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வருடாந்த செயற்திறன் அறிக்கை
ANNUAL PERFORMANCE REPORT

2016



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DEPARTMENT OF EXPORT AGRICULTURE

Web: www.exportagrdept.gov.lk

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ஆரம்பக் கைத்தொழில் அமைச்சு
MINISTRY OF PRIMARY INDUSTRIES

2016

லாஃகிக கார்டு காதல லாஃகால
வருடாந்த ஸெயற்திறன் அறிகுக்க

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DEPARTMENT OF EXPORT AGRICULTURE

MINISTRY OF PRIMARY INDUSTRIES

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Dr. M.A.P.K. Seneviratne
Director General
Department of Export Agriculture
2017. May

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ABBREVIATIONS

AD	-	Assistant Director
AM	-	Arbuscular Mycorrhiza
ASMEC	-	Annual Symposium of Minor Export Crops
BACC	-	Biodiversity conservation and Adaptation to Climate Change
BMICH	-	Bandaranayake Memorial International Conference
BRRD	-	Brown Rot Root Disease
CARP	-	Council for Agricultural Research Policy
COC	-	Copper Oxi Chloride
DEA	-	Department of Export Agriculture
GDP	-	Gross Domestic Product
EAC	-	Export Agricultural Crops
FTA	-	Free Trade Agreement
GAP	-	Good Agricultural Practices
GMP	-	Good Manufacturing Practices
HG	-	Home Garden
IBRS	-	Intercropping and Betel Research station
IPC	-	International Pepper Community
MT	-	Metric Tons
MOP	-	Muriate of Potash
NAA	-	Naphthalene Acetic Acid
NARP	-	National Agriculture Research Policy
NIPM	-	National Institute & Plantation management
NLFD	-	Nutmeg Leaf Fall Disease
PGIA	-	Postgraduate institute of Agriculture
PHASU	-	Post Harvest Advisory Service Unit
PHTD	-	Post Harvest Division
PIP	-	Productivity Improvement Program
SPnDP	-	Small Plantation and Development Program
SLIDA	-	Sri Lanka Institute of Development Administration
PGIA	-	Postgraduate Institute of Agriculture
SLIFTA	-	Sri Lanka India Free Trade Agreement

FOREWORD BY THE PRESENT DIRECTOR GENERAL

The mission of the Department of Export Agriculture (DEA) is to increase foreign exchange earnings from Export Agricultural Crops (EAC) sector through increasing the production, productivity, product quality and enhancing the value addition capacity of primary products. This sector comprises of Spices, Beverages, Industrial crops, Essential oil producing crops and Stimulant crops of perennial nature (other than Tea, Rubber, Coconut and Cashew). This sector contributes to an average share of over 15.3 % of all the Agricultural and Plantation sector export earnings. The DEA, under the supervision of the Ministry of Primary Industries, has planned and implemented its Research and Development programs in 2016 to achieve the mandated objectives.



As a policy, the DEA paid more attention to increase the production, productivity and to improve the quality of the products in order to meet the international standards and trade regulations, which enable to compete with other producing countries. Considering the international market requirements DEA continued its efforts in 2016 under the theme of “A Better Quality Product”, 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 “Dhana Saviya” was implemented , to uplift living standards of the rural community.

This report summarizes the overall performance and related information pertaining to the four sub-divisions of the Department namely Research, Development, Administration and Finance. It includes all activities of the department, strategies used to meet the desired goals and the progress achieved during the year 2016.

Dr. M.A.P.K. Seneviratne
Director General
Department of Export Agriculture
May 2017

GENERAL INFORMATION - 2016

- General information of the EAC sector in 2016
- Contribution to GDP – 0.4
- Contribution to export earnings of agriculture – 15.3%
- Export volume (Mt) – 44,861.66
- Export Value (Rs.mn.) – 51,739.41
- Estimated EAC extent (ha) – 118,670 ha (with ginger and turmeric)

District offices, research stations and nurseries of the department

Distribution District Offices

Fourteen 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

- 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, Wennooruwa 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

1. FUNCTION OF 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 persons involved in EAC production, processing and trading
- Providing advisory services for the promotion of EACs in estate sector
- Strengthening of the linkage 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

சாலை நிர்வாகம் ADMINISTRATION



2. ADMINISTRATION DIVISION

Highlights of the administration division

- Dr. M.A.P.K. Seneviratne, one of the most senior officers of the Sri Lanka scientific service in this department was appointed to the post of Director General from 04th March 2016.
- New Assistant Directors' Offices were established in Ampara, Polonnaruwa and Anuradhapura Districts.

2.1 Introduction

Being headed by the Additional Director General of Administration, the Administration Division of the department assists the operation of Administrative affairs of the Department coordinating with all the other sections and external organizations. Accordingly, new recruitments, promotions and transfers, human resource development, disciplinary control and matters related to departmental examinations, procurement and maintenance of capital assets of the department are mainly handled by the division. Besides the major responsibilities, the division carries out the welfare services and related activities for the motivation and welfare of the staff as well.

2.2 Staff

Approved cadre and existing cadre are given in Table 2.2.1. The organization structure of the department is given in attachment VI.

Table 2.2.1: Cadre information as at 31st December 2016

No	Post	Approved cadre		Actual Cadre		Vacancies
		permanent	Contract basic	Permanent	Contract basic	
01	Director General	01	-	-	-	01
02	Additional Director General (Research/Development)	02	-	-	-	02
03	Additional Director General (Administration)	01	-	01	-	-
04	Director (Research/Development/Regulation)	07	-	-	-	07
05	Deputy Director/Assistant Director (Administration)	01	-	01	-	-
06	Deputy Director/Assistant Director (Development/Research)	67	-	40	-	27
07	Chief Accountant	01	-	01	-	-
08	Accountant	01	-	01	-	-
10	Deputy Director/Assistant Director (Planning)	01	-	01	-	-
11	Internal Auditor	01	-	01	-	-
12	Statistician	01	-	01	-	-
Total of Senior Level		84	-	47	-	37
13	Administrative Officer	03	-	01	-	02
14	Extension Officer (Special Grade)	19	-	02	-	17
15	Chief Technical Officer	03	-	02	-	01
16	Farm Manager (Special Grade)	01	-	-	-	01
17	Translator	02	-	01	-	01
Total of Tertiary Level		28	-	06	-	22
18	Research and Development Assistant/ Development Assistant	84	-	78	-	06
19	Development Officer	411	-	274	-	137
20	Budget Assistant (To be attached by the Department of National budget)	01	-	01	-	-
21	Librarian	03	-	01	-	02
22	Extension Officer	171	-	148	-	23
23	Technological Officer	22	-	19	-	03
24	Technical Officer	01	-	01	-	-
25	Farmhouse Manager	17	-	-	-	17
26	Public Management Assistant	83	-	76	-	07
27	Information Technology Officer	01	-	01	-	-
28	Warden	01	-	01	-	-

29	Farm Service Assistant	05	-	05	-	-
Total of Secondary Level		800	-	605	-	195
30	Driver	61	-	55	-	06
31	Mason	01	-	01	-	-
32	Tractor Driver	02	-	01	-	01
33	Spray Machine Operator	02	-	02	-	-
34	Budder	01	-	01	-	-
35	Water Pump Operator	01	-	01	-	-
36	Nursery keeper	02	-	02	-	-
37	Office employee	35	-	29	-	06
39	Driver Assistant	08	-	08	-	-
40	Watcher	65	-	57	-	08
41	Labourer	303	97	253	-	50
42	Cook	01	-	01	-	-
43	Circuit Keeper	02	-	01	-	01
Total of Primary level		484	97	412	-	72
Total		1396	97	1070	-	326

2.3 Changes made in the Staff in 2016

New Appointments

Public Management Assistant Service	04
Office employee Service	06

Transfers -In

Accountant	02
Development Officer	14
Public Management Assistant	07
Information Technology Assistant	01
Driver	01
Office employee	03

Transfers – Out

Development Officer	13
Public Management Assistant	06
Driver	01

Resignation		
Information Technology Assistant		01
Extension Officer		01
Release		
Development Officer		11
Extension Officer		01
Deaths		
Administrative Officer		01
Retirements		
Director General		01
Assistant Director (Research)		01
Assistant Director (Development)		01
Assistant Director (Physical Resources Development)		01
Extension Officer		02
Public Management Assistant		06
Driver		03
Office Employee		01
Watcher		01
Labourer		04

2.4 Departmental Examinations in 2016

No:	Examination	Date
01	Tamil Language Oral Test for Officers in Sri Lanka Technological Service	10.02.2016
03	First departmental examination for Extension Officers in Sri Lanka Technological Service	06.06.2016
04	Second departmental examination for Extension Officers in Sri Lanka Technological Service	13.06.2016
	Second departmental examination for Technological Officers in Sri Lanka Technological Service	16.06.2016
05	First departmental examination for Officers in Sri Lanka Scientific Service	11.11.2016

2.5 Foreign tours and scholarships - 2016

Serial No:	Name of the Officer	Post	Description	Country	Period
01	Mr. Nishantha Perera	Research and Development Assistant	Visit to Thailand in Preparation for the Thai Deputy Prime Minister led delegation	Thailand	01.02.2016 to 06.02.2016
02	Dr. H.M.P.A. Subhasinghe	Deputy Director (Research)	IPC pepper production guide and guidelines for production of quality pepper planting material committee	Indonesia	14.03.2016 to 15.03.2016
03	Mrs. Thushari Liyanage	Extension Officer	IPC 22 nd meeting on pepper quality.	Malaysia	25.04.2016 to 27.04.2016
04	Dr. M.A.P.K. Senevirathne	Director General	IPC 22 nd meeting on standards and regulation.	Indonesia	25.04.2016 to 27.04.2016
05	Mrs. M.K.S.R.D.S. Samarasinghe	Assistant Director (Research)	Thermal treatment for disinfestations of fruit flies	Japan	11.05.2016 to 07.09.2016
06	Mr. W.A.K.G. Wickramasinghe	Assistant Director	Seminar on electronic conference for developing countries	China	05.05.2016 to 25.05.2016
07	Mr. H.A.M. Ilmi	Extension Officer	Seminar on spice cultivation and processing for Sri Lanka	China	03.06.2016 to 22.06.2016
08	Mr. K.H.M. Indika	Extension Officer	Seminar on trade facilitation for countries along the belt road 2016	China	13/07/2016 to 02/08/2016
09	Dr. M.A.P.K. Seneviratne	Director General	IPC 44 th Session	Indonesia	08.08.2016 to 14.08.2016
10	Dr. A.P. Heenkenda	Additional Director General (Research)	IPC 44 th Session	Indonesia	08.08.2016 to 14.08.2016
11	Mr. S.B.U.K. Ranaweera	Assistant Director	IPC 44 th Session	Indonesia	08.08.2016 to 14.08.2016
12	Mrs. C.K. Wickramaratne	Research and Development Assistant	Training course on new technology popular of agricultural mechanization.	China	09.09.2016 to 28.09.2016
13	Mr. D.M.P.R. Doragama	Research and Development Assistant	Seminar on business management for developing countries	China	03.08.2016 to 23.08.2016

14	Mr. Chandana Herath	Extension Officer	Seminar on business management for developing countries	China	03.08.2016 to 23.08.2016
15	Mr. R.P. Dayasena	Research and Development Assistant	Seminar on business management for developing countries	China	03.08.2016 to 23.08.2016
16	Dr. A.L.S. Dharmaparakrama	Director (Research)	Seminar on the construction of national standardization capacity along the road belt countries	China	03.08.2016 to 23.08.2016
17	Mrs. A.S.N. Jayalath	Research and Development Assistant	Construction of national standardization capacity along the belt countries in China	China	03.08.2016 to 23.08.2016
18	Mrs. R.A.D.R.A. Ranasinghe	Assistant Director (Research)	Rural development preparation of value chain	Japan	21.06.2016 to 28.08.2016
19	Mrs. K.A.R.D. Kodithuwakku	Research and Development Assistant	1 st International Agro Biodiversity Congress	India	06.11.2016 to 09.11.2016
20	Mr. G.A.M.U.S.K. Gunarathne	Extension Officer	Conference on the development of environment-friendly bamboo and cane industry	China	07.09.2016 to 27.09.2016
21	Mr. R.K.W. Rankethkumbura	Assistant Director	10 th Semaul undoll leadership training	Korea	13.10.2016 to 22.10.2016

2.6 Achievement of targets in 2016

- Takeover of land ownership

The transfer procedure of the land of the Head quarters of this department, the land of quarters No.30, Janasavigama, Kundasale and the land of the Extension Officer's quarters at Eththalapitiya, Bandarawela had been completed in due manner.

