 1: An inventory of maps within the Division is complete. A catalogue of soils and land use maps within the Division was published.

Objectives:

1. To give a compact summary of mapping work previously done within the Soil and Land Use Surveys Division of NARI;
2. To provide a basic document for easy access to maps present within the Soil and Land Use Surveys Division of NARI;
3. To give an appreciation of the state of mapping to land use planners, researchers, farmers and all who are likely to be involved in commissioning a soil and land use survey or making use of existing maps.

Output:

There are 14 themes in this catalogue. Each section attempts to cover aspects under its theme. Each map is identified by its accession number, name or area covered, author, date, scale and type of material. The accession number is intended to be the principal identifier in facilitating ready access to maps.

Included as an appendix, is a list of soil and land use survey reports in the Division. These reports were computerized and placed on CD. Unfortunately, they do not at present contain maps. It is hoped that the catalogue will be useful in sourcing maps to fill the gaps left by the CD.

Activity 2: Collection of soil samples and land use surveys

The Division has introduced (as a routine activity) the administering of a land use questionnaire whenever a request for services is made of the Division. Locations where samples are collected are also now given geographic coordinates using a GPS.

Objectives:

a. To create a land use data base for crop production in Guyana.

b. To have the ability to map in a GIS crop production practices in Guyana.

This questionnaire is presently being tested along the Soesdyke – Linden Highway and its environs.

Activity 3: Acquiring land title for NARI's holdings

ACT No. 19 of 1984, Part III, Section 12.3 gives NARI the right to occupy its headquarters and to establish research centers throughout Guyana. A number of holdings formerly administered by the Ministry of Agriculture are now controlled by NARI. Unfortunately, the “Institute" is not in possession of land titles for these holdings. Thus, NARI is faced with challenges from persons who have occupied parts of these holdings without lawful permission.

Objectives:

a. to verify NARI’s boundaries at these locations
b. to remove illegal occupants through negotiated settlements
c. to erect fences to secure boundary lines

Output:

A process to secure land titling for NARI's holdings at Charity, Region 2 has commenced. A joint team of representatives from NARI, Guyana Police Force and Guyana Lands & Surveys Commission (GLSC) visited NARI's holding at Charity on Wednesday 13th December 2006. During this visit, the team from GLSC conducted a Cadastral Survey. The cadastra revealed that NARI’s western neighbor (Mr. Kenneth Nickram) was occupying approximately four feet of NARI’s holdings.

The illegal occupation of NARI's holdings was pointed out to Mr. Nickram who willingly agreed to immediately cease occupation. Palls were driven and a barbed wire fence constructed.

The next step in the process is for NARI to vigorously pursue land titling for this holding.

Project 5: SOIL MICROBIOLOGY DIVISION

Introduction

This Division is presently not fully functional. Refurbishment works are continuing on its electrical systems. As these are rehabilitated equipment are being tested and repaired.

Objectives:

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

Activity 1: Refurbishment of Soil Micro-biology Division

Some materials needed for this activity were purchased and some work done to restore water to the Division. Refurbishment works will continue in 2007. Works on the evaluation of strains of Rhizobium bacteria will commence subsequently.

III. POST HARVEST AND AGROPROCESSING DEPARTMENT

1. STAFF:

Head of Department:	Mr. M.S.A. Faroze
Research Scientist*:	Ms. G. Parris
Research Assistant:	Mr. I. Khan
Research Technician:	Mr. R. Ori

2. Pectin production

Preliminary studies were completed on the production of pectin from fruit waste material including skins, pulp etc. The fruit types included grapefruit, orange, lime, lemon, golden apple, watermelon, gooseberry and passion fruit. The process involved the extraction of pectin using an alcohol to precipitate it, prior to drying. Pectin is a substance used extensively in industries such as in pharmaceuticals, cosmetics and agro-processing e.g jams, jellies, ice cream, beverages, baked products etc. as food stabilizers, enhancing viscosity etc. It provides the end product with good qualitative features such as stability and texture. Guyana imports all of the pectin substances from neighbouring Brazil at extremely high costs. The pectin is subsequently used in local food manufacturing.

The final product resulting from the extraction process was tested in jam to determine its effectiveness. The results obtained from this test were favourable as the sample of jam containing the pectin appeared to have a better consistency and firmness than the sample without any pectin. The various stages in the pectin production, including locally produced crude pectin material were exhibited for public scrutiny and information at national exhibitions, Guyana Night activities, World Food Day activities and NARI Open Day activities.

* Resigned from NARI, 2006-08-06

The results of the trial established the crude dry weight pectin composition per lb of the fresh fruit waste material which included:

Fruit	Crude Drying weight pectin (grms)
Passion fruit	2.50
Orange	2.00
Golden apple	3.75
Watermelon	0.50
Carambola	1.50
Grapefruit	3.50

3. The commercial production of edible mushrooms

The commercial production of edible mushrooms (Oyster) commenced during this year in support of the Government's Agricultural Diversification Programme to explore and analyse the developmental characteristics of new and untried non-traditional crop types in Guyana. Problems related to contamination of the inoculated bags were, however, experienced particularly in the final stages of the cultivation process. This severely affected the success of this project. This was the major problem and it was the intention of the Department to work assiduously towards a solution and to satisfy all the technical requirements before inviting potential investors and implementing a training programme. Measures were implemented to minimize contamination of the working lot by using a double sterilization process where the bags were sterilized on two consecutive days for a period of eight hours each. This strategy was developed after careful assessments and technical operational changes to limit contamination were made at each stage in the cultivation process. It was decided to investigate the double sterilization process due to the heavy contamination of the sawdust substrate material, particularly in the last stage of the process. It was the view that the temperature of the sterilization process was adequate to kill the contaminants in the substrate but the pressure of administrating the temperature at a constant level was not effective.

The preliminary results of this experiment after the first week indicated a significant increase in the success rate as the level of contamination was considerably reduced compared to the single or one day sterilization period. After a period of three weeks there was an average mycelial spread of 25 % in the bags with 60% showing no contamination. This double sterilization process was initiated as a strategy to increase the time of sterilization considering the low steam pressure delivered by the sterilization unit. At a high steam pressure it is the normal practice to reduce the time of sterilization. Conversely, at low steam pressure it is recommended to increase the sterilization time.

The successful mycelial development continued throughout the period of the spawn run course towards complete mycelial spread. Some of the bags which had developed complete mycelial spread were distributed to interested stakeholders and investors to ascertain fruiting body development and progress. The rest of the mycelial developed bags were stored in NARI's unit to monitor fruiting body development.

During the month of October 2006 the interested investors reported successful fruiting body development from their trial bags about three weeks after the time of procurement. The remaining bags in NARI's unit also produced very healthy, large and vigorous fruiting bodies.

The double sterilization technique has achieved success in producing good quality mycelial material with limited contamination. This technique will however, be repeated several times to further refine the process until 90 – 100 % contamination free bags are produced. Once successful growth and production are established it is intended to invite potential investors and producers to a training programme on the commercial aspects of edible mushroom cultivation as an activity to propagate the technology.

4. Consultations with key stakeholders on preparation of research proposals for postharvest agroprocessing

A meeting was coordinated and conducted with key stakeholders in the agroprocessing industry with the aim of developing an integrated approach to preparing research

proposals of an applied nature for the development of this industry. The participants of the meeting engaged in meaningful discussions which led to the formulation of a work programme that encompassed the issues highlighted at the meeting. It was considered a necessary strategy to involve the stakeholders since they will have the information on the needs and constraints of the industry and any research intervention will be of direct benefit to them.

The research proposals were prepared and incorporated into the work programme of the Department.

5. Dehydration trial on hot pepper

The processing of pepper using solar dryer technology has been identified as a cheap and effective means of extending the shelf life of this crop. A trial was established to evaluate the effects of solar drying on pepper in terms of colour retention, fresh weight to dry weight ratio, drying characteristics and rate of moisture loss on two varieties of pepper including Wiri wiri and Scotch Bonnet. The results of this experiment have been processed and analysed.

The results of Table 4 and 5 show data on weight loss and colour characteristics using the solar dryer (indirect) and bus dryer (in the mobile agroprocessing unit) on the two varieties of hot pepper, wiri-wiri and Scotch Bonnet, at eight hours drying time. The solar dryer is using a natural convection of air flow through the drying chamber, whereas the bus is being facilitated by a mechanized active system using a fan to speed up the airflow.

Table 4: Weight loss and colour characteristics of wiri-wiri pepper variety using two methods of dehydration in an eight hour drying period, Mon Repos, 2006

Solar Dryer							Bus Dryer						
Time (hrs)	Temp. (^oC)	Wt. (g)	Wt. loss (%)	COLOUR			Time (hrs)	Temp. (^oC)	Wt. (g)	Wt.loss (%)	COLOUR		
				L	A	b					L	a	B
0	Nil	132	Nil	34.5	38.4	21.2	0	Nil	132	Nil	43.5	38.4	21.2
1	45	118	10.6	43.7	36.5	20.6	1	50	114	13.6	31.1	36.8	28.3
2	43	109	7.6	43.7	36.5	20.6	2	50	106	7.0	31.1	36.8	28.3

3	42	101	7.3	43.7	36.5	20.6	3	50	90	15.1	31.1	36.8	28.3
4	43	94	6.9	41.7	37.3	27.4	4	50	80	11.1	52.2	37.9	25.1
5	45	89	5.3	42.5	38.8	20.1	5	50	72	0.1	48.0	37.7	26.5
6	35	83	6.7	36.9	46.4	37.8	6	50	49	31.9	44.7	38.1	28.4
7	42	80	3.6	27.1	36.4	20.7	7	50	43	12.2	34.1	32.1	18.4
8	42	72	0.1	35.3	35.1	23.5	8	50	25	41.9	32.4	28.1	18.7

Table 5: Weight loss and colour characteristics of Scotch Bonnet variety using two (2) methods of dehydration in an eight hour drying period.

