FOREWORD BY THE DIRECTOR GENERAL

The mission of the Department of Export Agriculture (DEA) is to increase the foreign exchange earnings from Export Agricultural Crops (EAC) Sector through increasing the production, productivity, quality improvement of products and enhancing the value addition capacity of primary products. This sector comprises of spices, beverage crops, industrial crops, essential oil producing crops and stimulant crops. The DEA, under the supervision of the Ministry of Primary Industries and Social Empowerment, has planned and implemented its Research and Development programs in 2018 to achieve the mandated objectives.

Total Export Volume of EAC has reached to 48331mt with the value of Rs.mn 64540 export earnings. Almost all crops showed a decline of exports in volume and earnings compared to year 2017 except cinnamon. The volume of Cinnamon exports which remained stagnant over the years began to indicate a significant growth starting from 2018.Now it has reached 17356 mt. showing 5.5%. increase over the previous year. It was the highest recorded export in the recent history. Export earnings also increased From Rs.Mn. 30873 in 2017 to Rs.mn. 34,853 in 2018 by 12.9 %. It was observed that around 54% of the Total Export Earnings of EAC in 2018 had obtained from Cinnamon Exports.

As a policy, the DEA paid more attention to increase the production, productivity and to improve the quality of products in order to meet the international standards and trade regulations, which enable to compete with other producing countries. The DEA gave more emphasis to ensure the implementation of Food Safety Standards in the domestic production system, while promoting Good Agricultural Practices (GAP) and Good Manufacturing Practices (GMP). In addition, a home garden promotion program called “Dhanasaviya” which was implemented in 2018.had a significant improvement achieving a target of 145,000 home gardens.

This report summarizes the overall performance and related information pertaining to the four divisions of the Department namely Research, Development, Administration and Finance. It includes all the activities of the Department, strategies used to meet the desired goals and the progress achieved during the year 2018.

Dr. A.P. Heenkende
Director General
Department of Export Agriculture
May 2019

GENERAL INFORMATION - 2018

- General information of the EAC sector in 2018
    - Contribution to GDP – 0.7
    - Contribution to export earnings of agriculture – 16.0%
    - Export volume (Mt) – 48,331.82
    - Export Value (Rs.mn.) – 64,590.51
    - Estimated EAC extent (ha) – 111,120 ha (with ginger and turmeric)

District offices, research stations and nurseries of the department

Distribution District Offices

Seventeen offices distributed in the following districts of the country as follows.

Central Province	- Kandy, Matale and Nuwara-eliya
Sabaragamuwa Province	- Kegalle and Ratnapura
Uva Province	- Badulla and Monaragala
Southern Province	- Galle, Matara and Hambantota
Western Province	- Colombo, Kalutara and Gampaha
North- Western Province	- Kurunegala and Puttalama
Eastern Provinse	- Ampara
North Central Province	- Anuradhapura and Polonnaruwa

- Locations of research stations and Sub-Units

Eight Research Stations and Sub-Units located as follows.

1. Central Research Station in Matale
2. Cinnamon Research Station at Pallolpitiya of Matara district
3. Intercropping and Betel Research Station at Dampelassa close to Narammala
4. Economics and Market Research Unit at Head Office in Peradeniya
5. Mid Country Research Station at Delpitiya close to Gampola
6. Tissue Culture Unit and Plant Nursery at Walpita of Gampaha district
7. Research Sub-Unit at Kundasale of Kandy district
8. Research Sub-Unit at Nilambe close to Galaha of Kandy district

- Location of department nurseries

Production of plants are carried out in 10 nurseries in different locations as follows.

Kurunegala District	-	Serapies Plant Nursery at Polgahawela, Holongolla Plant Nursery at Dodangaslanda, Wennoruwa Plant Nursery at Narammala
Nuwaraeliya District	-	Blackwater, Plant Nursery at Ginihaththena Mulhalkele Plant Nursery at Walapane
Matale District	-	Central Plant Nursery at Elwela
Matara District	-	Central Plant Nursery at Mapalana in Kamburupitiya
Kegalle District	-	Central Plant Nursery at Gasnawa, Nelundeniya
Gampaha District	-	Central Plant Nursery at Walpita
Hambantota District	-	Central Nursery and Spice Park at Middeniya

THE DEPARTMENT OF EXPORT AGRICULTURE

1.1 Role and objectives

The major responsibility of the Department of Export Agriculture (DEA) is to develop the Export Agricultural Crop (EAC) sector in order to earn more foreign exchange by increasing the export volume and improving the quality of the products. As officially defined, the perennial crops, of which over 32% of the annual production is exported (excluding tea, rubber, coconut and cashew) and any other crop that is named by the Minister in-charge to be brought under the purview of the department are classified as EACs. As to this classification DEA's main emphasis is to improve traditional crops such as Cinnamon, Pepper, Clove, Nutmeg, Cardamom, Coffee, Cocoa, Betel, Arecanut, Vanilla, Citronella, Lemongrass, Garcinia (*goraka*), *Kithul*, Ginger and Turmeric. The DEA is basically a technical Department and its functions are focused on research and development activities of the EAC sector.

1.2 Major functions

The Promotion of Export Agriculture Crops Act No. 46 dated 22nd September, 1992 of Parliament of the Democratic Socialist Republic of Sri Lanka, embodies and gives statutory status to the functions and services mentioned below.

- Organizing and promotion of cultivation and processing of EACs
- Undertaking multidisciplinary research on crop improvement, crop husbandry, crop protection, post-harvest handling and socio economics
- Production and supply of quality planting material
- Implementation of EAC assistant schemes on crop production, productivity improvement and quality improvement
- Providing crop protection advisory services
- Promotion of Integrated Pest Management
- Promotion of Integrated Plant Nutrient Management
- Promotion of Organic Farming
- Dissemination of information on marketing, quality standards and prices etc.
- Control of importation of EAC products and planting materials etc.
- Training of personals involved in EAC production, processing and trading
- Providing advisory services for the promotion of EACs in estate sector
- Strengthening of the linkages among public and private organizations involved with EACs
- Executive authority vested under the Export Agriculture Act No. 46 of 1992
- Contributing towards EACs related policy matters in other governmental organizations
- Maintenance of technological demonstrations

2. ADMINISTRATIVE DIVISION

2.1 Introduction

The Administrative Division which operates under the direction of the Additional Director General (Administration), oversees the operations of the administrative affairs of the department in co-ordination with all the other divisions and external institutes. Accordingly, major duties such as new recruitments, promotions, transfers, human resource development, control of discipline, departmental examinations, procurement and the maintenance of capital assets of the department are carried out by this division. In addition, the responsibility of implementing, as appropriate, welfare services for the welfare and motivation of the staff also rests with the administrative division.

2.2 The Staff

The approved cadre and the actual cadre in service are given below

Table 2.2.1 Cadre Particulars of the Department of Export Agriculture as at 31st December 2018

Post	Approved Cadre		Actual Cadre	Vacancies/ Excess
	Permanent	Contact Basis		
Director General	01	-	01	00
Additional Director General (Research)	01	-	00	01
Additional Director General Development	01	-	00	01
Additional Director General (Administration)	01	-	01	00
Chief Accountant	01	-	01	00
Director (Research/ Development/ Regulation / Special research)	07	-	00	07
Deputy Director/Assistant Director (Administration)	01	-	01	00
Deputy Director/Assistant Director	67	-	59	08
Accountant	01	-	01	00
Deputy Director /Assistant Director (Planning)	01	-	01	00
Internal Auditor	01	-	01	00
Statistician	01	-	01	00
Total of Senior Level	**84**	**-**	**67**	**17**

Administrative Officer	03	-	01	02
Extension Officer (District/Subject related)	19	-	01	18
Chief Technical Officer	03	-	02	01
Farm Manager (Special Grade)	01	-	0	01
Translator	02	-	01	01
Total of Tertiary Level	**28**	**-**	**05**	**23**
Technical Officer	01	-	00	01
Research and Development Assistant	84	-	79	05
Development Officer	411	-	313	98
Budget Assistant	01	-	01	00
Extension Officer	171	-	145	26
Technological Officer	22	-	19	03
Librarian	03	-	01	02
Farm Manager	20	-	07	13
Public Management Assistant	83	-	78	05
Information and Technological Assistant	01	-	01	00
Warden	01	-	01	00
Farm Services Assistant	02	-	2	00
Total of Secondary Level	800	-	647	153
Driver	61	-	55	06
Mason	01	-	01	00
Tractor Driver	02	-	01	01
Spray Machine Operator	02	-	02	00
Budder	01	-	01	00
Water Pump Operator	01	-	01	00
Nursery Keeper	02	-	02	00
Officer Employee	35	-	30	05
Driver Assistant	08	-	06	02
Watcher	47	-	36	11
Labourer	190	-	137	53
Cook	01	-	01	00
Circuit Bungalow Keeper	02	-	02	00
Total of Primary Level	**353**	**97**	**275**	**78**
Grand Total	**1265**	**-**	**994**	**271**
Watcher		-	17	00
Labourer		-	106	00
Grand Total		**-**	**1117**	**271**

2.3 Changes Made to the staff in 2018

New Appointments

1. Sri Lanka Scientific Service - 03
2. Public Management Assistant Service - 04
3. Driver Assistant - 01
4. Labourer - 21
5. Watcher - 06

Transferred In

1. Development Officer - 08
2. Sri Lanka Planning Service - 01
3. Sri Lanka Administrative Service - 01
4. Public Management Assistant - 08
5. Driver Service - 06
6. Office Employee Service - 03

Transferred Out

1. Sri Lanka Planning Service - 01
2. Administrative Service - 01
3. Development Officer - 05
4. Public Management Assistant - 11
5. Office Employee Service - 02
6. Driver Service - 04

Resignations

1. Development Officer - 02
2. Public Management Assistant - 01

Released from Service

1. Sri Lanka Scientific Service - 01
2. Development Officer - 02

3. Extension Officer - 02
4. Office Employee - 02
5. Driver - 01

Termination of Service

1. Labourer - 05
2. Watcher - 01

Deaths

1. Extension officer - 01

Retirements

1. Sri Lanka Scientific Service - 02
2. Extension Officer - 07
3. Public Management Assistant - 04
4. Driver - 01
5. Labourer - 04
6. Watcher - 01

2.4.1 Particulars on the departmental examinations / efficiency bar examinations held in 2018

Serial No.	Name of Examination / Test	Date of Examination
1	The Second Department Examination for the Technological Officers in Sri Lanka Technological Service	13.07.2018
2	The First Department Examination for the Extension Officers in Sri Lanka Technological Service	29.06.2018
3	The Second Departmental Examination for the Extension Officers in Sri Lanka Technological Service	22.02.2018
4	The First, Second and Third Efficiency Bar Examination for Labourers in Primary Grade	11.10.2018

2.5.1 Particulars on Officers who Received Training 2018

Serial No	Training Institute	Course Participated	Post	No
01	Institute of vocational Development	Bids Evaluation and Reporting	Assistant Director	03
02	Center for Disaster Management	DALA /PDNA Information System Management	Assistant Director	01
03	National Institute of Labour Studies	Preliminary Investigations	Assistant Director (Administration)	01
04	District Secretariat , Kandy	Office Management and Office Methods	Development Officers Public Management Assistant	01 01
05	District Secretariat , Kandy	Development of drivers Knowledge and skills	Drivers	01
06	Skills Development Fund	Continuation and Maintenance of Properties /Equipment Related To Fixed Assets	Development Officers	02
07	Skills Development Fund	F.R. 104, Reporting Losses, Indemnity and Book Keeping	Assistant Director (Administration), Public Management Assistant	01 01
08	Skills Development Fund	Application of Provisions of Establishment Code and Procedural Rules	Public Management Assistant	01
09	Skills Development Fund	Three Day Training for Public Officers	Public Management Assistant	02
10	National Institute of Labour Studies	Training on the Duties of office Assistant Service	Office Employee	02
11	Teleview Technology Academy	Diploma Course in 3D Animation	Development Officer	01
12	Institute of National Co-operative Development	Computer Training Course	Extension Officer Public Management Assistant Research & Development Assistant Development Officers Office Employee	02 30 05 39 05
13	Institute of Vocational Development	Leadership Skills and Personality Development	Public Management Assistant	02
14	Skills Development Fund	Calculation and Accounting of Employees Provident and Employees Trust Funds	Development Officer	01

15	Skills Development Fund	Improving Attitudes and Vocational Knowledge of Office Assistants	Office Employee	03
16	Skills Development Fund	Establishment Code and Financial Regulations	Public Management Assistant Development Officer	02 01
17	Skills Development Fund	Internal Auditing and Internal Control Methods	Public Management Assistant Development Officer	03 01
18	Skills Development Fund	Workshop and Pension Salaries	Public Management Assistant Development Officer	03 01
19	National Institute of labour Studies	Asset Management and Annual Board of Survey	Public Management Assistant Development Officer	01 02
20	University of Kelaniya	Diploma in Public and Media Relations	Development Officer	01
21	District secretariat	Course in Efficiency Bar for officers in Public management Assistant Service	Public Management Assistant	04
22	Ministry of Public Administration Management and Low and Order	Giving Second Language Proficiency to officers in Sri Lanka Scientific service	Assistant Director	16
23	National Institute of labour Studies	Skills Development for Office Management	Public Management Assistant	01
24	National Institute of Languages and Training	6- Day Non Residential Training Course in Tamil Language	Office Employee	28

2.6 Targets Achieved in 2018

- Tranfer of Lands

As per the Proviso 38 (A) Of the Land Acquistion Act the Possession of the Following Lands has been handen over to the department in 2018.

- The land where the Extension Officer Quarters Nikapotha, Haldummulla, Badulla,is located.
- The land where the National Cinnamon Research and Training Centre, Palolpitiya is located.
- The land where the Extension officer Quarters, Dunganwatta, Yatawatta, Matahale is lacated.

3. FINANCE

The Annual Estimates for the year 2018 allocated a financial provision for a sum of Rs1179.465 million under the Head 289 in one programme with, two Recurrent Expenditure projects and two capital Expenditure projects .

3.1: Financial Provision and Expenditure - 2018

Table 3.1: Financial Provision and Expenditure-2018			
Item	Net Provision(Rs)	Expenditure(Rs)	Expenditure (%)
Head - 289			
Programme - 02			
Project -01-Export Crops Development programme			
Capital Expenditure			
Rehabilitation and improvement of Capital Assets	12,500,000	11,669,057	93.35
Buildings and Structures	10,000,000	9,184,870	91.85
Plant, Machinery and equipment	500,000	488,525	97.71
Vehicles	2,000,000	1,995,662	99.78
Acquisition of Capital Assets	12,000,000	11,612,254	96.77
Furniture and office equipment	3,000,000	2,987,538	99.58
Plant machinery and equipment	2,000,000	1,994,205	99.71
Building & Structure	5,000,000	4,638,201	92.76
Lands and Land Improvements	2,000,000	1,992,310	99.62
Infrastrure Development	1,000,000	484,656	48.47
Assisting the Farmers for Export crop development)	500000000	440,432,183	88.09
Development Assistance			
Capacity Building	1,500,000	1,475,869	98.39
Staff Training	1,500,000	1,475,869	98.39
Total Capital Expenditure	527,000,000	465,674,019	88.36
Recurrent Expenditure			
Personal Emoluments	378,670,000	377,825,393	99.78
Other Charges	67,608,000	66,595,688	98.50
General Administration	446,278,000	444,421,081	99.58
TOTAL EXPENDITURE (project-01)	973,278,000	910,095,100	93.51

3.2: Financial Provision and Expenditure (Project- 02) - 2018

Item	Net Provision (Rs)	Expenditure (Rs)	Expenditure (%)
Project-02- Export Crops Research and Integrated pest/disease management (IPM) Programme			
Capital Expenditure			
Rehabilitation and improvement of Capital Assets	5,000,000	4,976,263	99.53
Buildings and Structures	2,500,000	2,488,686	99.55
Plant, machinery and equipment	500,000	494,918	98.98
Vehicles	2,000,000	1,992,659	99.63
.Acquisition of fixed Assets	16,000,000	10,239,228	64.00
Furniture and office equipment	2,000,000	1,733,321	86.67
Plant machinery and equipment	4,000,000	3,999,999	100.00
Buildings and Structures	7,000,000	1,672,329	23.89
Lands and Land Improvements	3,000,000	2,833,579	94.45
Capacity Building			
Staff Training	500,000	411,107	82.22
Other Capital Expenditure			
Infrastrure Development	1,000,000	962,261	96.23
Implementation of National Agricultural Research Plan			
Research and Development	6,000,000	5,930,986	98.85
Total Capital Expenditure	28,500,000	2,519,845	79.02
Recurrent Expenditure			
Personal Emoluments	156,690,000	156,414,291	99.82
Other Charges	20,997,000	20,579,795	98.01
General Administration	177,687,000	176,994,086	99.61
TOTAL EXPENDITURE (project 2)	206,187,000	199,513,931	96.76
TOTAL EXPENDITURE	1,179,465,000	1,109,609,031	94.08

Total allocation of consolidated fund to the development for the year 2018 has decreased by Rs. mn: 98.933 over 2017. Out of total Allocation of Rs. 1179.465 m the expenditure for the year was Rs. 1109.609 m. And this was a 94.08 % of the provision allocation for the year the financial performances of the project 1 and 2 were 93.51% and 96.76% of the allocated funds. Percentages of the amount spent under capital expenditure of the projects 1 2 for 2018

were 88.36% and 79.02% respectively and the same for the recurrent expenditure were 99.58% and 99.6 %. Despite the man power shortages at field level technical cadres the spending of 94.08% of the total annual allocation for the year 2018 was an impressive achievement of the DEA.

3.3 Revenue of 2018

Revenue Source	Estimate(Rs.m.)	Actual(Rs.m.)
Rent on Govt. Building s & Houses	1.70	2.00
Loan Interests -other	4.00	4.30
Departmental sales	9.00	28.40
Sundry Income	45.00	58.20
W & O P	25.00	23.76
Sale of Capital Assets	0.66	0.66
Other Receipts	5.00	15.00

Advance Account Limits

	Estimate Rs.	Actual Rs.
Maximum Limit of Expenditure	45,000,000	44,966,732
Minimum Limit of Receipts	29,000,000	31,555,343
Maximum Limit of Debit Balance	115,000,000	112,653,060

3.4 Internal Audit Division

Objective

Investigating and reporting as per the Financial Regulations 133 and 134 whether the duties and the responsibilities, assigned to our department comprising a head office , district offices, research centers, farms and nurseries and which involves in developmental activities and research , by the Export Agriculture Crops Promotion Act No: 46 dated 22nd September 1992 of the Parliament Of the Democratic Socialist Republic of Sri Lanka and the other acts, circulars and provisions ,are carried out in accordance with those acts, Financial Regulations, Establishment Code, Procurement Guidelines, circulars and other rules and regulations and provisions.

3.4.1 Objectives of Internal Auditing

- Prevention and exposure of frauds and errors in the financial activities by assisting the internal administration of the department and carrying out a continued investigation on the formality and adequacy through internal inspection and reporting to the Director General for future actions.
- Implementing the development and research project schemes assigned to this department and carried out by this development, assisting the Accounting Officer, and in progress reviews to determine the progress achieved in the accomplishment of plans and programs.
- Functioning as a co-ordinator between the persons involved in these activities and the Head of the Department / Progress Review Committee, as the necessity arises.

3.4.2 Responsibilities of Internal Auditing

- Providing assistance in the control of public finance on legal requirements in order to carry out efficiently, productively and transparently the tasks to be performed when reaching the vision, objectives and the mission of the department.

Internal auditing and probes are carried out through the following segments.

- Financial Auditing
- System Analysis
- Performance Analysis
- Special investigations.

3.4.3 Compilation of Internal Audit Reports.

- Audit Reports
- Special Investigative Audit Reports
- Determinations Reports of the Managements Audit Committee

3.4.4 Functions of the Internal Audit Division

- Investigating whether the functionality of the administrative activities is successful for the management of the department.
- Inspecting whether the financial Regulations, orders of the Establishment Code, orders of the Procurement Guidelines and the instructions of the circulars have been duly followed in the accounting and administration activities of the department.

- Probing the reliability of accounts and other reports.
- Assisting in the establishment of practices which enhance the efficiency within the institute.
- Minimizing the inefficiency and frauds and enhancing the quality of the services.
- Inspecting whether the responsibilities vested with the staff of the institute are fulfilled without failure.
- Inspecting to which extent the public properties and assets have been used free from damage.
- Inspecting whether the government transactions are carried out in a manner that minimizes waste and cost, maximizes quality and profitability and protects the properties and assets.
- Holding Auditing and Management committee meeting.
- Auditing of the risky areas of the institute and observing whether the activities of the institute are carried out in accordance with the Action Plan.
- Holding of special probes as the need arises.