- Recruitment of officers

- Steps were taken to fill the vacancies in the post of Technical Officer of Sri Lanka Technological Service.
- New employees had been recruited to fill 06 vacancies in the Office Employee Service of Combined Services.

Table 2.6.1 Details of Officers Participated in Training Programmes - 2016

Training Institute	Course	Post of participant	Number of participants
Sri Lanka Institute of Development Training	Provisions in establishment code and procedural rules	Public Management Assistants and Development Officers	4
	Financial administration of local administrative institutes	Development Officers	1
	Environment administration	Extension Officers	1
	SLIDA certified driver course	Drivers	2
	Government procurement procedure	Public Management Assistants	2
	Government auditing procedure	Accountant / Public Management Assistants	2
	Induction training for public management assistants	Public Management Assistants	3
Sri Lanka Media Training Institute	Certificate course in television programmes	Development Officers	1
Construction Plant Training Centre	Store management	Public Management Assistants	1
Government Accountant's Union	Minimising audit queries	Accountant	1
Department of National Archives	Management and archiving of government documents	Additional Director General (Admin)/Assistant Director (Admin)	2
	Making awareness among government employees on management of government documents and national archives law	Administrative Officer	2
Sri Lanka Foundation Institute	English language certificate course in speech training	Administrative Officer	2
Yatinuwara Divisional Secretariat	Second language skills development programme and bilingualization of public service	Public Management Assistants	2
Adams Skill Development Centre	MICROSOFT EXCEL- Advanced analysis tools	Assistant Director	1
Institute of Human Resource Advancement	Workshop on attitudes and skills development XIII	Director (Development)	1
	Advanced program on attitudes and skills development 11	Assistant Director	1
Sri Lanka Broadcasting Cooperation	Course for announcers - SLBC media academy	Development Officers	1
Department of Motor Traffic	Maintaining gas emission standards	Public Management Assistants	2
Skills Development Fund	Workshop on procurement and evaluation of goods related to information technology	Assistant Director	2
Agro-Business Development Board	Export and import procedures and documentation	Assistant Director/ Development Officers	7



உள்ள
நிதி
FINANCE



3. FINANCE

The Annual Estimates for the year 2016 allocated a financial provision for a sum of Rs. 1107.01 million under the Head 289 in one program with, two Recurrent Expenditure projects and two capital Expenditure projects.

3.1: Financial Provision and Expenditure in 2016

Table 3.1.1 : Financial Provision and Expenditure-2016

Item	Net Provision (Rs)	Expenditure (Rs)	Expenditure (%)
Head - 289			
Program - 02			
Project - 01(Export Crops Development program)			
Capital Expenditure			
Rehabilitation and improvement of Capital Assets	14,000,000.00	13,549,495.00	96.78
• Buildings and structures	10,000,000.00	9,715,666.00	97.16
• Plant, machinery and equipment	1,000,000.00	905,795.00	90.58
• Vehicles	3,000,000.00	2,928,033.00	97.60
Acquisition of Capital Assets	12,700,000.00	12,571,114.00	98.99
• Furniture and office equipment	2,500,000.00	2,383,134.00	95.33
• Plant machinery and equipment	2,200,000.00	2,199,999.00	100.00
• Building and Structure	5,000,000.00	4,996,854.00	76.91
• Lands and Land Improvements	3,000,000.00	2,991,127.00	99.70
Assisting the Farmers for Export crop development			
• Development Assistance	450,000,000.00	380,351,483.00	84.52
Capacity Building			
• Staff Training	1,600,000.00	1,529,384.00	95.59
Total Capital Expenditure	478,300,000.00	408,001,476.00	85.30
Recurrent Expenditure			
• Personal Emoluments	381,000,000.00	360,114,911.00	94.52
• Other Charges	44,950,000.00	43,726,152.00	97.28
• General Administration	425,950,000.00	403,841,063.00	94.81
Total expenditure (project-01)	904,250,000.00	811,842,539.00	89.78

Table 3.2: Financial Provision and Expenditure-2016

Item	Net provision (Rs)	Expenditure (Rs)	Expenditure (%)
Project-02-export crops research and integrated pest/disease management (IPM) program			
Capital expenditure			
Rehabilitation and improvement of capital assets	5,800,000.00	5,488,455.00	94.63
• Buildings and structures	2,500,000.00	2,356,530.00	94.26
• Plant, machinery and equipment	1,000,000.00	900,838.00	90.08
• Vehicles	2,300,000.00	2,231,087.00	97.00
Acquisition of fixed assets	13,000,000.00	12,592,603.00	96.87
• Furniture and office equipment	1,000,000.00	834,771.00	83.48
• Plant machinery and equipment	2,000,000.00	1,910,309.00	95.52
• Buildings and structures	6,000,000.00	5,862,710.00	97.71
• Lands and land improvements	4,000,000.00	3,984,814.00	99.62
Capacity building			
• Staff training	600,000.00	552,947.00	92.16
Implementation of national agricultural research plan			
• Investment (NARP)	4,000,000.00	3,320,080.00	83.00
• Investment (prevention and control of Nutmeg leaf fall disease)	2,000,000.00	1,497,478.00	74.87
Total capital expenditure	25,400,000.00	23,451,563.00	92.33
Recurrent expenditure			
• Personal emoluments	158,600,000.00	146,040,238.00	92.08
• Other charges	18,760,000.00	16,879,413.00	89.98
General administration	177,360,000.00	162,919,651.00	91.86
Total expenditure (project 2)	202,760,000.00	186,371,214.00	91.92
Total expenditure	1,107,010,000.00	998,213,753.00	90.17

Total allocation of consolidate funds to the development for the year 2016 has increased by Rs. Mn.131.24 Over 2015 which was a 13.4 % increase. Out of total allocation of Rs.Mn.1107 expenditure for the year was Rs 998m. This was a 90.17% of the allocation provided for the year. The financial performances of the project 1 and 2 were 89.78% and 91.92% of the allocated funds. Percentages of the amount spent under capital expenditure of the projects 1 and 2 for 2016 were 85.30% and 92.33% respectively and the same for the recurrent expenditure was 94.81% and 91.86%, in spite of the man power shortages at field level technical cadres. The spending of 90.17% of the total annual allocation for the year 2016 was a significant achievement of the DEA.

3.3 Revenue of 2016

Revenue Source	Estimate (Rs.mn.)	Actual (Rs.mn.)
Rent on Govt. Buildings and Houses	1.45	1.50
Loan Interests -other	3.20	3.25
Departmental sales	8.00	9.27
Sundry Income	35.00	44.10
W and O P	15.00	15.80
Sale of Capital Assets	3.00	3.96
Other Receipts	7.00	7.40
Total	72.65	85.28
Advance Account Limits		
	Estimate	Actual
Maximum Limit of Expenditure	30,000,000.00	29,970,628.36
Minimum Limit of Receipts	24,000,000.00	27,958,248.66
Maximum Limit of Debit Balance	110,000,000.00	78,911,328.46

3.4 Internal audit division

Role

Our role is to scrutinize and determine whether the duties and responsibilities imposed by Financial Regulation No. 128 are duly fulfilled by the Department of Export Agriculture.

3.4.1 Responsibilities of Internal Auditing

- Determining the efficient, effective and transparent accomplishment of the tasks that shall be performed in achieving the vision, mission and the objectives of the department.
- Since the proprietorship and utilization of public finance is separated between two parties it is the responsibility of the IAU to assist the department to determine whether the utilization of public finance is in compliance with the financial regulations, related circulars and the objectives of the department.

Internal auditing and inspections are performed on the following sub sections.

Financial auditing	}	Focusing upon all the sections such as annual IA programme, new Budget scheme and Foreign Aid Projects.
Special inquiries		

3.4.2 Preparation of Internal Audit Reports

- Audit reports
- Special inquiry audit reports
- Management Audit Committee decision reports

3.4.3 Main Elements of Focus in IA

- Authorisation under FR 135
- Annual performance plan
- Procurement plan and schedule
- Imprest accounts, unsettled imprest accounts, expenditure control and asset management
- Personal files, leave files

3.4.4 Scope

The Internal Audit Unit examined 28 auditing units in 2016 consisting of the followings.

- 08 District offices
- 06 Research and sub research stations
- 09 Central nurseries
- 01 Training Centre
- 01 Special inquiry
- 01 Farmhouse and store
- Head Office
 - Accounts Division
 - Administration Division

3.4.5 Other Activities

- Composing answers for the government audit queries forwarded to the department.
- Composing and submitting answers for 10 audit queries during the year under review.

கலீர்லல அபிவிருத்தி DEVELOPMENT



4. DEVELOPMENT DIVISION

Highlights of Development Division

- A business Advisory unit (BAU) was established at the headquarter
- Two grand scale ‘Prime Expo’ exhibitions were held successfully in Kandy and Embilipitiya to promote EACs
- To increase the productivity of pepper cultivation ‘Shade Pruning Month’ was launched from 2016.11.05 to 2016.11.25
- ‘Danasaviya’ program, a program to strengthen the economy of women through EAC home gardening completed its first phase improving 53,152 home gardens
- The best three pepper farmers were given a study tour to China for studying spice value addition
- Annual Cinnamon harvest offering ceremony was held at Seenigama Devalaya, praying for prosperity to the cinnamon industry

4.1 Introduction

The Development Division of the Department plays a significant role to provide technical advice and guidance to stakeholders; to produce and distribute planting materials and to grant financial assistance for them with view of promotion of the EAC sector. The division is headed by an Additional Director General (Development) supported by three Directors (Development), each of them has been assigned two provinces, for the effective management and implementation of the EAC development program. In addition, Assistant Directors

attached to the respective districts, Extension Officers in-charge of the Extension Officer Ranges, Research and Development Assistants and Development Officers attached to the divisions worked as a supportive staff to continue the services and functions of the development division.

The development activities and services of the division mainly focused on the wet and intermediate zones of Sri Lanka covering 14 districts viz Kandy, Matale, Nuwara Eliya, Kurunegala, Colombo, Kalutara, Gampaha, Galle, Matara, Hambantota, Kegalle, Ratnapura, Badulla and Moneragala. In 2016 three new offices were opened in Ampara, Polonnaruwa and Anuradhapura Districts to expand EAC development activities thereby introduction of EACs to non-traditional areas was continued.

4.2 Crop development program

The following major programs were carried out by the development division in 2015.

1. New/Replanting program
2. Danasaviya Economic Home Garden Development Program
3. Productivity improvement program
4. Post-Harvest assistance and quality improvement programme

The special programs such as post-harvest advisory services, plantation advisory services and plant certification program for quality assurance of plants and planting material also implemented during the year 2016. Extension and training of stakeholders were carried out as tools for promoting above mentioned four major development programs.

4.3 Investment assistance scheme for the promotion of Export Agricultural Crop sector

This scheme was introduced in 1972 with the inception of the Department and it was revised several times over the past 40 years. The assistance scheme which was revised in April, 2015, is being implemented with some changes in 2016 to promote production, productivity and quality of EACs.

4.3.1 Export agricultural crops investment assistance scheme for new planting

Export agriculture crops investment assistance scheme is being implemented for new planting program is given in table 4.3.1.1 and the progress of the new planting program has been summarized in table 4.3.1.2. In 2016 planting materials for new cultivations of EACs were given recording 50% of cost of plants.