Solar Dryer							Bus Dryer						
				Colour							Colour		
Time (hrs)	Temp. (^oC)	Wt. (g)	Wt.loss (%)	L	A	b	Time (hrs)	Temp. (^oC)	Wt. (g)	Wt.loss (%)	L	a	B
0	Nil	132	Nil	40.9	40.71	27.5	Nil	50	132	Nil	40.84	40.7	27.5
1	45	110.7	16.1	47.9	38.7	34.9	1	50	109.7	16.9	47.98	38.7	34.9
2	43	97.3	12.1	47.9	38.7	34.9	2	50	96.3	12.2	47.98	38.7	34.9
3	42	86.1	11.5	47.9	38.7	34.9	3	50	75	22.1	48.67	40.4	35.0
4	43	77.2	10.3	45.4	41.7	33.2	4	50	61.5	18	48.67	40.4	35.0
5	45	69.4	10.1	43.9	40.8	31.5	5	50	50.3	18.2	48.40	42.0	36.9
6	35	61.6	11.2	45.8	47.2	36.5	6	50	32.2	36	47.24	37.5	34.5
7	42	57.2	7.14	37.7	35.1	17.2	7	50	26.7	17.1	38.72	33.1	18.5
8	42	49.4	13.6	42.8	40.1	27.8	8	50	5.6	7.9	28.94	22.0	13.7

6. Packaging of processed food products

This project was initiated to assist manufacturers to develop suitable packages for processed food products as well as appropriate label designs for food product packages. This was identified as one of the critical areas requiring attention by the participants at the meeting with key stakeholders in the agroprocessing industry. Preliminary work was initiated in the design of an appropriate label that will illustrate concepts such as branding (Guyana brand), consumer appeal and attractiveness, durability and versatility to manufacturers. After the design is finalized, in conjunction with the respective agroprocessors, a prototype will be produced by Caribbean Containers Inc. Initial contact was made with this company to assist in this respect and a favourable response was received. This company was chosen because it is the only packaging company in Guyana that is capable of producing small quantities of packaging material (minimum of 500) that will suit the needs of local manufacturers. The package will be tested at exhibitions, fairs and in supermarkets.

7. Dehydration of perishable commodities

Research on dehydration of perishable produce including fruits, vegetables and root crops was identified as an important project at the meeting of the agroprocessing stakeholders. This was based on an attempt to develop new and variable processed products for the benefit of the industry. The Department was engaged in work on dehydration of a number of fruit and vegetable types including candied mango, candied pineapple, candied papaw, candied carambola, pumpkin chips, banana chips, garlic powder, ginger powder, dehydrated jackfruit, dehydrated pumpkin seeds, dehydrated sweet pepper, ground hot pepper, yam chips, sweet potato chips, pumpkin powder, sweet potato flour, banana flour, yam flour, ground celery, ground sorrel, ground thyme, pumpkin jam, banana jam, papaw and grapefruit jam, papaw and lemon jam, banana and grapefruit jam, fruit based sauces (pineapple, carambola, papaw), pepper sauce and banana raisins. In addition, a health snack food containing dehydrated fruit, candied fruit, peanuts and cashew nuts, ginger flavoured pepper sauce were produced by the Department.

Samples of most of the products produced were distributed to staff members of NARI to solicit views and opinions.

The primary objective of this work is to extend to investors and stakeholders some of the products that can be obtained from the dehydration process using inexpensive inputs and materials.

Information such as fresh weight to dry weight ratio, moisture content of the produce, shelf life of the product and cost analysis are being recorded.

8. National activities

The postharvest and agroprocessing department participated in a number of national activities including World Food Day, GuyExpo and NARI Open Day. All the products manufactured by the department were on display. Three prototypes of solar dryers using different systems including the indirect system, mechanically operated system and the

mixed mode system were produced by the department and displayed at all of these activities. The responses of the public were very encouraging and enthusiastic.

9. Training and capacity building activities

a) Mobile agroprocessing unit

The Department conducted several demonstrations in West Berbice using the processing equipment in the mobile agroprocessing unit. This was intended as a training exercise to acquaint stakeholders on the operation of the various equipment and the range of products that can be produced using this facility. The areas visited included Crabwood Creek, Benab, Bengal, Lesbeholden, Yakasari, Mara and Adventure. A number of products produced by the Department were displayed in the unit. Samples of some of the products were distributed to the trainees during the exercise. In addition, a number of leaflets, handouts and brochures produced by NARI on production and processing technologies and technical information were distributed to the participants.

IV. BIOTECHNOLOGY, PLANT GENETIC RESOURCES AND CROP PROTECTION DEPARTMENT

1.0 PLANT GENETIC RESOURCES SECTION

STAFF:	Research Scientist:	Mr. C. R. Paul
	Research Assistant:	Mr. E. Willabus
	Research Technician:	Ms. A. Connel-Chester

1.0 INTRODUCTION

Sweet potato (*Ipomoea batatas*) was the major commodity focused on. A successful attempt was made to acclimatize four sweet potato landrace varieties to the white sand ecologies along the Soesdyke-Linden Highway. Germplasm maintenance and collection was also pivotal to the work done. Specifically, germplasm maintenance focused on the establishment of out-station depositories of local mango germplasm resource, while successful collecting expeditions were made to the lower Pomeroon River District, and the Moruca-Shell Beach Sub-Region of Region 1. The results of the projects undertaken by the PGR Section are reported below.

2.0 PROJECTS UNDERTAKEN IN 2006

2.1 Project Title: Acclimatization of new sweet potato varieties to white sand agro-ecologies of the Soesdyke-Linden Highway

The objectives of this intervention were to release into commercial cultivation, new varieties of sweet potato with improved production and marketing packages, and to develop a production package for their specific adaptation to the white sand ecologies along the Soesdyke-Linden Highway. Transitional trials conducted during 2005 indicated that the four entries (Amjad Pumpkin Potato, Little, Professor #1, and Scientist) could be successfully produced in the target ecology. Results of this project were reported in the NARI Annual Report for 2005. Based upon those results

the four varieties are recommended for release into commercial production in the target ecology. Towards this end, seed cutting materials of these four varieties are currently established in field plots.

2.2 Project Title: Seed yam and sweet potato germplasm banks/mass regeneration nurseries in on-farm plots and at the Kairuni and Ebini Out-stations

In order to provide adequate quantities of seed material to supply requirements for advanced evaluations, and simultaneously maintain germplasm accessions in field gene banks, depositories of yam and sweet potato accessions were established at one on-farm location at Kuru Kururu and the Kairuni and Ebini out-stations.

2.2.1 Yam

Trench nurseries of one exotic yam variety were established on-farm at Kuru Kururu and at the Kairuni out-station. The on-farm depository at Kuru Kururu stands in good condition, but the trench nursery at Kairuni was apparently damaged by grazing sheep.

2.2.2 Sweet Potato

One on-farm sweet potato germplasm plot was established aback of Kuru Kururu. Owing to adverse dry weather and brush fires, the 14 collections had to be rescued and brought to Mon Repos where they were maintained in the screen-house. The 28 accessions (inclusive of putative duplicates) deposited at Ebini were maintained in excellent condition. Following elimination of these

duplicates the resulting 12 varieties were subsequently established in depositories at the Ebini out-station and on-farm aback of Kuru Kururu.

2.3 Project Title: Establishment of out-station field depositories of targeted crop species

In order to establish secure basal collections of threatened local mango and coconut germplasm resources at isolated locations two mango safe depositories were each established at the Ebini and St Ignatius out-stations.

2.3.1 Mango

Twenty-four coastal mango accessions were established on approximately 5 acres at Ebini in May, 2006. Field plant establishment rate was 100% and the depository is currently in good standing. A parallel 6-acre depository at St Ignatius was established in September, 2006 with 27 accessions. By December 2006, brush fires had reduced this stand to 75%, but current supplying efforts can restore the plant survival rate to about 90%. Brush fires apart, the St Ignatius depository is in fair-to-good shape. Maintenance of the St Ignatius depository would be supported by a shallow artesian well which is in its final stage of construction.

2.3.2 Coconut

In light of the threat from lethal yellowing disease, the coconut depositories are currently treated with urgency. Sites for duplicate depositories at St Ignatius and Ebini have been identified and their layout designed. An initial collection of coconut germplasm was done. The more than 120-accession allotment for Ebini has been assembled on site in preparation for planting towards the end of January 2007. The approximately 100-accession allotment for St

Ignatius is expected to be transported to that location early February 2007 for planting in April 2007.

2.4 Project Title: PGR collection of targeted and threatened landrace varieties

Four successful expeditions were conducted at Ebini and Kimbia (Intermediate Savannahs), in the Lower Pomeroon and in the Moruca-Shell Beach Sub-region of Region 1. Scoping collection visits are continuing in the West Coast Berbice area.

2.4.1 Expedition Ebini

In February 2006, seventeen exotic collections of mango established since 1974 were rescued from their un-maintained depository at the Ebini out-station. All of these accessions are currently established in the new Ebini mango germplasm depository.

2.4.2 Expedition Kimbia

In October 2006, eighty four accessions of the tall coconut variety were rescued from their abandoned Kimbia depository and assembled at Kimbia. These accessions will serve as the 'clean' source of tall coconut varieties comprising the 'safe' coconut depositories.

2.4.3 Expedition Pomeroon

This expedition was conducted from November 13-15, 2006. The target of this expedition was the coconut population comprising the 'bastard' coconut variety characteristic of this farming community. A total of 229 seed nuts was selected from 31 selected trees. Sampling was done to represent the composition characteristic of

‘bastard’ coconut populations. It is here acknowledged that although this sample may be representative of the native population, its size is inadequate to mimic the dynamics and maintenance of its genetic balance. This expedition also yielded one pepper and two sweet potato accessions.

2.4.4 Expedition Moruca-Shell Beach

This expedition was conducted from November 21-24, 2006 This Moruca-Shell Beach Sub-region is relatively large, and except for the small village settlements where most of the population is concentrated, the decreased number of farms and homesteads are scattered over terrain accessible mainly by trail hiking. Under these situations it is usually prudent to target species collection with a view to maximizing resources in terms of time, logistical support, and financial outlays.

Coconut

This expedition therefore targeted species diversity (endemism) more than species sample representation. One accession (10 seednuts/seedlings) was sampled at Aquero, Moruca River and five more (5 seednuts/seedlings each) were sampled at the Marine Turtle Conservation Site at Shell Beach. It was apparent that most of the coconut cultivations in Moruca are of aged palms obtained from the Lower Pomeroon District.

Cassava

Seven cassava accessions were sampled in the Moruca District and these were thought to represent the current diversity. An additional eight accessions were sampled from a five-acre plot at Shell Beach and these were thought to be representative of each of the different types found on this location and in the Shell Beach farming community.