3.4.5 Areas Focused in Internal Audit

- Authorization under Financial Regulation 135
- Annual Action Plan
- Procurement Plan and Schedule
- All the accounts including Imprest Accounts, Unsettled Imprest Accounts, expenditure control and asset management.
- Personal files and files related to leave.

Functions Fulfilled

16 Audit Reports were forwarded by the Internal Audit Division in 2018. It included the following units.

- Head Office
- District Office
- Training Center
- Research Centers and Sub Research Stations.
- Central Nurseries
- Auditing and Management Committee meetings were held for all the four quarters of 2018.
- 05 special Investigations were carried out.

4. Development Division

4.1. Introduction

The Development division of DEA plays a vital role in supporting the promotional activities of all stages in EAC value chain development. The division continued its endeavor for efficient implementation of the Development plan - 2018 throughout the year which includes area expansion, productivity improvement, post-harvest and quality product development and certification, human resource development and creating employment opportunities.

The division is headed by an Additional Director General of SL Scientific Services Super grade assisted by 03 Directors of SL Scientific Services class 1 assigned with separate development programmers and two provinces each for the smooth management of district offices. The development activities and services of the division is mainly focused in wet and intermediate zone of Sri Lanka, but recently the DEA has expanded its coverage in to non-traditional districts. The division has now 17 District offices spread across the country namely Galle, Matara, Hambantota, Colombo, Gampaha, Kalutara, Kandy, Matale, NuwaraEliya, Kegalle, Rathnapura, Monaragala, Badulla,Kurunegala, Ampara, Anuradhapura and Polonnaruwa. For district level implementation of Development plan, Assistant Directors of SL Scientific Services Class II/III are entrusted with District level duties of the development division. Field level implementation of the development plan is executed by the Extension officers of SL Technical Services assisted by the Research and Development Officers and Development Officers. For training purposes, the division has an In-service Centre in Matale. Additionally, the Development unit has a Media unit to support the extension and promotional work of the DEA and Business counseling unit to facilitate the marketing aspects.

4.2. Development Programme

With our vision and mission in mind, the Development Plan 2018 was prepared and it has 5 main programmes. All the programs were implemented on 100% GOSL funding.

Table.4.2.1 Development Program 2018

Program	Financial Target (Rs.mn)
1. Crop development program	163.7
2. Productivity Improvement and Home Garden Development Program	247.92
3. Crop value addition Programme	28.5
4. Mass media Program	35.1
5. Capacity building	6.57
6. Administration	18.00
Total	**500.00**

4.2.1. EA Crop development program

The objective of this programme is to increase the extent of EACs to reach higher income for the country as well as for the EAC stake holders while safe guarding the environment.

4.2.1.1. Plant production program

Production of quality planting material is a prime requirement and healthy and quality plant is key to a successful cultivation. To achieve the DEA has 10 central nurseries and annually registered private nurseries in earlier mentioned districts.

Table.4.2.1.1.1 Total Plant requirement of 2018

District	Pepper	Cinnamon	Citronella	Coffee	Nutmeg	Clove	Cardamom	Cocoa	Arecanut	Garcenia	Ginger (Kg.)	Turmeric (Kg.)	Total
Colombo	75,000	150,000	-	-	1,500	-	-	-	10,000	-	5,545	-	236,500
Gampha	310,000	200,000	-	-		-	-	-	50,000	-		-	560,000
Kalutara	245,000	1,000,000	-	-	500	-	-	-	80,000	-	7,935	-	1,325,500
Galle	240,000	4,000,000	-	-	-	-	-	-	1,800	-	15,173	-	4,241,800
Matara	160,000	2,500,000	-	-	-	-	-	-	1,800	-	-	-	2,661,800
Hambantota	200,000	1,800,000	135,000	-	1,500	210	-	-	115,000		240	200	2,251,710
Kandy	350,000	35,000	-	5,000	6,500	600	-	600	25,000	10	555	5,480	422,710
Matale	225,000	210,000	-	6,000	3,000	1,500		10,000	80,000	-	-	-	535,500
N.Eliya	160,000	0	-	50,000	100	2,000	1,700	-	20,000	10	-	-	233,810
Kurunegala	450,000	250,000	-	-	3,000	-	-	5,000	40,000	175	-	-	748,175
Kegalle	445,000	440,000	-	-	3,000	2,000	-	-	30,000		2,319	330	920,000
Ratnapura	475,000	3,600,000	-	-	140		-	-	250,000	315	6,575		4,325,455
Badulla	230,000	105,000	285,000	20,000		2,000	-	-	30,000	-	-	-	672,000
Monaragala	260,000	160,000	-	-	40	-	-	20,000	70,000	-	145	1,985	510,040
Ampara	55,000	30,000	-	-	-	-	-	-	50,000	-	1,765	350	135,000
A.Pura	30,000	40,000	-	-	-	-	-	-	35,000	-	-	-	105,000
Polonnaruwa	80,000	0	-	-	-	-	-	-	35,000	-	-	-	115,000
Total	3,990,000	14,520,000	420,000	81,000	19,280	8,310	1,700	35,600	923,600	510	40,252	8,345	20,000,000

The development division is launching a plant certification program led by an expert team constituted for this purpose, to supply quality planting materials to all growers.

4.2.1.2. Departmental Prices of the EAC planting materials -2018

Central nurseries of the DEA are providing high quality planting materials and demonstrating scientifically advanced nursery techniques. To strengthen the central nurseries several infrastructure developments were taken place in 2018 as given in Table 4.2.1.2.

Table.4.2.1.2. Departmental Prices of the EAC planting materials -2018

Crop	Plants/ Suckers	Price (Rs.)	Seed Material /Cuttings	Price (Rs.)
Cinnamon	Pot with 5 plants	13.00	per 01 kg of seeds	80.00
Pepper	Plant	23.00	per 03 node cutting	0.20
Clove	Large Plant	70.00	-	-
Nutmeg	Seedling (large)	100.00	per 01 seed	10.00
Nutmeg	Budded	180.00	-	-
Cardamom	Sucker (normal)	10.00	-	-
Cardamom	Tissue cultured sucker	50.00	-	-
Vanilla	per 1m cutting	5.00	-	-
Arecanut	per Plant	13.00	per nut	2.00
Cocoa	per Plant	14.00	per pod	20.00
Coffee	Plant	14.00	Per 01 kg of ripened fresh berries	80.00
Coffee			per 01 kg of parchment, dry coffee beans	150.00
Citronella	per sucker	2.00	-	-
Lemongrass	per sucker	2.00	-	-
Garcinea	Seedling	70.00	-	-
Garcinea	Budded	120.00	-	-
Kitul	Large	45.00	-	-
Kitul	Small	12.00	-	-
Ginger	-		per kg	100.00
Turmeric	-		per kg	40.00

Table. 4. 2.1.3. Infrastructure Development Activities of Central Nurseries in 2018

Name of Central Nursery	Development activities Completed
Walpita, Wennoruwa,Holongolla,Gasnawa,Mapalana,Blackwater,Matale, Middeniya,	Construction of new shade net houses (07) & repairing of existing shade net houses(28)
Mapalana -Matara	Deepening the existing well and Construction of a water tank
Gasnawa - Kegalle	Establishment of water pump and three phase power supply

Table.4.2.1.4. Plant Production of Central Nurseries in 2018

Nursery	Pepper	Cinnamon	Coffee	Arecanut	Clove	Nutmeg	Garcinia	Cocoa	Cardamom	Nut (Bud)	Garcinia (Bud)	MudunRikili	Bush pepper	mitikithul	other	Total
Gasnawa	33,496	125,660	-	22,095	315	2,983	2,340	-	-	607	817	700	300	400	-	189,713
Cerapeece	151,000	100,000	-	14,340	-	2,000	-	4,000	-	-	-	3,650	-	-		274,990
Holongolla	88,000	110,000	-	11,000	36	865	-	4,000	-	-	80	3,200	-	-	1,900	219,081
Wennoruwa	62,000	100,000	-	18,000	-	-	500	4,000	-	-	-	1,400	-	-	-	185,900
Middeniya	12,439	10,600	-	450	-	-	-	-	-	-	-	-	-	-	200	23,689
Matale	100,000	25,000	1,335	30,547	-	1,405	-	12,500	-	-	-	-	-	-	-	170,787
Walpita	95,700	128,500	-	19,100	135	-	75	-	4,620	-	-	1,175	577	-	1,915	251,797
Mapalana	11,073	240,000	-	-	-	650	-	-	-	-	-	135	-	-	2,400	254,258
Mulhalkele	20,335	-	34,500	2,700	350	-	-	-	-	-	-	-	-	-	-	57,885
Black Water	25,298	-	25,514	5,500	-	1,325	750	-	-	-	-	516	-	-	-	58,903
Total	599,341	839,760	61,349	123,732	836	9,228	3,665	24,500	4,620	607	897	10,776	877	400	6,415	1,687,003

To increase the accessibility to healthy EAC plants, during 2018, 854 registered nurseries were established by the district extension staff. Nurserymen were given skill development training and nurseries were provided with investment assistance programme to strengthen infra-structure facilities i.e. to establish shade net houses and establish micro - irrigation systems.

Table.4.2.1.5 Active Registered Nurseries in 2018

District	No. of Nurseries
Colombo	19
Gampaha	31
Kalutara	44
Galle	71
Matara	81
Hambantota	32
Kandy	75
Matale	57
Nuwara Eliya	38
Kurunagala	40
Kegalle	52
Rathnapura	77
Badulla	54
Monaragala	79
Ampara	39
Anuradhapura	27
Polonnaruwa	38
Total	**854**

To establish a micro-irrigation system nurseryman were provided with financial assistance up to 50,000.00 which is the 50% of the establishment cost. For a new shade net house, a financial assistance of Rs, 150,000.00 was granted in two steps and 50% of that sum has to pay back when the plants were issued. (This program was funded by the Treasury)

Table.4.2.1.6. Infrastructure Developments of Registered Nurseries – 2018

District	Shade net houses	Micro-irrigation systems
Colombo	1	0
Gampaha	1	1
Kalutara	1	6
Galle	1	5
Matara	3	5
Hambantota	2	3
Kandy	5	1
Matale	4	0
Nuwara Eliya	3	0
Kurunegala	7	0
Kegalle	4	5
Rathnapura	5	3
Badulla	2	0
Monaragala	4	1
Ampara	2	0
Anuradhapura	0	0
Polonnaruwa	2	0
Total	**47**	**30**

Plants issued by the registered nurseries of the districts in 2018 are given below.

Table. 4.2.1.7. Plant issues by the Registered Nurseries in 2018

District	Number of Plant Issued
Colombo	239,969
Gampaha	375,483
Kalutara	1,241,231
Galle	4,146,242
Matara	2,569,970
Hambantota	1,941,300
Kandy	348,941
Matale	456,519
Nuwara Eliya	131,983
Kurunagala	478,494
Kegalle	751,780
Rathnapura	4,319,014
Badulla	474,060
Monaragala	461,680
Ampara	106,797
Anuradhapura	1,710
Polonnaruwa	35,369
Total	**18,080,542**

Table.4.2.1.8. District wise Total Plant issues -2018

District	Pepper	Cinnamon	Citronella	Coffee	Nutmeg	Clove	Cardamom	Cocoa	Arecanut	Garcenia	Ginger (Kg.)	Turmeric (Kg.)	Total
Colombo	72,404	154,075	-	-	1,300	-	-	-	13,490	-	5,545	-	241,269
Gampha	304,341	203,350	-	-	-	-	-	-	42,403	-	-	-	550,094
Kalutara	240,398	994,800	-	-	237	-	-	-	73,980	-	7,935	-	1,309,415
Galle	244,762	3,932,560	-	-	-	-	-	-	1,220	-	15,173	-	4,178,542
Matara	160,316	2,509,096	-	-	-	-	-	-	1,140	-	-	-	2,670,552
Hambantota	199,195	1,724,900	125,560	-	1,000	245	-	-	110,090	-	240	200	2,160,990
Kandy	345,348	37,600	-	4,710	6,441	586	-	525	22,611	3	555	5,480	417,824
Matale	227,209	212,500	-	5,400	2,560	1,406	-	8,087	70,566	-	-	-	527,728
Nuwara Eliya	157,560	-	-	42,561	47	1,862	2,000	-	16,843	10	-	-	220,883
Kurunegala	450,430	245,500	-	-	2,407	-	-	5,490	34,766	146	-	-	738,739
Kegalle	440,901	434,350	-	-	2,840	2,023	-	-	20,330	-	2,319	330	900,444
Ratnapura	470,275	3,597,600	-	-	148	-	-	-	238,605	200	6,575	-	4,306,828
Badulla	232,485	99,600	274,400	16,310	-	1,795	-	-	28,310	-	-	-	652,900
Moneragala	267,905	130,900	-	-	45	-	-	16,200	62,040	-	145	1,985	477,090
Ampara	49,247	21,750	-	-	-	-	-	-	43,230	-	1,765	350	114,227
Anuradhapura	28,651	32,720	-	-	-	-	-	-	20,340	-	-	-	81,711
Polonnaruwa	77,213	-	-	-	-	-	-	-	27,390	-	-	-	104,603
Total	3,968,640	14,331,301	399,960	68,981	17,025	7,917	2,000	30,302	827,354	359	40,252	8,345	19,627,881

4.2.1.2. New planting program

This is one of the main programs of the DEA where area expansion of EAC is concerned. Good Agricultural Practices has to be practiced by the grower during the land preparation to minimize the soil and water degradation. For the cultivation of pepper, cinnamon, citronella and coffee, growers has to pay 50% of the cost of planting materials while nutmeg clove, cocoa and cardamom plants were given 100% free of charge.

Table.4.2.1.2.1 Investment Assistance Scheme of new planting program in 2018

Crop	No of Plants/Ha	Total Value for Plants/Ha (Rs.)	Departmental Investment for Plants(Rs.)	Farmer Investment for Plants(Rs.)
Cinnamon	9,000	117,000	58,500	58,500
Pepper	1,700	39,100	19,550	19,550
Arabica Coffee	3,000	42,000	21,000	21,000
Robusta Coffee	1,600	22,400	11,200	11,200
Citronella	28,000	56,000	28,000	28,000
Nutmeg	250	25,000	25,000	-
Cardamom	2,000	20,000	2,000	-
Clove	250	17,500	17,500	-
Cocoa (With Rubber)	10,000	14,000	14,000	-

A target of 1030 ha was set as the target of new cultivation for 2018 and that target was successfully achieved. The District wise progress is given in the Table below.

Table.4.2.1.2.2. Progress of New Planting program 2018

District	Cinnamon	Pepper	Citronella	Coffee	Nutmeg	Clove	Cocoa	Cardamom	Total
Colombo	11.70	4.60	-	-	-	-	-	-	16.30
Kalutara	74.10	7.70	-	-	-	-	-	-	81.80
Gampaha	18.55	20.90	-	-	-	-	-	-	39.45
Galle	139.79	1.98	-	-	-	-	-	-	141.77
Matara	141.20	5.45	-	-	-	-	-	-	146.65
Hambantota	89.40	6.20	2.00	-	-	-	-	-	97.60
Kandy	4.11	41.00	-	1.30	5.5	1.8	-	-	53.71
Matale	23.50	38.19	-	1.80	4	2.8	2.5	-	72.79
Nuwara Eliya	-	13.80	-	3.20	-	1.9	-	1.00	19.90
Kegalle	39.40	36.40	-	-	-	6.80	-	-	82.60
Rathnapura	88.35	31.15	-	-	-		-	-	119.50
Badulla	7.60	38.70	9.80	1.60	-	1.60	-	-	59.30
Monaragala	7.40	43.08	-	-	-	-	16.20	-	66.68
Kurunegala	18.70	41.00	-	-	5.40	-	3.00	-	68.10
Ampara	0.40	8.70	-	-	-	-	-	-	9.10
Anuradhapura	1.10	1.30	-	-	-	-	-	-	2.40
Polonnaruwa	-	2.90	-	-	-	-	-	-	2.90
Total	665.30	343.05	11.80	7.90	14.90	14.90	21.70	1.00	1080.55

4.2.2 Productivity Improvement Programme

Under this program 2 sub programs were launched, namely, Productivity enhancement of existing pepper and cinnamon cultivations and "Danasaviya" Home Garden Development Program.

4.2.2.1: Productivity Improvement of Pepper and Cinnamon Cultivations

Given the importance of reaching the one billion dollars of foreign exchange by exporting EACs in the year of 2020, enhancement of crop productivity was given a priority role. In 2018 productivity improvement programme was initiated with the objective of supporting the EAC growers to increase the productivity of their pepper and cinnamon plantations by increasing awareness, providing planting materials for gap-filling under 50% investment assistance scheme and providing assistance to establish micro irrigation systems to mitigate drought hazards, also under 50% investment assistance scheme.

Growers were given scientific knowledge of GAP and GMP of productivity improvement of pepper and cinnamon through farmer training classes. For this purpose, extension staff was supplied with advanced training aids. To tackle the problem of soil acidity which is common in EAC growing areas, extension officers used pH meters to test the soil samples and advice farmers on soil nutrition management.

Farmer clinics, mass awareness programmes on PIP of pepper and cinnamon, were earmarked to provide extension and other agro services at one stop shop model. These were conducted in high potential areas with active participation of farmers with public and private sector institutions related to agriculture. Research specialists were available to solve field problems such as pest and diseases, plant nutrition etc. Farmers were given facilities to test soil samples and quality of their EAC products. Private sector was represented by fertilizer, agrochemical, pest management, micro irrigation areas.

Table.4.2.2.1. Progress of the Productivity Improvement Programme - 2018

Disrtic	Gap filing						Farmer Clinic		Micro irrigation systems
	Pepper (Ha)	No of plants issued	Cinnamon (Ha)	No of plants issued	Total (Ha.)	Total No of plants issued	No	Beneficiary	
Colombo	1.4	680	6.7	15375	8.1	16055	1	258	
Gampaha	12.8	3790	7.5	9750	20.3	13540	1	436	9
Kalutara	1	400	15.2	18800	16.2	19200	1	260	-
Galle	-	-	168.5	84360	168.5	84360	1	232	-
Matara	-	-	41.2	39023	41.2	39023	1	409	-
Hambantota	-	-	31.2	44500	31.2	44500	1	226	5
Kandy	1.2	640	-	-	1.2	640	1	247	-
Matale	40.6	12460	0.6	1000	41.2	13460	1	395	-
Nuwara Eliya	2	860	-	-	2	860	1	267	1
Kurunegala	21.2	11500	-	-	21.2	11500	1	300	4
Kegalle	7	3510	4	10750	11	14260	1	381	1
Rathnapura	2.8	1770	7.2	12950	10	14720	1	300	2
Badulla	10.9	4025	2.1	3200	13	7225	1	320	-
Monaragala	4.9	3430	-	-	4.9	3430	1	265	-
Ampara	-	-	-	-	-	-	-	-	-
Anuradhapura	-	-	-	-	-	-	-	-	1
Polonnaruwa	-	-	-	-	-	-	1	436	2
Total	104.4	42385	277.5	224333	381.9	266718	15	4,474	26

4.2.2.2. "Danasaviya" EAC based Home Garden Programme

This program was initiated to uplift the economic capability of women by supporting them to establish export agricultural crop dominated home gardens. The programme was aimed at the holistic development of small scale EAC sector by ensuring forward and backward linkages through a cluster approach with the active participation of women. It is expected that the production of these EAC dominated home gardens will contribute to the national economy. Table: 4.2.2.2.1 shows the Compositions of Export Agriculture Crops in Home Gardens.

Table: 4.2.2.2.1. Composition of crops in EAC based Home gardens – 2018

Type of HG	Pepper	Cinnamon	Arecanut	Nutmeg	Clove	Coffee	Citronella	Garcinia	Turmeric	Ginger	AVERAGE
Pepper	30-80	-	-	-	-	-	-	-	-	-	pepper -40
Cinnamon	-	300-500	-	-	-	-	-	-	-	-	cinnamon - 500
Nutmeg	-	-	-	3-10	-	-	-	-	-	-	nutmeg - 5
Clove	-	-	-		3_10	-	-	-	-	-	clove - 5
Arecanut	-	-	50-100	-	-	-	-	-	-	-	Arecanut -80
Coffee / pepper	0-10	-	-	-	-	50-100	-	-	-	-	coffee -60 / pepper -10
Citronella	-	-	-	-	-	-	1000	-	-	-	citronella - 1000
Garcinia	-	-	-	-	-	-	-	5	-	-	Garcinia - 5
Turmeric	-	-	-	-	-	-	-	-	30	-	turmeric - 30kg
Ginger	-	-	-	-	-	-	-	-	-	40	ginger - 40 kg

Crop composition of home gardens was selected based on the preference of the beneficiary as well as climatic suitability for the region. All women beneficiaries were trained on GAP of home gardening and productivity improvement of their existing home gardens.