Table 4.3.1.1: EAC assistance scheme for new planting - 2016

Crop	Assistance scheme for new planting					Total value of installments (Rs./ha)
	Crop spacing	Number of plants per hectare	1 st installment (Rs.) (03 months after planting)	2 nd installment (Rs.) (18 months after planting)	3 rd installment (Rs.) (24-36 months after planting)	
Cinnamon	1.2x0.9m	9000	40,000.00	20,000.00	20,000.00	80,000.00
Black Pepper	2.4x2.4m	1700	40,000.00	20,000.00	20,000.00	80,000.00
Clove	6.0x6.0m	250	20,000.00	10,000.00	10,000.00	40,000.00
Nutmeg	6.0x6.0m	250	20,000.00	10,000.00	10,000.00	40,000.00
Cardamom	2.0x2.5m	2000	40,000.00	10,000.00	10,000.00	60,000.00
Areca nut		1600	20,000.00	5,000.00	15,000.00	40,000.00
Coffee (Arabica)	1.8x1.8m 1.8x2.5m	3000	40,000.00	20,000.00	20,000.00	80,000.00
Coffee (Robusta)	3.0x3.0m	1600	20,000.00	10,000.00	10,000.00	40,000.00
Cocoa	3.0x3.0m	1100	40,000.00	20,000.00	20,000.00	80,000.00
Citronella/ Lemongrass	0.9x0.9m 0.6x0.6m	27500	20,000.00	20,000.00	-	40,000.00

Table 4.3.1.2 Progress of new planting program– 2016

Crop	Applications received		Applications recommended		Permits issued		Extent planted		Rewards paid	
	No.	ha	No.	ha	No.	ha	No.	ha	No.	ha
Cinnamon	3566	1468.90	2641	1057.78	1442	557.75	1456	561.05	2669	928.65
Pepper	7624	2229.70	5239	1385.38	2735	762.93	2030	492.51	3482	759.09
Clove	81	26.40	60	19.40	36	10.90	36	13.10	15	4.30
Nutmeg	251	94.40	181	53.80	137	39.00	93	24.55	100	24.90
Cardamom	17	10.60	14	9.90	3	3.40	2	2.80	2	0.4
Vanilla	47	7.50	40	4.50	6	0.60	2	0.20	0	0
Areca nut	371	125.45	315	103.40	196	58.01	157	44.46	82	20.75
Betel	11	1.40	1	0.40	1	0.40	1911	31.11	0	0
Coffee	179	143.80	142	111.00	58	52.80	53	46.10	56	12.1
Cocoa	754	218.20	663	182.10	571	180.30	504	161.90	861	254.10
Citronella	401	249.20	361	196.30	346	214.40	249	157.70	176	67.40
Total	13302	4575.55	9657	3123.96	5531	1880.49	6493	1535.48	7443	2071.69

4.3.2 Productivity improvement program

The Productivity Improvement Program (PIP) was introduced to increase the production of the existing EAC cultivations per unit area, where production is below the potentials due to low crop density and poor crop management. According to research findings most of the soils in cinnamon growing areas are acidic and soils of other crop such as pepper, clove, nutmeg, coffee and cocoa need nutrient management to develop root system to tolerate drought conditions. To meet these challenges growers were assisted with technical advice and supplying of dolomite to existing low production cinnamon lands and rock phosphate to

existing cultivations of pepper, cocoa, coffee, clove and nutmeg in order to improve the existing cultivations from the cash grant provided under the assistance scheme. Adoption of recommended agronomic practices such as filling vacancies, adoption of proper soil and moisture conservation measures, crop and shade tree pruning, integrated plant nutrient management and integrated pest management are the practices required to qualify under the assistance scheme. The details of the assistance scheme are given in Table 4.3.2.1.

Table 4.3.2.1: Assistance scheme for productivity improvement program (Cash grant per hectare)

Crop	1 st Year (Rs.)	2 nd Year (Rs.)	3 rd Year (Rs.)	Total (Rs.)
Cinnamon	13,000.00	13,000.00	14,000.00	40,000.00
Black pepper	13,000.00	13,000.00	14,000.00	40,000.00
Clove	7,800.00	7,800.00	4,400.00	20,000.00
Nutmeg	7,800.00	7,800.00	4,400.00	20,000.00
Cardamom	13,000.00	13,000.00	14,000.00	40,000.00
Coffee	13,000.00	13,000.00	14,000.00	40,000.00
Cocoa	13,000.00	13,000.00	14,000.00	40,000.00

Progress of the extent developed under productivity improvement program in 2016 are given in the table 4.3.2.2

Table 4.3.2.2: The extent (ha) developed under productivity improvement program (PIP) in different districts - 2016

District	Crop							Total
	Cinnamon	Pepper	Coffee	Cocoa	Cardamom	Clove	Nutmeg	
Kurunegala	11.8	56.2	0.8	-	-	2.4	-	71.2
Matale	13.3	94.5	-	2	-	8.1	-	117.9
Kandy	2.3	126	4.1	1.2	-	25	13	171.6
Nuwara- Eliya	-	9.9	8.5	-	1.7	0.6	-	20.7
Badulla	11.3	158.8	-	-	-	-	-	170.1
Monaragala	3	91	-	4.4	-	-	-	98.4
Hambantota	65.3	12.9	-	-	-	-	-	78.2
Matara	117.2	-	-	-	-	-	-	117.2
Galle	3.5	-	-	-	-	-	-	3.5
Kalutara	45	-	-	-	-	-	-	45
Colombo	3.9	-	-	-	-	-	-	3.9
Gampaha	5.6	11.4	-	-	-	-	-	17
Kegalle	1.3	5.9	0.1	-	-	4.4	-	11.7
Ratnapura	77.9	119	-	-	-	-	-	196.9
Total	361.4	685.6	13.5	7.6	1.7	40.5	13	1123.3

4.3.3 Export agricultural crop assistance scheme for post-harvest activities

Post-harvest advisory service unit (PHASU) was established in 1998 to upgrade the quality of export agricultural crop products and continued its activities during the reporting year too. The investment assistance scheme was revised in April 2015 to suit the stakeholders at different levels of operation. The main objective of this assistance scheme was to maintain the quality of the product to be competitive in international markets, product diversification and value addition and to facilitate marketing of EAC products. The details of the three assistance schemes are given below (Table 4.3.3.1)

Table 4.3.3.1: Assistance scheme for post-harvest activities

a) Machineries

Equipment		Capacity (minimum)	Investment Assistance per unit (Maximum) Rs.
1.1	Equipment for Pepper Processing		
A	Blancher	25 kg/batch	Rs. 3,000.00
B	Decorticator	150kg/hour	Rs. 30,000.00
C	Thresher		
i	Manual	100 kg/hour	Rs. 15,000.00
ii	Electric	500 kg/hour	Rs. 40,000.00
iii	Motor driven	500 kg/hour	Rs. 40,000.00
D	Shifter-Green berry separator	250 kg/hour	Rs. 15,000.00
E	Grader / Blower	200 kg/hour	Rs. 30,000.00
F	Hand Sieves - No 6/8/10 net	Volume 2' x2' x3"	Rs. 200.00
1.2	Equipment for Coffee Processing		
A	Pulpier – Disc / Rotary		
i	Manual	100 kg/hour	Rs.10,000.00
ii	Motor Driven or Electric (with the facility of seed washing)	250 kg/hour	Rs.20,000.00
B	Huller	250 kg/hour	Rs.25,000.00
1.3	Equipment for Cocoa Processing		
a	Fermentation Box (3 units) (1 st class Timber)	2'x2'x2'	(Rs. 2,000 *3) Rs 6,000.00
1.4	Other Crops		
a	Ginger/Turmeric Slicer		30 kg/hour
i.	Manual		Rs.5,000.00
ii.	Electric	100 kg/hour	Rs.20,000.00
b	Turmeric boiler		10 kg
			Rs 1,500.00
c	Turmeric Polisher		
i.	Manual	30 kg/hour	Rs 5,000.00
ii.	Electric	60 kg/hour	Rs 10,000.00
d	Crusher		Rs10,000.00
e	Grinder		Rs 30,000.00
f	Nutmeg Sheller		100 kg/hour
			Rs 10,000.00
g	Vanilla fermentation box		20 kg /unit
			Rs.15,000.00

1.5	Drying Units (fuel wood or fuel)				
	a	Drying Trays - Should be located 2.5 feet above floor level			
		Drying trays	i. 100 sq feet minimum		Rs 6,000.00
			ii. > 100 sq feet (60.00 Rs/ sq feet)		Maximum Rs 10,000 .00
b	Green House Dryer/ Drying Chamber should furnish with drying trays				
	Drying Chambers	i. sq feet 400 – 799		Rs.40,000.00	
		ii. > 800 sq feet		Rs. 100,000	
	c	Multicrop Driers			
		i	Cabinet type	i. 50 kg – 149 kg	Rs 25,000.00
				ii. 150 kg – 299 kg	Rs.75,000.00
	iii. 300 kg or more	Rs.250,000.00			
	ii	Flat bed type	500 kg or more		Rs 250,000.00
	d	Cardamom Barn	250 kg		Rs.200,000.00
	e	Solar Dryer	Minimum 100 sq feet		Rs. 15,000.00
f	Drying Floor	minimum 200 sq feet		Rs.10,000.00	

b) Processing centres

	Type of building		
2.1	Small scale processing centres New/Repairing (Group B)		
	• New constructions		Maximum amount (Rs)
	a. sq feet 400-599		Rs.100,000.00
	b. sq feet 600 - 999		Rs.150,000.00
	c. sq feet 1000 or more		Rs.200,000.00
	• Repairing/ rehabilitation of old buildings	Maximum amount Rs	Rs.100,000.00
	a. 400 sq feet or more		
		i. Roof	Rs. 25,000.00
		ii.Ceiling	Rs. 15,000.00
		iii.Plastering and painting	Rs.15,000.00
		iii. Tiling of floor	Rs. 25,000.00
		v. Pavement	Rs. 10,000.00
		vi. Ventilation	Rs. 10,000.00
2.2	Central processing centres (Group D)		
	Investment	i. Over Rs. Mn. 01	Rs.250,000.00
		ii. Over Rs. Mn. 02	Rs.500,000.00
		iii. Over Rs. Mn. 03	Rs.600,000.00
		iv. Over Rs. Mn. 04	Rs.700,000.00
		v. Over Rs. Mn. 05	Rs.750,000.00
			} Should be more than 1000sq feet
2.3	Group processing centres (Group C) As per the circular no 3/2014 , (2014/08/01) .		

c) Investment assistance for oil distillation units

Oil distillation units			
Equipment	minimum capacity	maximum investment assistance Rs.	
4.1. New constructions			
• Bark oil	50 kg/batch (minimum)	} Rs. 250,000.00	
• Leaf oil	250 kg/batch (minimum)		
3.2. Repair/Improvements			
• Bark oil	50 kg/batch (minimum)	} Rs. 200,000.00 (maximum)	
• Leaf oil	250 kg/batch (minimum)		
		i. Boiler (steel)	Rs.10,000.00
		ii. Boiler (stainless steel)	Rs 25,000.00
		iii. Furnace /chimney	Rs 12,000.00
		iv. Still for cinnamon leaf - with lid ((stainless steel)	Rs 40,000.00
		v. Steam conveying tubes with controllers (stainless steel)	Rs 10,000.00
		vi. Pre-cooler (stainless steel)	Rs 15,000.00
		vii. accessories	Rs 7,000.00
		viii. Condenser tube 1½" or 2" (steel, stainless steel))	Rs 25,000.00
		ix. Oil separator(stainless steel)	Rs 15,000.00
		x. Goose neck (stainless steel)	Rs 10,000.00
		xi. Still for cinnamon bark (stainless steel)	Rs 25,000.00
		xii. Building (sq. feet 1200)	Rs 40,000.00

d) Investment assistance for EAC storage facilities

This assistance scheme was established to encourage GMP in order to achieve and maintain high quality products throughout the value chain.