Pepper

A total of twenty-one hot pepper accessions was sampled. Twelve were obtained from several homesteads in the Moruca Area, two from Shell Beach and seven from one homestead at Charity (Pomeroon River). It should be noted that the two accessions obtained at Shell Beach represented a marked reduction in diversity when compared with that which obtained in 1997.

Sweet Potato

Only one sweet potato accession was encountered at Shell Beach; a stark contrast to the more than five accessions collected during 1997, while at Moruca sweet potato cultivation was reported and found not to be popular among residents since no cultivation was encountered. Residents, however, differentiated between sweet potato and black potato. The latter was found to be very popular among residents at two trail locations called Four-miles and Five-miles. We were able to access about five pounds of this black-potato 'tubers', and from the larger size of tubers it is believed that this 'variety' may be different from those we have accessed previously.

Pesticidal Plant Germplasm

A number of variants of a group of plants known to intoxicate fish were reported to be prevalent in the Moruca District. Two species of these plants (cuttings of 'cunami' and mature seeds of the other) were accessed.

2.4.5 Expedition West Coast Berbice

This expedition commenced in early December 2006. To date one accession of cassava and one of banana were collected. An additional five sweet potato and twelve pepper accessions were collected.

PLANT PROTECTION

STAFF:

Research Scientists:	Ms. Kaye Mc Allister
	Dr. R. Chandranauth
	Mr. C. R. Paul

SUPPORT STAFF:

Research Assistants:	Mr. E. Willabus
	Ms. Shri Devi Dhanpaul
Senior Research Technician:	Mr. M. Ramphal
Research Technicians 11:	Ms. A. Connel-Chester
	Ms. S. Nicholson
Laboratory Assistants:	Ms. M. Somerset
	Ms. M. Moses
Laboratory Attendants:	Ms. S. Kellman
Cleaner:	Ms. S. Singh

Project 1: Provision of effective, timely and affordable services in Plant Pathology, Entomology and Weed Science

Aim: To develop and maintain skills and laboratory capability to provide

i. Support for the national quarantine system and
ii. A diagnostic and advisory service to the farming community in Guyana

Objective 1: Identification of pests of crops and recommendations on their management.

Sub-activity 1. Processing of plant pest samples/specimen

Forty six samples/specimen collected from various locations were submitted by or on behalf of non-traditional crop farmers to the laboratory. The samples were processed utilizing standard procedures and techniques. As far as possible attempts were made to diagnose the pest problems and provide recommendations for the most practical means of management. See Table 6 for summarized results based on sample/specimen type submitted and location/ source.

Most of the samples submitted were of vegetable and fruit crops mainly from Region 4 and other areas along the coastal belt of Guyana. The most common pathogens isolated were anthracnose of fruits and vegetables, fusarium and pathogenic bacteria such as moko disease on plantain. Three soil samples were processed for nematode testing. Samples of wild tamarind and apple were given health tests for quarantine purposes as was requested by the Ministry of Agriculture Plant Health Department. Diagnostic sheets/forms were completed for the processed samples.

Table 6: Samples/specimen processed in the Plant Protection Laboratories, 2006

Crop/Sample Type	No of Samples	Origin (Region of Guyana) / Country
Fruit and Orchard	16	3, 4, 6, 10, USA
Vegetables	17	1, 2, 4, 10
Rice and other cereals	1	4
Soil	3	2, 4
Weed	1	Burkina Faso (Africa)
Field	7	2, 10
Total	**45**	

Other Sub- activities. Pest surveys, field monitoring

Monitoring for pest problems in on-station and off-station locations was conducted including the vegetable plots in fields 17 and 19 at Mon Repos and Scotch Bonnet pepper seedlings at NARI's nurseries at Mon Repos and Timehri.

Investigations/assessments of crop protection problems around the country were conducted based on requests. In Regions - 2 and 3 roots and tubers and vegetables; Regions - 4, 5 and 6 -vegetables, papaw, passion fruit, pineapple, plantain, sweet potato, coconut, cassava, sour sop, sapodilla, peach and other crops; in Region 8 –vegetables, roots and tubers, field and orchard crops. The necessary advice and recommendations were given to address the pest problems.

Objective 2: Training of farmers, technicians, extension agents, teachers and students in plant disease management.

A five-day in house training course in **General Laboratory Techniques** coordinated by Ms. Kaye Mc Allister was conducted during the period March 29th - 30th and April 4th - 6th 2006. Fourteen of the fifteen persons identified for training participated. See Table 7 for a list of participants. The training was aimed at:

i) Providing participants with basic training in general laboratory techniques with emphasis on plant tissue culture and

ii) Equipping the participants with adequate knowledge and skills to facilitate the basic functioning of the plant tissue culture laboratory. Resource personnel were Ms K. Mc Allister, Mr. Cleveland Paul, Mr. E. Willabus and Mr. D. Fredericks

Topics covered during the course included the following:

- Laboratory safety practices

- Maintenance of facility
- Aseptic techniques
- Sterilization techniques for various materials
- Guidelines for minimizing contamination
- Preparation and storage of stock solutions and nutrient media
- Initiation of cultures
- Laboratory records
- Chemical list and handling notes

Table 7: List of participants of training course in general laboratory techniques, Mon Repos, 2006

No.	Participants	Department/Section	Designation
1	R. Seepaul	Agronomy	Research Assistant
2	S. Dhanpaul	Biotechnology	Research Assistant
3	C. Nunes	Biotechnology	Research Technician I
4	D. Benjamin	Biotechnology	Research Technician I
5	R. Mohabir	Crop Protection	Senior Research Technician
6	A. Connell-Chester	Crop Protection	Research Technician II
7	S. Nicholson	Crop Protection	Research Technician II
8	M. Sookdeo	Horticulture	Research Assistant
9	D. Singh	Horticulture	Research Technician I
10	M. Goopcharran	Office of the Director	Research Technician I
11	R. Ori	Post Harvest	Research Technician I
12	I. Khan	Post Harvest	Research Assistant
13	S. Hollingsworth	Soil and Water Management	Research Technician III
14	M. Joseph	Soil and Water Management	Research Technician I

A report on the training course was submitted to the Director, Dr. O. Homenauth.

Objective 3: Provision of a plant pest reference service

The weed herbarium and insectarium were maintained and conducted tours were carried out with assistance from the technicians. Supervised use of the reference facilities in the Crop Protection Section was granted based on requests made to the Institute by several

schools. Over 100 students from ten secondary schools visited the section. In addition, individual assistance and guidance were also given to groups of student in the collection, pressing, drying and mounting of herbarium samples of diseases and weeds as well as insect pest collection for their School Based Assessment practicals/projects.

A published list of species was revised and kept in the collection.

Objective 4: Production of formulated baits for the control of Azteca and Acoushi ants.

A total of **7,906** 200g packets of baits was produced. Of this quantity **6,756** packets were sold /distributed representing **85** percent of the quantity produced. A total of **1150** packets of bait was in stock at the end of the reporting period. Distribution of the baits was done in collaboration with Ministry of Amerindian Affairs, Ministry of Agriculture and the NARI nurseries.

Table 8: Acoushi ant bait production and distribution 2006

Quantity sold/distributed (pks)	Location/Agency
3,500	Ministry of Amerindian Affairs
475	Timehri Nursery
225	Kairuni Nursery
150	Moruka
200	Region 2 (Mainstay/Tapakuma)
600	Region 6 (Orealla)
200	Ministry of Agriculture
1,406	Sold at NARI Head Quarters, Mon Repos
Total sold/distributed 6,756	
Stock as at 31.12.2006 1,150	

Project 2: Identification, conservation and evaluation of plants with biopesticidal properties

Aim: To make available semi-chemicals or plants producing such agents associated with plant-pest interactions as alternatives to broad spectrum eradicant pesticides

Five plants have been added to the list of plants identified for work. These are as follows:

1. Buru Buru - *Solanum stramonifolium*
2. Inflamation bush - *Vernonia cinerea*
3. Nenwah - *Luffa cylindrica*
4. Shame bush - *Neptunia prostrata*
5. Money bush - *Cassia aptusifolia*

Collaborative Projects

Ms. Kaye McAllister served as a resource person in the provision of technical assistance (training) to the peanut farmers in Region 1 under a project funded by the United Nations Development Programme through the Office of the Prime Minister according to a training programme developed/designed by the Ministry of Agriculture. The "Farm School Principle" was the model utilized for the training sessions and the officer was part of a technical training team which visited several areas in the region to train and assist in the setting up of demonstration farms. Topics presented and discussed during the training were insect, disease and weed control in peanut cultivation and the application of pesticides in peanut cultivation. A total of three visits was made.

Other Activities

The section participated in several highlight activities during the year 2006 including the following:

- Participation in launching of drip irrigation project at NARI.
- Participation in launching of world food day activities. Preparation of leaflets, posters and specimen.
- Participation in NARI's open day activities. Preparation of leaflets, posters and herbarium material for display and referencing.

Staff Training

Research Scientist Ms. Kaye Mc Allister was selected as one of four **Norman E. Borlaug International Agricultural Science and Technology Fellows for Guyana 2006.** Under this programme Ms. Mc Allister spent six weeks at the Plant Genetics Laboratory, Mc Carty Hall D., University of Florida, Gainesville under the supervision of Dr. Mario Gallo.

The focus of the specific training was on:

- Use of different electrophoretic methods for the identification of varieties
- DNA extraction methods
- PCR based methods for detection of genetically modified organisms (GMOs)

Activities engaged in during the training period included intensive hands-on laboratory training, visits to field out-stations Citra, Marianna and Quincy, seminars and literature reviews/lectures, visits to the Plant Diagnostic Clinic in Quincy, Florida, meetings with leading specialists in agriculture and attendance at the American Peanut Research and Education Society Conference in Savannah, Georgia (July11th-14th , 2006) . A report on the training was submitted to the Director, Dr. O. Homenauth.

VIROLOGY

Project: **NARI's Certification Scheme for Citrus**

Aim:

To establish a certification programme for citrus seeds, seedlings, budwoods, rootstocks, scions, and plants, produced at NARI's nurseries to be free from Citrus Tristeza Virus (CTV) and its vector, the brown citrus aphid (BrCA) – *Toxoptera citricida (Kirkaldy)*, through the application of various diagnostic techniques and methods. The certification guarantees to the fruit producers that the plant is free of the known degenerating diseases and true to type. It allows following the plant up until its plantation.

Justification:

Citrus is one of the most important group of fruit crops in Guyana, in terms of nutrition and the generation of employment and commerce.