This “Danasaviya” program was introduced to this country by the DEA in 2018 targeting **50,000** home gardens. In 2017 140,904 home gardens were established and for 2018 121,302 number of home gardens were targeted and 125,910 number of home garden units were successfully completed. The extension officers and development officers of DEA have successfully achieved this.

Table. 4.2.2.2.2 Progress of the Danasaviya home garden Development Programme-2018

District	Established HG											
	Pepper	Cinnamon	Nutmeg	Clove	Arecanut	Citronella	Garcenia	Pepper with Areca/Coffee	Cocoa	Turmeric	Ginger	Total
Colombo	1,695	53	424	-	42	-	-	-	-	-	142	2,356
Gampaha	6,738	33	-	-	43	-	-	-	-	-	-	6,814
Kalutara	6,604	580	77	-	108	-		736	-	-	194	8,299
Galle	5,743	4,517	-	-	5	-	-	-	-	-	435	10,700
Matara	4,321	1,973	-	-	26	-	-	-	-	-	-	6,320
Hambantota	2,401	1,700	200	49	51	71	-	3739	-	10	12	8,233
Kandy	8,730	1	1,159	38	138	-	-	13	-	16	146	10,241
Matale	5,723	-	-	-	-	-	-	-	-	-	-	5,723
Nuwara Eliya	4,059	-	4	334	7	-	-	665	-	-	-	5,069
Kurunegala/ Puttalama	12,502	158	255	-	123	-	63	508	63	-	-	13,672
Kegalle	10,781	121	753	88	179	-	-	-	-	11	68	12,001
Rathnapura	12,971	5,525	30	-	599	-	1	1793	-	-	165	21,084
Badulla	4,884	56	-	279	146	-	-	230	-	-	-	5,595
Monaragala	4,971	126	14	-	96	-	-	-	-	4	56	5,267
Ampara	975	36	-	-	562	-	-	-	-	58	9	1,640
Anuradhapura	839	28	-	-	27	-	-	-	-	-	-	894
Polonnaruwa	1,944	-	-	-	6	-	-	52	-	-	-	2,002
Total	**95,881**	**14,907**	**2,916**	**788**	**2,158**	**71**	**64**	**7,736**	**63**	**99**	**1,227**	**125,910**

Table: 4.2.2.2.3 Plant Issues of "Danasaviya" Home Garden Development Program - 2018

District	Pepper	Cinnamon	Citronella	Coffee	Nutmeg	Clove	Cardomom	Cocoa	Arecanut	Garcenia	Total
Colombo	63,904	33,400	-	-	1,300	-	-	-	7,380	-	105,984
Gampaha	263,536	18,750	-	-	-	-	-	-	32,678	-	314,964
Kalutara	226,908	309,100	-	-	237	-	-	-	13,715	-	549,960
Galle	240,887	2,558,350	-	-	-	-	-	-	1,220	-	2,800,457
Matara	151,051	1,196,273	-	-	-	-	-	-	1,140	-	1,348,464
Hambantota	188,655	875,800	71,000	-	1,000	245	-	-	91,495	-	1,228,195
Kandy	275,008	600	-	810	5,066	136	-	525	10,096	3	292,244
Matale	148,780	1,000	-	-	1,560	706	-	7,000	43,960	-	203,006
Nuwara Eliya	133,240	-	-	32,961	47	1,387	-	-	3,575	10	171,220
Kurunegala/ Puttalama	365,815	77,200	-	-	1,057	-	-	2,190	11,466	146	457,874
Kegalle	375,515	69,000	-	-	2,840	323	-	-	15,080	-	462,758
Ratnapura	415,550	2,789,500	-	-	148	-	-	-	164,960	200	3,370,358
Badulla	162,670	28,000	-	11,510	-	1,395	-	-	8,810	-	212,385
Moneragala	196,415	64,300	-	-	45	-	-	-	42,820	-	303,580
Ampara	34,457	18,150	-	-	-	-	-	-	28,840	-	81,447
Anuradhapura	27,291	22,820	-	-	-	-	-	-	11,030	-	61,141
Polonnaruwa	70,753	-	-	-	-	-	-	-	2,090	-	72,843
Total	**3,340,435**	**8,062,243**	**71,000**	**45,281**	**13,300**	**4,192**	**-**	**9,715**	**490,355**	**359**	**12,036,880**

4.2.3. Crop Value Addition Programme

The objective of this programme is to increase foreign income and explore new markets through value addition to EAC products. This programme had two sub programmes. These sub programmes were carried out by the Business Counseling unit of the division.

4.2.3.1. Quality improvement

Extension officers were given quality measuring equipments to help farmers to measure the quality of their processed EAC products

4.2.3.2. Establishing organic villages

Under this programme establishment of organic villages and facilitating to acquire organic certification to meet the growing international organic EAC market were carried out. For this purpose, some of the EAC cultivations were converted in to organic. Growers were trained on aspects of organic farming and assisted their farmer organization to get internationally accredited Organic certificate by facilitating 50% of the cost of certification.

Table.4.2.3.2.1 Progress of the Organic Villages Programme – 2018

District	Main Crop/s	1st Installment (2018)		2nd Installment (2017 Continuation)	
		Beneficiaries	Ha	Beneficiaries	Ha
Kaluthara	Cinnamon	11	4.4	75	23.2
Kandy	Pepper/ Nutmeg/ Clove	6	3.8	159	43.3
Matale	Pepper/ Nutmeg/ Clove	41	17.3	78	75
Kurunegala	Pepper	57	20	83	35
Nuwara Eliya	Pepper	61	14.5	15	4
Gampaha	Pepper	9	10.2	23	13
Kegalle	Pepper/ Clove	32	10.9	35	12.4
Badulla	Pepper	64	33	56	17.9
Rathnapura	Pepper / Cinnamon	41	10.8	36	9.35
Total		**322**	**124.9**	**560**	**233.15**

4.2.3.3. Popularize Good Agricultural Practices (GAP) and Good Manufacturing Practices (GMP)

Under this programme awareness of the EAC stake holders on GAP and GMP were enhanced through training. With the aim of uplifting the standards of existing post-harvest processing centres the processors of were encouraged to develop their processing techniques

to suit the required level. Under the above programme **03 Processing Centers** were developed to suit Good Manufacturing Practices.

4.2.3.4. Optimization of yield through appropriate technology i.e. use of advance post-harvest machineries and processing techniques.

Farmers were supported to purchase machineries with high technology and establish processing centres to improve quality of the final EAC product and the efficiency of the system by means of investment assistance. This investment assistance was paid only for stainless steel machineries and processing units. This step was taken to encourage them to be in par with the international food standards.

Table. 4.2.3.4.1 Progress of the Optimization of yield through appropriate technology

District	Processing Units					
	Machinery			Processing Centers		
	Dryers (Multicrop)	Coffee Pulper	Oil Distillation Units	Cinnamon Processing Centers		Coffee Processing Centers
				Medium	Small	Small
Kandy	2		-	-	-	-
Matale	1		-	-	-	-
Nuwara Eliya	-	1	-	-	-	1
Kurunegala	-		-	-	1	-
Galle	1		9	1	5	-
Matara	-		4	1	4	-
Hambantota	-			1	1	-
Badulla	-	-	1	1		-
Moneragala	-	-	-	-	-	-
Kegalle	-	-	-	-	-	-
Ratnapura	-	-	1		3	-
Colombo	-	-				-
Kalutara	-	-	1	2	4	-
Gampaha	4	-	-	1	1	-
Total	8	1	16	7	19	1

4.2.3.5. Trade promotion

To increase the awareness of the people on EACs and their importance as well as the current developments of the trade two mass scale programmes were taken place in 2018. A Cinnamon Week was declared in Matara with Exhibition which was attended by record

number of visitors. Annual Fresh Cinnamon Pooja (Nevum kurundu mangallaya) was successfully held at Seenigama Devalaya in Galle with the participation of cinnamon farmer societies.

Table.4.2.3.5.1 Progress of the Cinnamon week

Date	Place	Programme/Activity	No.of Participants
2018.05.07	Pallebedda (Rathnapura)	Awareness programme on Cinnamon Cultivation at Sathi Pola	552
2018.05.07	Kamburupitiya	Field day programme on Productivity improvement of Cinnamon	53
2018.05.07	Ethkandura (Galle)	Field day programme	86
2018.05.08	Handugala (Hambantota)	Field day programme	110
2018.05.08	Agalawatte (Kalutara)	Field day programme on Organic Cinnamon	79
2018.05.08	Aluthwela (Galle)	Field day programme on Productivity improvement of Cinnamon	46
2018.05.08	Dehiyandara (Matara)	Awareness programme on Cinnamon Cultivation at Sathi Pola	202
2018.05.08	Kolonna (Rathnapura)	Farmer Clinic programme	104
2018.05.09	Cinnammon Research Station (Matara)	Regional Technical Working Group meeting on cinnamon	80
2018.05.10	Matara	Exhibition on Cinnamon cultivation processing and value addition	905
2018.05.11	Matara	Exhibition on Cinnamon cultivation processing and value addition	1557

4.2.4 Awareness and Communication

4.2.4.1 Mass Media program

Main task of this programme is to promote all research and development activities of DEA and dissemination of latest scientific and technical know-how to the EAC stake holders through print and electronic media as well as through exhibitions. The division has well

equipped media and communication unit with qualified staff. In several exhibitions the DEA stall has been awarded for its artistic and informative way of style.

Table.4.2.4.1. Progress of the Mass Media Programme

Media	Activity	Progress (No. of Programs)
Printed Media	Leaflets printed in Sinhala, Tamil and English languages were distributed among the general public who were the interested parties of the spice sector.	296,189
	Large boards and flexes were designed and displayed in the special exhibitions and other events held in national level.	70
	Weekly average Prices of the Export Agricultural Crops were published in "Dinamina" national newspaper on every Friday.	51
Electronic Media - Rupawahini	Production and telecasting of "SangawunuKahawanu" program on 2nd and 4th Friday of each month on "JathikaRupawahini".	24
	"Production and telecasting of "RanmasuUyana" program on every 1st and 3rdSaturday at 07.15 am on "JathikaRupawahini".	08
	"Spice Mag" documentary was telecasted on Chanel Eye at 09.30 pm on 1st Sunday of every month.	07
Electronic Media - Radio	"Rasa Janani" program was broadcast on every Saturday at 04.00 pm on Kandurata Service(F.M. 107.3) at 04.30 on Ruhunu Service (F.M. 107.3), Commercial Service(F.M. 94.3), Rajarata Service (F.M. 107.3)Wayamba Service(F.M. 90.1)in the same time.	49
	"Rasa Manjari" program was broadcast on ITN service at 08.00 pm on every Sunday.	43
	"Krushi FM web Radio program was webcast at 10.00 am on 1st and 3rd Thursday of every month.	24
Exhibitions (National Level)	Exhibition stalls were designed and installed.	15

4.2.4. 2. Spice Park Project

To demonstrate the scientific methods of EAC cultivation and attract the local and foreign tourists a spice park was established in the Matale research centre premises.

4.2.5 Capacity building program

4.2.5.1 Knowledge and skill development of farmers

To obtain the targeted production, productivity, quality and finally the income farmers should be armed with scientific knowledge in Good Agriculture Practices and Good Management Practices. Extension staff of the DEA is entrusted with this responsibility in field level. They transfer technical knowhow of all aspects of EACs and disseminate research findings to the growers as well as other EAC sector personnel. Through farmer training and field day the data confirmed from the districts reflected huge number of participation by the beneficiaries. (Table.4.2.5.1.)

Table 4.2.5.1.1 Progress of the Farmer Training and Field Days held in 2018

District	Training Programs				Field days				Dhanasaviya			
	GAP &GMP											
	No. of Training Programs		No. of Beneficiaries		No. of Training Programs		No. of Beneficiaries		No. of Training Programs		No. of Beneficiaries	
	Target	Progress	Target	Progress	Target	Progress	Target	Progress	Target	Progress	Target	Progress
Colombo	30	33	600	727	6	6	120	168	48	67	1440	1364
Gampaha	190	191	5700	4879	44	41	1350	1175	170	199	7200	7504
Kaluthara	125	103	3559	2818	16	15	320	471	110	156	4400	4405
Galle	220	136	4400	4275	7	15	140	639	150	234	6000	7678
Matara	30	34	700	1237	10	8	250	462	130	136	6944	5048
Hambanthota	55	43	1000	1417	15	12	0	701	105	162	11250	8081
Kandy	175	210	3480	6573	4	31	120	1314	120	190	3600	6419
Matale	113	116	3390	2930	11	17	220	378	191	185	5760	4820
Nuwara Eliya	62	60	1550	1968	35	49	875	1424	134	136	4020	4648
Kurunegala	210	155	4200	4592	4	15	80	356	260	283	8800	10349
Kegalle	45	76	800	2122	7	20	140	804	300	321	1200	10636
Rathnapura	77	98	2200	3315	22	37	660	1098	220	313	13200	13127
Badulla	120	136	2200	3369	30	32	600	887	220	223	6000	6250
Monaragala	90	57	2000	1305	20	14	400	329	100	88	4000	2447
Ampara	12	15	280	376	7	5	140	207	70	82	3000	3505
Anuradhapura	20	10	400	446	4	0	120	0	40	57	1400	2648
Polonnaruwa	8	8	240	359	4	2	80	130	100	76	3000	2493
Total	1593	1493	36924	43096	248	323	5655	10588	2488	2944	92014	102259

4.2.5.2 In-Service Training Centre in Matale

In the In-Service Centre of the DEA training programs are conducting to improve the skills and professional competence of departmental staff as well as officers of other public and private organizations. Additionally, many stake holders of EAC value chain are trained during the year of 2018. (Table.4.2.5.2.1)

Table. 4.2.5.2.1 Training Programs conducted at In Service Training Centre in Matale

Training Programmes	Total Number of Training Programmes	Total Number of Beneficiaries
DEA Officers Trainings	15	492
Field Staff trainings of other Institutes	7	381
Entrepreneurs Trainings (Crops & Organic)	11	496
Other Institutes (Universities/Agriculture Schools/Mahaweli Authority/Defence Ministry)	20	679
Conference/Workshops	13	526
Total	**66**	**2,574**

4.2.6. Other Programmes

4.2.6.1. Mushroom Cultivation Programme

This program was initiated to uplift the economy of the rural sector by facilitating them to acquire technology of mushroom cultivation and provide investment assistance to establish mushroom sheds. This program was initiated and funded by the Ministry of Primary Industries and field implementation was done by the extension staff of the. Under the above programme **09** Mushroom sheds were established.

4.2.6.2. Pineapple Cultivation Programme

This program was initiated and funded by the Ministry of Primary industries to enhance the export volume and earning from the pineapple and create an income for the

growers. Field implementation was performed by the extension staff of the DEA and was funded by the Ministry of Primary Industries. This programme was launched in Kurunegala, Gampaha and Puttalama Districts and 128.08 ha of pineapple was cultivated with 129 beneficiaries.

4.2.6.3. Compensation for the EAC growers for flood Damages in 2017

In 2017 many cinnamon and pepper cultivations, EAC nurseries and processing centres were damaged by severe floods in Galle, Matara. Kalutara, Hambantota and Rathnapura districts. The damaged cultivations were provided with planting materials free of charge. Additionally, all farmers, nurserymen and processers of whom EAC assets were damaged were given compensation worth Rs.mn.19.2. This was funded by the Ministry of Primary Industries.

Table. 4.2.6.3.1 Details of the compensation for flood damages

District	cultivations		Nurseries		Processing centres		Plant issues for gap filling		Total
	No	Compensation, Rs	No	compensation Rs	No	Compensation Rs	beneficiaries	Value of plants Rs	
Kalutara	40	1,229,050.00	3	582,400.00	-	-	34	571,343.00	2,382,830.00
Rarhnapura	48	1,298,100.00	6	739,800.00	-	-	-	-	2,037,906.00
Galle	371	7,560,850.00	6	735,500.00	-	-	404	2,740,850.00	11,037,610.00
Matara	71	982,150.00	13	1,301,300.00	1	75,000.00	398	521,885.00	2,880,747.00
Hambantota	-	-	4	3,144,600.00	-	-	-	-	944,600.00
Total	530	11,070,150.00	32	6,503,600.00	1	75,000.00	836	3,834,078.00	19,283,693.00

4.2.6.4. Introduction of Pepper cultivation as a substitute crop for Tobacco

The programme of pepper cultivation replacing tobacco was successfully implemented under the program of "National Drug Prevention Programme." by the Department of Export

Agriculture funded by the Presidential Secretariat under the concept of the president of socialist republic of Sri Lanka.

The programme, which is designed to in par with the presidential concept of "a country free from drugs", was conducted in Ududumbara and Medadumbara divisional secretariats of Kandy District. Numbers of training programmes were conducted to aware tobacco cultivators in the area and 50% cash grant was granted for the selected farmers based on the actual cost spent by the farmers for pepper cultivations. In addition, quality certified planting materials were distributed to the selected farmers and closely supervised the cultural practices of pepper including land preparation and planting. Similarly, with having objective of mitigating the effect of climate change to pepper cultivations, 13 micro irrigation systems were introduced to selected pepper farmers in the above areas. In addition, free plastic tanks were provided for every pepper land to stock water to use at an adverse drought conditions. The Presidential Secretariat provided a provision of Rs.mn 17.99 and final financial progress was Rs. Mn17.58.

Table.4.2.6.4.1 Introduction of Pepper cultivation as a substitute crop for Tobacco

Activity	Number of Beneficiaries	Financial Progress Rs. Mn
Farmer Training	185	0.17
Financial assistance	185	12.42
Water tanks	300	2.50
Drip Irrigation	13	1.70
Field Day Programms	-	0.02
Purchasing equipment	-	0.32
Administration cost	-	0.41
Total		**17.58**

5. RESEARCH DIVISION

5.1 Technical functions and organization of Research Division

The Research Division operates under the supervision of the Additional Director General (Research) and consists of three main units; Commodity Research Unit, Economic Research Unit and Plant Protection Unit. Central Research Station and six sub-stations had constantly been developing appropriate technologies to solve farmers' problems and new technology to enhance the production, productivity and quality of Export Agriculture Crops. The locations of the Research stations and their functions are given below.

- Central Research Station, Matale - Multidisciplinary Research on EACs except Cinnamon, Citronella and Betel
- National Cinnamon Research and Training Center, Pallolpitiya, Matara - Multidisciplinary Research on Cinnamon and Citronella
- Intercropping & Betel Research Station, Narammala - Intercropping of EACs with Coconut and Betel
- Tissue Culture Laboratory and Plant Production Nursery, Walpita - Tissue Culture Research and Plant Propagation
- Sub-Research Station, Kundasale - Multidisciplinary Research mainly on Cocoa, Kithul, Ginger and Turmeric
- Sub-Research Station, Nillambe - Cropping Systems
- Sub-Research Station, Delpitiya - Organic Farming and Spice Park
- Economic Research Unit, Head Office, Peradeniya - Conducting of Economics and Marketing Research

Central Research Station and Plant Protection Unit function under the Director (Research) of Matale. Cinnamon Research Station and Betel Research Station are also operated under two Directors (Research), while other sub-research stations function under the supervision of the respective Research Officers in-charge. The progress of the research projects conducted in 2018 at the main research station and other sub-stations are described below, on crop and discipline basis.

5.2 Research achievements on EAC's during the year of 2018

5.2.1 Cinnamon

Agronomy & Crop improvement

Evaluation and comparison of superior quality characteristics of Accession A1 with selected cinnamon accessions (Sri Gemunu and Sri Wijaya).

To identify superior accessions of true cinnamon for future breeding programs, collection, establishment of cinnamon accessions at National Cinnamon Research & Training Centre NCRTC, screening and evaluation of different elite accessions in farmer fields have been performed. According to the information received "Pieris Cinnamon", one accession with elite characteristics known by cinnamon growers in Galle district was collected from different locations and established at NCRTC. However, a pure line could not be survived as cinnamon is totally adapted for cross pollination, the study was conducted to screen and evaluate superior quality characteristics of the said accession comparing with selected accessions and Sri Gemunu and Sri Wijaya aiming to identify the possibility of using in future varietal improvement programs. Similar to the previous harvests, out of the four accessions collected, accession A1 showed the highest average dry bark yield per stem (182 g), greater growth performances, low severity of disease and pest damages (<10 %) and distinctively erect stem with lengthy internodes comparing to superior varieties Sri Wijaya and Sri Gemunu.

Multiplication and evaluation of selected hybrid cinnamon plants under recommended agronomic practices for quality, growth, and yield performances.

Hybridization program was started at NCRTC in order to produce elite new varieties to enhance quality and quantity of cinnamon production. Crosses were made between selected cinnamon accessions and 46 hybrid plants were produced and established in the field of NCRTC. After screening and evaluation of the plants, ten plants with elite characteristics (higher bark yield and low severity of pest and disease) were initially selected. For further evaluation multi-locational trials under recommended agronomic practices were conducted and multiplication of the selected hybrid plants by vegetative propagation was started.