No.	Area (sq.ft)	Investment (Rs.)	Assistance (Rs.)
1	300-500	200,000-400,000	50,000.00
2	More than 500	More than 400,000	100,000.00

c) Investment assistance for EAC value added products Industries

This program was initiated to promote the investors to enter into the EAC value addition with GMP to increase the foreign exchange earnings to the country.

No.	Investment(Rs. Mn)	Assistance (Rs. Mn.)
1	More than 2.0	0.70
2	More than 3.0	0.75
3	More than 4.0	0.80
4	More than 5.00	0.90

Table 4.3.3.2 : Progress of the post- harvest assistance scheme in 2016

Item	Number of units granted
Processing centres	45
Distillation units	24
Pepper threshers	53
Blanchers	29
Dryers	22
Drying floors	06
Coffee pulpers	05
Pepper decorticators	08
Ginger and turmeric slicer	04
Grinder	04
Drying chamber/trays	04
Graders	02
Turmeric polisher	02
Nutmeg sheller	01
Total	209

4.4: “Danasaviya” Economic home Garden program

This program was implemented to strengthen the economy of women through cultivation of EACs in their home gardens. The beneficiaries were trained and provided planting materials free of charge which are well suited to the area as well as to the home garden. Crop combinations offered in this program are given in Table 4.4.1

Table 4.4.1: Crop combinations offered in “Danasaviya” program

Crop combination	Plant type	Number of plants
Cinnamon	Cinnamon	700
Pepper/areca nut	pepper	30-80
	Areca nut	20
Clove	Clove	05
Nutmeg	Nutmeg	05
Clove/ Nutmeg	Clove	2-3
	Nutmeg	2-3
Arabica coffee	Arabica coffee	100
Citronella	Citronella	2000

Progress of the establishment of “Danasaviya” economic home gardens is shown in Table 4.4.2

Table 4.4.2 Progress of the establishment of “Danasaviya” economic home gardens

Crop	Number of Home garden	Plant Issues											
		Pepper	Coffee	Cinnamon new planting	Cinnamon Replanting	Clove	Nutmeg	Citronella New planting	Arecanut	Vanilla	Betel	Other	Total
Badulla	4,367	163,038	-	-	-	-	-	-	16,107	-	-	-	179,145
Colombo	1,118	18,040	-	5,600	-	-	1,380	-	28,288	-	-	-	53,308
Kalutara	4,021	142,893	-	82,150	-	-	1,955	-	56,945	-	-	-	283,943
Galle	3,684	41,965	-	1,468,760	-	-	-	-	840	-	-	-	1,511,565
Gampaha	3,946	118,785	-	23,500	-	-	-	-	99,040	-	-	-	241,325
Hambantota	3,856	76,510	-	278,313	-	-	1,007	154,000	104,710	-	-	-	614,540
Kandy	3,489	74,692	6,594	-	-	601	5,108	-	18,269	4,640	-	-	109,904
Kegalle	4,184	152,912	-	-	-	267	2,743	-	29,080	-	150	-	185,152
Kurunagala	3,232	151,417	346	27,900	-	1	191	-	50,217	-	-	-	230,072
Matale	3,544	128,070	-	-	-	-	564	-	53,580	-	-	-	182,214
Matara	1,564	33,436	-	514,175	-	-	112	-	2,600	-	-	-	550,323
Monaragala	2,609	126,655	-	4,800	-	-	-	-	33,395	-	-	-	164,850
Nuwaraeliya	2,966	66,960	55,210	-	-	1,309	528	-	12,840	-	-	-	136,847
Rathnapura	6,031	180,405	-	369,900	-	1,257	726	202,000	108,195	-	-	500	862,983
Putatalama	378	-	-	1,000	15,680	-	-	-	5,540	-	-	-	22,220
Ampara	2,642	65,720	-	160,700	-	-	-	-	19,945	-	-	-	246,365
Polonnaruwa	594	18,251	-	-	-	-	-	-	8,414	-	-	-	26,665
Anuradapura	205	8,164	-	20,302	-	-	-	-	1,560	-	-	-	30,026
Total	52,430	1,567,913	62,150	2,957,100	15,680	3,435	14,314	356,000	649,565	4,640	150	500	5,631,447

4.5. Production and issuing of planting material

The objective of this program is to issue quality planting material for new planting and PIP programs. Planting material was provided under 50% investment assistance scheme to all farmers who were qualified under the development assistance scheme and successfully completed the practices like land preparation, soil conservation and other field operations as per the instructions given by the department officers. Planting material was raised in 11 central nurseries managed by the department (table 4.5.1) and in registered private nurseries under the close supervision of extension staff of the department. There were 758 private nurseries registered with the department in the year 2016. The distribution of private nurseries is shown in table 4.5.2.

Table 4.5.1: Details of the central nurseries of the department

District	No. of nurseries
Kurunegala	03
Matale	01
Nuwara-Eliya	02
Hambantota	01
Matara	01
Gampaha	01
Kegalle	01
Total	10

Table 4.5.2: Number of private nurseries registered with the department - 2016

District	No. of nurseries	District	No. of nurseries
Kurunegala	50	Galle	51
Matale	44	Kalutara	60
Kandy	66	Colombo	37
Nuwara-Eliya	50	Gampaha	23
Badulla	70	Kegalle	39
Monaragala	41	Rathnapura	60
Ampara	30	Anuradhapura	25
Hambantota	32		
Matara	65		
Total		754	

Prices of the planting material were revised with effect from 20.04.2015 and prevailed prices for the same in 2016 are given in table 4.5.3

Table 4.5.3. Prices of seeds/cuttings and plants/suckers (Rs.)

Crop	Seed material /cuttings (Rs.)	Plants/ suckers (Rs.)
Cinnamon	80.00 per kg of seeds	Plant 13.00
Pepper	0.20 per 3 node cutting	Plant 23.00
Clove		Large Plant 70.00
Nutmeg	10.00 per seed	Seedling 100.00 Budded 180.00
Cardamom	-	Sucker 10.00
Cardamom		Tissue cultured sucker 50.00
Vanilla	5.00 per 1m cutting	5.00
Arecanut	2.00 per nut	Plant 13.00
Cocoa	20.00 per pod	Plant 14.00
Coffee	80.00 per kg of ripened fresh berries and 150.00 per kg of parchment, dry coffee beans	Plant 14.00
Citronella	-	2.00 per sucker
Lemongrass	-	2.00 per sucker
Garcinea	-	Seedling 70.00 Budded 120.00
Kitul	-	Large 45.00 Small 12.00
Ginger	60.00 per kg	-
Turmeric	30.00 per kg	-

4.6. Plant certification program

Supplying of certified plants to the growers has been made a mandatory requirement by the Department. Starting with good quality plants is a prerequisite in achieving a high productive cultivation. In order to ensure supply of quality plants through EAC development program, a team of officers consisting of a Director, District Assistant Directors and/or Assistant Directors (Research) and an Extension Officer, or officer appointed by the Director General visited each nursery and plant certification was performed using the guidelines given by the Department. The details of certified plants are given in table 4.6.1.

Table 4.6.1: Details of the plants certified in 2016

Crop	Number of plants (certified)
Cinnamon	8,191,516
Pepper	2,945,445
Clove	13,977
Nutmeg	33,885
Arecanut	1,028,112
Coffee	129,338
Cocoa	337,303
Garcinia	1,685
Grand total	12,681,261

4.7. Issuing of plants under the export agricultural crops assistance schemes

Table 4.7.1 illustrates the details of plants issued under the different programs during 2016.

Table 4.7.1 Issuing of planting material (in numbers) – 2016

Crop	New Planting	Danasaviya	Other programs	Total
Pepper	814,971	1,567,913	42,454	2,425,338
Coffee	119,590	62,150	10,720	192,460
Cinnamon	4,688,305	2,972,780	338,273	7,999,358
Cardamom	5,600	-	205	5,805
Cocoa	160,710	-	55	160,765
Clove	3,475	3,435	928	7,838
Nutmeg	6,550	14,314	1,548	22,412
Citronella	5,093,450	356,000	0	5,449,450
Areca nut	79,825	649,565	157,225	886,615
Vanilla	600	4,640	600	5,840
Beetle	-	150	-	150
Other	10,925	500	374	11,799
Total	10,984,001	5,631,447	552,382	17,167,830

(other includes supplying of plants under productivity improvement program and organic farming program)

4.8. Organic farming program

Considering the growing demand for organically produced food in the international market, the department initiated this program for promotion of organic farming since the year 1998. The major role of the Department in this program was to educate growers on organic farming and principles behind it, establishment of demonstrations in selected villages, encourage organic farmers to keep records, promotion of the use of organic manure and integrated pest management practices. Farmers were facilitated for marketing their products through linking of buyers/exporters. The program was targeted to popularize organic farming among EAC growers and bring the benefits of this niche market to them and to the country while conserving the environment.

Table 4.8.1: Extent established under organic farming development program in 2016

District	Progress	
	Number of organic villages	Extent (ha)
Kurunegala	1	2
Monaragala	1	10
Galle	8	3
Kaluthara	2	39.4
Rathnapura	1	53.2
Total	13	107.6

4.9. Farmer training

Farmer training programs were organized and conducted by the Assistant Director in-charge of each district with their supporting technical staff in order to improve knowledge and skills of farmers and other stakeholders with updated technological information and to motivate farmers to adopt improved Good Agricultural Practices (GAP) in cultivation and Good management Practices (GMP) in processing of EACs. Required resource personnel and other services were obtained from the Research Division, whenever necessary, to conduct the training programs. Progress of the training classes conducted on the topics of Good Agricultural Practices (GAP) and Good Manufacturing Practices (GMP) in the year reviewed are given in table 4.9.1

Table 4.9.1: Progress of farmer training 2016

Activity	Number of programs		Number of beneficiaries
	GAP	GMP	
Farmer Training Classes	2,683	364	82,283
Field Days	376	148	15,689

4.9.2 Training programs conducted in In-Service Training Centre, Matale

Progress of the training programs held at the In-Service Training Centre, Matale is given in table 4.9.2.1

Table 4.9.2.1: Details of the training programs conducted at In-Service Training centre, Matale

Type of training	Nature of trainees	Number of training programs conducted	Number of trainees trained	Number of training days	Number of man-days
Officer training	Officers of DEA	19	659	51	1808
Officer training	Officers of other institutions	18	497	27	704
Farmer training	Farmers and other stakeholders	20	585	30	789
Conferences and workshops	Stakeholders of EAC sector	7	232	7	232
Training programs conducted outside institution	Stakeholders of EAC sector	5	607	5	607
Total		69	2580	120	4140

The training programs were conducted for stakeholders of EAC sector including farmers on establishment and maintenance of crops and post-harvest technology, ginger, turmeric and pepper in particular.

4.10. Other development programs

Uva-Wellasse cocoa development project, small plantation development programs two million areca-nut planting program and the activities related to pepper pruning week are other development programs that were carried out within the year 2016. These programs are described below.

4.10.1 Uva-Wellasse cocoa development project

This project was initiated to establish 225 ha of cocoa under rubber in Monaragala District of Uva province. In spite of prolonged drought, 180.6 ha of cocoa have been successfully

established. In order to meet this target, 160,600 cocoa seedlings were raised and distributed among beneficiaries. A sum of Rs.Mn.2.59 was spent on the project for production of plants and training of farmers.

4.10.2 Small plantation development program (SPnDP)

Pepper plants were distributed among members of farmer societies in Kandy, Nuwaraeliya and Kegalle districts for intercropping with tea under the SPnD project. The details are given in table 4.10.2.1

4.10.2.1: Distribution of plants for intercropping with tea under SPnD project

District	No. of farmer societies	No. of beneficiaries	Pepper plants distributed
Kandy	38	540	9,113
Nuwaraeliya	34	620	9,335
Kegalle	10	313	1,910
Total	82	1,473	20,358

A productivity improvement program was also implemented under the assistance of SPnDP in Kegalle District. Under this program, productivity of pepper vines, which have already been established in tea cultivations, were improved and 1,585 farmers were benefited. One thousand six hundred and eighty nine farmers were trained under the SPnDP as follows (Table 4.10.2.2).