Tristeza disease of citrus (CTV) was first reported in Guyana in 1961. It is caused by a closterovirus and is the most economically important viral disease of citrus and possibly the most destructive disease of citrus.

CTV infects almost all citrus species, cultivars and intergeneric hybrids of citrus and some citrus relatives. Many strains of the virus, from mild to severe, exist and contribute to the diversity of symptoms associated with CTV infection. The disease is vector transmitted.

The most important vector of CTV, the brown citrus aphid BrCA-*Toxoptera citricida* was reported widely distributed in Guyana (Grant, 1961). It is by far the most efficient aphid vector of CTV, about 20 times more effective in virus transmission than *A. gossypii.* The brown citrus aphid was responsible for the rapid movement of severe strains of CTV that killed tens of millions of citrus trees on sour orange rootstock in Brazil and Argentina in the 1930's and 1940's (Yokomi *et al.,* 1994).

CTV is spread through the use of CTV infected budwood and by aphid vectors. CTV is vectored by several aphid species in a semi-persistent manner with the aphid retaining the ability to transmit CTV for up to 24-48 hours after acquisition (Bar-Joseph, Lee, 1989).

There are strains of tristeza that are difficult to detect in seedlings of Mexican lime but can be easily detected by ELISA. For example, a California tristeza isolate (T-159) is very difficult to identify in Mexican lime indicator plants grown under temperature regimes conducive to good symptom development, but is readily detected by ELISA. This illustrates the value of, and need for, using more than one technique in a programme.

The only possible way to get viral free plants is to have a certification scheme.

A certification scheme coupled with clean stock programmes can ensure that all budwood available in Guyana is certified free of CTV as well as other graft transmissible pathogens. This is universally recognized as the most important strategy to prevent and reduce further crop losses and for the improvement and continued productivity of a citrus industry.

Activity 1: The monitoring and periodical testing of all NARI's plant nurseries, and citrus growing areas of Guyana for strains of CTV and its vectors.

Activity 2: A citrus sanitary selection programme of different varieties tested for the absence of diseases (CTV) using various laboratory techniques.

Activity 3: Developing biological control methods for the brown citrus aphid (BrCA) as part of an Integrated Pest Management (IPM) system to reduce spread of CTV.

Activity 4: The establishment of a CTV free nuclear stock reserve in a screen house.

Activity 5: The establishment and production of CTV free budded plants in multiplication blocks at NARI's nurseries.

Activity 6: **a.** Gathering of data on the spread of CTV as affected by strains of CTV, vector type, hosts and location effects.

b. Maintaining a reference collection of citrus plant viruses, viroids, isolates, slides, photographs etc.

Activity 7: Education and extension programme on the CTV- complex for citrus growers, nurserymen, farm advisers, technicians, extension agents, teachers, students and other concerned parties.

Results:

1. Field tests using a starch test, and monitoring of citrus plants commenced on the 6th February and ended on the 5 th June, 2006 at Fort Wellington and Timehri Plant Nurseries.
2. Field tests concluded at Fort Wellington nursery- 33 plants tested, of which 6 showed signs of tristeza infection.

   Timehri nursery -600 plants tested for CTV infection, of which 160 showed signs of tristeza infection.
3. Collection of photographs was taken depicting, the host (brown citrus aphid) and various stages of viral and other pathological infections, and epiphytes and parasitic vines (bird vine - *Phthirusa aadunca*).

Table 9 – Budded and Grafted Plants at Timehri Field 3 – MB2

Rows	Plant 1	Plant 2	Plant 3
1	VCA/SoO	VAL/CaC	*VCA/SoO
2	VCA/SoO	VAL/CaC	√VAL/CaC
3	VAL/SoO	VCA/SoO	VCA/SoO
4	√VON/SoO	*VOL/SoO	VON/SoO
5	√VON/SoO	*VON/SoO	*VON/SoO
6	VON/SoO	VON/SoO	√VAL/CaC
7	√VAL/CaC	VON/SoO	VAL/CaC
8	√VON/SoO	*VON/SoO	VON/SoO
9	√HAM/RoL	*HAM/RoL	*HAM/CTrB
10	√HAM/RoL	*HAM/RoL	*HAM/RoL
11	√HAM/CTrB	HAM/RoL	*HAM/RoL
12	√GWM/RoL	GWM/RoL	GWM/RoL
13	GWM/RoL	GWM/RoL	GWM/RoL
14	*GWM/RoL	GWM/RoL	GWM/RoL
15	√TND/CeM	TND/CeM	TND/CeM
16	√TNC/RoL	*TNC/RoL	√TNC/RoL
17	√TND/RoL	TND/RoL	*TND/CeM
18	TND/SoO	TND/CeM	TND/SoO
19	TGM/SoO	TGM/SoO	TGM/SoO
20	√TGM/SoO	*TGM/SoO	*TGM/SoO
21	√TGM/SoO	*TGM/SoO	√TGM/SoO
22	*VCU/SoO	*VCU/SoO	VCU/SoO
23	VCU/SoO	√VCU/SoO	*VCU/SoO
24	*VCU/SoO	VCU/SoO	VCU/MC226
25	√VCU/SoO	*VCU/SoO	VCU/MC226
26	√ORT/RoL	*ORT/RoL	ORT/RoL
27	ORT/RoL	*ORT/RoL	ORT/RoL
28	*ORT/RoL	ORT/RoL	*ORT/RoL
29	NNE/SoO	NNE/SoO	√NNE/CaC
30	*NNE/SoO	NNE/SoO	NNE/CaC
31	√NNE/SoO	NNE/SoO	NNE/CaC
32	PCH/SoO	PCH/SoO	PCH/CaC
33	PCH/SoO	PCH/SoO	√PCH/CaC
34	PIN/SoO	PIN/SoO	PIN/CeM
35	PIN/CeM	PIN/SoO	PIN/SoO
36	*PIN/SoO	√PIN/SoO	PIN/CeM
37	PIN/RoL	PIN/RoL	√PIN/CeM
38	√PIN/RoL	*PIN/RoL	PIN/RoL

39	PIN/CeM	√PIN/RoL	PIN/RoL
40	√PIN/RoL	√PIN/RoL	√PIN/RoL

* Citrus triseza virus infected plants – 28
√ Missing plants - 29

At Timehri Plant Nursery, the total number of budded and grafted plants tested for Tristeza was 91. Therefore, there were 34 that showed no symptoms of tristeza (Table 9).

- Varieties tested for citrus tristeza virus (CTV) and its vector, the brown citrus aphid (BrCA) – *Toxoptera citricida were*: Valencia (VAL), Valencia Campbell (VCA), Valencia Olinda (VON), Valencia Cutter (VCU), Hamlin (HAM), Grapefruit White Marsh (GWM), Tangerine Clementine (TNC), Tangerine Dancy (TND), Tangello Minneola (TGM), Ortanique (ORT), Navel New Hall (NNE), Pinnello Chandler (PCH), and Pineapple Orange (PIN).

At the Screen House, Mon Repos

There are 28 citrus plants in the screen house.

They were pruned and sprayed with Amidor and Fastac for leaf minor and mealy bug infestation.

Plants were also fertilized with 12:12:17:2.

V. AGRONOMY DEPARTMENT

1.0 STAFF

Head of Department: Ms. B. Forde

Research Scientist: Mr. E. Ralph

Research Assistants: Mrs. A. Peters-Evans

Mrs. R. Seepaul

Research Technicians: Ms. C. Cort

Ms. R. Cato[1]

2.0 INTRODUCTION

For 2006, the crops in the Agronomy Department's work programme were bora (*Vigna sesquepedalis*) boulanger (*Solanum melongena*), cowpea (*Vigna unguiculata*), cucumber (*Cucumis sativus*), ochro (*Abelmoschus esculenta*), poi (*Basella alba*), pumpkin (*Cucurbita maxima*), soybean (*Glycine max*), squash (*Cucurbita maxima*), tomato (*Lycopersicon esculentum*) and watermelon (*Citrulus lanatus*)

Three trials were completed. Varietal evaluations were completed on cowpea and soybean. One trial was completed in the area of crop management to examine the influence of the plant density on the yield of ten cowpea lines.

One trial was in progress at the end of 2006. This trial was set up to evaluate the effects of pruning and nitrogen on the yield of poi.

Seed of selected vegetables and cowpea was produced.

Details of the work programme of the Agronomy Department are presented in this report.

[1] Resigned in October, 2006

3.0 COMPLETED TRIALS

3.1 Project Title: *Cowpea varietal trial*

This trial was conducted in Field No. 19, Mon Repos.

The treatments were 20 cowpea entries. Nineteen of these entries were obtained from the International Institute of Tropical Agriculture (IITA), Nigeria. This was the second set of cowpea lines from this institution. The first set was evaluated in 2005. The variety Minica IV was used as the local check. The objectives of the trial were to evaluate the performance of the lines and provide NARI with the opportunity to select lines for future testing and use.

The experimental design and procedure were provided by IITA. The statistical design used was randomized complete block with three replicates.

The data showed that there were significant differences among the entries in the number of days to 50 percent first flower. Table 10 shows the mean number of days to 50 percent first flower. The line IT98K-1111-1 took the least number of days (35.3) to 50 percent first flower while the local check Minica IV took the greatest number of days (60.6) to 50 percent first flower.

TABLE 10: **Mean number of days to 50 percent first flower of 20 cowpea entries, Mon Repos 2006**

ENTRIES	MEAN NUMBER OF DAYS TO 50 PERCENT FIRST FLOWER
Local Check (Minica IV)	60.6
IT 00K – 1263	49.0
IT 97K-1069-6	47.3
IT 97K – 556-4	46.6
IT 98K – 131 – 2	45.0
IT 98K – 503 – 1	43.3
IT 97K – 818 – 35	42.0
IT 98K – 128 – 3	42.0
IT 98K – 128 – 4	42.0
IT 97K – 568 – 18	41.6
IT 00K – 901 – 5	40.6
IT 98K – 205 – 9	40.6
IT 93K – 625	40.6
IT 99K – 718 – 6	40.3
IT 98K – 205 – 15	40.3
IT 98D – 1399	39.3
IT 97K – 499 -35	38.6
IT 98K – 501 – 1	38.6
IT 00K – 1217	37.6
IT 98K – 1111 -1	35.3

There was also significant variation in days to maturity (Table 11). The earliest maturing entries were IT 00K -1217 and IT 98K-1111-1 which matured in 58.6 days and 59 days respectively. The latest maturing lines were IT 00K – 1263 and IT 98K – 503-1 which matured in 73.3 days and 77.3 days respectively. The local check Minica IV matured in 71.3 days.