Identification of chemical and element composition of sandy textured cinnamon bark tissues

Cross sections of bark tissues were observed under the microscope and total elements of affected bark samples were determined in sandy textured plants in comparison to variety Sri

Gemunu considering as the normal plant at different maturity level of the stem. When observing the cross sections under microscope of affected bark in comparison to normal bark, it was evident that affected bark showed rod shape light brown depositions in between cell layers of bark tissues than normal bark increased with maturity. Correspondingly sandy textured bark tissues contain Calcium than variety Sri Gemunu and increased significantly with maturity of the stem.

Effect of different concentration of plant hormone

The concentrations 0 ppm (Control), 1000ppm, 2000ppm, 3000ppm, 4000ppm and 5000ppm of Indole Butyric Acid (IBA) and Naphthalene Acetic Acid (NAA) were tested on propagation through stem cuttings of cinnamon. IBA and NAA 4000ppm, 5000ppm treated cuttings showed better effect on the root dry weight and root volume but 1000ppm to 5000ppm IBA and NAA did not show significant effect to the shoot length, no of leaves, shoot dry weight, survival rate and sprouting compared to the control. In case of all parameters, from 1000ppm to 5000ppm concentration of neither IBA nor NAA showed significant effect on success rate of stem cutting propagation of cinnamon.

- **Soil and Plant Nutrition**

When cinnamon plants are established with two rows of Gliricidia and applied with half amount of current fertilizer recommendation showed significantly higher microbial activity (mg day-1) when compared to Cinnamon cultivated with recommended dose of fertilizer after eight years of planting.

Most common visual deficiency symptom of cinnamon plants that showed yellowing of leaf edges in older leaves with brown color dots. This symptom indicates inadequate level of plant N and Mg

Soil chemical parameters were observed after application of different rate of compost, inorganic fertilizer and their combinations. When cinnamon growing soil treated with, 20 t/ha/yr. of Cinnamon leaf phosphor compost showed highest pH (5.05), 1/2 current recommendation with 10t/ha/yr. of Cinnamon leaf phosphor compost shows highest soil Electrical conductivity (0.14 dSm^{-1}) and Current fertilizer recommendation shows highest Total soil Nitrogen percentage (0.20%).

When cinnamon plants are treated with current fertilizer recommendation with 375 kg/ha/yr. of Kieserite gives higher values in four different components such as Length of harvested

stick, Stem Diameter, Weight of sticks, Weight of sticks and fresh bark weight after eight years of planting.

When applied 163.5kg of sulfur through 675kg of Ammonium sulphate fertilizer gives significantly high stem diameter (27.1cm) in cinnamon cultivation after 2 year of planting.

Soil pH was checked in 8 places (GPS : 176340 E, 92448 N – soil pH 5.91 ; GPS : 176389 E, 92448 N – soil pH 4.88 , GPS : 176397 E, 92516 N – soil pH 4.77 , GPS : 176343 E, 92398 N – soil pH 4.61 , GPS : 176448 E, 92413 N – soil pH 4.20 , GPS : 176444 E, 92418 N – soil pH 4.71, GPS : 176461 E, 92423 N – soil pH 4.58, and GPS : 176392 E, 92410 N – soil pH 4.81) in Cinnamon research station to establish the Cinnamon plant in field with different level of soil pH.

The significant effect on plant growth parameters was not observed when apply different rates of Biofilm bio fertilizer with chemical fertilizer to cinnamon fields after six month of fertilizer application.

The study was conducted to investigate the effect of type of planting materials and different rates of inorganic and organic fertilizers on growth and yield of cinnamon (*Cinnamomum Zeylanicum* Blume) revealed that 2 years after planting normal seedlings recorded significantly higher plant height and stem diameter than selected variety Sri Gemunu and Sri Wijaya. It was noticed that using normal seedlings, plant height increase could be obtained by 19% than Sri wijaya and 11% than Sri Gemunu and stem diameter increases can be obtained by 9% than Sri Gemunu and 11% than Sri Wijaya.

Applying 1 ½ current Recomendation of N (N_3) gives significantly higher plant height and stem diameter in cinnamon cultivation 18 months after planting .Also applying half of current recommendation of P gives significantly higher plant height in cinnamon cultivation 18 months after planting. (90)

- **Plant Protection.**

Field survey was conducted to investigate the special variation of cinnamon pest and disease in Matara District. Average percentages of leaf blight, rough bark disease, vertebrate pests, wood borer damage, thrips damage, upper leaf galls, lower leaf galls and stem canker incidences were 40.3, 33.5, 16.15, 10.6, 9.8, 7.9, 7.05 and 4, respectively. The disease severity of same were 23.6, 22.5, 9.25, 5.12, 5.05, 2.8, 3.25 and 1, respectively.

Mineral nutrition contents (N, P, K, Mg, ca and Fe) in leaves significantly decreased when rough bark disease incidence was progressed in cinnamon, but nutrient contents in surrounded soil not changed during the period of disease progress. This is happened due to invasion and disturbance of xylem tissues by the penetrated causal organism related to rough bark disease.

Different concentrations of sea water with some organic materials (cow dung and vermicompost) were tested for managing nursery pests and diseases in cinnamon and plant growth as well. 1% sea water with cow dung and vermicompost had showed significantly higher growth (plant height) and lower pest and disease incidences (leaf blight, leaf galls and thrips damage). These combinations themselves were not enough to manage nursery pest and disease in cinnamon under heavy infestation at favourable climatic conditions for pests and diseases in nurseries. Integration of limited amount of agrochemicals are going to be tested in 2019.

Ultra-sonic sound devices with 10 specific frequencies were used to repel vertebrate pest damaged to cinnamon plants as a preliminary study. Less damage to young cinnamon shoots and less number of peacock population were observed in experimental area. Quantitative experiment is in progress.

Different agronomic practices such as slash weeding instead of mammoty weeding, additional selective weeding in between two harvesting interval, earthing-up to manage wood borer damage, application of Bordeaux mixture to manage rough bark disease and their combination were tested for pest and disease incidences and productivity of cinnamon land in two locations (Yatiyana and Cinnamon Research Station, CRS). Cinnamon lands (plots) that applied all the practices showed low percentage of wood borer damage, 3.77 and 13.78 in CRS and Yatiyana respectively (13.55 and 40.44 in control); low percentage of rough bark disease, 19.33 and 33.22 in CRS and Yatiyana respectively (53.78 and 84 in control); higher productivity of cinnamon (kg/ha), 926.37 and 1165.69 in CRS and Yatiyana respectively (743.17 and 730.48 in control).

- **Post-Harvest Technology**

Effect of sulphur- fumigation and packaging materials on shelf life of cinnamon quills

After one-year period of cinnamon quill packaging Triple layer polypropylene (PET/AL/LLDPE) material showed the least number of insects and it is significantly differed

from other types of packaging material (PET/LLDPE, LDPE & PP) except Metalized one. Triple layer polypropylene (PET/AL/LLDPE) showed the least moisture content and Water activity, significantly differed from other materials. Significantly higher oil content was present in cinnamon that packaged from PET/AL/LLDPE and PP than MPET/LLDPE, PET/LLDPE, and LDPE.

Quality parameters in cinnamon quills in value chain after primary processing in Sri Lanka

Quality parameters were checked in cinnamon quills at three levels (farmer, collector, and exporter) in value chain after primary processing in Galle district. Levels of farmer and collector have exceeded the limit of moisture content in SLS standard (81:2010). Cinnamon quills have contaminated with insects and microbes at all three levels. Although minimum count of insects and microbes have been occurred at exporter level.

Oil content in cinnamon wood and scrapings

Investigation of the oil in cinnamon scrapers was done. Quantification and identification of the oil composition using GCMS (Gas Chromatography Mass Spectrometer) were done. Oil percentage was 0.08%. The chemical composition according to the stick position is mentioned as follows (base, mid and apex were measured. Similar amounts of cinnamaldehyde (36%) was found in base & mid while 29.61% in the apex. Amount of Eugenol was approximately similar in all positions. Cinnamic acetate was different in three positions as base it was 13.38%, mid 9.37% and 11.88% in apex. β-Caryophyllene was 11.18%, 9.00% & 9.94% in base, mid & apex respectively. β- Linalool was 9.71%, 10.87% and 11.32% in base, mid and apex while Benzyl Benzoate was 0.96%, 1.05 & 0.94% in base, mid and apex respectively. $\propto$-Terpineol was more or less similar in all 3 positions of the stick.

Introducing soup cube using cinnamon bark oleoresin

Cinnamon soup cube was made and two sensory evaluations were done at cinnamon week in Matara on 11th May 2018 and 90 people participated and also 526 people attended to 22^{nd,} .23rd 24th of June 2018 at BMICH *INCO* exhibition sensory test. Results were given as 75% people had made their comments as the most favorable and also 23% had give their comments more favorable

Comparative evaluation of Anti -diabetic activity of cinnamon

The level of glucose in blood was checked by giving cinnamon drink of introduced two varieties (Sri Gemunu & Sri Vijaya). The group consists with staff members in different age group. The results showed, after 14 days of giving "Gamunu" and "Vijaya" cinnamon as a drink, percentage of lowering glucose level is respectively 90% and 86% for a normal people (non-diabetic). The effective percentage of giving these two varieties as a drink for 14 days for diabetic people is 100%.

Introducing ice cream using cinnamon bark oleoresin

Cinnamon flavoured ice cream was prepared and Sensory evaluation was done at NCR&TC. Results were given as 98% people had made their comments as the most favorable and lot of people comment cinnamon ice cream is good value addition product and little brownish colour would give nice appearance

Identification of critical hazards in cinnamon primary processing and improvement of quality in cinnamon primary process by reducing hazards contamination

According to the study *Penicillium* sp., and *Aspergillus* spp. were the most common species of fungi encountered on cinnamon quills. Other than that Mucor, (SOIL) fungi were present in the cinnamon quills in all collected cinnamon cultivating areas. Moisture content proportional to the fungal growth. Dead insects, insect parts, hair, scraped bark, sand, dust, fibers root and insect droppings were physical contaminants which were identified in all locations. Partially scraped bark was the most common contaminant one among that contaminant. Carelessness or lack of proper facilities and hygiene during processing of cinnamon quill processing directly affect to biological and physical contamination of cinnamon quills. According to the results there were no significant difference between initial cinnamon samples and processed cinnamon quills except Ni, so primary processing steps do not affect to chemical contamination while primary processing. But primary processing steps tend to physical and biological contaminations.

Investigation on medicinal value of cinnamon based products

Sampls were collected from Galle, Matara, Matale, Rathnapura district and chemical analysis were done for standardize cinnamon bark as a raw material for pharmaceutical industry. Oil oleoresin and chemical composition is different in place to place. Under this

result if produced pharmaceutical products that quality also different. Therefore, raw material standardization is very important. Research is progressing.

Evaluation of yield and quality characteristics of true cinnamon (*Cinnamomum zeylanicum* Blume) in different Agro-ecological regions in Southern Province

There are three different Agro-ecological zones in Hambanthota district as DL5, IL1b and WL2a. In evaluating of yield and quality characteristics of cinnamon belongs to Hambanthota district, DL5 showed the significantly higher stem length, stem girth, dry bark weight and bark oil content than WL2a and IL1b agro-ecological zone. Leaf oil content was significantly lower in WL2a than DL5 and IL1b agro-ecological zone. Leaf dry weight was not significantly differed among DL5, WL2a and IL1b agro-ecological zone. However, the age of the plant in DL5 was higher than the other sites due to low growth rate. In addition, irrigation has done during dry periods due to the lack of rainfall. Therefore, the observed variations can't be compared with other zones because they may not be due to ecological variations.

5.2.2 Black Pepper

- **Agronomy & Crop improvement**

Studies on variation of vegetative growth, flowering, fruit setting and yield of black pepper under different agro-ecological zones.

Amount rainfall received has significant effect on flower initiation of black pepper. Number of flower initiation events were well correlated with peaks of the rains which higher than 100mm.

Among the varieties used in the experiment, hybrid Panniyur-1 is highly sensitive with rains in terms of flower initiations.

Effect of micro- irrigation on yield performances of Areca nut (Areca catechu) + Black pepper (*Piper nigrum* L.) system.

One of the major problems of pepper cultivation is, labour cost for support tree manipulation. Therefore, using areca-nut as the support tree for pepper, could be a good cropping system. This study was started to analyse the yield performances of areca nut + pepper system under micro- irrigation system. Five different irrigation levels were used as treatments (25, 20, 15, 10 litres per day and control without irrigation system) with four replicates. All the growth and yield parameters were measured to find the effects of treatments on plants.

Data were collected throughout the year to find the effects of micro-irrigation on growth of pepper. Treatment 1 (25 l/day) has shown higher height than other treatments. Number of orthotropic and plagiotropic branches were high in T4 with 10 l/day irrigation while control (T5) showed the lesser number of branches.

Effect of Planting Material Originated from Different Cutting Types on Canopy Development of Black Pepper (*Piper nigrum* L.)

In 2018 data collected in Nillamba research field shown that the highest number of laterals, maximum average height per vine and highest number of spikes per vine were in ground runners. However, data gathered in Matale research field has shown highest number of laterals and spikes per vine shown in uprights while height per vine is almost similar in both uprights and ground runners. Both laterals and knitted lateral shown inferior parameters compared to uprights and ground runners.

Improvement of Resource Use Efficiency of Black Pepper (*Piper nigrum* L.) to Increase the Yield through Support Tree Manipulation

This research initiated to increase productivity of pepper through more appropriate live support and better crop management practices. Thus, finding out most beneficial support provides high potential to find out an alternative for Gliricidia

Highest average vine height shown in Dapdap and Gansooriya (355cm, 344cm), While height of Gliricidiea and Kapok seems to be bit inferior (335cm, 315cm). Highest average number of spikes per vine shown in Gliricidiea by large margin in contrast with other live supports (Gliricidiea – 228, Dapdap – 202, Gansooriya – 153, Kapok – 95) Average spike filling rates are almost equal in Dapdap, Gliricidiea and Kapok (70%). Gansooriya shows 65% of spike filling rate which is bit less than its other three counterparts.

Effect of soil moisture on flowering and fruiting habits of black pepper (*Piper nigrum* L.)

Water stress condition produce taller plants with less laterals in pepper. The total number of panicals increased with the length of dry spell

Study of flowering and fruiting behaviour of newly introduced *Piper nigrum* variety (Dingirala) and local selection (MB-12) in Matale and Nillamba of Sri Lanka

The planting of different pepper cultivars was done in Matale and Nillamba field. The first data set have been collected about growth of plant and observations were done to find the survival rate of Dingirala and MB – 12 varieties under the drought conditions. Dingirala plants (87.2 %) were showed more survivability than MB-12 (61.3 %) in drought period.

Plant protection

Evaluation of new hybrid Black pepper varieties against insect pest damages

Study revealed that Thrips and Aulakaphora beetle damage were the higher at nursery stage for new pepper cultivars and essential to good management practices and nursery sanitations to control the pest damages.

Sustainable Management of Quick Wilt Disease in Black Pepper (*Pipper nigrum* L) Caused by *Phytophthora capsici*

Phytophthora capsici is one of the most important soil borne pathogens that causes quick wilt or foot rot disease in black pepper (*Piper nigrum* L.). Although chemical control is effective, repeated applications are required with re-emergence of the disease. The experiment was planned to find alternatives for managing the disease in a sustainable manner. The treatments used were T1-Redoxyl 25 g/ 10 l water, T2- *Trichoderma asperellum* mass multiplied cattle manure @ 2.5 kg/vine (6.81x105 cfu/g), T3- cattle manure with no artificial inoculation @ 2.5 kg/vine, T4- untreated control. According to the observation during two years study period, T2 treated vines recorded significantly lower quick wilt disease incidence (3.3%) compared to T1. Results revealed that sustainable management of quick wilt disease in black pepper could be achieved by application of *T. asperellum* treated cattle manure.

Preparation of a bio control agent (*Trichoderma* spp,) for the nursery and field level applications in black pepper (*Piper nigrum* L.)

An experiment was planned to identify a suitable commercial product of *Trichoderma* spp. biocontrol agent. Talc based formulation is showing higher shelf life. The initial colour of all talc formulations was dull white and during the three months study period, no colour change was observed in any formulation. Three months after preparation, all the talc formulations yielded with mean spore count of $0.92x10^8$ cfu/g, $1.11x10^8$ cfu/g and $1.21x10^8$ cfu/g respectively. pH value of all talc preparations ranged 7.5 to 8.5 throughout the study period.

Management of black pepper (*Piper nigrum* L.) quick wilt disease through enhancing rhizosphere antagonistic microflora

With the objectives of identification of the possibility of managing quick wilt disease through enhancing rhizosphere antagonistic microflora, this project was initiated during the year 2018. Laboratory testing confirmed the presence of *Phytophthora capsici* in the soil collected from the field. Initial quick wilt disease infected percentage in the field is 4.59%. Soil samples were collected and dilution plating technique was followed for identification of initial microflora availability.

Defining visual indicators for nematode borne slow wilt of black pepper (*Piper nigrum*) and investigating the effect of different control methods on pepper slow wilt causing nematodes.

This project was initiated in later part of the year 2015 to define the visual indicators for nematode borne slow wilt disease of black pepper. During the period preliminary studies were carried out for extraction and identification of nematodes and nursery plants were prepared for the field trial. The project activities are continued next year.

❖ **Post-Harvest Technology**

Design, fabrication and evaluation of greenhouse dryer for pepper

The fabrication of the dryer has been completed in the drying floor premises. The dryer is 20 feet in length and 10 feet in width. Thirty-six (36) trays with the size of 3"x2" can be placed on iron structure. Two drying trials were conducted for pepper drying. Maximum temperature achieved was 45 ^{o}C. Drying time for two trials were 13 hours and 16 hours respectively for blanched pepper. Capacity of the dryer is 130 – 140 kg of fresh pepper.

Determination of suitable packaging material for bulk storage of pepper

An experiment was started in October 2017 to determine suitable packaging material for bulk Storage of pepper. There are four treatments such as T1. woven polypropylene bags 2.Low Density Poly Ethylene - LDPE (300 guage) lined woven polypropylene bags 3.Poly propylene laminated (80 guage) Woven polypropylene bagsnand Polypropylene (150 guage) lined woven polypropylene bags. Five kilogram of dried pepper were packed and stored under room temperature in atmospheric pressure. Moisture content, weight loss, oil content, oleoresin content and external colour are being measured as quality parameters. Data has been collected for 12 months at one-month interval.

Effect of steam blanching in black pepper processing

Black pepper was blanched by steam produced at room temperature under atmospheric pressure. Fresh pepper was undergone for different time of blanching. Drying time, initial moisture content and color was determined. The experiment design is CRD with 03 replicates. The steamer used for sterilization of potting media of mushroom was tested for pepper blanching at New Everest Enterprises, Warakapola. A prototype machine is being newly designed to increase the capacity and enhance the effectiveness.

❖ **Genetics and Plant Breeding**

Multi-faceted crop improvement project on black pepper

Research project on multi faceted crop development of black pepper was completed and study revealed that Panniyur 1 and UD 21 performed well in all locations showing horizontal adaptability. They were also better in field establishment. The yield data showed that four varieties in the Middeniya site, namely KWW-12, UD-21, MB-12 and Wasanagama were performed better, yielding 4796.7, 4460, 3622, and 3363.3g of black pepper per vine, per year respectively. The yield data from Matale site revealed that, UD- 21, Panniyur-1, and KWW-10 varieties were the best cultivars in that side giving more than two kg of dry pepper per vine per year. In the Nillambe site, Panniyur-1, DM-7, Wasanagama and KWW-12 varieties yield 1937.3, 1887.1, 1752, 1477.9g of black pepper per vine per year, respectively. The varieties UD-21 and MB-12 were performed well in both Middeniya and Matale sites while KWW-12 was also performing well in the Middeniya experimental plot. Hence, black pepper varietiesKWW-12, UD-21, and MB012 are suitable to the Middeniya area.

In-situ evaluation of local pepper selections

Objective of this research is to find superior lines from local cultivations and to develop and recommend high yielding variety well adapted to regional conditions. Kolonna, Badalkumbura, Raththota, Badulla and Middeniya have been selected to establish research fields. Plants have been established in Kolonna, Raththota and Badalkumbura fields. Raththota and Badalkumbura fields were established in 2018 and growth data is being collected.