Table 4.10.2.2 : Training programs conducted under SPnDP for beneficiaries of EAC

District	Number of training programs held	Number of beneficiaries
Kandy	54	776
Nuwara Eliya	41	600
Kegalle	10	313
Total	105	1,689

4.10.3 Pepper shade pruning month

The major factor impedes the yield of black pepper is the excessive shade in cultivations. Pepper pruning month was meant for mass-scale pruning of gliricidea shade trees in pepper cultivations in order to facilitate light penetration to increase yield of pepper vines. The pepper growers were encouraged for shade tree pruning and applying green manure at the base of the vines. The pepper pruning month lasted from 2016.11.05 to 2016.12.5. This program was implemented island wide covering 4593 ha of pepper cultivations belonging to 8,236 farmers. The details of the program are given in the Table 4.10.3.1.

Table 4.10.3.1: Progress of pepper pruning month (2016.11.05 to 2016.12.5)

District	Number of DS divisions covered	Number of GN divisions covered	Number of pepper growers involved	Extent of pepper cultivations pruned (ha)
Kurunagala	8	13	358	45
Matale	6	6	212	236
Kandy	20	74	1597	950
Nuwaraeliya	4	17	675	263.25
Badulla	10	30	825	530
Monaragala	6	30	738	631
Hambantota	7	21	888	592
Matara	4	5	101	4.5
Galle	11	13	424	86
Kalutara	15	20	495	117
Colombo	3	3	78	22.5
Gampaha	10	41	765	292
Kegalle	13	22	627	448
Ratnapura	10	11	453	375
Total	127	306	8236	4593

4.10.4 Two million arecanut planting program

Two million arecanut seedling planting program was launched as a special project for two years from 2015 to 2016. The objective of this program was to increase arecanut production to fulfil national requirement and increase arecanut exports as well as for the soil and water conservation. Under this program, arecanut seedlings were distributed in selected cultivable lands, estates, home gardens, and government office premises, camps of armed-forces,

boundaries of stream, tanks, roads and forest reserves. The details of the seedling distribution program in 2015 are given in table 4.10.4.1

Table 4.10.4.1: Arecanut seedlings distributed district -wise in 2016

District	No. of seedlings distributed
Kurunegala	63,422
Puttalam	3,700
Matale	76,131
Kandy	20,349
NuwaraEliya	35,903
Badulla	18,147
Moneragala	60,445
Ampara	19,945
Hambantota	104,479
Matara	2,600
Galle	7,079
Kalutara	92,570
Colombo	35,495
Gampaha	107,880
Kegalle	37,040
Rathnapura	119,245
Polonnaruwa	8,414
Anuradapura	93,560
Total	906,404

4.10.5. National food security program

This program was funded by the Presidential Secretariat to achieve national food security and sustainable income generation for the farmers. The DEA joined this program to grow ginger and turmeric and increase the productivity of these crops and mechanization of processing industry with value addition. This program was implemented in two directions, namely cultivation program and post-harvest development program. Total expenditure of the program

was Rs.Mn 19.12 .The progress of cultivation program is shown in Table.4.10.5.1 while that of post-harvest development program is in table 4.10.5.2.

Table.4.10.5.1: Extent of Ginger and Turmeric cultivated in 2016

District	Cultivated extent, Ha	
	Ginger	Turmeric
Kurunegala	103.0	3.21
Matale	8.5	0.62
Kandy	25.1	8.66
Badulla	6.6	0.06
Moneragala	11.0	9.01
Ampara	0.5	9.71
Galle	10.8	-
Kaluthara	13.1	3.87
Colombo	8.7	-
Gampaha	21.4	7.45
Kegalle	3.5	0.76
Ratnapura	14.0	-
Anuradhapura	33.0	-
Total	259.2	43.35

Table 4.10.5.2: Progress of the post-harvest development program of ginger and turmeric in 2016

District	Processing facility given	No. of units
Kurunegala	Individual processing center	01
	Central processing center	01
Nuwara Eliya	Ginger slicer	01
Kalutara	Turmeric grinder	01
Colombo	Dryer	02
Anuradhapura	Dryer	01
	Ginger slicer	01
	Ginger grinder	01

4.10.6 Cultivation of Arabica coffee in higher elevations of Sri Lanka

Coffee is one of the main EAC but its cultivation in lower elevations of the country is diminishing due to shifting into more lucrative commercial crops. Arabica coffee in higher elevations of Sri Lanka is famous for its intrinsic quality and taste. Under this program 117,200 of high quality arabica coffee plants were given to plantation sector in Nuwara-Eliya district at half a cost of plants. Progress of this program is given in Table 4.10.6.1.

Table 4.10.6.1: Progress of the Arabica coffee cultivation program in higher elevations 2016

Name of the Estate	Coffee plants issued	Extent cultivated (Ha)
Merigold Estate	48,000	16.0
Kabaragala Estate	2,400	0.8
Firland Estate	3,600	1.2
Medakumbura Estate	5,000	1.6
Duncinon Estate	8,000	2.6
Sheen Estate	6,000	2.0
Eton Estate	1,200	0.4
Diyaniella Estate	5,400	1.8
Madawala Estate	1,200	0.4
Dunculd Estate	1,500	0.5
Agyle Estate	2,400	0.8
Keit Estate	3,000	1.0
Invory Estate	3,000	1.0
Venture Estate	2,100	0.7
Cuacuswall Estate	3,700	1.2
Harington Estate	4,500	1.5
Ayona Estate	4,500	1.5
Theresia Estate	2,100	0.7
Delmar Estate	9,600	3.2
Total	117,200	38.9

4.10.7. Adaptation of Mahaweli River basin farmers to climate changes

This project was initiated and financed by the Ministry of Mahaweli Development and Environment. The DEA implemented this program in Walapane of Nuwara Eliya district and Medirigiriya and Lankagama of Polonnauwa district. The project had two components, home garden development program with EACs in Nuwara-Eliya and Polonnauwa districts and productivity improvement program in pepper cultivations in Nuwara Eliya district with special attention to soil and water conservation practices. The main aim of this project was to train the farmers to face the climatic changes by growing perennial crops and improve the soil and water conservation. In Nuwara-Eliya District 100 home gardens with pepper and areca nut plants were established and productivity of 100 acres of pepper cultivations were improved. Due to severe drought prevailed in Polonnaruwa district only 235 of home gardens were able to be established.

4.11. Progress of media and communication division

The prime objective of the media and communication division is to link all the stakeholders and enhance their awareness and knowledge on Export Agricultural Crops (EAC) industry. For this purpose, audio-visual media streams such as electronic and printed means are used. In addition, exhibitions, demonstrations are also held by this division to raise public awareness on the EAC sector. All the media and publicity events are guided, formulated, organized and dispersed towards the enrichment of the vision of the Ministry of Primary Industry and the Department of Export Agriculture

4.11.1. Electronic media

National level mass media usage facilitates the coverage of the highest number of stakeholders in cost effective manner. All the documentary, commercial and other programs telecast / broadcast were in-house productions of the division. The following table (4.11.1.1) shows the all-electronic media activities performed in year 2016.

Table 4.11.1.1: Details of television programs and radio programs

No	Media	Name of the program	No. of episodes	Chanel broadcast
01	Rupavahini	Sengawunu Kahawanu	21	National television channel
02	TV Spot	Dangers of indiscriminate harvesting of pepper	10	National television channel
03	Radio	Rasa Janani	48	Kandurata, Ruhunu, Wayamba, and Swadeshiya Sevaya of SLBC
		Kahawanu thuru	24	Kandurata Sevaya of SLBC

4.11.2. Print media

In order to keep the stakeholders aware with timely updates and the newly generated knowledge were mainly delivered through the press media. For this purpose, national level newspapers were used and also sought the support of regional level journalists to further dissemination of such information in their own newspapers. Table (4.11.2.1) shows the relevant activities done in year 2016.

Table 4.11.2.1: Publishing of EAC related articles in national newspapers

No	Item	No of occasions	Newspaper
01	Price list of export agriculture crop products	52	Dinamina (Every Friday)
02	Timely news and feature writings	20	Dinamina

4.11.3 Subject related magazines, leaflets and banners published

Subject related magazines, leaflets and banners etc. are the important source of technical information and knowledge records in the sector. Through these media the department is disseminating updated knowledge on EAC industry to the stakeholders' regularly. Table (4.11.3.1) shows the relevant activities done in year 2016.

Table 4.11.3.1: Details of printed material published in 2016

No	Category	Name of item	No. of copies printed
01	Leaflets	Betel cultivation, areca nut cultivation, ginger cultivation and turmeric cultivation	167,000
02	Flex / Banners	Related to EAC	47
03	Magazine	“Sarathee”	3,000

4.11.4 Demonstrations / Social media

Direct interaction with the stakeholders brings better results than other media activities performed since it interacts with the live and active two-way social communities. Therefore, such sources and streams play a crucial role in delivering the particular information towards the betterment of the spice sector. Following table (4.11.4.1) shows the relevant activities and service details in year 2016

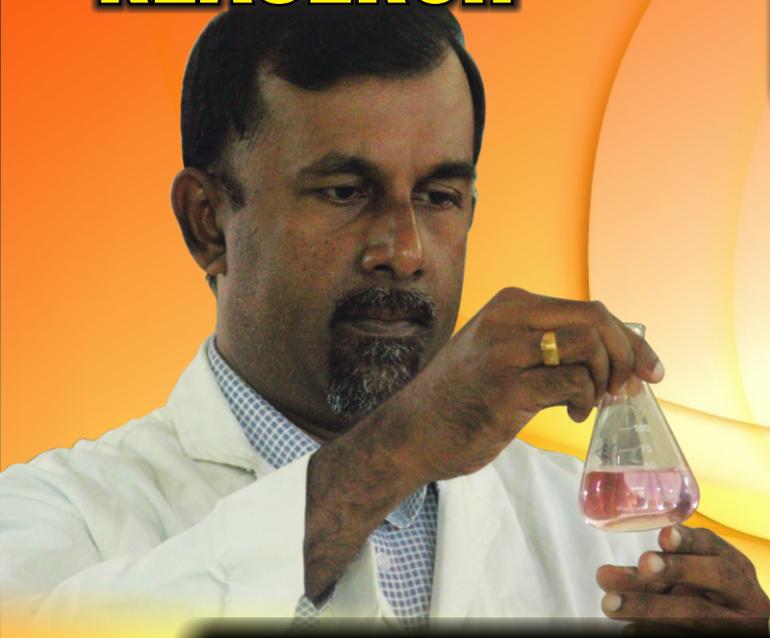
Table 4.11.4.1: Usage of activities related to two-way social communities

No	Item	Function	No. of incident / addressed
01	Exhibition	Stalls and demonstrations	23
04	Consultancy/advisory	Direct and through telephone	3,000

4.11.5. Other special events

Indoor and outdoor media and communication needs of the department were facilitated by the division throughout the year. During 2016 special events such as “Newum Kurundu Mangalya”, Annual Symposium of Minor Export Crops (ASMEC) and Prime Expo exhibitions were the main highlights covered.