TABLE 11: Mean number of days to maturity[2] of 20 Cowpeas entries, Mon Repos, 2006

ENTRIES	MEAN NUMBER OF DAYS TO MATURITY
IT 98K – 503 -1	77.3
IT 00K-1263	73.3
Local Check (Minica IV)	71.3
IT 00K – 901 – 5	69.3
IT 99K – 718 – 6	69.3
IT 97K – 1069 – 6	68.6
IT 97K – 556 – 4	66.0
IT 98K – 131 – 2	65.6
IT 93K – 625	65.0
IT 97K – 818 – 35	64.3
IT 98K – 205 – 9	64.0
IT 98K – 128 – 3	63.6
IT 98K – 128 – 4	63.6
IT 97K – 506 – 1	63.3
IT 97K – 568 – 18	63.3
IT 98D – 1399	63.0
IT 97K – 499 – 35	60.6
IT 98K – 205 – 15	60.3
IT 98K – 1111 – 1	59.0
IT 00K – 1217	58.6

Table 12 shows the seed yield obtained in the trial. The highest yield was produced by the entry IT 97K – 1069 – 6 while the lowest yielding line was IT 00K – 1217. It was reported, in previous cowpea trials in Guyana that seed yields ranged from 800 kg to 2500 kg per hectare. In this trial seven entries had yields higher than the lower end of the range but no entry reached the higher end of the range. Generally, the yields were lower than those obtained in the 2005 cowpea trial that was done at Kairuni. The conditions were different and the trial in 2006 was adversely affected by rainy weather. This trial was also a "no spray" trial therefore no pesticides were applied.

On the basis of the results the first seven entries (IT 97K – 1069 – 6, IT 98K- 131-2, IT 97K -556-4, IT 98K -128-3, IT 98-506 -1, IT 00K – 1263 and IT 98K – 205-9) will be

[2] Maturity – When 95% of pods turn brown

used in agronomic trials. The varietal trial will be repeated for another season to confirm these data.

Table 12: Total Seed Yield per hectare for 20 cowpea entries, Mon Repos, 2006

ENTRIES	MEAN YIELD (kg/ha)
IT 97K – 1069 – 6	1180.6
IT 98K – 131 – 2	1129.5
IT 97K – 556 – 4	1043.0
IT 98K – 128 – 3	944.5
IT 98K – 506 – 1	875.0
IT 00K – 1263	850.5
IT 98K – 205 – 9	817.2
IT 98K – 503 – 1	787.5
IT 98K – 205 – 15	787.2
Local Check (Minica IV)	746.7
IT 97K – 818 – 35	716.7
IT 93K – 625	708.3
IT 99K – 718 – 6	697.2
IT 98K – 1111 – 1	669.5
IT 97K – 499 – 35	664.5
IT 97K – 568 – 18	623.8
IT 98K – 128 – 4	606.2
IT 98D – 1399	565.5
IT 00K – 901 – 5	416.7
IT 00K – 1217	223.3

3.2 **Project Title:** *Soybean Varietal Trial*

NARI was provided with ten lines of soybean from the IITA as part of its 2004 Soyabean International Observation Trial. The trial was conducted at the Kairuni Horticultural Station during August – November 2006. The treatments included ten soybean lines, namely: TGX 1871 – 12E, TGX 1903 – IF, TGX 1903 – 2F, TGX 1903 – 3F, TGX 1903 – 13 F, TGX 1904 – 2F, TGX 1904 – 4F, TGX 1904 – 5F, TGX 1908 8F and TGX 1909 – 3F in a randomized complete block design with three replications.

The crop management practices, the trial layout and data collection for this trial were provided by IITA.

Preliminary Results

Table 13 shows the mean number of days to flowering and the mean number of days to maturity. The days to flowering ranged from 43 to 47 days with 40 percent of the lines flowering at 47 days after planting. The days to maturity ranged from 82 to 96 days with 80 percent of the lines maturing at 96 days after planting.

Table 13: Mean number of days to flowering and mean number of days to maturity of ten soyabean lines, Kairuni, 2006

	Days to Flowering	**Days to Maturity**
TGX 1871 – 12E	46	96
TGX 1903 – 1F	45	82
TGX 1903 – 2F	43	96
TGX 1903 – 3F	47	96
TGX 1903 – 13F	47	96
TGX 1904 – 2F	44	96
TGX 1904 – 4F	46	96
TGX 1904 – 5F	44	96
TGX 1904 – 8F	47	96
TGX 1909 – 3F	47	89

To date, only some of the yield parameters have been measured. Data on total yield have not yet been completed.

Table 14 shows the number of seeds per pod and the length of pods. The data indicate that there was a greater number of two seeded pods/plant.

Table 14: Number of seeds per pod and length of pods of ten soyabean lines, Kairuni, 2006

	No. of 1 seeded pods/plant	No. of 2 seeded pods/plant	No. of 3 seeded pods/plant	Length of 2 seeded pods	Length of 3 seeded pods
TGX 1871 – 12E	7.44	27.3	13.5	3	3.9
TGX 12903 – 1F	4.2	25.53	11.286	3.64	4.46
TGX – 1903 – 2F	3.86	17.47	5.53	3.16	3.96
TGX 1903 – 3F	3	19.87	4.73	3.35	4.06
TGX 1903 – 13F	3.46	24.47	8.46	3.4	3.92
TGX 1904 – 2F	2.2	17.07	7.2	3.1	3.93
TGX 1904 – 4F	3	17.5	6.47	3.31	4.18
TGX 1904 – 5F	4.73	18.34	5.26	3.28	3.7
TGX 1908 – 8F	5.43	22.14	9.43	3.07	3.93
TGX 1909 – 3F	2.83	1.18	13.13	3.5	3.92

3.3 **Project Title:** *The influence of Plant density on the yield of ten cowpea lines, Kairuni, 2006*

Ten cowpea lines which produced the highest yields in a 2005 varietal trial were selected for this trial. The lines were IT 98K – 491-4, IT 00K – 1263, IT 98 – 128 – 4, IT 99K – 491 – 7, IT 97K – 461 – 4, IT 99K – 429 – 2, IT 96D – 610, IT 99K – 529 – 1, IT 99K – 1122 and IT 99K – 316 – 2.

The objective of the trial was to determine the plant density that would produce maximum yield. The statistical design was randomized complete block with three replications. Three plant spacings 5cm, 10cm and 15cm were used.

Preliminary results

The yield per plot of the ten lines at the three spacings is presented in Table 15.

TABLE 15: Yield (g) per plot of ten cowpea lines at three plant spacing, Kairuni, 2006.

Lines	Spacings (cm)			Mean
	5	10	15	
IT 98K – 491 – 4	290.6	258.3	283.0	277.3
IT 00K – 1263	199.0	194.6	200.6	264.7
IT 98K – 128 – 4	297.0	242.3	230.6	256.6
IT 99K – 491 – 7	332.3	315.6	279.0	308.9
IT 97K – 461 – 4	289.0	239.0	275.0	267.0
IT 99K – 429 – 2	272.0	303.0	277.3	284.1
IT 96D – 61	356.6	321.0	294.6	330.7
IT 99K – 521 – 1	286.0	244.0	198.3	242.7
IT 99K – 1122	242.3	211.0	196.0	216.4
IT 99K – 316 – 2	351.0	309.0	296.0	318.6
MEAN	291.4	263.8	253.0	

Although the statistical analysis has not yet been completed, the data show that there are differences in yield at the different spacings. The present recommendation for cowpea is 15cm between plants but the data suggest that a closer spacing may be used.

4.0 TRIALS IN PROGRESS

4.1 **Project Title:** *The effects of pruning and nitrogen on the yield of poi.*

This trial is in progress in Field # 19 Mon Repos. The statistical design is randomized complete block with four replications.

Harvesting will commence in January, 2007.

5.0 SEED PRODUCTION

Seed was produced to ensure quality seed of adapted varieties reached farmers. During 2006, seed was produced of ten crops. Two crops were harvested from

Fort Wellington, these were boulanger and tomato. The other crop types were produced in Field 19, Mon Repos.

Selection for varietal conformity continued particularly for bora, ochro and boulanger. Harvesting of bora started in 2006 but will continue into 2007. The same is true for boulanger. There was improved uniformity in bora.

During 2006, the department received seed equipment. The grain dryer was not tested or used since no operations manual was received. The new equipment will aid in the assurance of seed quality.

Table 16 shows the quantity of seed produced for each crop.

TABLE 16: *Seed yield (g) of selected crops, Fort Wellington and Mon Repos, 2006*

CROP	SEED YIELD (g)
Bora	2,979
Boulanger	7,820
Cowpea (Minica IV)	26,000
Cucumber	45
Ochro	300
Poi	300
Pumpkin	210
Squash	340
Tomato	1,420
Watermelon	50
TOTAL	**39,464**

6.0 OTHER ACTIVITIES

6.1 Multiplication of planting material

Since all vegetative material was lost in the flood of 2005, efforts began to multiply material. During 2006, a small quantity of sweet potato slips were obtained and planted in Field #19 for multiplication.

6.2 NARI Day

The department prepared posters and hand outs on seed production for this activity. All the persons who visited the department were particularly interested in seed production.

VI. LIVESTOCK AND PASTURE PRODUCTION DEPARTMENT

STAFF:

Department Head: Mr. R. N. Cumberbatch - Senior Research Scientist

Department Officers:

Dr. R. Austin - Research Scientist

Mr. J. K. Q. Solomon - Senior Research Scientist

INTRODUCTION

The activities of the of the Livestock Department of the National Agricultural Research Institute are geared towards the improvement of production parameters in four areas, ducks, sheep, beef and forage production. Towards this end the department was able to undertake a number of research, development and technology transfer activities that were intended to improve livestock production and productivity. The results of the research activities were documented in the Journal of Livestock Research and Rural Development. The research activities included:

A comparison of live weight and carcass gain of Pekin, Kunshan and Muscovy ducks on a commercial ration. Journal of Livestock Research for Rural Development 18 (11) 2006.