Collection, Characterization, Conservation and Utilization of Piper species exist in Sri Lanka

According to the main objective 10 *Piper* varieties had been collected. Another two varieties were taken from Monaragala area and cuttings were planted for future multiplication and fine identification. Post-Harvest Technology division has collaboratively participated for chemical analysis. Chemical analysis was completed in all given samples and oil, oleoresin and piperine were determined in 6 wild species of *Piper*

Establishment of mother vine gardens using newly recommended Pepper Hybrids

Objective of this research is to establish mother vine gardens of newly released varieties, Dingiraala, Butaweraata and Kohukumbureraala. Mother vine gardens have been established in central plant nurseries of Department of Export Agriculture. They are available in Holongolla, Serapise, Wennoruwa and Walpita nurseries. Maintaining and using for plant production is carrying out.

❖ **Soil Science and Plant nutrition**

Investigation of effect of source of nitrogen on growth and yield of black pepper

Results showed that application of half of recommended fertilizer mixture (Ammonium sulphate (NH4)2SO4 as the nitrogen source) along with 10 Kg of Gliricidia green manure for a plant/year has given significant improvement in Black pepper yield.

Effect of cover crops on soil properties, growth and yield of pepper

This trial was initiated with the objective of evaluating and identifying a suitable cover crop plant that can be used in pepper plantations of Sri Lanka. The treatments with *Arachi spintoi, Desmodium ovalifolium* and *Mucuna bracteata* as cover crop have recorded relatively higher values for all the soil chemical properties like soil pH, total N%, available P, exchangeable K, Organic matter and EC compare to no cover crop control treatment. All the leguminous cover crop treatments reported significantly higher total soil N contents compared to without cover crop treatment. The highest organic matter percentage was observed in *Mucuna* treatment (2.34%), due to high biomass production by *Mucuna*.

Effect of arbuscular mycorrhizal infections on occurrence of yellowing in Black pepper (*Piper nigrum* L.) plants under different soil moisture levels.

Most of the mature black pepper plants in RBL soils of Matale found infected with indigenous species of vesicular arbuscular mycorrhizae forming high spore abundance in soil and root modifications such as arbuscules and vesicles in infected black pepper roots. Those indigenous species are seems to be members of order Glomerales which consisted with *Glomus* spp.

Development of land suitability classification for black pepper (*Piper nigrum* L) in Sri Lanka

Research was started in January, 2018. Main objectives of this research were To identify most suitable soil characters for black pepper in Sri Lanka and To develop and introduce a land suitability classification system for black pepper. In 2018 soil sampling locations were selected based on the extent of pepper cultivation of different agro ecological zones in Ratnapura district. (Imbulpe, Balangoda, Godakawela and Kolonna). Soil pH in surveyed fields varied from 4.92 to 6.61, organic carbon (OC) from 0.52% to 2.14% with a mean of 1.42% for Imbulpe, 1.43% for Balangoda ,1.24% for Godakawela and 1.04% for Kolonna. Olsen P varied from 2.6 to 30.0ppm with a mean of 12.04 ppm for Imbulpe, 6.1ppm for Balangoda, 7.6ppm for Godakawela and 6.6ppm for Kolonna. Exchangeable K varied from 62.90ppm to 363ppm, and exchangeable Mg from 66 ppm to 381ppm.

According to tissue analysis 6% of samples collected had leaf N status below their critical range, and 94% samples collected had N status in required level. Major pepper growing areas in Ratnapura district 88 % and 48 % samples recorded P and K status below required values, respectively. The rest of the samples are in optimum range. None of samples recorded in above critical level leaf tissue N, P, K content. Out of surveyed samples 28% of samples recorded optimum level of Mg content in leaf tissues and 60 % samples are in below the critical level.

Recycling of pepper stalks for sustainable crop production in pepper plantations (*Piper nigrum* L) in Sri Lanka

Preparation of compost according the recipes was done and to the quality evaluation of the end product currently being carried out. The prepared compost will be analyzed for physicochemical properties, nutrient status and biological properties with the help of pathology division of Export Agriculture Research Station, Matale.

Study of inorganic fertilizer response and pest and disease resilience of new black pepper hybrid "Dingirala" variety in dry zone of Sri Lanka

This trial was initiated in 2018 and the field establishment was carried out successfully. After one year, plant establishment more than 90% and average plant height 5-6 ft but poor development of plagiotropic Branches.

❖ **Physiology and Plant Production**

60 x 120 mm cocopeat can be used for raising pepper plants as growth medium instead of normal potting media with 0.5 g albert solution per pot at 8 and 12 weeks after planting.

Comparison of growth and yield of pepper raised from orthotropic (terminal), plagiotropic and rooted cuttings from Bamboo rapid multiplication system.

Main objectives of this research were conducted to compare the plant production efficiency in three types of pepper cuttings i.e. orthotropic, plagiotropic and single nodal cuttings from Bamboo Rapid Multiplication System of black pepper local selections and field performance of these plants.

There was no significant difference on plant growth parameters between single nodal cutting plants and orthotropic cutting plants. Canopy spread was higher in orthotropic plants than single nodal cutting plants. In year 2018 pepper yield was low in Matale area and spike number was same in both plant types. Average yield /vine was higher in orthotropic plants than single nodal plants.

Comparison of growth and yield of pepper (*Piper nigrum L.)* raised from tissue cultured plants and single nodal cutting plants.

Main objective of this research was to find out the suitability of tissue culture plants for field cultivation. There was no significant difference between growth and yield parameters among two types of pepper plants i.e; single nodal cutting plants and tissue cultured plants.

5.2.3 Cocoa

❖ **Agronomy & Crop improvement**

Evaluation of field performance of rooted cuttings of cocoa (*Theobroma cacoa.L)* cultivars at Matale

The cultivar Na32 x ICS1 of bud gafted cocoa (*Theobroma cacoa.L*) plant originated from chupon scion showed highest establishment rate (91.6%) and rooted cutting plant was lowest (58.3%) at the location Matale (IM 3a). The establishment rate (83.3%) of Wk2 (Wykumbara -2) was high irrespective of propagation techniques. Field performance of rooted cuttings of

different cultivars via all three propagation techniques were performed above 58.3 % establishment rate with all cultivars

❖ **Genetic and Plant Breeding**

Evaluation of different cocoa lines for different climatic zones (Matale, Badalkumbura)

Objective of this research is to find elite cocoa lines for different agro climatic zones. 10 different treatments have been used and treatment 168 has performed well by giving 27 pods in Badalkumbura research field. In Matale research field harvesting has no yet done and field maintenance is going on.

Characterization of available cocoa (*Theobroma cacao* L.) lines and Establishment of a clonal garden

Objective of this research is to establish a clonal garden. The field is being maintained in Matale Central Research Station. Research is about to terminate in 2019

❖ **Soil & Plant nutrition**

Productivity Improvement of cocoa (*Theobroma cacao* L.) Through integrated soil and plant nutrient management system including good management practices

Cocoa plants intercropped under rubber are well grown and 7 years in age thus successfully produce pods indicating the suitability of cultivating cocoa under rubber at Nakkala (IM2a) in Monaragala district and Padiyathalawa (IL2) located in border of Ampara. Cocoa plants cultivated under coconut in Narammala and Mawathagama sites are also well grown and all are at reproductive stage.

Development of soil conditioner using bio-fortified cocoa pod husk for reclamation of cocoa fields

Beneficial soil microbes isolated from composted cocoa pod husk were multiplied and tested for re-inoculation of composted cocoa pod husk was failed. So stored isolates of bacterial and fungal organisms were retransferred and maintained to observe their activity on different other media instead of cocoa pod husk.

5.2.4 Coffee

Genetic and Plant Breeding

Evaluation of Catimor coffee progeny

The objective of this research is to find high yielding plants with high quality and resistant to pest and diseases and drought. Five varieties have been planted in the field with total number of 820 plants. Catimor, S9 4/5, S9 4/2, HTD and S4711 are five varieties. They have been established in field in 2012. Yield data collection have been initiated in 2015. According to the collected data in 2018, catimor has given higher yield than others.

Fixing Geographical indication for coffee in Sri Lanka

Objective of this research is to identify unique characters of coffee in Sri Lanka according to the geographical area. GI fixing is done for Arabica coffee. Fields are maintained at Kotmale, Ethipola and Panwila areas and in CRS Matale

Evaluation of Arabica coffee(*Coffea arabica*) accessions for yield, quality and resistant to major pest & diseases

Objective of this research is to find high yielding Arabica coffee accessions resistant to major pest and diseases. Field located in CRS, Matale. Total number of plants are 322 with 14 different accessions. Field planting have been done in 2009. Data collection have been initiated in 2014. According to the collected data in 2018 following varieties have been performed well by giving average raw yield of more than 3.5 kg per year.

Plant Protection

Investigation on *Spodoptera* damage to coffee hybrids

As a new pest, Army worm (*Spodoptera* sp.) damage was reported severely for Lak Parakum coffee plant at Matale Research Station.

Use of *Beauveria brassiana* for the control of Coffee Berry Borer

Field application of entomopathogenic fungi, *Beauveria brassiana* at the rate of 5 ml /stem, Spore concentration 1 x 10^8 conidia ml-1 in the pod development period indicated average number of berries with presence of fungus were almost same in 1 to 5 month of coffee berry development period.

Investigation of biological control agents of Coffee Berry Borer

Identification of parasitoids of Coffee Berry Borer as biological control agents were done under laboratory condition and results indicated that one parasitoids belong to the family Eulophiday of Order Hymenoptera, *Phymastichus coffea* LaSalle.

Design a trap for a coffee berry borer

The HDT cultivar of Arabica variety showed significantly higher damage by Coffee Berry Borer than other cultivars of Arabica and Robusta varieties while the hybrid cultivar 'Lak Parakum' showed significantly lower berry damage than the HDT.

❖ **Soil &Plant Nutrition**

Strategies for organic cultivation of Arabica coffee

According to the available data 10 kg of cow dung is tentatively recommended for Arabica coffee as an organic package

❖ **Post Harvest Technology**

Development of small scale coffee roaster

A small-scale coffee roaster was designed, fabricated and developed for coffee roasting. The coffee roaster was fabricated with stainless steel and mid steel. The food material touching pars were made in stainless steel for food quality. The capacity of the roaster is 5- 8 kg per batch. The testing is in progressing for better performance and to develop a roasting programme for coffee.

Coffee can be roasted within 1-1.5 hrs for full capacity. The temperature and time can be adjusted. Cost of production for coffee roasting and other details will be included in the final report. This type of coffee roaster can be introduced for small scale entrepreneurs for coffee business in SME level. The roaster can be used for roasting many agriculture and food commodity like curry powder, cashew, peanut, cocoa, etc.

Determination of caffeine content of Arabica and Robusta coffee selections

This study was carried out to find out phytochemical, mineral and proximate composition of market sample of roasted Coffea arabica having four different origin, namely Brazilian, Colombian, Ethiopian and Ceylon that have same genetic characteristics with different agro climatic condition in the plantation in 2017. Caffeine content of four origin of *Coffea arabica* are 1.202, 1.048, 1.114 and 1.109 respectively. Chemical analysis and sensory evaluation were done for HDT, S9 and Catimor (3 local selections). The caffeine content of S9, HDT, and Catimor variety were 1.029, 0.909 and 0.820 respectively. In sensory evaluation coffee

brew of S9 variety showed most preference on color (3.931), taste (3.436), aroma (3.8636) and overall acceptance (3.588) like attributes than other varieties, but for mouth feel coffee brew of HDT variety showed most preference and value was 3.293.

5.2.5 Cardamom

❖ **Genetics & Plant Breeding**

Evaluation of promising cardamom lines for low elevation under Mahogany (Kiriella)

Field has been established at Awissawella with 9 treatments. Main objective is to find cardamom variety that can be grown with Mahogany as an intercrop

Field evaluation of low elevation cardamom varieties under irrigation

Objective of this research is to evaluate performance of cardamom in lower elevation. Research field have been established in Nillambe.

5.2.6 Clove

❖ **Physiology & Plant Production**

Application of Plant Growth regulators (PGR) for flowering induction of clove (*Eugenia caryophyllus)*

Three chemicals with different concentration levels such as Thiourea – (100 ppm, 300 ppm, 500 ppm, 700 ppm), Ethral – (100 ppm, 300 ppm, 500 ppm, 700 ppm) and Paclobutrazole – (100 ppm, 300 ppm, 500 ppm, 700 ppm) were applied for seedlings (3- 4 years old) and newly established plants (8 -10 years old). Treatments were applied just after harvesting. No positive response observed.

❖ **Plant protection**

Management of leaf fall disease (leaf blight & leaf spots) of clove (*Euginia caryophyllus*) in mid country

Two different fungal isolates which are morphologically similar to the *Cylindrocladium* spp were isolated from infected leaves and these fungal isolates were inoculated to the six-month-old healthy clove seedlings for confirmation. Hence, it was confirmed these fungal isolates are causal organism of the disease. Isolated fungal cultures handed over to the Asiri Surgical Hospital, Kirimandala Mawatha, Colombo 05 to identify the causal organism up to the species level by using molecular biological techniques (28s rRNA sequencing) and two different fungal isolates were identified as *Cylindrocladium reteaudi* and *Calonetria* spp by the 28s ribosomal RNA gene sequencing. According to the results of pathogenicity test

(Koch's Postulation) and molecular identification fungus *Calonetria* spp caused the Clove Leaf Blight disease and *Cylindrocladium reteaudi* caused the leaf spot to the clove plants. However, in presence both isolates show the high disease severity.

❖ **Post-Harvest technology**

Comparative analysis on essential oil, chemical, proximate and mineral composition of clove bud, clove stem and leaf (*Syzygium aromaticum* L., *Eugenia caryophyllata* thunb.) grown in Matale

Clove (*Syzigium aromaticum* L., *Eugenia caryophyllata* Thunb.) is a well-known spice which possess great potential for pharmaceutical, cosmetic, food and agricultural applications. It is widely cultivated in tropical and sub-tropical regions. *Syzygium aromaticum* Volatile oil percentage in clove bud, stem and leaf 18.739, 7.870, and 7.564 Non-volatile ether extract percentage in clove bud, stem and leaf 22.682, 8.893, and 5.229 respectively. Gas chromatographic analysis of Matale grown clove bud, stem and leaf oil revealed the true eugenol contents as 69.9672%, 81.5781%, 85.5558% respectively. Although total euginol content consist with euginol and euginol acetate which is 80 % in clove flower bud. Recommendation is Not only clove bud, but Clove leaf and stem also can be used to produce essential oil and euginol.

5.2.7. Ginger

❖ **Agronomy & crop improvement**

Effect of different mulching material on growth and yield of local ginger (*Zingiber officinale*).

An experiment was conducted at the Intercropping and Betel Research station, Narammala to identify the most suitable mulching material for local ginger. Five mulching materials such as straw (1.5 kg/plot), Gliricidia leaves (5kg/ plot), coconut leaves (2 coconut leaves/plot), coir dust (5.5 kg/plot) and polythene were used. One treatment was used without mulch as a control. After the application of mulching materials, Gliricidia mulch positively affected on growth and yield of ginger. The highest local ginger yield (490 g/ clump) was given from Gliricidia mulched ginger plot.

Effects of different harvesting age of rhizomes on growth and yield of ginger (*Zingiber officinale* Roscoe).

Four seed beds were prepared in August, September, October and November in order to prepare 10 months, 9 months, 8 months and 7 months old seeds as the treatments. Those four beds were maintained and survival percentage was calculated.

Effect of Different Level of Shade on Growth, Yield and Quality of Ginger (*Zingiber officinale*)

Ginger was planted under six different shade levels. Highest yield data was recorded from 60 % shade level while least was from 80 % shade level.60% shade level is the optimum shade level for ginger cultivation.

- **Soil & Plant nutrition**

Sustainable methods of growing ginger in polybags for household consumption and for commercial purpose

As an improved method of ginger cultivation, a poly bag field experiment was conducted in Central Research Station of the Department of Export Agriculture, Matale. The result revealed that best poly bag to grow ginger to get highest growth and yield (yield 4.8kg/polybag) of ginger was 50kg poly woven bag filled with 50l of 1:1:1:1 cow dung, coir dust, top soil and sand medium with 100g rhizome as seed material. As an alternative, low-cost medium in poly bag cultivation of ginger can be done using cow dung, partially burn paddy husk, top soil and sand as potting medium.

- **Plant Protection**

Management of major diseases of ginger (*Zingiber officinale* Rosc.)

Causal Organisms of three major diseases of ginger were already identified up to genus level such as soft rot (*Phthium* sp.), bacterial wilt (*Ralstonia* sp) and leaf spot (*Phyllostica* spp). Control measures were recommended for each disease separately and IDM package was recommended incorporation cultural, physical, biological and chemical control measures to control above three major diseases.

Effect of rhizome scales (*Asperdiella hartti*) on germination and subsequent yield of ginger

Three varieties of ginger (Local, Chinese and Rangoon) rhizomes was observed in three months of storage period for the emergence of scales on the surface of rhizomes. The lemon leaves treated local ginger showed no infection of scale insects up to 3 months and Chinese

variety were infected at second month of storage period. Naththasooriya and Gandapana leaves were not effective significantly for the control of rhizome scales on ginger.

5.2.8 Turmeric

❖ **Post-Harvest Technology**

Determination of chemical constituents & antioxidant properties of turmeric in Sri Lanka

Turmeric was collected from Matale research station, Local sample from Matale market & another sample from Matale home garden. Turmeric powder was prepared according to the sample preparation method. Chemical Constituents analysis has started. Plan to collect turmeric from Ampara, germoplasm collection of Matale & Narammala research stations during coming season as suggested by last forum. Started evaluating Moisture content, colour (L,a,b values) & curcumin content of already available samples of germoplasm collection of Matale

5.2.9 Betel

❖ **Soil and Plant Nutrition:**

Studies on effect of partially burnt paddy husk as an alternative nutrient source for growth and yield of betel (*Piper betle*).

This study was carried out to investigate the effect of partially burnt paddy husk as an alternative nutrient source for betel (*Piper betle*). Four different treatment combinations: T1- DEA recommended fertilizer mixture for betel, T2 - DEA recommended fertilizer mixture + 5 kg of partially burnt paddy husk/100 stakes, T3 - DEA recommended fertilizer mixture + 100% MOP replaces with 10kg of partially burnt paddy husk/100 stakes, T4- DEA recommended fertilizer mixture + 50% MOP replaces with 5 kg of partially burnt paddy husk/100 stakes were evaluated. T3 was given the highest yield and it was not significantly different with the T1: DEA recommended fertilizer mixture. Therefore, partially burnt paddy husk can use as an alternative nutrient source for betel.

Evaluation of different potting mixtures for nursery production of betel (*Piper betle* L.*)* stem cuttings.

When evaluated with different materials, incorporation of coconut husk chips in place of coir dust has enhanced plant growth and produced the highest number of betel stem cuttings per

nursery pot. Coir dust incorporation also appeared as beneficial. The ratio among potting mixture and 2" length of coconut husk chips is 1.5:1.

5.2.10 Nutmeg

❖ **Genetics & Plant Breeding**

Molecular biological sex determination of Nutmeg (*Myristica fragrans*)

Objective of this research is to determine the sex of the plant in early stage. A nutmeg progeny will be established as the experimental population.

❖ **Plant protection**

Management of Nutmeg Leaf Fall Disease (NLFD)

Avocado, mango and papaw were identified as alternative host plants for nutmeg leaf fall disease (NLFD). At the same time, the disease severity caused to the nutmeg seedlings by the fungal strains isolated from avocado, mango and papaw were not significantly different. Therefore, the field sanitation of avocado, mango and papaw plants must be recommended as an additional measure, where nutmeg and these crops are grown together to avoid spreading of NLFD as a long-term disease management.

❖ **Physiology and Plant Production**

Nutmeg (*Myristica fragrans*)

Ten selections were used for the field evaluation (A3, B, C1, C2, D1, D2, D4, D5, D6 and E1). Grafted plants were established in the field at 12’ x 10’ spacing in 2004. Well grown four grafted plants of each selection were established in a plot and replicated three times. Growth and yield data (number of nuts/plant) were measured and recorded.

Based on past 11 years data, selection B perform well in both places Gasnawa and Matale followed by selection E1. Plant height was about 6.5 m and canopy spread was 4.2 m in selection B. Considering yield data number of fruits were higher in selection B in both places Gasnawa and Matale (235) and followed by selection E1 (135). Average fresh weight of a seed is higher in selection E1 (10.4 g) followed by selection B (8.7 g) and dry weight of a seed is higher in selection B (5.1 g) followed by selection E1 (4.2 g). Average number of nuts /ha/year is around 209385. Selection B could be recommended for mass propagation of nutmeg as best selection

Field evaluation of the seedlings and air layered planting materials from different sizes of lateral and upright branches of high yielding matured Nutmeg (*Myristica fragrans*)

With the objective of the performance evaluation of air layering method for different sizes of lateral and upright branches of nutmeg, air layering was done for different size and different type of branches in farmer fields. Well rooted layers were removed and established in large pots for further rooting. Performance of air layering method should be evaluated (for rooting ability), and also field evaluation should be done for lateral, upright and seedling planting materials.