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5. RESEARCH DIVISION

Highlights of the research division

- Pieris Cinnamon showed greater growth performances (avg. stem length 177.5 cm, avg. diameter 3.75 cm, avg. bark thickness 0.15 cm), low severity of disease and pest damages (>10%) and distinctively erect stem compared to selected accessions of Sri Gemunu and Sri Wijaya
- Soil analytical data collected from cinnamon cultivation indicated that soil pH, electrical conductivity, total Nitrogen and exchangeable K are related to the cinnamon bark yield levels.
- Up to 1% sea water can be applied for cinnamon plant nurseries without adverse effect and achieving 50% control of leaf blight and thrips damage.
- Sand can be replaced with granite powder in potting mixtures.
- Inoculation of Arbuscular Mycorrhiza (AM) has shown positive impact on growth performance of cocoa and improvement of soil organic Carbon
- Planting material of black pepper originated from terminal branches showed highest field establishment rate in all locations (Matale 100%, Nillambe 98% and Narammala 68%), highest canopy development and more lateral branches.
- Nutmeg and mace samples were collected directly picked from the tree, fallen under the tree and from market places. *Aspergillus* spp. fungal contamination in all the collected samples were observed.
- Both ginger and turmeric can be stored under 19-20 °C up to five months with 40- 22% weight loss respectively.
- *Colletotricum gloeosporioides* and *Neofusicoccum* spp. were identified as causal organisms of Nutmeg leaf fall disease in DNA homology search and it was confirmed by the pathogenicity test

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 and 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 2016 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 2016

5.2.1. Cinnamon

Agronomy and Crop Improvement

The study was conducted to identify and evaluate superior quality characteristics of the accession comparing with selected accessions Sri Gemunu and Sri Wijaya to identify the possibility of using "Pieris cinnamon" collected from cinnamon growers in Galle district for future varietal improvement programs. According to the observations made so far, it was evident that the collected accession from Ahungalle (A1) showed greater growth performances (avg. stem length 177.5 cm, avg. diameter 3.75 cm, avg. bark thickness 0.15 cm), low severity of disease and pest damages (>10%) and distinctively erect stem comparing to selected accessions. At the initial harvesting the average dry bark yield per stem was 148g.

To produce elite varieties with superior quality characteristics, through hybridization among selected cinnamon accessions 46 hybrid plants were produced and established in the field. After screening and evaluation of the plants, four plants (14-1, 32-1, 33-1, 36-1) with elite characteristics [higher bark yield (100 – 150 g dry bark yield per stem) and low severity of pest and disease (RBD and WBM > 20%)] were selected for further evaluation under recommended agronomic practices.

Experiment was conducted to investigate the effect of fertilizer application time on growth, yield and peelability of cinnamon. Recommended fertilizer mixture was applied at five months, four months, three months (control), two months, one month and two weeks before harvesting as treatments. Higher peelability (fresh bark 1.611kg/hour) were observed in applying fertilizer 2 months before harvesting to 2 weeks before harvesting compare with other treatments. Considering this finding most suitable time period for applying fertilizer was between 2 months and 0.5 month before harvesting.

Experiment was conducted to evaluate the different pruning method, on high bark yield and reduce pest and disease incidence. Harvesting interval of this experiment was 6 months and 8 treatments were tested with control (pruning height up to 1m, pruning interval 3 months and allowed 3 new healthy shoots per cut at three months after harvesting). Considering dry bark yield, most suitable pruning method was pruning height up to 1m, pruning interval 6 months and allowed new 3 healthy shoots per cut at three months after harvesting. Rough bark disease incidence decreased when pruning up to half height of the bushes (45.40 %) than up to 1m height of the bushes (68.58%).

Evaluation of yield and quality characteristics of true cinnamon (*Cinnamomum zeylanicum* Blume) in different agro-ecological regions in Matara district was completed. This research shows that there are significant differences between the GN divisions of each agro ecological zone of Matara district with respect to important yield parameters of Cinnamon such as length, fresh weight and girth of stem, Thickness of bark, fresh and dry weight of bark, oil content of bark and leaves, fresh and dry weight of leaves were taken as yield parameters.

Soil and Plant Nutrition

Integration of cinnamon leaf compost 10t ha⁻¹ yr⁻¹ with half of current fertilizer recommendation (450 kg ha⁻¹ yr⁻¹) recorded 877.3kg ha⁻¹ yr⁻¹ of the highest dry bark yield and current fertilizer recommendation (900 kg ha⁻¹ yr⁻¹) recorded 870.7kg ha⁻¹ yr⁻¹ of dry bark yield. Cinnamon leaf compost 10t ha⁻¹ yr⁻¹ with half of current fertilizer recommendation also recorded 3.5% increases in cumulative bark yield of five harvests when compared to current fertilizer recommendation for cinnamon indicating the possibility of sound practice of integrated Nutrient Management in Cinnamon to reduce the fertilizer cost and improve the soil quality.

Soil analytical data collected from cinnamon cultivations having different bark yield levels (Mean high bark yield 1875kg/ha/yr and mean low bark yield 385.8kg/ha/yr) in three EO ranges as Mathugama, Bulathsinghela, and Baduraliya of Kalutara District indicated that soil pH, electrical conductivity (EC), total Nitrogen (N) and exchangeable potassium (K) are related to the cinnamon bark yield levels. The mean values of different soil variables for high and low yield classes were 5.38 and 5.13 for pH, 0.02 ds m⁻¹ and 0.03 ds m⁻¹ for EC, 0.069% and 0.035% for total Nitrogen and 90 mg kg⁻¹ and 60 mg kg⁻¹ for exchangeable potassium respectively. These soil properties can be employed to predict the yield potential of cinnamon grown soils.

Three months after field establishment, 98% of survival rates recorded in seedlings and 85% of survival rates recorded in vegetatively propagated (VP) plants at the research field in National Cinnamon Research and Training Center field. After three months of field establishment the average higher plant height also showed in seedlings than VP plants.

Plant Protection

Pathogenicity tests confirmed that the responsible causal organism of rough bark disease in cinnamon as *Phomopsis* species. Morphological characters do not support to identify the

Phomopsis fungi to species level. Further studies such as molecular technology is required for the correct identification of the pathogen up to species level.

Rough bark disease reaches critical stages when the fungus invades the xylem tissues of stem showing interveinal chlorosis of leaves as the pathogen blocks the water and mineral nutrient translocation. However, further studies are required to quantify the relationships among nutritional status of diseased plant, pathogen and the soil.

Up to 1 % seawater can be applied for cinnamon plants nurseries without adverse effect and achieving 50 % control of leaf blight and thrips damage.

Post Harvest Technology

New peeling table having low space requirement compared with the existing table for peeling efficiency, peeler comfort and compliance with food sanitary requirements. There is no significant difference between peeling efficiency of new peeling table and the existing peeling table. Peeler comfort is higher in new peeling table than the existing one with regard to sitting facilities. Food sanitary requirements are the same in both tables. Peeling efficiency is a concern among labours and there are significant differences on peeling efficiency among labours.

Comparative Study on Major Chemical Constituents in Volatile Oil of True Cinnamon (*Cinnamomum verum* presl. syn. *C. zeylanicum* blum.) and Five Wild Cinnamon Species Grown in Sri Lanka

There are eight species of cinnamon grown in Sri Lanka, of which, *Cinnamomum verum* Presl (syn. *C. zeylanicum* Blume) which is widely cultivated in the country. In addition, seven other species of wild cinnamon are also grown which are endemic to Sri Lanka are considered wild cinnamon. In this study, six *Cinnamomum* species were selected among this eight species, namely *Cinnamomum verum*, *Cinnamomum dubium* Nees (Sinhala: Sewel Kurundu or Wal Kurundu), *Cinnamomum citriodorum* (Sinhala: Pangiri Kurundu), *Cinnamomum rivulorum* Kostermans, *Cinnamomum sinharajense* Kostermans, *Cinnamomum capparu-corende* Blume (Sinhala: Kapuru Kurundu). Much work has been carried out with *Cinnamomum verum*, however, work on wild cinnamon varieties is scanty. In this backdrop, this study was carried out to identify and quantify the major chemical constituents of volatile oils obtained from bark and leaves of wild and true cinnamon species cultivated or grown in Sri Lanka. It was revealed that leaf oil of *Cinnamomum verum* contains significantly ($p < 0.05$) higher percentage of volatile oil (3.23%). Although significantly ($p = 0.05$) highest bark oil

content (3.53 %) was observed in the *Cinnamomum sinharajense*, the lowest leaf oil (0.41 %) and stem bark oil (0.51 %) contents were observed in the *Cinnamomum rivulorum*. The 15 major volatile chemical constituents were identified by Liquid Gas Chromatography analysis in the essential oils of bark and leaf oils of cinnamon species. The highest cinnamaldehyde content (67.57 %) was observed in *Cinnamomum verum*. *Cinnamomum sinharajense* has comparatively higher amount of cinnamaldehyde (57.46 %) than the other wild cinnamon species. The highest eugenol content (87.53 %) was observed in *Cinnamomum sinharajense* leaf. When compared to chemical composition of *Cinnamomum dubium* leaf oil, geraniol was the most abundant (24.05%) among the volatile chemical constituents. β -Caryophyllene (41.31%) was observed in *Cinnamomum dubium* stem bark oil. The highest Eugenol (22.29%) content was determined in essential oil of *Cinnamomum rivulorum* stem bark. It was not observed in other cinnamon species.

5.2.2 Black Pepper

Agronomy

Effect of planting material originated from different cutting type on canopy development of Black pepper (*Piper nigrum*)

Planting material of black pepper originated from different cutting types was established at three different locations of Matale, Narammala and Nillambe. Initial growth performances among different planting material were evaluated during the first year after planting, revealed that field establishment rate was highest in plating material originated from terminal branches an all locations (Matale – 100%, Nillambe – 98% and Narammala – 68%). Lowest field establishment rates (70% - Nillambe, 62% - Matale and 31% - Narammala) were recorded with the plating material of plagiotopic branches. Initial canopy development with highest number of lateral branches was also performed by terminal branches planting material as compared to other types.

Improvement of resource use efficiency of black pepper to increase the yield through support tree manipulation

Four different live supports of Gliricidia, Dadap, Kapok and Sooriya are being evaluated for pepper cultivation to compare the competition between pepper and different live supports. Growth performances indicated that pepper on different supports were not significantly different. However, growth of adventitious roots attaching to the supports were comparatively highest in pepper growing on sooriya and almost all characteristics such as number of roots, total root length and number of secondary roots initiating from single node showed better on sooriya than that of other supports. Further, biomass production of different

supports was also significantly different among support type, highest (3.27 kg/support) observed in gliricidia while lowest (0.02 kg/support) was recorded with sooriya.

Comparison of Novel Planting Material Production through Terminal Branches with other Rapid Multiplication Techniques of Black Pepper (*Piper nigrum* L.)

Planting material production through terminal branches with maintaining a mother plant garden was compared with the existing rapid multiplication systems of bamboo method, soil heap method, and polythene tube method to find the differences in growth performances as well as the cost of production in different techniques using pepper hybrid Panniyur- 1. The economics for four different treatments and biometric data were collected to compare the different techniques. Shoot height, number of leaves, total leaf area, shoot fresh weight, shoot dry weight, root fresh weight and root dry weight were significantly higher in the planting material taken from terminal shoots. The highest number of root and root length was also observed in the same and followed by in heaped method, polythene tube method and bamboo method respectively. The highest cost of production per plants was calculated from terminal shoot technique. Even though, the cost of production was the highest in this novel technique, growth performances were also the best as compared to other existing methods.

Studies on variation of flowering, fruit setting and yield of black pepper under different agro-ecological zones (Coconut Intercropping component)

The filling rates of these two local varieties GK49 and MB12 is 25% and 36% respectively. These filling rates are very low with comparing the Panniyur 1 which has 86% of filling rate. The flowering pattern in Maha season has shifted to December in 2016 due to delaying the North East monsoon. Normally, the flower initiation is started with the North East monsoon in October and November.

Plant protection

Occurrence of pest and diseases Survival Rate of Black Pepper (*Piper nigrum* L.) Plants in Humid Chambers and Shade Houses Under Different Microclimatic Conditions

Through a study on occurrence of pest and diseases of Black Pepper plants under different micro climatic environments in the nursery stage, it was revealed that the survival rate of Black pepper plants inside the humid chambers was higher (100%) than without chambers (36.6%) and no pests and diseases were appeared inside the chambers. Manipulation of water levels applied for the plants inside the chambers would not significantly have an effect on the RH% inside the chamber. Also it was revealed that there is a positive correlation between the

shade levels and the number of newly emerged leaves of Black Pepper plants. Also it was observed that the shade levels affect the Thrips damage on the Pepper plants in nursery stage. This study was conducted in collaboration with the Agric Biology Department of the Faculty of Agriculture, University of Peradeniya.