Restricted feeding of Pekin ducks: A comparison of three levels of quantitative feed restriction and full feed on the growth, carcass and economic indices. (Accepted for Publication in the April Issue of the Journal of Livestock Research for Rural Development)

The production parameters of the Barbados Blackbelly and crossbred sheep in a controlled semi-intensive system. Journal of Livestock Research for Rural Development 18 (4) 2006.

A beef production project was developed by the National Agricultural Research Institute, The Inter-American Institute for Cooperation on Agriculture, the National Dairy Development Programme and the Ministry of Agriculture, the aim of this project was to expose beef cattle farmers to new perspectives, ideas and technologies required to increase beef production and productivity, in order to take advantage of the Caribbean markets. A seminar was held to expose the farmers to the new techniques and in addition herds of selected farms were tested for both brucellosis and tuberculosis. Scientists from the Department presented two topics at this seminar. The reports are contained in the proceedings of the seminar.

The transfer of technology was another important aspect of the livestock programme of the Livestock Department during the reporting year. The Department was instrumental in developing a number of information products, on sheep, poultry, forage and pig production. In addition, the officers of the Department made farm visits and established duck production facilities in a number of regions in Guyana. The Livestock Farm was also used as a teaching laboratory by various groups, which included both farmers and students who visited the Farm.

Mr. J. Solomon, Senior Research Assistant in the Department was awarded a Norman E. Borlaug Fellowship, to study livestock production systems; he spent a six week period at the University of Florida, Gainesville, USA.

DUCK UNIT

The duck production unit performed favorably during the reporting period, egg production was good and the fertility percentage of the eggs from the three breed types of

ducks was greater than 80%. There were, however, numerous problems with the incubation unit which negated the good performance of the duck production unit.

During the first half of the year the incubation problems stemmed from the malfunctioning of the compressor unit of the incubator, a rather simple problem that was allowed to persist and fester for a period of some six months. The end result of this gross mismanagement was a decline in the hatchability percentage of the eggs and subsequently a decline in the number of ducks sold. While in the latter half of the year the problem was related to the unstable supply of power that resulted in the destruction of a mother board of the incubator and the malfunctioning of the heating ring in the hatching unit. This unfortunate situation did not only affect duckling production of the Institute but also duckling production of the farming community, because a number of farmers utilize the facilities of the Institute to hatch duck eggs.

Table 17: Fertility Percentages, Duck Unit, Livestock Farm, Mon Repos, 2006

	BREED TYPE		
PERIOD	PEKIN	KUNSHAN	MUSCOVY
2006	81.75	80.97	81.25

Table 18: Hatchability Percentages, Duck Unit, Livestock Farm, Mon Repos, 2006

	BREED TYPE		
BATCH	PEKIN	KUNSHAN	MUSCOVY
2006	73.75	73.2	71.25

The continued development of two new strains of Muscovy ducks, **THE NARI SOLO WHITE MUSCOVY** and the **ROBIN BLUE NARI MUSCOVY** were also a part of the activities of the duck unit. During the year both birds continued to exhibit good growth

characteristics, particularly the **NARI SOLO WHITE MUSCOVY**. Selection and production of both the Robin Blue and Solo White Muscovy breeds of ducks are ongoing.

The Department during the reporting year concentrated its efforts on studying/investigating strategies for the lowering of feed cost for duck production, by investigating restricted feeding systems for duck. The study was entitled:
The effect of restricted feeding of Pekin ducks: A comparison of three levels of quantitative feed restriction and full feed on the growth, carcass and economic indices. A summary of the findings indicated the following:

This experiment was conducted to evaluate the performance of Pekin ducks on three levels of restricted feeding as against full feed. Feed utilization accounted for approximately 72% of the total cost of production for Pekin ducks reared intensively on commercial feed in Guyana.

Sixty F_2 Pekin ducklings of male sex were selected and used in conducting this experiment. Five ducklings were randomly selected and placed in a treatment unit with three units representing a treatment in a completely randomized designed study.

Ducklings were weighed individually and body weight recorded on a weekly basis. The mean of the birds' body weight were taken to represent each treatment units throughout the duration of the experiment.

The data recorded during this investigation for each treatment unit was analyzed using the General Linear Models (GLM) procedures of SAS institute (1985) with significance set at ($P<0.05$).

There were no significant differences between treatment 1 and 2 for mean live weight at 56 days old however, treatment 3 recorded significantly lower mean live weight at 56 days than T4, T1 and T2 respectively ($P<0.05$).

There were no significant differences in feed conversion rates for birds under the four treatments ($P<0.05$).

In relation to carcass index, differences and similarities were observed among the four treatments.

Treatment 4 had the highest profit margin followed by treatment1, 2 and 3 respectively.

(The paper was accepted for publication in the April (2007) Issue of the Journal of Livestock Research for Rural Development)

SHEEP UNIT

During the reporting period the sheep production unit was engaged in a number of activities. These included the introduction of the concept of creep feeding of the lambs in an attempt to increase the average daily gains of the pre and post weaned lambs and make available to the farming community a better breeding animal. This new concept was to be tested and compared with the production parameters of two previous years 2004 and 2005, but the lack of a computer in the Department frustrated the efforts of this activity.

The demand for breeding animals has exceeded the ability of the Programme to supply, however, with assistance from the Ebini Unit the programme was able to partially satisfy the demand of animals from the Region 6 farmers, particularly those who reside and farm in the Black Bush Polder area.

During the reporting period two of the Barbados Black Belly breeding males used in the multiplication programme died, the post-mortem suggested that one of the animals died as a result of a restriction of the animal to excrete urine. The death of these breeding rams would seriously affect the programme, however the programme is making efforts to acquire replacement animals.

Overall, in spite of the setbacks the sheep production unit had a rather successful year. Table 19 shows the flock size. The unit sold approximately 80 breeding males to the farming community.

Table 19: Flock size of sheep at the Livestock Farm, Mon Repos, 2006

PARAMETERS	OPENING STOCK	CLOSING STOCK
Breeding males	5	5
Breeding females	128	147
Weaned males	6	3
Weaned females	10	50
Male lambs	22	8
Female lambs	69	28
TOTAL	**240**	**241**

The comparisons of production parameters of the unit for the 2004-2006 period are highlighted in Table 20.

Table 20: Production parameters of the sheep unit at NARI Mon Repos for 2004-2006

Parameters	2004	2005	2006 *
Number of lambs born	272	175	48*
Number of ewes giving birth	84	119	33*
Average lambs/litter	1.543	1.47	1.45
Single births (%)	35	37.1	48
Twin births (%)	55.9	56	54
Triplets births (%)	8.5	6.9	nil
Male lambs (%)	49.3	50.2	54.1
Female lambs (%)	50.6	49.8	45.8
Male birth weights (kg)	2.7	2.55	2.7
Female birth weights (kg)	2.4	2.325	2.4
Average daily gains - Male (kg)	102.49	102.125	103.6
Average daily gains –Females (kg)	91.83	95.075	97.7

* The data for 2006 are incomplete because the computer systems in the Department were not functioning for the greater part of the year. The farm needs a computer to facilitate the collation of the sheep records, if not we would have to discontinue this vital and important activity. The comparison of the records from previous years assists the

programme to plan for improved production parameters. Therefore the data presented for 2006 are not a true reflection of the programme.

FORAGE UNIT

The forage production unit continues to strive to provide good quality forage for the animals by maintaining improved pastures for the grazing animals. The programme was able to acquire a donation of forage seeds from Florida. The seeds acquired were 100kg of *Paspalum notatun* Var Tifton, and 50 kg of forage millet. These seeds are to be planted on the Livestock farm. The department also plans to share some of the seeds with some of the more progressive farmers. It must be mentioned that all of the pastures require rehabilitation. A lack of machinery to effect land preparation was mainly responsible for this programme not being completed.

The unit was used as a teaching laboratory for students from the University of Guyana, the Guyana School of Agriculture and secondary school students who were preparing for the Caribbean Examination Council Examination.

TECHNOLOGY TRANSFER

The transfer of technology is another important aspect of the work programme of the Livestock Department. The methodologies used to ensure that activities are extended include the hosting of farmers and students on tours of the Livestock facilities, mounting and displaying, prominently, various aspects of the department's work programme at national exhibitions. In addition, the facilities and officers of the Livestock Department were used as a vehicle for the training of students primarily in the secondary and tertiary educational programmes, and more importantly, the Department also disseminated information by preparing information products on different aspects of livestock production in both print and electronic form, by utilizing tools such as fact sheets, radio, scientific journals and newspaper articles.

Personnel from the Livestock Department were involved in a number of training exercises on livestock production. The department has therefore prepared a number of information products on various aspects of animal production. The list includes.

(i) Care and management of the chicken

Feeding of the chicken

Housing of the chicken

Health management for chickens

(ii) Improved pig rearing

Pig breeds and their adaptability

Selection of breeding animals

Housing

Feeding

Health matters

Record keeping

(iii) Sheep production systems

Physical examination of the sheep

Determining the age of sheep

Administering medicine to sheep

Simple record keeping systems for sheep

Feeding systems/pastures for successful sheep rearing

Effective and cheap fences for sheep

(iv) Care and management of the duck

Feeding of the duck

Housing of the duck

Health management of the duck

All of the information products produced for use as training tools by the Department are available from the Communications Unit of the Institute.

Developmental Activities

A beef production project was developed by NARI, IICA, NDDP and the M of A, the aim of this project was to expose beef cattle farmers to new perspectives, ideas and technologies required to increase beef production and productivity, in order to take advantage of the Caribbean markets. A training workshop was held for farmers in February 2006. At the workshop presentations were made by personnel from the department on topics such as: By-product feeding systems for cattle and pasture feeding systems for cattle production

Staff Training

Mr. J. Solomon, Senior Research Assistant in the Department was awarded a Norman E. Borlaug Fellowship 2006, to study livestock production systems; he spent a six week period at the University of Florida, Gainesville, USA. The topic studied was:

Recent Advances in Ruminant Nutrition Development

The objectives of the fellowship were to expose the participants:

- The current developments in ruminant livestock nutrition with specific reference to beef cattle and sheep nutrition.
- Ration formulation software for beef cattle and sheep.
- Modern laboratory methods in feed and forage samples analysis.
- Modern record keeping systems with direct application to cattle and sheep.