Synchronization of flowering and fruiting behavior of Grafted Nutmeg in the context of climate change effects

With the objective of reduce flowering variability and increasing flowering and fruiting volume of nutmeg through physiological manipulations, grafted nutmeg plants were established in the field at 10' x 10' spacing. Paclobutrazol will be used for the induction of flowering in Nutmeg at flowering stage

❖ **Post-Harvest technology**

Natural colour preservation in mace

Mace sample treated with different solution and blanch in 70 ^{0}C separately and stored using black polythene. After 6 months high colour intensity was recorded in treatment of sodium meta bi sulphite (SMS) 2.5% solution with blanching 1 min. Therefore, mace red colour can be preserved 6 months period by treating 70 ^{0}C for 1 minutes blanching in Sodium meta bi sulfite 2.5% solution (25 g Sodium meta bi sulfite in 1-liter portable water) and store in black colour polythene

Determination of chemical constituents & antioxidant properties of nutmeg in Sri Lanka

Nutmeg were collected from Matale research station, Dalpitiya & Gasnawa sub research stations, Mawanella, Pilimathalawa, Katugasthota,Wattegama, Ankumbura & Menikhinna, Sample preparation of all collected samples were completed. Chemical Constituents analysis has started.Three procedures were followed for oleoresin extraction in order to find out the method which gives highest nutmeg oleoresin extraction. Moisture percentage, oil percentage, oleoresin percentage and ash percentage of nutmeg from different locations were analyzed.

Development of Nutmeg splitting tool

Several mechanisms were tested for splitting of nutmeg fruit to use for a tool. A simple mechanism was identified for develop a tool for manual operate. A tool is developing for splitting nutmeg fruit without damage to the seed. This tool will be a better answer for efficient nutmeg splitting in hygienically with ergonomic interventions.

5.2.11 Goraka

❖ **Plant Protection**

Identification of resistant cultivars of Goraka for Scale insect (*Ceroplastes* sp.) attack

This project was conducted to evaluate the different Goraka types for resistance of Oyster scales and to find resistance and susceptible types of goraka cultivar/s. Goraka plants were observed in the affected areas that had not been attacked by the scale insects. Although plants at the close proximity had been severely under infestation, some plants were intact or showed less susceptible to the attack. This could have been due to physical or chemical adaptation of the plants against the scale insect. The Goraka plants with resistance were already identified and the plant parts for propagation were extracted from those identified plants. Those plant parts were used as the scion in already established rootstocks. These genetic materials were tested for its resistance against the attack of Goraka scale insect by evaluating the insect population increase, mortality of the plants, average health of plant, sooty mold growth, Number of leaves, bud initiation and height of the plant. The data collection is in progress yet. The plants selected as the resistant cultivars would be introduced to further evaluation in the field level and subsequently for the breeding programmes.

❖ **Post-Harvest technology**

Development of technology to produce value added products of Garcinia (Goraka)

Goraka *(Garcinia quaesita)* rind of the ripped fruit are processed and used in Sri Lanka and India as a condiment after drying. Garcinia dried powder, Garcinia fresh Drink, Garcinia jam, Garcinia Chutney, Garcinia dried sweeten cubes, Garcinia paste were produces as a value-added product. Sensory evaluation and further modification were completed. This product was introduced to market through training program and exhibitions.

❖ **Genetics & Plant Breeding**

Exploration of Goraka (*Garciniaquaesita* Pierre and *Garcinia zeylanica* Roxb.) Accessions Based on Chemical Properties and Establishment of a Field Gene Bank

One of main objective of this research is to establish a field gene bank with grafted Goraka plants. Grafting has been done for certain seedlings. Success rate is low when mature scions are used. Field is being prepared for nearly 80 plants except guard rows with the spacing of 10 x 8 ft.

- **Physiology &Plant production**

Goraka (*Garcinia quaesita*)

Three maturity stages of rootstock and 4 wrapping materials were tested to upgrade the success percentage of grafting. 288 plants were grafted and 265 plants were survived. Success percentage was 98.9 and maturity stage 1 (three months old and1.5 cm stem diameter) is the best stage for grafting of Garcinia. Planting material collection was done from six districts, i.e; Ratnapura, Kurunagala, Kaluthara, Matale, Kandy and Hambantota. Grafting was commenced and plants are in good condition.

Collection and investigation for growth, yield and chemical properties of different Garcinia (*Garcinia quaesita* Pierre.) selections in Sri Lanka (CARP 2017).

Planting material collection was done from six districts, i.e; Ratnapura, Kurunagala, Kaluthara, Matale, Kegalle and Hambantota. Grafting was commenced and plants are in good condition. 18 accessions were planted in field (Randomized complete block design) with three replicate for further evaluation. Closer spacing 10' x10' was used for plant establishment.

5.2.12 Other

***In-vitro* propagation of Export Agricultural Crops (Garcinia, Wallapatta and Pepper (Hybrids)**

With the objective of identification of basal media for Garcinia, Wallapatta and Pepper hybrids,this research was started. Black pepper was introduced to two basal media, i.e; full MS and woody plant media (WPM). MS medium performs well and success percentage was about 40%. The success percentage of Wallapatta in WPM was about 30. Experiment is continuing.

Develop, test and implement monitoring procedures and practices at site, regional and national levels for: Belowground soil biodiversity

The project was started with the objectives of understanding the soil belowground biodiversity of selected sites and developing physical indicators for soil biodiversity

assessment. The study in Udukumbura site revealed that, land use practices have substantial effects on the abundance and diversity of the belowground organisms. Even if the home garden was considered as a non-chemical field, the abundance and diversity of belowground organisms was lower than the natural forest possibly due to the disturbances to the micro climate. Study was conducted at prominent land use systems namely; home garden, mixed cropping and *Owita* at two apparently different portions of a land under each system called plot type 1 and plot type 2 in Milleniya, Sri Lanka (N 06.69621^0, E 080.03806^0). Plot 1: top soil is loosely arranged organic matter rich soil, low gravel and sand, soil colour is ash to black and plot 2: top soil is compact soil with less organic matter, high amount of sand and gravel, soil colour is light brown of the same soil, Boralu series of RYP soils in each land use system. In conclusion, visual deterioration of physical status of top soil found to be highly correlated with soil biodiversity. The selected parameters can be used as indicators for participatory assessment of soil biodiversity in agricultural lands.

The awareness and use of pesticide usage of farmers on export agriculture crops in economic and technical perspectives

This study was initiated on ginger (*Zingiber officinale* Rosc.) farmers in the Rathnapura district of Sri Lanka to study their pesticide use in technical and social perspectives. The major pest and diseases problems, the extent of pesticide use, pesticide use behaviour including safety concerns, information seeking and decision-making regarding use of pesticides were studied through different parameters. The results highlighted the gap between the existing and the expected levels of chemical use in connection to the concerned aspects. The second phase of this study included the Pepper farmers in Kandy district and data were collected from 80 farmers in about 60 GS divisions of the district. Comprehensive questionnaires and fields visits were included in the data collection and data is being analysed.

Effect of steam sterilization on chemical, physical and microbial quality of spices

The experiment on steam sterilization of pepper has been conducted. Experimental design is two factor factorial. The factors are temperature of the steam and sterilization time. Total Plate count was determined and research is progressing.

5.3. Ongoing Research during the year 2018

5.3.1 Cinnamon.

- Evaluation and comparison of superior quality characteristics of accession A1 with selected cinnamon accessions (Sri Gemunu and Sri Wijaya)
- Multiplication and evaluation of selected hybrid cinnamon plants under recommended agronomic practices for quality, growth and yield performances
- Identification of chemical and element composition of sandy textured cinnamon bark tissues
- Studies on growth performance of Cinnamon (*Cinnamomum zeylanicum* Blume) in Coco peat as nursery pots
- Effect of Stem Bending on the Formation of Shoots of Cinnamon (*Cinnamomum Zeylanicum* Blume)
- Effect of fertilizer application time on growth, yield and peeling ability of cinnamon

  Effect of different concentration of plant hormones (IBA and NAA) on rooting and growth of stem cuttings of cinnamon
- Effect of Cinnamon Leaf compost and inorganic fertilizer and their combinations
- Effect of dolomite application on growth and yield of cinnamon grown in acid soil.
- Effect of growing *Gliricidia* and legume cover crops on growth, yield and soil fertility status in cinnamon
- Characterization and evaluation of soil fertility status of selected soils of major
- cinnamon growing areas and crop productivity relations.
- Effect of applied Sulphur containing fertilizers on growth and yield of Cinnamon.
- Determination of optimum pH level for growth of Cinnamon.
- Identification of visible indicators of Cinnamon (*Cinnamomum Zeylanicum*) to monitor major and minor soil nutrients.
- Effect of biofilm- biofertilizer on growth and yield of Cinnamon.
- Effect of type of planting materials and different rates of fertilizers on growth and yield of cinnamon
- Effect of different levels of N, P and K fertilizers on growth, yield and quality of the Cinnamon

- Study the effect of seawater with limited agrochemicals for management of pest and disease in cinnamon nurseries.
- Studying etiology, symptomatology and histopathology of Rough Bark Disease of cinnamon.
- Study the ecology (seasonal abundance, locality of spread and peak swarming period etc.) of cinnamon wood borer and other pests
- Identification of studying the biology, ecology and management of cinnamon thrips
- Establishment and evaluation of ultra-sonic audio devices to manage vertebrate pests in cinnamon
- Study the white root disease infection, its pathogenicity and ecological factors that enhance the disease in cinnamon
- Study the effect of water stress on pest and disease incidences in Cinnamon nurseries
- Study the disease progressive pattern and yield loss by canker incidences in Cinnamon
- Study about canker formation in cinnamon
- Screening of cinnamon germplasm for pest and disease resistance
- Evaluation of yield and quality characteristics of true cinnamon (*Cinnamomum zeylanicum* Blume) in different Agro-ecological regions in Southern Province
- Effect of sulphur- fumigation and packaging materials on shelf life of cinnamon quills
- Anti-Fungal and Anti-Bacterial activity of true cinnamon (*Cinnamomum zeylanicum* Blume) for skin and oral diseases in human
- Study the quality of cinnamon quills at three levels in value chain after primary processing in Sri Lanka.
- Formulation of herbal mosquito repellent sticks by using essential oils of True Cinnamon
- (*Cinnamomum zeylanicum* Blume) and Citronella (*Cymbopogon nardus*)
- Introducing soup cube by using cinnamon bark oleoresin.
- Introducing ice cream by using cinnamon bark oleoresin.
- Identification of critical hazards in cinnamon primary processing and improvement of quality in cinnamon primary process by reducing hazards contamination
- Investigation on medicinal value of cinnamon base products

5.3.2 Black Pepper

- Effect of arbuscular mycorrhizal infections on occurrence of yellowing in Black pepper (*Piper nigrum* L.) plants under different soil moisture levels (NARP).
- Evaluation of different irrigation techniques for black pepper at different agro climatic regions in Sri Lanka
- Comparison of growth and yield of pepper (*Piper nigrum* L.) raised from tissue cultured plants and single nodal cutting plants.
- Defining visual indicators for nematode borne slow wilt of black pepper (*Piper nigrum*) and investigating the effect of different control methods on pepper slow wilt causing nematodes.
- Preparation of a bio control agent (*Trichoderma* spp,) for the nursery and field level applications in black pepper (*Piper nigrum* L.)
- Management of black pepper (*Piper nigrum* L.) quick wilt disease through enhancing rhizosphere antagonistic microflora
- Evaluation of new hybrid black pepper verities against insect pest damages.
- Comparison of growth and yield of pepper raised from orthotropic (terminal), plagiotropic and rooted cuttings from Bamboo rapid multiplication system.
- Occurrence of insect pest and disease incidences in three commonly cultivated Black pepper (*Piper nigrum* L.) cultivars grown under different shade levels and climatic conditions
- Study of inorganic fertilizer response and pest and disease resilience of new black pepper hybrid "Dingirala" variety in dry zone of Sri Lanka
- Recycling of pepper stalks for sustainable crop production in pepper plantations (*Piper nigrum* L) in Sri Lanka
- Development of land suitability classification for black pepper (*Piper nigrum* L) in Sri Lanka

- Improvement of resource use efficiency of black pepper (*Piper nigrum* L.) to increase yield through support tree manipulation
- Synchronization of flowering and fruiting behavior of newly introduced *Piper nigrum* varieties (Butaweraala, Dingiraala and Kohukumbureraala) as climate change adaptation technique
- Investigation of effect of source of nitrogen on growth and yield of black pepper
- Effect of cover crops on soil properties, growth and yield of Black pepper
- Study of flowering and fruiting behaviour of newly introduced *Piper nigrum* variety (Dingirala) and local selection (MB-12) in Matale and Nillamba of Sri Lanka.
- Effect of Irrigation and fertilizer application on inducing of flower initiation and yield of bush pepper throughout the year.
- Hybridization of selected black pepper (*Piper nigrum* L) cultivars for low country intermediate zone.
- Study the potential use of coconut tree as a live supporting material for pepper (*Piper nigrum* L)
- Effect of different pruning levels on canopy development and yield of black pepper.
- Studies on use of soil moisture conservation methods and agronomic management practices for improvement of black pepper (*Piper nigrum* L.) productivity as climate change adaptation practices.
- Field evaluation of different concentrations of albert solution treated Black pepper nursery plants originated from cocopeat potting media.
- Evaluation of new hybrid black pepper verities against insect pest damages.
- Occurrence of insect pest and disease incidences in three commonly cultivated Black pepper (*piper nigrum* L.) cultivars grown under different shade levels and climatic conditions
- Defining visual indicators for nematode borne slow wilt of black pepper
- (*Piper nigrum*) and investigating the effect of different control methods on pepper slow wilt causing nematodes.

- Preparation of a bio control agent (*Trichoderma* spp,) for the nursery and field level applications in black pepper (*Piper nigrum* L.)
- Management of black pepper (*Piper nigrum* L.) quick wilt disease through enhancing rhizosphere antagonistic microflora
- Comparison of growth and yield of pepper raised from orthotropic (terminal), plagiotropic and rooted cuttings from Bamboo rapid multiplication system.
- Comparison of growth and yield of pepper (*Piper nigrum* L.) raised from tissue cultured plants and single nodal cutting plants.
- In-vitro propagation of Export Agricultural Crops (Garcinia, Wallapatta and Pepper (Hybrids)
- Production of high yielding local pepper selections, grafted nutmeg and grafted Goraka plants.
- Evaluation of different irrigation techniques for black pepper at different agro climatical regions in Sri Lanka
- Isolation of Piperine from Whole Dried Black Pepper
- Variation in chemical constituents of Piper species exist in Sri Lanka
- Design, fabrication and evaluation of greenhouse dryer for pepper
- Fixing Geographical indication for pepper in Sri Lanka
- In-situ evaluation of local pepper selections
- Collection, Characterization, Conservation and Utilization of Piper species exist in Sri Lanka
- Establishment of mother vine gardens using newly recommended Pepper Hybrids

5.3.3 Cocoa

- Evaluation of selected cocoa (*Theobroma cacao* L) lines for intercropping with coconut in low country intermediate zone.
- Studies on productivity improvement of cocoa (*Theobroma cacao* L.) under coconut in Kurunegala district.
- Evaluation of field performance of rooted cocoa (*Theobroma cacao*. L) cutting at Matale

- Evaluation of field performance of rooted cocoa (*Theobroma cacao*. L) cutting at Matale
- Home garden model of export agricultural crops at Matale
- Study the growth and yield performance of cocoa (*Theobroma cacao*. L) under micro irrigation
- Productivity Improvement of cocoa (*Theobroma cacao* L.) Through integrated soil and plant nutrient management system including good management practices
- Development of soil conditioner using bio-fortified cocoa pod husk for reclamation of cocoa fields
- Evaluation of different cocoa lines for different climatic zones (Matale, Badalkumbura)
- Characterization of available cocoa (*Theobroma cacao* L.) lines and Establishment of a clonal garden

5.3.4 Coffee

- Evaluation of the performance of selected coffee cultivars (*Coffia* sp.) under coconut in low-country intermediate zone
- In vitro propagation of Coffee
- Use of *Beauveria brassiana* for the control of Coffee Berry Borer
- Investigation of biological control agents of Coffee Berry Borer
- Design a Trap for Coffee Berry Borer
- Plant training system effect on growth and yield of Arabica coffee cv. (Hybrid de Timor - HDT) under natural shade at Matale
- Plant training system effect on growth and yield of Arabica coffee cv. (Hybrid de Timor - HDT) under natural shade at Matale
- Evaluation of cocopeat as a potential substitute for recommended potting media to coffee.
- Strategies for organic cultivation of Arabica coffee
- Development of small-scale coffee roaster
- Determination of caffeine content of Arabica and Robusta coffee selections
- Fixing Geographical indication for coffee in Sri Lanka

- Evaluation of Catimor coffee progeny
- Establishment of seed gardens from *Lak Parakum* Coffee
- Evaluation of Arabica coffee (*Coffea arabica*) accessions for yield, quality and resistant to major pest & diseases

5.3.5 Cardamom

- Screening of different accessions of cardamom against thrips (*Sciothrips cardamomi*)
- Evaluation of promising cardamom lines for low elevation under Mahogany (Kiriella)
- Finger printing of Cardamom accessions
- Field evaluation of low elevation cardamom varieties under irrigation

5.3.6 Clove

- Application of Plant Growth regulators (PGR) for flowering induction of clove (*Eugenia caryophyllus*)
- Comparative analysis on essential oil, chemical, proximate and mineral composition of clove bud, clove stem and leaf (*Syzygium aromaticum* L., Eugenia *caryophyllata thunb*.) grown in Matale

5.3.7 Nutmeg

- In vitro propagation of Nutmeg
- Field evaluation of the seedlings and air layered planting materials from different sizes of lateral and upright branches of high yielding matured Nutmeg (*Myristica fragrans*)
- Synchronization of flowering and fruiting behavior of Grafted Nutmeg in the context of climate change effects.
- Natural colour preservation in mace
- Determination of chemical constituents & antioxidant properties of nutmeg in Sri Lanka
- Development of Nutmeg splitting tool
- Molecular biological sex determination of Nutmeg

5.3.8 Goraka

- Evaluation of collected Goraka cultivars for the resistance against the Oyster scale insect
- Collection and investigation for growth, yield and chemical properties of different Garcinia (*Garcinia quaesita* Pierre.) selections in Sri Lanka
- Development of technology to produce value added products of Garcinia (Goraka)
- Exploration of Goraka (*Garciniaquaesita* Pierre and *Garcinia zeylanica* Roxb.) Accessions Based on Chemical Properties and Establishment of a Field Gene Bank

5.3.9 Betel

- Collection, establishment, evaluation and conservation of betel (*Piper betle*) germplasm in Sri Lanka.
- Study the optimum shade level for producing export quality betel leaves (*Piper betle*L.).
- Studies on effect of partially burnt paddy husk as an alternative nutrient source for growth and yield of betel (*Piper betle*).
- Development of value added products using waste betel (*Piper betle*) leaves .
- Characterization of soil fertility status in betel cultivations.
- Fertilizer Studies in betel (*Piper betle* L.).
- Investigation on use of indigenous techniques for controlling Bacterial Leaf Blight in Betel (*Piper betle* L.).
- Identification of Pests of Betel (*Piper betle* L.) Cultivation and Appropriate Management Practices to Maintain the Export Quality of the Leaves.
- Evaluation of department fertilizer mixture for single supporting system in betel (*Pipper betle* L) cultivation
- Evaluation of different plant raising methods for the production of betel (*Pipper betle L*) planting materials under shade nursery.
- Comparison of different potting/ nursery media used with coconut husk and coir dust for betel cutting production.
- Effect of traditional shelter belt on growth, yield & leaf quality of betel (*Piper betle*).
- Studies on Bacteria Leaf Blight (BLB) disease and its causative factors.
- Study the prevalence of BLB and other disease on betel cultivations.