Soil Science and Plant nutrition

Two nursery experiments were carried out with young black pepper (*Piper nigrum* L.) and coffee (*Coffea arabica*) plants under plant house conditions in order to evaluate the effect of different combinations N.P.K on their early growth. Combinations of 2.5g (230ppm of N) or 5 g (460 ppm of N) of Urea(46 % N) and 25 g (1400 ppm of P) of ERP (28% P₂O₅) with 2.5g (300 ppm) or 5 g (600 ppm)of MoP (60% K₂O) were tested for select the best N:P:K combination for nursery plants. Results revealed that black pepper plants were highly sensitive to applied amounts of urea and MOP and the lowest combination 2.5 g of Urea, 25 g of ERP and 2.5 g of MOP was the suitable mixture for black pepper nursery plants. Coffee seedlings responded well to above combinations and 5g of Urea, 25 g of ERP and 2.5 g of MOP was the best combination of N: P:K for plant growth. Repetition and further research is required to confirm the results.

Physiology and Plant Production

Multiplication of Black Pepper (*Piper nigrum* L)

Rooted cuttings from orthotropic (terminal), plagiotropic (lateral branches) and single nodal cuttings from Bamboo Rapid Multiplication System of two local pepper selections (GK49 and MB12) were field planted in January 2010. Pepper vine length of orthotropic plants and single nodal cuttings plants were not significantly different with the time, though the highest length was associated with orthotropic plants. Highest number of lateral branches was observed in plants taken from orthotropic cutting as compared to the plants taken from single nodal cutting and plagiotropic cutting. After the six years, total number of spikes of plants from orthotropic cutting was 130spikes/plant and single nodal cuttings were 100 spikes/ plant respectively.

Evaluation of low cost potting mixture for Black pepper

It was revealed that replacement of sand with granite powder in potting mixtures was suitable for low cost commercial potting mixture production.

In- vitro multiplication of Pepper (*Piper nigrum* L)

Woody plant medium was the best medium for establishment. Maximum culture establishment (71%) was observed in WPM medium containing CuSO₄ 50 mg/L. The highest shoot multiplication has shown in medium fortified with 4 mg L⁻¹ BAP and 0.25 mg/L IAA 6-7 plantlets per explants half strength medium containing 0.5mg/L IBA and 0.15% charcoal has shown best rooting

Evaluation of different rapid multiplication techniques of Pepper for commercial plant production (Bamboo method, Heap method, and polythene tube method)

Maximum number of cuttings per unit area was possible with polythene tube method (1728). The best overall growth performances of vine were observed in heap method and in polythene tube method. The least number of nodes were observed in Heap + Straw method. Other methods were not significantly different. This study provided useful information in utilization of different materials for rapid multiplication techniques, according to the availability in the surrounding environment.

5.2.3. Cocoa

Soil and Plant Nutrition

A study was carried out to evaluate pedologic alterations in more than 20 years old cocoa agro-eco system under woody perennials, compared to an abandoned forest and continuously vegetable cultivating land. Characteristics of soil profile of immature brown loam soil in cocoa land was not physically altered due to long term existence of cocoa. Top soil of cocoa land was significantly ($P < 0.05$) high in organic carbon OC (2.39 %) and exchangeable K (307 ppm) with a favourable bulk density (1.31 mg m^{-3}), while pH (5.98), total N (0.21 %), Mg (520 ppm) contents were also good and similar to that of forest land, but available P (3.26 ppm) was very low. Accordingly, it is clear that soil of cocoa agro-ecosystem is physically and nutritionally sustainable, but insufficient in P for a better cocoa production. A cocoa long term agro ecosystem seems to be more fertile even under minimum management practices.

Effect of bio fertilizers, crop residues and inorganic nutrient sources on growth and soil properties of cocoa under rubber

The inoculation of Arbuscular Mycorrhiza (AM) has shown positive impact on growth performances of cocoa and improvement of soil organic carbon. The application of ground cocoa pod husk and inoculation of AM can reduce the application of inorganic fertilizer by 50% of recommended amount of P by 75% or 50%. Finally it can be concluded that

application of half of recommended amount of inorganic fertilizer with 10 kg of ground cocoa pod husk and inoculation of AM will not only enhance the growth of cocoa but also the soil organic carbon content and number of AM spores in soil.

5.2.4. Coffee

Genetic and Plant Breeding

Yield performances of coffee cultivars in low country intermediate zone

Performances of selected coffee cultivars under coconut (*Coffea* sp.) were evaluated in low country intermediate zone. Coffee cultivars of CxR, CCI, I 44/1, Q 105, IMY, BS I, BS II, BS III, BS IV, BS V and Catimor were used for the evaluation. First yield was harvested at the end of second year. Out of these 11 cultivars, CCI gave the highest significant yield (457g of fresh coffee/plant/harvest) and the second highest significant yield was given by Q 105 (30 g of fresh coffee/ plant/harvest).

Postharvest Technology

Comparative Study of Roasted Coffee (*Coffea arabica*) with Different Origin

Objective of this study was to investigate the comparative phytochemical, mineral and proximate content among coffee of different origin. *Coffea arabica* having four different origin, namely Brazilian, Colombian, Ethiopian and Ceylon that have the same genetic characteristics with different agro climatic conditions in the plantation. Standard analytical procedures were followed to analyze phytochemical, mineral and proximate composition. The phytochemical analysis showed that quantitatively higher percentage of Caffeine content, total phenol content and melanoidins content present in coffee of Brazilian origin than other origins. The results of proximate analysis revealed that coffee of Brazilian origin was richer in acid insoluble ash and total ash content while that of Colombian origin exhibiting greater amount of moisture content and crude fat. Coffee of Ceylon origin showed that the highest water soluble matter content and significantly higher amount of Magnesium. Phosphorous, Pottasium and Zinc were observed in Brazilian origin, while the coffee of Colombian origin contained the highest amount of Copper and Ceylon origin contained highest amount of Ferrus. Ethiopian origin contained significantly ($p < 0.05$) higher amount of Calcium. In sensory evaluation, Brazilian origin coffee brew received the most preference on color, taste, mouth feel and overall acceptance like attributes than other origins. But for aroma, Ceylon origin coffee brew gained the most preference.

Soil and Plant nutrition

Strategies for organic cultivation of Arabica coffee

Results showed that application of Compost 10kg /year/ plant or application of gliricidia at the rate of 15kg/Plant/ year gave significantly higher yield of 1342 kg/ha/year and 1162 kg/ha/year respectively, while control was given 797 kg/ha/ year only.

5.2.5. Ginger

Agronomy

Effect of Different Substrates on Sprouting and Subsequent Growth of Ginger (*Zingiber officinale* Rosc.)

A study was carried out to investigate the effect of different substrates on sprouting and subsequent growth of ginger in field level. Four different substrates: of T1 - gunny bags without moisture, T2 - wet coir dust, T3 - wet gunny bags and T4 - wet paddy husk was used and sprouted seed rhizomes were field planted to evaluate subsequent growth. Results revealed that sprouted percentage of seed rhizome were significantly highest in wet coir dust medium and the highest number of sprouted eye buds per rhizome were also observed in the same treatment. At the field, almost all growth parameters such as plant height, leaf area, total root length, fresh weight of above ground biomass, fresh weight of below ground biomass, dry weight of above ground biomass, dry weight of below ground biomass was significantly highest in the same treatment (T2). However, number of shoot initiation points, number of pseudo stems and number of leaves were not significantly different among the treatments.

Investigation on the effect of different storage condition for germination ability of ginger and turmeric

Both ginger and turmeric can be stored under 19 and 20 °C up to five months with 40 and 22% weight loss respectively, 16 % sprouting percentage and 2 % deteriorate rate in Narammala. In this experiment, it was revealed that the cold storage was best method among other storage media which were soil, sand, coir dust and paddy husk for both ginger and turmeric in Narammala.

Physiology and Plant Production

In-vitro multiplication of ginger (*Zingiber officinale* Rosc.) cultivars – Local, Chinese and Rangun

The best treatment for surface sterilization of rhizome sprouted buds was observed in 30% Clorox for 30 minutes. Highest survival rate of the explants was observed in Chinese ginger while lowest was observed in Local ginger. MS medium supplemented with 2mg l^{-1} BA and 0.25mg l^{-1} NAA has shown the best performance for initial multiplication of local ginger buds (8.6 shoots per explants). Half strength MS medium supplemented with $1.5 - 2.0\text{mg l}^{-1}$ NAA has shown highest induction of roots

Factors Affecting on Induction of Microrhizomes in Ginger (*Zingiber officinale* Rosc.), Cultivar Local from Sri Lanka

The medium containing 4.0 mgL^{-1} BAP with 0.1 mgL^{-1} NAA showed the best response followed by 6.0 mgL^{-1} BAP with 0.1 mgL^{-1} NAA for induction of micro rhizomes within 60 days. Different photoperiod exposure levels revealed that 16 hrs of light and 4 hrs of dark condition with solid medium produced highest fresh weight and highest number of micro rhizomes (9.6)

5.2.6. Betel

Genetic and Plant Breeding

Breeding of ‘Maneru’ and ‘Mala bulath’ with ‘Ratadalu’ and comparison of the yield parameters of their subsequent generations with ‘Ratadalu’.

Most of the cultivated betel vines only produced female inflorescences. Bisexual inflorescences very rare. At seldom, very few ‘Ratadalu’ vines produced bisexual inflorescences. ‘Malabulath’ had large leaves and ‘Maneru’ had round shape leaves which were more preferred for export market. Crossing will be practiced ‘Ratadalu’ X ‘Maneru’ and ‘Ratadalu’ X ‘Mala bulath’. Intercropping and Betel Research Station has a betel germplasm. Bisexual ‘Ratadalu’ vines were selected by observing of spicks. Cuttings from ‘Mala bulath’, ‘Maneru’ and ‘Ratadalu’ (bisexual inflorescences) were potted to produce parental lines.

5.2.7. Arecanut

Physiology and Plant production

In-vitro propagation of areca nut (*Areca catechu* L.)

The best method for sterilization of areca nut observed was dip in 30% Clorox for 20 minutes followed with open flame sterilization after dipping in 70% ethanol. The best method of

establishment of isolated embryos was observed in the hormone free woody plant medium (WPM) and incubated under dark conditions for four weeks. Then the cultures were grown at $40.5 \mu \text{mol m}^{-2} \text{s}^{-1}$ for 16 h of light at 25 C^0 for two weeks.

Callus Proliferation and somatic embryogenesis of areca nut (*Areca catechu* L.)

WPM+ 9 mg/l BAP medium gave the highest healthy callus formation percentage (95%). Therefore WPM+9 mg/l medium is ideal for callus proliferation of *Areca catechu* L. local selections. Somatic embryogenesis of areca nut was observed woody plant medium (WPM) supplemented with higher concentration of 2,4 D (100mg/l)

5.2.8. Nutmeg

Plant protection

Management of Nutmeg Leaf Fall Disease

Colletotrichum gloeosporioides and *Neofusicoccum* spp were identified as causal organism of Nutmeg Leaf Fall Disease (NLFD) in DNA homology search and it was confirmed by the Pathogenicity test. *In vitro* fungicidal assay, Mancozeb @ 800ppm showed poor performance for controlling *Neofusicoccum* spp. However Copper Oxi Chloride (COC) @ 2000ppm showed effective controlling of both causal organisms at *in vitro* and *in vivo* conditions. Therefore, foliar application of Copper Oxi Chloride (COC) @ 2000ppm (40g/10 L water) for 3-4 times at 2 week interval was recommended as a chemical control method of nutmeg leaf fall disease from 2016 onwards instead of Mancozeb @ 800ppm

Detection of microbial contaminations at different stages of postharvest practices of Export Agricultural Crops (EACs) and their control

Nutmeg and mace samples were collected from Kandy and Kurunegala Districts by directly picking from the tree, samples fallen under the tree and collecting at market places. The collected samples were tested for fungal contaminations. All the collected samples were found to be contaminated with fungus *Aspergillus* spp .