Areas covered during the six weeks fellowship included:

- Ruminant nutrition current trends in the feeding industry. E.g. Utilizing several bacteria (Silage inoculants) *Lactobacillus buchneri*, Biotal II plus containing *Pediococcus pentasaceus, Propionibacteria freudenreichii* and a dual purpose inoculant or combo (Buchneri 500) containing *Pediococcus pentasaceus* and *L. buchneri* for improved rumen function and digestibility, thus, leading to better utilization of fibrous feed materials and ultimately an increase in animal outputs.

- Forage and feeding systems to support ruminant livestock development. The contribution of indigenous feed materials and hybrid grass species in ruminant livestock production.
- Laboratory methods in analyzing feed materials: Ankom technology – protein, energy, fats, neutral detergent fibre, acid detergent fibre, minerals and tannins and i*n vivo* and i*n vitro* digestibility analysis.
- Computer software programmes in beef and dairy cattle feed formulation for tropical environment.

As a part of the fellowship, Mr. Solomon also attended the Conference of the American Society for Animal Science and the American Dairy Science Association, as well as seminars focusing primarily on ruminant nutrition for beef, dairy cattle and sheep. In addition, he attended several symposia on beef and dairy science current issues and trends (Nutritional Outlook).

VII. HUMAN RESOURCES REPORT

1. RECRUITMENT OF STAFF

A. Administration:

1)	Vickram Ramnarine –		Chief Accountant	-	2006-06-01

B. Senior Technical:

1)	Shri Devi Dhanpaul	-	Research Assistant	-	2006-01-09

C. Other Technical and Craft Skilled:

1)	Carlyle Nunes	-	Research Technician 1	-	2006-01-03
2)	Clement Benjamin	-	Research Technician 1	-	2006-01-03
3)	Vishnu Beharry	-	Mechanical Supervisor	-	2006-03-27

D. Clerical and Office Support:

1)	Narinedat Ori	-	General Clerk	-	2006-09-18

E. Semi-Skilled Operatives and Unskilled:

1)	Keswin Morris	-	General Worker	-	2006-01-09
2)	Deandra Marshall	-	General Worker	-	2006-01-16
3)	Cornell Adrian	-	General Worker	-	2006-01-23
4)	Carlton Taylor	-	General Worker	-	2006-02-01
5)	Arlene Couchman	-	General Worker	-	2006-03-01
6)	T. Persaud	-	General Worker	-	2006-06-06
7)	Cassius Baretto	-	General Worker	-	2006-06-12
8)	Kelton Jennings	-	General Worker	-	2006-06-26
9)	Ravichand Jadbeer	-	General Worker	-	2006-07-12
10)	Ronald Jaundoo	-	General Worker	-	2006-07-17
11)	Garfield Leacock	-	General Worker	-	2007-08-07
12)	Hodari Simon	-	General Worker	-	2006-08-21
13)	Kenrick Ramsammy	-	Security Guard	-	2006-07-23
14)	Ravindra Singh	-	General Worker	-	2006-10-25
15)	Harripaul Harripersaud		Driver	-	2006-11-21
16)	Petrenia Sinclair	-	General Worker	-	2006-12-01
17)	Cyril Williams	-	General Worker	-	2006-10-09

2. PROMOTION

A. Senior Technical:

1) Juan Solomon - Snr. Research Assistant - 2006-01-01

B Other technical and Craft Skilled

1) Winston Lyte - Storekeeper - 2006-03-01

3. RESIGNATION

A. Administration:

1) Haris Umadas - Personnel & Industrial Relations Officer - 2006-05-01

B. Senior Technical

1) Grace Parris - Research Scientist - 2006-08-06

2) Mechelle Lutchman - Research Assistant - 2006-10-19

C. Other Technical and Craft Skilled:

1) Anthony Dhanraj - Research Technician 1- 2006-09-30

2) Rockquel Cato - Research Technician 1- 2006-10-27

D. Semi-skilled Operatives and Unskilled:

1) Rocquel Gonsalves - General Worker - 2006-01-16

2) Carla Bovell - General Worker - 2006-06-14

3) Surrendra Samaroo - Mobile Equipment Operator - 2006-11-30

4. DISMISSAL:

A. Clerical and Office Support

1) Roseann Jaundoo Asst. Accountant - 2006-06-01

2) Melinda Beckham Accounts Clerk - 2005-11-07

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(Retroactively)

B. Semi Skilled Operatives and Unskilled

1) Hodari Simon - General Worker - 2006-08-25

2) Deandra Marshall - General Worker - 2006-09-01

3) Carlton Taylor - General Worker - 2006-09-01

4) Vanessa Daniels - General Worker - 2006-09-18

5) Azad Bacchus - General Worker - 2006-10-03

6) Cassius Baretto - General Worker - 2006-10-01

5. RETIREMENT

Senior Technical

1) Mortimer Livan - Research Scientist - 2006-10-31

6. MEDICALLY UNFIT FOR SERVICE

A. Semi Skilled Operatives and Unskilled

1) Carol Thomas - Security Guard - 2006-04-30

7. DEATH

A. Semi Skilled Operative and Unskilled

1) Azeem Baksh - General Worker - 2006-12-07

8. NON RENEWAL OF CONTRACT

Semi Skilled Operatives and Unskilled

1) Bhojraj Sahadeo - Plant Nursery Supervisor - 2006-12-31

STAFF TRAINING

A. OVERSEAS

Short Courses/Workshops/Meetings

Short Courses:

1. Ms. Indira Badal, Communication Officer, participated in a CTA/CARDI Training Course on "**Introduction to Communication Tools and Methods",** held in Grenada from May 01, 2006 to May 05, 2006.

2. Mr. Cleveland Paul, Research Scientist, participated in a Training Course on "the **Borlaug International Agricultural Science and Technology Fellows for Guyana",** held at the University of Washington, Seattle from June 11, 2006 to June 21, 2006; and the Washington State University (Pullman) from June 22, 2006 to July 31, 2006.

3. Ms. Kaye McAllister, Research Scientist, participated in a Training Course on the "the **Borlaug International Agricultural Science and Technology fellows for Guyana"** held at the University of Florida (USA), from June 14, 2006 to July 28, 2006.

4. Mr. Juan Solomon, Senior Research Assistant, participated in a Training Course on the "**Borlaug International Agricultural Science and Technology fellows for Guyana**", held at the University of Florida (USA) from June 16, 2006 to July 28, 2006.

5. Mr. Imran Khan, Research Assistant, participated in a training Course on **"Edible Fungi Cultivated Technology",** held in North China Electric Power University, Beijing from August 01, 2006 to September 27, 2006.

Workshops

1. Dr. Oudho Homenauth, Director, participated in a IICA/CARDI Workshop, held in Tobago from May 03, 2006 to may 04, 2006.

2. Mr. Mohamed Faroze, Research Scientist, participated in a Regional Workshop on **"The Use of Produce Quality and Food Safety Principles to Enhance the Marketing of Agricultural and Food Products"**, held in Port-of-Spain, Trinidad from October 09, 2006 to October 13, 2006.

Meetings

1. Dr. Robin Austin, Research Scientist, participated in the **"Caribbean Large marine Eco-System Project" (CLME)**, first Steering Committee Meeting, held in Panama from August 02, 2006 to August 03, 2006

B LOCAL

Short Courses

The under-mentioned members of staff participated in the following training courses conducted by the Training Division, Public Service Management.

1. **Occupational Safety and Health – May 15, 2006 to May 17, 2006**
   - i) Goldwyn Todd - Plant Nursery Supervisor
   - ii) Khayam Odhoo - Assistant Foreman

2. **Performance Management – May 17 and 18, 2006**
   - i) Grace Parris - Research Scientist
   - ii) Evan Willabus - Research Assistant
   - iii) Lionel Jagbir - Farm Manager

3. **Supervisory Management (Module 1) – June 26 to June 30, 2006**
   - i) Aretha Peters - Research Assistant
   - ii) Ramdeo Seepaul - Research Assistant

4. Supervisory Management (Module 11) – September 04 to September 08, 2006

i) Aretha Peters - Research Assistant
ii) Ramdeo Seepaul - Research Assistant

5. Supervisory Management (Module 111) –October 09 to October 13, 2006

i) Aretha Peters - Research Assistant
ii) Ramdeo Seepaul - Research Assistant

6. Strategic Planning – July 17 to July 19, 2006

i) Indira Badal - Communication Officer

7. Certificate in Professional Secretariat Practice (Module 1) – July 24 to 28, 2006

i) Anthonette Benjamin - Typist Clerk

8. Certificate in Professional Secretariat Practice (Module 111) – October 02 to October 06, 2006

i) Anthonette Benjamin - Typist Clerk

9. Office Assistant Seminar - July 10 to July 11, 2006

i) Paulette Beveney - Office Assistant

Table 21: Staffing at NARI 2006

Categories	No. of Positions	Positions filled	Positions vacant
Administration	16	10	6
Senior Technical	50	20	30
Other Technical and Craft skilled	72	33	39
Clerical and Office Support	36	14	22
Semi-skilled Operatives and unskilled	305	158	147
TOTAL	**479**	**235**	**244**

Table 22: Staffing in the Administration Category, NARI 2006

	Authorized Positions	Positions filled	Vacant Posts
Director	1	1	0
Head-of-Unit	3	2	1
Administrative/Finance Manager	1	1	0
Internal Auditor	1	0	1
Personnel & Industrial Relations Officer	1	0	1
Library/Documantalist	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
Administrative Assistant	1	1	0
Chief Security Officer	1	1	0
Supervisor, General Services	1	0	1
Deputy Chief Security Officer	1	1	0

TOTAL	**16**	**10**	**6**

Table 23: Staffing in the Senior Technical Category, NARI 2006

	Authorized Positions	**Positions Filled**	**Vacant Posts**
Senior Research Scientists	8	1	7
Research Scientists	20	9	11
Senior Research Assistants	4	1	3
Research Assistants	18	9	9
TOTAL	**50**	**20**	**30**

Table 24: Staffing in the Clerical and Office Support Category, NARI 2006

	Authorized Positions	Positions Filled	Vacant Posts
Confidential Secretary	1	1	0
Registry Supervisor	1	1	0
Personnel Assistant	1	0	1
Secretary	4	0	4
Typist/Clerk 1/11	5	2	3
General Clerk	3	3	0
Assistant Accountant	1	1	0
Assistant Accountant (Audit)	1	1	0
Accounts Clerk 111	1	0	1
Accounts Clerk 11	4	2	2
Records Clerk	2	1	1
Audit Clerk	1	0	1
Cartographic Trainee	1	0	1
Expediter 1/11	1	1	0
Telephonist 1/11	1	0	1
Office Attendant	5	1	4
Stores Clerk	1	0	1
Inventory Clerk	2	0	2
TOTAL	**36**	**14**	**22**