- In vitro propagation of Betel

5.3.10 Ginger

- Evaluation of ginger (*Zingiber officinale*) germplasm under coconut.
- Initial Experiments works were conducted on Ginger cultivation using polysack bags with different weight of ginger rhizomes. (According to Hon. Minister's order and DG's recommendations)
- Effects of different harvesting age of rhizomes on growth and yield of ginger (*Zingiber officinale* Roscoe).
- Sustainable methods of growing ginger in polybags for household consumption and for commercial purpose
- Effect of Different Level of Shade on Growth, Yield and Quality of Ginger
- (*Zingiber officinale*)

5.3.11 Turmeric

- Collection, establishment and evaluation of turmeric (*Curcuma domestica* L) germplasm under coconut.
- Effect of Different Level of Irrigation on Growth and Yield of Turmeric (*Curcuma longa L.)*
- Effect of Different Level of Shade on Growth, Yield and Quality of Turmeric (*Curcuma longa* L.)
- Determination of chemical constituents & antioxidant properties of turmeric in Sri Lanka
- Analysis of physico-chemical properties of turmeric powder available in Sri Lankan market

5.3.12 Vanilla

- Identification of the Feasibility of Expanding Vanilla Cultivation in Central Province, Sri Lanka

5.3.13 other

- Micropropagation of Pineapple
- Technology innovation for large scale *In –vitro* multiplication of Cardamom, Cinnamon, Black pepper, Ginger and Turmeric
- Pineapple vegetative propagation by rhizomes. (According to Hon. Minister's order and DG's recommendations)
- Pineapple vegetative propagation by fruit crown. (According to Hon. Minister's order and DG's recommendations)
- The awareness and use of pesticide usage of farmers on Export agriculture crops in Economic and technical perspectives
- Develop, test and Implement monitoring procedures and practices at site, regional and national levels for: Below-ground soil biodiversity
- Home garden model of export agricultural crops at Matale
- Effect of extreme weather events on productivity of Export Agriculture Crops.
- *In-vitro* propagation of Export Agricultural Crops (Garcinia, Wallapatta and Pepper (Hybrids)
- Production of high yielding local pepper selections, grafted nutmeg and grafted Goraka plants.

5.4. Progress of Other Activities of the Research Division

5.4.1 Development Activities at National Cinnamon Research Station at Pllolpitiya

- Construction of the Directors room with the office in the upper story of Agronomy laboratory
- Purchasing of UV visible spectrophotometer

5.4.2. Development Activities at IBRS, Naramamala 2018

- The fence adjustment to main road has being replaced with a new fence (cost - Rs 1,90,000.00).

- A 12 feet wide strip of land was developed with landscaping using export agricultural crops (cost - Rs 53,000,00).

- Construction of new building behind the main research labs for farm office and for new labs (cost Rs. 70,00,000.00).
- Preparation of sewage tank of 10 feet deep and 5 feet in diameter (cost - Rs 43,000.00).
- Construction of new main gate for the research station.
- Preparation of land for betel cultivars (cost - Rs 37,000.00).
- Complete the partition the office of Director (Research)
- Preparation of 320 planting holes of 3ft x3ft x3ft size for replanting of coconut plants, covering 5 ac land area in research station (Rs 64,000.00).
- A land was prepared for the establishment of pepper and betel mother plant garden in IBRS/Narammala.

5.4.3 Development activities at Central Research Station, Matale

- Establishment of an information centre at National Spice Park
- Development of a road for staff quarters
- Establishment of new toilet complex at new laboratory premises
- Development of a fence about 3000 feet around research station premises and purchasing of materials for further extension of fence
- Establishment of record room to facilitate of office activities
- Preparation of leaflets for how to control quick wilt disease, Little leaf disease, Slow wilt disease in pepper and leaf blight disease of Clove.
- Land preparation for varietal demonstration field of Pepper
- Construction of Stone bridges for Soil technological garden
- Construction new toilets for New laboratory

- Purchasing of laboratory chemicals and equipment – Bench pH meter, Soil Munson colour chart etc.
- Construction of roads to quarters BT/01 and BT/02

5.4.4 Development activities at Tissue culture Research Station, Walpita

- Repairing of office & painting
- Repaired vehicles in the research station
- Constructed two new net houses (18'*60')
- Floor of the Farm office tilled

5.4.5. Development activities at Sub Research Station, Kundasale

- Improvements to laboratory, Security room &office tiling were completed
- Construction of two full shade net houses were completed.
- Construction of a drying floor at Kundasale sub research station was completed.
- Land preparation was completed to construct another two brand-new full shade net houses

5.4.5.1 National Exhibitions and workshops

Exhibitions in co-operation with the Ministry of primary industries. PHTD offered a major contribution for each and every event in districts level as well as national level. Ex. Profood propack Exhibition, Inco BMICH, Colombo.

5.4.5. Other activities at Central Research Station, Matale

1. Printing of book (English medium) on potential crops for commercialization which contained details of agronomy, uses and potential for future development etc on 34 crops that important as medicinal or food crops was completed
2. Annual Symposium on Export Agricultural Crops (ASEAC) which held on 18-19 October 2018 at Plant Genetic Resources Centre, Gannoruwa was successfully organized under the theme of "Quality Products through sustainable crop husbandry". Proceedings of the symposium contained 22 research papers and edited by Prof. B. Marambe. All the findings were presented under four main subject areas as Soil &

Plant Nutrition, Agronomy & Plant Science, Post-harvest technology and Economics and Plant Protection

3. Participated as Resource persons in training programmes organized by the In-Service Training Centre, successfully conducted several practical training programmes on Value Addition of EA crops at the PHTD, Research Station, Matale with the help of In-Service Training Centre.
4. Conducting Training Prgrammes: For Extension Officers and other officers- Export Agriculture Department, University students (University of Wayamba, University of Uwawellassa, University of Peradeniya, University of Rajarata University of Ruhuna), Farmer groups coordinating by Vidatha Training centres, other Farmer training programmes, Other students (School, Farm schools, etc).
5. As external supervisor for final year research projects: - 4 no. of university students were supervised and advised them to complete final year research project in the PHTD at Matale.
6. Participated to of meeting of review of the Sri Lanka Standard specification for Whole and ground Chilie, Turmeric, Coriander and Curry powder (6 numbers meeting) as a review committee member at Sri Lanka Standards Institute, Narahenpita
7. Soil samples collected from farmer fields were analyzed and recommendations were given.
8. Students from universities, other institutes and schools were trained on integrated plant nutrient management for EACs and practical training on identification of arbuscular mycorrhizal spores and root staining.
9. Participated for crop clinics and other development activities
10. Plant production programmeIn year 2018, around 5500 pepper plants including single nodal, lateral and top cutting were produced and 4000 plants and 2500 pepper cuttings were issued to other divisions for research purpose, Assistant Director's office Matale, Kundasale substation, Moneragala exhibition, ASEAC 2018 exhibition and outside farmers. Remaining plants were used for replanting programme in Bamboo Rapid Multiplication System for future plant production process and research work. Around 595 goraka plants were grafted by using scion parts that are collected from different district for research work. 288 Garcinia plants were grafted for research work and 265 were successes and remaining.

5.4.6. Advisory services

5.4.7 Training Programmes carried out by the research staff

Training programs for farmers /students/ officers at Cinnamon Research station-Thihagoda

Time frame	Number of training programmes	Total Number of participants
5 days	16	213
2 days	03	93
1 days	03	190
½ days	02	48
Total	24	544

Knowledge and Technology Dissemination of Betel through IBRS in Year 2018

The number of training programms conducted on EACs -15

The number of participants participated for training programme (farmers, growers)-372

The number of personnel who acquired advice over the telephone -118

The number of personnel who visited to IBRS -103

Knowledge and Technology Dissemination of EAC through Tissue culture Research in Year 2018

The number of training Programs conducted 05

The number of participants in training programs (Farmers, growers and students) 178

The number of personnel who acquired advice over the phone 500

The number of personnel who visited for seeking advices 750

Training programs for farmers /students/ officers at Central Research Station, Matale

Group	Number of groups	Total Number of participants
Farmer groups	08	348
University Students	14	473
Students of technical colleges	13	423
Students from schools	11	1362
Other officers	02	32
Total	48	2638

Industrial Trainings (more than 2 months) Undergraduate research projects conducted at Central Research Station, Matale

Division	Number of under graduate research project students	In-plant training of university stdents	Industrial Training
Division of Soil and Plant Nutrition	01		
Physiology and Plant Production Division	01		
Post harvest Technology Division	05		
In all divisions		06	02
Total	07	06	02

TV & Radio Programmes

1. Recorded Two Radio programmes and one Segavunu Kahawanu TV programs I
2. Technology transfer on ginger cultivation using poly bags was done via 06 radio programs and one TV program and on IPNM

Local/foreign training programmes and workshops attended IBRS

1. S. I. C. Silva (AD/R). Participated a training programme on scientific writing. Held on 19, 20 & 21-03-2018 at Rice Research and Development Institute, Department of Agriculture, Batalegoda, Ibbagamuwa. Organized by Sri Lanka Council for Agricultural Research Policy, Colombo 07.

2. S. I. C. Silva (AD/R), D. M. P.V. Dissanayake (AD/R), R. A. D. R. A. Ranasinghe (AD/R), W. M. Chandrarathna (R&DA), K. G. P. Shantha (R&DA), M. D. S. Dharmarathne (DO). Participated a workshop on Climate Change Adaptation. Held on 31-05-2018 and 26- 05- 2018 at In-Service Training Centre, Department of Export Agriculture, Matale. Sponsored by Lanka "Jalani", Battaramulla.

5.4.8. Pest and Disease Control

Plant Protection Service

- 05 farmer training classes, 03 field days and 07 field visits were conducted on the request of stakeholders and it was given the appropriate solutions for their Plant protection problems. These farmer training classes, field days and field visits were organized in collaboration with officers of Development Division of DEA in respective areas. (Table 03)
- Participated to the 09 Crop Clinics organized by the Extension staff of 09 Districts (Matale, Kegalle, Rathnapura, Badulla, Monaragala, Gampaha, Colombo, Polonnaruwa and Kandy). In crop clinics, it was given appropriate solutions to the stakeholders for their pest and disease problems of EACs, delivered the lectures on major pest and disease management strategies of EACs.
- Technical advisory service and recommended fungicides worth 834,000.00 were provided to manage the black pepper quick wilt disease outbreak at Morahela, Bandarawela extension officer range in Badulla District and Wellawaya in Monaragala
- Participate as a resource person to the two radio programmes (Rasamanjari – ITN FM) produce to aware about Black pepper quick wit and slow wilt diseases

- 04 leaflets (Pepper little leaf, quick wilt, slow wilt and clove leaf fall,) were reprinted to aware stakeholders
- Provided technical advisory service and monitoring of activities of Nutmeg Leaf Fall Disease Management Project (NLFD) conducting in Kandy, Kurunegala, Matale and Kegalle Districts
- Appropriate solutions were given for more than 500 plant protection problems raised via our direct telephone lines and 1920 "Govi Shana Sarana Sevaya"

Table 5.4.8.1: **Number of farmer field visits, training class and field days conducted in year 2018 under the plant protection service**

Crop	Disease/ Pest	Number of Trainings	No. Participants for training	Number of Field Days	Number of Field Visits
Coffee	Rust disease				01
Pepper	Little leaf disease Slow wilt Quick wilt Leaf blight Vine borer	03	250	03	06
All EACs	Prevention of postharvest contaminants	02	200		
Total		05	450	03	07

Table 5.4.9.1 Planting material issued by the Research Division

Item	**Quantity**
Pepper rooted cuttings	12000
Cinnamon Seedlings	2919
Cinnamon cuttings	1479

5.4.10. Collaborative research and development project

1. Mainstreaming Biodiversity Conservation and use in Sri Lankan Agro-ecosystems for livelihoods and adaptation to climate change (BACC) project.

University Students research

1. Effect of Fertilizer and Soil Moisture for Increasing the Number of Stem Cutting for Rapid Planting Material Production of Betel (*Piper betle* L.) D. A. Y.Wickramanayake (Wayamba University of Sri Lanka) , H.M.P.A. Subasinghe , H.A.W.S. Gunathilaka and K.H.M.I. Karunarathne.

2. Evaluation of Different Planting Hole Filling Materials on Growth Performance of Betel (*Piper betle* L.) for Production of Quality Stem Cuttings. G.D.D.P. Kumari (Wayamba University of Sri Lanka), H.M.P.A. Subasinghe and E. H. M. I. Herath.

3. Effect of Different Fertilizers Application on , Flower Initiation and Subsequent Spike Development of Black Pepper (*Piper nigrum* L.) M. P. Kolambage (Wayamba University of Sri Lanka), H.M.P.A. Subasinghe and H.AW.S. Gunathilake.

4. Effect of Different Types of Fertilizer on Growth Performances of Betel (*Piper betle* L.) for Production of Quality Stem Cuttings. H.M.S.N. Herath (Wayamba University of Sri Lanka), H.M.P.A. Subasinghe, H.M.I.K. Herath.

5. Growth performances of stem cuttings under organic amendments for planting material production of black pepper (*Piper nigrum* L.) Mizwer Rameez (University of Kelaniya, Sri Lanka), H.M.P.A. Subasinghe, R.M.C.S Ratnayake

5.4.11 Revenue earned by Research Division during 2018

Table 5.4.11.1 Revenue earned by selling of crops harvest/ bulletins at IBRS/ Narammala during year 2018:

Item	Value (Rs)
Coconut	18,76,835.91
Betel leaves	35,961.68
Betel shoots	1,20,520.00
Pineapple	28,481.00
Banana	2,762.50
Cinnamon plants	17,550.00
Technical bulletin	41,470.00

Revenue earned by Tissue culture research station Walpita

Mode of income (By selling)					
The amount	Plants	Banana and King coconut	Technical Bulletins	Auction of used goods	Total(Rs.)
Total amount(Rs.)	3898561.00	2250.00	13935.00	14670.00	1670266.00

Revenue earned by Cinnamon Research Station Sample testing, selling plantlets – Pallolpitiya

Type of sample	Number	Earnings RS.
pH & EC test	123	12,300.00
NPK testing & analysis	132	92,400.00
Bar test	1	3,400.00
Oil percentage test	12	9,000.00
Water activity test	68	30,600.00
Sulfur test	3	2,250.00
GCMS test	24	72,000.00
Total Amount	**363**	**221,950.00**

Selling planting materials -Cinnamon

Type of planting material	Number	Earnings RS.
Cuttings	1,479	44,370.00
Seedlings	2,919	37,947.00
Total	**4,398**	**82,317.00**

5.5. Economics & Market Research on EAC

5.5.1. Studies & Surveys

Evaluation of the Effectiveness of Measures taken to control Nutmeg Leaf Fall Disease

Nutmeg is a one among five main EAC which brings over Rs. 2500mn. foreign exchange earnings annually into Sri Lankan economy. Total extent of nutmeg in Sri Lanka is about 2589ha. but the crop has mainly concentrated in to Kandy district and surrounding areas of adjacent districts. One reason for recent drawback of the Nutmeg industry was the leaf fall disease which devastated nutmeg plantations mainly in Kandy district. By 2014 disease came to peak and about 2000 nutmeg trees had reported to be died and more than 15,000 trees had reported to be infected severely. Research division of DEA had long studied about this disease and had found out treatments for the control. Based on those recommendations Extension division of DEA had implemented a wide spread chemical spraying program in severely affected areas. Required chemicals and sprayers were supplied by the Department of Export Agriculture and spray men, who were volunteered to do the job in respective GN division, were trained by the department staff. Farmers had to bear the spraying cost for workers. The program continued in 2014 and 2015 and it was possible to control the disease at that stage. However, it was felt that a post evaluation is necessary to understand effectiveness of the program after completion and positive and negative impact of non-selective spraying.

This research work started in late 2017 and continued till July 2018. Survey work was done in Kandy, Matale, Kegalle and Kurunegala districts and lists of farmers, whose lands were selected for spraying, were obtained from district offices. Some other fields were also selected based on the field information. Altogether 290 farmer fields were visited and

information was collected with a structured questionnaire. Tabulation of questionnaires has been completed and the analytical work is being done.

Comparison of total Eco system benefits of pepper mono crop with intercropping and mixed cropping systems of pepper with special reference to Kandayan Home Gardens.

EAC such as pepper, clove, nutmeg, cardamom, coffee, cocoa, vanilla and areca nut have traditionally been grown in home gardens of mid country areas such as Kandy, Matale and Kegalle districts as mixed cropping systems. Since all those crops are perennials, they could generate yields for a long period and traditionally farmers had used to mix all those crops together with other useful annual and perennial plants in a perfect blend in the home garden to get maximum benefits. By doing that they achieved various returns ranging from crop harvests, daily food needs, medicinal plants, timer etc. as well as beautiful surroundings. Also it enriched lands with required soil fertility, protected soil texture, structure and supportive microorganisms and prevented soil erosion. With the commencement of the DEA assistance schemes in 1972 establishment of mono cropping of above crops have been popularized and currently a considerable extent of mono crops, especially pepper, exist in these areas. Due to higher returns some EAC such as pepper, clove etc. has been recommended as inter crops with plantation crops such as tea. With those entire options crop yield from the land is considered as the key factor to take decisions on land use. However, a recently introduced concept, known as Eco System approach, which consider all goods and services generated from the land could be used to calculate total eco system benefits of EAC cropping systems. Objectives of the study were **t**o identify, measure and value tangible and intangible benefits of three pepper-based cropping systems Kandy district. Three pepper-based cropping systems, as pepper mono cropping system, pepper-tea inter cropping system and pepper based mixed cropping system, were selected for the study. Survey activities have been started in five DS divisions, Udunuwara, Yatinuwara, Minipe, Ududumbara and Teldeniya. Structured questionnaires were used to collect information and sample of 35 farmers were selected for each category. Survey activities of mono cropping were completed in all DS divisions and around 70% of survey works of tea-pepper intercropping system were completed by the end of 2018.

5.5.2 Extent of EAC

Extent of EAC, adopted from the extent figures collected and published by the Department of Census and Statistics in 2018 are presented in the Annexure I.

5.5.3 Estimated Production of EAC in 2018

The annual production of main EAC is usually estimated considering exports, local consumption in different sectors in the economy (household consumption based on per capita annual consumption reported by the Department of Census and Statistics, industry consumption and food service industry consumption) and imports. Substantial amounts are allocated for withholding stocks and unreported exports. Based on those assumptions, the estimated production of EAC for 2015-2018 is given below (table 5.5.3.1)

Table 5.5.3.1 Estimated Production of EAC (MT) – 2016-2018

Estimated Production (mt) of EAC s (2016-2018)

Commodity/Year	2016 **	2017**	2018*
Coffee	2,824	2,496	2,398
Cocoa *	650	471	654
Cloves	1,823	6,413	1,284
Cardamom	120	113	71
Cinnamon	18,945	22,341	23,019
Pepper	18,476	29,546	20,135
Nutmeg & Mace	2,723	3,545	3,036
Citronella oil *	54	42	56
Betel	15,040	15,549	14,013
Arecanuts	13,260	11,570	12,117
Ginger (fresh) ++	23,184	16,326	14,208
Turmeric (fresh) ++	25,204	10,267	10,727

** Revised * Provisional

Source: Department of the Census & Statistics and DEA data base.

++ Department of Census & Statistics.

* Annual Prod. Forecast

5.5.3 Exports and Export Earnings of EAC in 2018

Total export volume of EAC had reached to 48,331.82mt with Rs. 64,590.51mn export earnings (Annexure II). Almost all crops showed declined exports in volume and earnings compared to year 2017 except cinnamon.

As same as in the last two years, black pepper received high public attention in 2018 creating a significant political tension within the country. Sri Lankan pepper prices showed slow but steady decline throughout 2018. However, in this background Sri Lanka has exported 13,118.10mt pepper and earned Rs. 12,074.02mn in 2018 showing around 1.4% decrease of export volume and5.4% decrease of export earnings compared to year 2017. Export volume and earnings of pepper oil were 66.51mt and Rs. 308.98mn respectively which showed 35.8% increase of export volume and 36.2%decrease of export earnings. Export volume of oleoresins in 2018 had decreased in to 360mt from 382.24mt in the previous year. Export earnings of oleoresins also had declined significantly from Rs.2, 742.72mn in 2017 to Rs. 2,064.59mn in 2018.

Cinnamon exports shows a continuous growth starting from 2018 by breaking the stagnation of export volume over decades. Export volume of cinnamon has reached to 17,536.51mt showing a 5.5% increase over previous year. It was the recorded highest export in recent history. Export earnings also had increased by 12.9% over the previous year from Rs. 30,872.79mn in 2017 to Rs. 34,852.88mn in 2018. It was observed that, around 54%of the total export earnings of EAC in 2018 had obtained from cinnamon exportation.

Except coffee and ginger, export volumes of all other EAC in 2018 had decreased over 2017. Export volume and earnings of ginger were97.17mt and Rs. 121.96mn respectively which showed 19.1% increase of export volume and 30%increase of export earnings. Export volume and earnings of coffee had shown a significant increase and the percentage of increased export volume and earning are 71.1% and 59.2% respectively. Except clove stem, nutmeg and vanilla, export earnings of all other EAC in 2018 had declined over 2017. Vanilla had shown a significant increase in export earnings (133.6%) where clove stem and nutmeg had shown an increase of 1.1% and 7% respectively.

Except cinnamon leaf oil, cardamom oil, citronella oil, nutmeg oil, mace oil and ginger oil, export volume and earning of all other essential oils had increased and notable increases were shown by vanilla oil and lemongrass oil. Though the values and volumes are small, a considerable positive growth had been shown in export of vanilla oil and lemongrass oil over previous year. Therefore it is important to note this achievement as there are no established large scale commercial cultivations in those two crop sectors. Although the export earnings had declined, citronella oil and ginger oil had shown an increase in export volumes by 7.5% and 56.2% respectively. As a whole, export earnings of essential oils of EAC had increased by 4.13% in 2018 over 2017 and export volumes had declined by 31% over last year.

5.5.4 Importing Countries of EAC from Sri Lanka

As usual, Mexico had purchased around 55% of total cinnamon export and many Latin American Countries had purchased large bulks. Purchase of cinnamon by USA had declined from 1995mt in 2017 to 1827.5mt in 2018. India was the main buyer of Sri Lanka Pepper, clove, nutmeg and mace with 84% of pepper export, 64% of clove export, 57% of nutmeg export and 74% of mace export respectively. Similarly around 99% of areca nut export in 2018 had also reached to India. India had imported 1496mt of cocoa from Sri Lanka and it was around 67% of total cocoa export in 2018. Pakistan, the main importer of Sri Lankan betel had shown a declined export share from 5030mt in 2017 to 3858mt in 2018. USA was the main buyer of cinnamon leaf and bark oils, citronella oil, ginger oil, lemongrass oil in 2018. France, Canada, India, Spain and Germany had appeared as main buyers of cardamom oil, clove oil, nutmeg oil, Pepper oil and vanilla oil in 2018.

5.5.5 Behaviour of Prices

Average annual farm gate price of coffee, clove, cinnamon quills, mace, cardamom and betel had increased in 2018 while the same in cocoa, pepper, nutmeg, citronella. Ginger and citronella had decreased (Annexure III). Among EAC most outstanding price increases in 2018 were shown by betel. Average annual farm gate price per betel 1000 leaves had increased from Rs. 1,855.26 in 2017 to Rs. 3,728.65 in 2018. Average annual farm gate price of cinnamon had increased from Rs. 1,846.13 per Kg in 2017 to Rs. 2,018.70 per Kg in 2018 while the same of cardamom had increased from Rs. 2,502.47 per Kg in 2017 to Rs. 2,778.36 per Kg in 2018. Decline of pepper price was a noticeable feature even in 2018 as the previous years. Pepper prices had started to decline since the end of 2018 but sharp and steady decline was noted after May. The average pepper price in 2018 was Rs. 586 per Kg which was Rs. 831 in 2017.

According to the “Public Ledger”, international prices of most of the EAC commodities except cocoa, mace, cardamom and citronella had declined in the year 2018 over the prices of 2017 (Annexure III).

5.5.6 Trends in EAC Imports in 2018

Total import of EAC in 2018 had increased by 12% from 13670mt in 2017 to 15,323.68mt in 2018 while the import expenditure too had increased from Rs. 6769mn in 2017 to Rs. 7,374.51mn in 2018 (Annexure IV). Turmeric, cocoa, ginger and pepper were major EAC items imported to Sri Lanka in 2018. Especially, recorded import of pepper mainly for the value addition purposes had increased by 127% from 1398mt in 2017 to 3,179mtin 2018.

A significant decline in importation of cardamom by 89% from 321.88mt in 2017 to 34mt in 2018 is noticeable while import of ginger had declined by19% from 1,731.53mt in 2017 to 1,395.38mt in 2018.Importation expenditure of cocoa and cocoa products had shown a decline of 3.7% over 2017 though there is a slight increase in the volume. Importation volume and expenditure of clove, cinnamon and coffee had shown an increase in 2018 over 2017. Essential oils which are cinnamon bark oil, citronella oil and vanilla oil had shown a significant increase in importation over previous year. All other EAC except areca nut had imported to Sri Lanka in 2018 in minor quantities (Annexure IV).

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Annexure I: Estimated Extent (ha) of EAC by Districts – 2018*

District	Cinnamon	Pepper	Clove	Cardamom	Coffee	Cocoa	Nutmeg	Arecanut	Betel	Citronella	Total (EAC)	Ginger	Turmeric	Grand Total (including Ginger & Turmeric)
Colombo	208	282	47	1	38	1	8	12	18		616	81	7	704
Gampaha	291	1,227	210	8	182	13	27	802	276		3,037	295	89	3,421
Kalutara	2,505	551	97	1	92	16	12	499	24		3,797	142	45	3,984
Kandy	186	4,988	3,207	597	1,067	182	1,909	1,173	5		13,314	337	254	13,904
Matale	353	5,736	783	350	470	607	358	814	9		9,480	37	32	9,549
NuwaraEliya	58	1,379	402	210	632	7	8	374	3		3,074	134	145	3,353
Galle	11,805	671	107	13	97	40	12	475	32		13,253	43	27	13,323
Matara	9,258	832	387	38	169	33	14	911	10		11,651	88	64	11,804
Hambantota	3,281	2,048	86	1	85	14	6	464	8	851	6,847	17	9	6,873
Jaffna			1					186	11		198			198
Mannar								7	4		10			10
Vavuniya		1						73	2		75			75
Mullaitivu		1						63	3		68			68
Kilinochchi								44	2		47			47
Batticaloa		2						14	56		71			71
Ampara	25	201	2	5	19	8	2	206	7		474	12	32	518
Trincomalee	6	61	1		1		2	38	34		143			143
Kurunegala	272	2,960	323	15	459	127	180	1,278	731		6,344	378	85	6,807
Puttalam	16	108	2		32	1		57	101		317	56	1	375
Anuradhapura	36	195	1		17	26		282	30		586	8	2	596
Polonnaruwa	6	189	1		11	4		152	21		383	18	14	416
Badulla	479	5,729	77	4	367	58	7	1,006	6	10	7,742	97	59	7,898
Moneragala	167	4,884	11	4	137	555	3	754	13		6,527	6	3	6,536
Ratnapura	4,285	6,566	348	215	221	42	27	1,767	20	564	14,054	98	50	14,202
Kegalle	351	1,634	1,865	261	445	70	212	1,082	37		5,956	150	137	6,243
Sri Lanka	**33,589**	**40,244**	**7,956**	**1,722**	**4,542**	**1,805**	**2,788**	**12,533**	**1,462**	**1,425**	**108,065**	**1,999**	**1,056**	**111,120**

Source : Economic Census. 2014, Department of Census & Statistics. * Provisional

Nutmeg & Citronella, DEA Data.

Ginger & Turmeric , DCS Agricultural Statistics.

Annexure II: Export Volume and Value of Export Agriculture Crops – 2017 & 2018

Commodity	Units	2017	2018 *	Growth% 2017/18
Cinnamon	Vol (mt.)	16,617.04	17,536.51	5.5
	Val (Rs.mn)	30,872.79	34,852.88	12.9
Cinnamon Leaf Oil	Vol (mt.)	309.01	280.87	-9.1
	Val (Rs.mn)	976.45	812.66	-16.8
Cinnamon Bark Oil	Vol (mt.)	40.50	42.79	5.6
	Val (Rs.mn)	1,492.63	1,649.96	10.5
Clove	Vol (mt.)	5,809.89	1,485.15	-74.4
	Val (Rs.mn)	6,761.46	2,174.69	-67.8
Clove Stems	Vol (MT)	1,995.70	1,794.09	-10.1
	Val (Rs.Mn)	400.43	404.79	1.1
Clove Oil	Vol (mt.)	9.41	10.66	13.3
	Val (Rs.mn)	84.83	130.86	54.3
Cocoa & Cocoa Products	Vol(mt.)	2,583.36	2,324.68	-10.0
	Val (Rs.mn)	2,339.48	1,205.45	-48.5
Coffee	Vol(mt.)	13.79	23.60	71.1
	Val (Rs.mn)	29.26	46.58	59.2
Pepper	Vol(mt.)	13,309.08	13,118.10	-1.4
	Val (Rs.mn)	12,767.97	12,074.02	-5.4
Pepper Oil	Vol(mt.)	48.96	66.51	35.8
	Val (Rs.mn)	484.42	308.98	-36.2
Oleoresine	Vol (MT)	382.24	360.00	-5.8
	Val (Rs.Mn)	2,742.72	2,064.59	-24.7
Cardamom	Vol(mt.)	839.17	108.31	-87.1
	Val (Rs.mn)	870.52	156.33	-82.0
Cardamom Oil	Vol(mt.)	0.42	0.22	-47.6
	Val (Rs.mn)	22.11	12.51	-43.4
Citronella	Vol(mt.)	38.02	40.88	7.5
	Val (Rs.mn)	263.15	177.33	-32.6
Nutmeg	Vol(mt.)	1,691.71	1,657.56	-2.0
	Val (Rs.mn)	1,562.11	1,671.38	7.0
Nutmeg Oil	Vol(mt.)	65.45	51.50	-21.3
	Val (Rs.mn)	424.43	344.53	-18.8
Mace	Vol(mt.)	351.15	280.80	-20.0
	Val (Rs.mn)	636.48	600.61	-5.6
Mace Oil	Vol(mt.)	0.04	0.03	-25.0
	Val (Rs.mn)	0.58	0.24	-58.6
Arecanut	Vol(mt.)	10,645.28	4,947.29	-53.5
	Val (Rs.mn)	5,744.48	2,864.19	-50.1
Betel	Vol(mt.)	5,144.92	4,009.01	-22.1
	Val (Rs.mn)	3,164.08	2,615.72	-17.3
Vanilla	Vol(mt.)	5.99	1.56	-73.9
	Val (Rs.mn)	27.06	63.22	133.6
Vanilla Oil	Vol(mt.)	0.23	6.28	2,628.3
	Val (Rs.mn)	0.40	18.50	4,525.0
Lemon Grass Oil	Vol(mt.)	0.98	5.39	449.8
	Val (Rs.mn)	5.00	28.59	471.8
Total EAC	**Vol(mt.)**	**59,902.34**	**48,151.76**	**-19.62**
	Val (Rs.mn)	**71,672.84**	**64,278.59**	**-10.32**
Ginger	Vol(mt.)	81.59	97.17	19.1
	Val (Rs.mn)	93.83	121.96	30.0
Ginger Oil	Vol(mt.)	4.18	6.53	56.2
	Val (Rs.mn)	100.37	87.29	-13.0
Turmeric	Vol(mt.)	114.88	76.36	-33.5
	Val (Rs.mn)	103.12	102.67	-0.4
Total (Ginger & Turmeric)	**Vol(mt.)**	**200.65**	**180.06**	**-10.3**
	Val (Rs.mn)	**297.32**	**311.92**	**4.9**
Total (with Ginger & Turmeric)	**Vol(mt.)**	**60,102.99**	**48,331.82**	**-19.58**
	Val (Rs.mn)	**71,970.16**	**64,590.51**	**-10.25**
Source: Sri Lanka Customs			* Provisional.	

Annexure III: Average Prices of Export Agriculture Crops (Rs/Kg) in 2015/2018

Crop	Price	Annual Average Price				Growth % 2017/18
		2015	**2016**	**2017**	**2018**	
Cocoa	FG	244.38	297.47	309.81	302.77	-2.27
	AU	369.81	403.58	418.52	467.55	11.71
	WM	473.39	491.66	365.35	421.10	15.26
Coffee	FG	251.19	362.65	463.93	489.53	5.52
	AU	301.72	414.32	343.80	677.29	97.00
	WM*	381.96	415.88	425.19	393.10	-7.55
Pepper	FG	1,090.34	1,246.23	831.90	585.84	-29.58
	AU	1,144.36	1,308.72	904.32	631.19	-30.20
	WM	1,449.41	1,609.09	1,347.46	995.72	-26.10
Clove	FG	1,046.11	1,053.14	975.38	1,071.39	9.84
	AU	1257.9	1246.63	1,145.02	1,296.48	13.23
	WM	1,822.37	1,220.53	1,366.09	1,263.68	-7.50
Cinnamon	FG	1,246.06	1,544.58	1,846.13	2,018.70	9.35
- Quills	AU	1,365.86	1,805.51	1,834.66	2,495.09	36.00
	WM				2374.73	
Nutmeg	FG	511.28	522.88	460.00	428.51	-6.85
	AU	556.65	562.5	547.40	501.74	-8.34
	WM	1,776.92	1,567.80	1,555.31	1,364.67	-12.26
Mace	FG	1,423.59	1,478.08	1,324.68	1,495.23	12.87
	AU	1,619.73	1,743.07	2,045.83	1,670.83	-18.33
	WM	1,996.08	1,986.27	2,044.76	2,207.13	7.94
Cardamom	FG	1,610.78	1,638.50	2,502.47	2,778.36	11.02
	AU	1,755.61	1,967.55	1,758.89	2,618.11	48.85
	WM	1,576.12	1,331.15	2,394.56	3,180.52	32.82
Betel (Rs./1000 leaves)	FG	3,583.89	4,151.63	1,855.26	3,728.65	100.98
	AU					
	WM					
Areca nut	FG	341.74	294.90	294.75	295.68	0.32
	AU	364.74	394.55	304.17	292.62	-3.80
	WM					
Citronella	FG	6,381.12	9,668.99	3,745.18	2,788.78	-25.54
	AU		10,500.00	8,750.00		-100.00
	WM	2,459.08	2,457.29	2,974.94	4,679.04	57.28
Ginger (Raw)	FG	137.72	127.12	425.67	349.09	-17.99
	AU		90.00	75.00		-100.00
	WM	415.74	421.53	337.06		-100.00
Turmeric (Raw)	FG	34.72	43.18	65.38	52.08	-20.34
	AU		32.5	27.08		-100.00
	WM					
Source: ERU data base	FG: Farm-gate Price; AU: Auction Price; WM: World Market Price					
*Robusta coffee						

Annexure IV: Import Volume and Value of Export Agriculture Crops – 2017 & 2018

Commodity	Units	2017	2018 *	Growth% 2017/18
Cinnamon	Vol (mt.)	61.64	112.52	82.5
	Val (Rs.mn)	87.70	187.26	113.5
Cinnamon Leaf Oil	Vol (mt.)	0.10		
	Val (Rs.mn)	0.04		
Cinnamon Bark Oil	Vol (mt.)	0.16	0.80	398.1
	Val (Rs.mn)	3.81	8.56	124.7
Clove	Vol (mt.)	9.51	11.62	22.2
	Val (Rs.mn)	11.32	16.02	41.5
Clove Stems	Vol (MT)	14.01		
	Val (Rs.Mn)	1.87		
Clove Oil	Vol (mt.)	3.15	2.09	-33.7
	Val (Rs.mn)	11.71	9.73	-16.9
Cocoa & Cocoa Products	Vol(mt.)	4,828.04	4,866.51	0.8
	Val (Rs.mn)	3,557.86	3,425.04	-3.7
Coffee	Vol(mt.)	75.04	95.71	27.5
	Val (Rs.mn)	88.54	129.52	46.3
Pepper	Vol(mt.)	1,398.08	3,179.05	127.4
	Val (Rs.mn)	1,231.30	1,931.97	56.9
Pepper Oil	Vol(mt.)	0.99	0.36	-63.9
	Val (Rs.mn)	0.07	0.05	-28.6
Oleoresine	Vol (MT)	1.69	2.66	57.5
	Val (Rs.Mn)	8.08	16.32	102.0
Cardamom	Vol(mt.)	321.88	34.03	-89.4
	Val (Rs.mn)	334.42	81.90	-75.5
Cardamom Oil	Vol(mt.)	2.20		
	Val (Rs.mn)	12.51		
Citronella	Vol(mt.)	2.45	16.08	556.5
	Val (Rs.mn)	5.87	29.06	395.1
Nutmeg	Vol(mt.)	10.23	0.29	-97.2
	Val (Rs.mn)	8.40	0.07	-99.2
Nutmeg Oil	Vol(mt.)			
	Val (Rs.mn)			
Mace	Vol(mt.)		0.02	
	Val (Rs.mn)		0.01	
Mace Oil	Vol(mt.)		0.01	
	Val (Rs.mn)		0.02	
Arecanut	Vol(mt.)	242.34	211.62	
	Val (Rs.mn)	73.16	87.48	
Betel	Vol(mt.)		0.75	
	Val (Rs.mn)		0.71	
Vanilla	Vol(mt.)	5.27	4.75	-9.9
	Val (Rs.mn)	5.40	7.97	47.6
Vanilla Oil	Vol(mt.)	0.65	2.06	216.9
	Val (Rs.mn)	0.95	2.91	206.3
Lemon Grass Oil	Vol(mt.)	0.96	0.49	-49.0
	Val (Rs.mn)	2.55	2.18	-14.5
Total EAC	**Vol(mt.)**	**6,978.39**	**8,541.42**	**22.40**
	Val (Rs.mn)	**5,445.56**	**5,936.78**	**9.02**
Ginger	Vol(mt.)	1,731.53	1,395.38	-19.4
	Val (Rs.mn)	259.82	276.97	6.6
Ginger Oil	Vol(mt.)	1.67	0.16	-90.4
	Val (Rs.mn)	17.19	2.28	-86.7
Turmeric	Vol(mt.)	4,958.32	5,386.72	8.6
	Val (Rs.mn)	1,046.87	1,158.48	10.7
Total (Ginger & Turmeric)	**Vol(mt.)**	**6,691.52**	**6,782.26**	**1.4**
	Val (Rs.mn)	**1,323.88**	**1,437.73**	**8.6**
Total (with Ginger & Turmeric)	**Vol(mt.)**	**13,669.91**	**15,323.68**	**12.10**
	Val (Rs.mn)	**6,769.44**	**7,374.51**	**8.94**
Source: Sri Lanka Customs			* Provisional.	

Annexure V: Deployment of Extension Officers

Galle	EO's Range
	Aluthwela
	Hiniduma
	Habaraduwa
	Ambalangoda
	Balapitiya
	Akmeemana
	Ethkandura
	Elpitiya
	Karandeniya
	Baddegama
	Niyagama
	Hikkaduwa
	Yakkalamulla
	Nagoda
Hambantota	EO's Range
	Okewela
	Beliaththa
	Middeniya
	Katuwana
	Walasmulla
	Sooriyawawa
	Weeraketiya
	Warapitiya
	Thangalle
Nuwaraeliya	EO's Range
	Ginigathhena
	Helboda
	Hanguranketha
	Walapane
	Rikillagaskada
	Maldeniya

Kandy	EO's Range
	Galagedara
	Udunuwara
	Kurunduwatte
	Harispattuwa
	Poojapitiya
	Udadumbara
	Rambukpitiya
	Yatinuwara
	Wattegama,
	Kundasale
	Hatharaliyadde
	Alawathugoda
	Medapitiya
	Gangawatakorale
	Udapalatha
	Teldeniya
	Talathuoya
	Minipe
	Galaha
Rathnapura	EO's Range
	Weligepola
	Kolonne
	Ayagama
	Godakawela
	Palmadulle
	Balangoda
	Rathnapura
	Embilipitiya
	Niwithigala
	Kealla
	Elapatha
	Pothupitiya
	Pallebadda

Gampaha	EO's Range
	Dompe
	Udugampola
	Gampaha
	Mahara
	Badalgama
	Pallewela
	Biyagama
	Meerigama
	Divulapitiya
	Minuwangoda
	Aththanagalle

Kegalle	EO's Range
	Mawanalle
	Ussapitiya
	Pinnawala
	Kegalle
	Warakapola
	Daraniyagala
	Dedigama
	Aranayake
	Ruwanwelle
	Yatiyantota
	Bulathkohupitiya
	Galigamuwa
	Rambukkana

Colombo	EO's Range
	Avissawella
	Homagama
	Padukke

Monaragala	
	EO's Range
	Bibile
	Monaragala
	Badalkumbura
	Madulle
	Hingurukaduwa
	Madagama
	Padiyathalawa
	Wellawaya
	Meegahayaya
	kotagama

Badulla	EO's Range
	Badulle
	Haldummulle
	Nikapotha
	Uvaparanagama
	Passara
	Ridimaliyadde
	Haliela
	Meegahakiula
	Kandaketiya
	Bandarawela

Matara	EO's Range
	Deniyaya
	Akuressa
	Pasgoda
	Hakmana
	Weligama
	Devinuwara
	Deiyandara
	Kamburupitiya
	Matara
	Pitabaddara

Kurunegala	EO's Range
	Polgahawela
	Dodamgaslande
	Mawathagama
	Rambadagalle
	Polpithigama
	Karandagolle
	Melsiripura
	Dambadeniya
	Katugampola
	Ududbaddawa
	Wariyapola
	Kuliyapitiya
	Panduwasnuwara
	Madampe
	Naththandiya
	Chilaw

Kaluthara	EO's Range
	Madurawela
	Bandaragama
	Kaluthara
	Mathugama
	Iththepana
	Baduraliya
	Beruwala
	Horana
	Bulathsinghala
	Pelawatta
	Agalawatta

Matale	EO's Range
	Palapathwala
	Ukuwela
	Thenna
	Rattota
	Weragama
	Yatawatta
	Hunukataela
	Pallepola
	Wahakotte
	Alugolla