Table 25: Staffing in the Other Technical and Craft Skilled Category, NARI 2006

	Authorized Positions	Positions Filled	Vacant Posts
Senior Research Technician	5	3	2
Research Technician 11	9	5	4
Research Technician 1	22	9	13
Senior Field Assistant	1	0	1
Farm Manager	1	1	0
Plant Nursery Supervisor	3	3	0
Livestock Farm Manager	1	1	0
Senior Electrician	1	0	1
Mechanical Supervisor	1	1	0
Senior Mechanic	1	1	0
Senior Mechanic/Operator	1	0	1
Senior Storekeeper	2	0	2
Auto Electrician	1	0	1
Carpenter	4	2	2
Electrician	2	1	1
Mechanic	4	0	4
Plumber	2	0	2
Senior Library Assistant	1	1	0
Library Assistant	1	1	0
Mechanic Trainee	1	0	1
Senior Welder	1	0	1
Welder	1	1	0
Senior Carpenter	1	0	1
Senior Plumber	1	1	0
Assistant Plumber	1	0	1
Storekeeper	3	2	1
TOTAL	**72**	**33**	**39**

Positions Created

Other Technical and Craft Skilled

	Positions Filled
Communication Officer	1
Communication Information Specialist	1
Information Technology Technician	1

Table 26: Staffing in the Skilled Operatives and Unskilled Category, NARI 2006

	Authorized Positions	**Positions Filled**	**Vacant Posts**
Nurseryman 1	15	3	12
Nurseryman 11	10	2	8
Crop Attendant	4	1	3
Plant Operator	2	0	2
Equipment Operator	7	3	4
Mobile Equipment Operator	9	3	6
Tool-Room Attendant	1	0	1
Stores Attendant	2	0	2
Heavy Duty Driver	4	3	1
Heavy Duty Mobile Equipment Operator	1	0	1
Driver/Mechanic	3	0	3
Drivers	6	2	4

Sanitation Workers	8	5	3
Personal Assistant	1	0	1
Senior Field Foreman	4	0	4
Senior Nursery Foreman	1	0	1
Senior Stock Foreman	1	0	1
Field Foreman	5	0	5
Nursery Foreman	5	0	5
Foreman	2	1	1
Stock Foreman	1	0	1
Assistant Foreman	3	3	0
Assistant Nursery Foreman	3	2	1
Laboratory Assistant	4	1	3
Laboratory Attendant	9	7	2
Senior Livestock Attendant	1	0	1
Caretaker	2	2	0
Livestock Attendant	4	2	2
Handyman	2	0	2
Porter	2	1	1
Library Attendant	1	0	1
Security Supervisor	3	0	3
Senior Guard	6	6	0
Security Guard	49	29	20
General Worker	120	82	38
Watchman	4	0	4
TOTAL	**305**	**158**	**147**

VIII. FINANCIAL REPORT

BALANCE SHEET

AS AT DECEMBER 31, 2006

$	NOTES	$	$

2005				
176,150,299	**FIXED ASSETS**	**6**		**163,892,872**
	CURRENT ASSETS			
11,866,950	Stocks		24,658,081	
14,167,758	Debtors		8,328,103	
8,288,200	Short Term Investment	**7**	8,463,604	
680,727	Cash at Bank and on Hand		13,853,436	
35,003,635			55,303,224	
	CREDITOR AND ACCRUALS			
	Amount due within one (1) year			
(3,618,603)	Creditors		(3,320,160)	
-	Bank Overdraft			
31,385,032	NET CURRENT ASSETS			51,983,064
207,535,331				215,875,936
	PROVISION FOR LIABILITIES & CHARGES			
(5,606,815)	Ministry of Works		(5,606,815)	
-	Ministry of Finance		-	
(5,606,815)				(5,606,815)
201,928,516	NET TOTAL ASSETS			210,269,121
	FINANCED BY:			
51,897,479	Grant Foreign Sources			51,897,479
235,858,647	Government Contribution	**8**		255,858,647
935,796	Revaluation of Stock			935,796
(86,763,406)	Accumulated Surplus (Deficit)			(98,422,801)
201,928,516				210,269,121

NATIONAL AGRICULTURAL RESEARCH INSTITUTE

STATEMENT OF INCOME AND EXPENDITURE

FOR THE YEAR ENDED DECEMBER, 31, 2006

$ 2005	OPERATING INCOME	NOTES	$	$

14,829,592	Income from Agricultural Produce	**2**		13,252,635
8,859,002	Grant	**3**		32,145,296
208,741,537	Government Subvention			216,236,533
9,403,475	Miscellaneous Income	**4**		4,519,609
241,833,606				266,154,073
	OPERATING EXPENDITURE			
166,395,922	Employment		173,363,181	
8,270,952	Fuel and Lubricants		8,723,947	
11,043,313	Repairs and Maintenance		12,610,168	
12,851,337	Field Supplies and Services		16,293,620	
24,172,959	Depreciation		22,874,297	
34,619,105	Administrative Costs		43,948,255	
257,353,588				277,813,468
(15,519,982)	Net Surplus/(Deficit)			(11,659,395)
	STATEMENT OF ACCUMULATED SURPLUS/(DEFICIT)			
(71,243,424)	Accumulated Surplus/(Deficit) as at Jan. 1, 2006	**5**		(86,763,406)
(15,519,982)	Add Current Year Surplus / (Deficit)			(11,659,395)
(86,763,406)	Accumulated Surplus/(Deficit) as at Dec. 31, 2006			(98,422,801)

NATIONAL AGRICULTURAL RESEARCH INSTITUTE

STATEMENT OF SOURCE AND APPLICATION OF FUNDS

FOR THE YEAR ENDED DECEMBER, 31, 2006

$ 2005		$	$
	SOURCE OF FUNDS		
	Deficit for the year		

(15,519,982)			(11,659,395)
	Add : Adjustments for just items not involving the use of funds :-		
	Loss on Disposal of Fixed Assets	2,957,320	
24,172,959	Depreciation	22,874,297	
24,172,959			25,831,617
8,652,977			14,172,222
	FUNDS FROM OTHER SOURCES		
17,200,000	Government Contribution	20,000,000	
-	Revaluation of Stock	-	
-	Grant Foreign Sources	-	
17,200,000			20,000,000
25,852,977	Total Funds From All Sources		34,172,222
	APPLICATION OF FUNDS		
-	Ministry of Finance	-	
22,071,878	Purchase of Fixed Assets	13,574,190	
22,071,878			13,574,190
3,781,099			20,598,032
	INCREASE/DECREASE IN WORKING CAPITAL		
-	Increase/(Decrease) in Stock	12,791,131	
5,146,385	Increase/(Decrease) in Debtors	(5,839,655)	
(784,846)	(Increase)/Decrease in Creditors	298,443	
4,361,539			7,249,919
	MOVEMENT IN NET LIQUID FUNDS		
179,860	Increase/(Decrease) in Short Term Investment	175,404	
(760,300)	Increase/(Decrease) in cash at Bank & on Hand	13,172,709	
(580,440)			13,348,113
3,781,099			20,598,032

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 Agricultural 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 fund.

(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	5,983,109
Sale of Organic Produce	400,291
Sale of Livestock Produce	5,841,495
Sale of Grain Legumes	798,520

	Sale of Vegetables & Seeds	194,200
	Sale of Papaw & Other Fruits	650
	Sale of Processed Items	34,370
	Sale of Orchard Produce	
		13,252,635

3 GRANTS

This figure is made up as follows:	**$**
Ministry of Agriculture (I N S A P)	1,900,000
Geology & Mines Commission	3,525,665
FAO/Drip Irrigation System	13,285,631
Office of the President	6,934,000
Poor Rural Communities Support Services Project	4,000,000
Ministry of Agriculture	1,300,000
Guyana School of Agriculture	1,200,000
	32,145,296

4 MISCELLANEOUS INCOME

This figure is made up as follows:	**$**
Sale of Acoushi Ant Bait	370,870
Electricity Receivable	234,173
Interest Receivable	199,906
Other Income	558,120
Rental of House	1,137,000
Rental of Equipment	1,456,300
Sale of Printed Materials	18,360
Accommodation Guest House	544,880
	4,519,609

5. SCHEDULE OF FIXED ASSETS AS AT DECEMBER 31, 2006

COST	BUILDINGS ETC.	MACH. & EQUIP. & MOTOR VEHICLES	FURNITURE & FITTINGS & OFFICE EQUIPMENT	LABORATORY EQUIPMENT	LIBRARY BOOKS	ANIMALS	CONSTRUCTION WORK IN PROGRESS	-GRAND TOTAL
AT 2006 - 01 -1	220,930,730	121,779,057	48,401,469	49,555,352	2,187,669	1,656,131	71,410	444,581,818
ADDITIONS / ACQUISITION	1,983,929	4,392,059	3,014,242	3,407,413			7,621,651	20,419,294
DISPOSAL / TRANSFERS		7,393,300					(6,845,104)	(14,238,404)
AT 2006 - 12 – 31	222,914,659	118,777,816	51,415,711	52,962,765	2,187,669	1,656,131	847,957	450,762,708
DEPRECIATION								
AT 2006 - 1 – 1	84,832,201	93,341,343	44,126,067	44,218,987	1,912,921	-	-	268,431,519
DISPOSAL / TRANSFERS		4,435,980						-4,435,980
CHARGED FOR THE YEAR	10,670,291	9,393,548	1,455,475	1,235,844	119,139	-		22,874,297
AT 2006 - 12 – 31	95,502,492	98,298,911	45,581,542	45,454,831	2,032,060	-	-	286,869,836
NET BOOK VALUE	127,412,167	20,478,905	5,834,169	7,507,934	155,609	1,656,131	847,957	163,892,872

6	SHORT TERM INVESTMENT		$
	4-Jul-91	Certificate No. 99221	8,463,604
			8,463,604

7 GOVERNMENT CONTRIBUTION

This figures represents Inflows from Government for Capital Works

	$
Incorporated Reserves	12,454,472
Govt. Contribution Balance as at Jan. 1, 2006	223,404,175
Add Govt. Contribution during the Year	20,000,000
	-
	$255,858,647