Physiology and Plant Production

Field Evaluation of grafted Nutmeg (*Myristica fragrans*)

Field evaluation of grafted nutmeg was carried out in Matale and Gasnawa. After studing 10 years data, it was found that plant growth was higher in selection B and selection C1 in Gasnawa (WL_{2b}) and Selection E1 and selection B in Matale (WM_{3b}). Average number of fruits / tree was higher (80) in selection B at Gasnawa and selection C1 (145) and E1 (75) at

Matale. Total number of fruit /tree varied from 50 to 145. Average fresh weight of seed was higher in Selection B (13 g) and followed by selection E1 (12 g) and C1 (11 g).

Field evaluation of seedlings and air layering planting material

Field evaluation of seedlings and air layering planting material originated from different sized lateral and upright branches of high yielding nutmeg cultivars was carried out and 1st part of the research, layering evaluation and performance testing have been completed. Marcotted branches were being transferred into pots. Recommendation was built as 2, 3, feet branches can be used to layering and nutmeg plant production.

5.2.9. Goraka

Post Harvest technology

Development of different value added products from Goraka

Goraka (*Garcinia quaesita*) rind of the ripen fruit are processed and used in Sri Lanka and India as a condiment in fish and prawn preparations to impart flavor and taste and to improve the keeping quality. Drying, an old age method for preserving food is the existing preservation technique for *Garcinia*. *Garcinia* produced in excess, can be converted to more durable value added products by applying modern preservative and processing techniques, in order to avoid wastage during seasonal glut. If utilized properly, medicinally and nutritionally valuable *Garcinia* can be processed into a variety of food products. In this context, present study was done with an aim to fully exploit the processing capacity of *Garcinia* and the shelf stability of the products. Based on the principles of preservation and in order to enhance the shelf life properties, techniques of preservation such as use of controlled osmotic pressure, controlled pH, dehydration and preparation of fruit beverages was selected for the preparation of the products using *Garcinia*. Out of the 20 recipes planned, six such recipes were developed. Such as jam, dried preserve, spicy pickle, wet chutney, *Garcinia* ready to serve drink and *Garcinia* slice in sugar syrup.

Physiology and Plant production

Field evaluation of grafted goraka was carried out in Matale Research station and Gasnawa Central nursery. A substantial growth improvement was observed with time (nine year) for each parameter (height, canopy spread and girth) irrespective of grafted Goraka accession. Slight variations were observed in plant height, canopy spread and plant girth and there was no any significant difference on growth parameters among the accessions. First flowering occurred at four years after field establishment. Flowering appeared in some of the plants

(A1, C1, C2 and B) in early 2009 and fruit set was observed in July 2009. Accession C2 showed a consistent significantly higher improvement in fruit number throughout the period from 2012 to 2015. Similarly, accession C2 showed higher growth performances in the field. The average yield of nine years old plant was 165 fruits. Colour of the mature fruit was reddish orange. The average fresh weight of accession C2 was 82.2g and it varies from 82 – 190g. The average weight of accession A1 was 66.8g and it varies from 66 to 100g. Total number of grooves of accession C2 was 8 and accession A1 was 6. This research was terminated in December, 2016.

5.2.10. Other

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

Comparatively higher number of earthworm count and earthworm biomass were recorded at Milleniya home garden while the highest count of free living nematodes was recorded at owita system. Remarkably higher count of mycorrhiza spore count was also recorded at the owita system. It was possible to identify the presence of biological control agent *Trichoderma* sp. only in fields with no application of inorganic fertilizer or agrochemicals. According to the data so far gathered it seems to be having positive correlation between earthworm abundance and the soil moisture content, supporting the argument that higher soil moisture favoured an increment in earthworm numbers.

5.3. Ongoing Research during the year 2016

5.3.1. Cinnamon

- Study of the effect of sea water with different compost mixture for managing pest and disease incidences in cinnamon nurseries.
- Investigation of ethology, disease development and management of rough bark disease (RBD) of cinnamon (*Cinnamomum zeylanicum* Blume).
- Study of the ecology (seasonal abundance, locality of spreads, peak swarming period etc.,) of cinnamon wood borer (*Ichneumenoptera cinnamomumi*)
- Identification and studying the biology, ecology and management of cinnamon thrips
- Establishment and evaluation of electric fence to manage vertebrates pests in cinnamon
- Study the white root disease infection, its pathogenicity and ecological factors that enhance the disease in cinnamon
- Establishment of plant protection advisory services for cinnamon growers

- Effect of cinnamon Leaf compost and inorganic fertilizer and their combinations on growth and yield of cinnamon
- 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 sulfur containing fertilizers on growth and yield of cinnamon.
- Effect of sulfur- fumigation and packaging materials on shelf life of cinnamon quills
- Determination of optimum pH level for growth of cinnamon
- Evaluation of yield and quality characteristics of true cinnamon (*Cinnamomum zeylanicum* Blume) in different Agro-ecological regions in Southern Province
- 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 material and different rates of inorganic and organic fertilizers on growth and yield of cinnamon (*Cinnamomum zeylanicum* Blume)
- Effect of different levels of N, P, and K nutrients of growth , yield and quality of cinnamon (*Cinnamomum zeylanicum* Blume)
- Anti-fungal and anti-bacterial activity of true cinnamon (*Cinnamomum zeylanicum* Blume) for skin and oral diseases in human
- Comparative evaluation of anti-diabetic activity of two introduced varieties (Sri Gemunu and Sri Vijaya) of true cinnamon (*Cinnamomum zeylanicum* Blume)
- Anatomical and physiological basis on peelability of true cinnamon (*Cinnamomum zeylanicum* Blume)
- Effect of different concentration of plant hormones (IBA and NAA) on rooting and growth of stem cuttings of cinnamon
- Effect of time of fertilizer application time on growth, yield and peeling ability of cinnamon
- Evaluation and comparison of superior quality characteristics of “Pieris cinnamon” with selected cinnamon accessions (Sri Gemunu and Sri Wijaya).
- Screening and evaluation of selected hybrid cinnamon plants for quality, growth, and yield performances
- Development of soup cube by using cinnamon bark oleoresin

- Study about canker in cinnamon
- Determination of the effect of rough bark disease infection on quality and peeling ability of bark
- Identification of critical hazards in cinnamon primary processing and improvement of quality in cinnamon primary processing by reducing hazards contamination
- Investigation on medicinal value of cinnamon base products
- Evaluation of selected cinnamon lines in mid country region
- Study on enhancing the efficiency of cinnamon peeling

5.3.2. Black Pepper

- 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
- Identification of suitable bio-indicators to monitor soil qualities responsible for Black pepper yellowing
- Study the effects of soil amendments at planting on field establishment rate of pepper
- Effect of micro-irrigation on plant establishment, growth and yield of black pepper.
- Effect of arbuscular mycorrhiza infections in Nitrogen uptake in Black pepper plant on their susceptibility for yellowing under different soil moisture level
- Effect of arbuscular mycorrhizal infections on occurrence of yellowing in Black pepper (*Piper nigrum* L.) plants under different soil moisture levels.
- Effect of planting material originated from different cutting type on canopy development of Black pepper (*Piper nigrum*)
- Effect of soil moisture on flowering and fruiting habit of Black pepper
- Improvement of resource use efficiency of black pepper to increase the yield through support tree manipulation (Matale)
- Investigation of effect of source of Nitrogen on growth and yield of black pepper
- Development of land suitability classification for black pepper (*Piper nigrum* L) in Sri Lanka
- Evaluation of new hybrid black pepper varieties 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
- Multi-faceted crop improvement project on Black Pepper (NARP Project)
- Fixing Geographical indication for pepper in Sri Lanka

- Collection and In-situ evaluation of local pepper selections
- Collection, Characterization, Conservation and Utilization of Piper species exist in Sri Lanka
- Detection of microbial contamination of different stages of post harvest practices of EACs mainly black pepper (*Piper nigrum* L.) and nutmeg and its control
- Application of biocontrol agent (*Trichoderma* sp.) on controlling black pepper quick wilt disease
- Determination of oil, oleo-resin and piperin content in pepper from different locations in Sri Lanka
- Variation in chemical constituents of Piper species exist in Sri Lanka
- Design, fabrication and evaluation of steam blancher for pepper
- Effect of immature harvesting on the physical and chemical properties of black pepper (*Piper nigrum* L.)
- Comparison of growth and yield of pepper raised from orthotropic (terminal), plagiotropic and rooted cuttings
- Comparison of growth and yield of pepper (*Piper nigrum* L.) raised from tissue cultured plants and single nodal cutting plants GK49
- Synchronisation of flowering and fruiting behavior of black pepper (*Piper nigrum*) cultivars (bootawerala, Dingirala and Kohukubumburerala) in the context of climate change effects
- Study of flowering and fruiting behaviour of newly introduce *Piper nigrum* cultivar (Dingirala) and local selection (MB12) in four different regions of Sri Lanka
- Hybridization of selected black pepper (*Piper nigrum* L) cultivars for low country intermediate zone
- Comparison of black pepper (*Piper nigrum*) yield per unit area of plants originated from orthotropic and plageotropic branches (GK49)
- 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 techniques
- Effect of Irrigation and fertilizer application on inducing of flower initiation and yield of bush pepper throughout the year
- Effect of different pruning levels on canopy development and yield of pepper
- Field evaluation of bush pepper (Local and Pannyur)
- Evaluation of selected accessions of Black pepper under organic conditions

- Pepper canopy improvement through different planting material originated from different cutting types and canopy training
- Effect of supplementary irrigation on establishment and early growth of Black pepper
- A study on marketing behaviour of pepper farmers in major pepper growing regions
- Study the potential use of coconut tree as a live supporting material for Pepper (*Piper nigrum*)
- Quantification of heavy berries and light berries yield component and their physical chemical analysis at the time of mature pepper harvest at farmer level

5.3.3. Cocoa

- Evaluation of field performance of rooted cocoa (*Theobroma cacao* L.) (Narammala)
- Productivity improvement of cocoa through integrated soil and plant nutrients management under rubber and coconut
- Development of soil conditioner using cocoa pod husk for reclamation of poor quality cocoa fields
- Evaluation of different cocoa lines for different climatic zones (Matale, Badulla)
- Characterization of available cocoa (*Theobroma cacao* L.) lines and establishment of a clonal garden
- Evaluation of selected cocoa (*Theobroma cacao*) lines for intercropping with coconut in low country intermediate zone.
- Establishment of cocoa clonal seed garden
- Studies on productivity improvement of cocoa under coconut in Kurunegala District in Sri Lanka
- Development of technology to produce wine and vinegar from cocoa mucilage

5.3.4. Coffee

- Use of *Beauveria brassiana* for the control of Coffee berry borer
- Investigations of biological control agents of coffee berry borer
- Design a trap for coffee berry borer
- Strategies for organic cultivation of Arabica coffee
- Evaluation of catimore coffee progeny
- Evaluation of Arabica coffee (*Coffea arabica*) accessions for yield, quality and resistant to major pest and diseases.
- Fixing Geographical indication for coffee in Sri Lanka

- Development of a small scale coffee roaster
- Determination of caffeine content of Arabica and Robusta coffee selections.
- Evaluation of the performance of selected coffee cultivars (*Coffea* sp.) under coconut in low-country intermediate zone
- *In vitro* Propagation of Coffee

5.3.5. Cardamom

- Screening of wild types of cardamom against thrips
- 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

- Management of leaf fall disease (leaf blight and leaf spots) of clove (*Eugenia caryophyllus*) in mid country
- Application of plant growth regulators (Paclobutrazol) for flowering induction of clove (*Eugenia caryophyllus*).
- Estimation of crop loss in clove (*Eugenia caryophyllus*) due to occurrence of extreme weather during the flower buds development stage.
- Estimation of Crop loss in clove (*Eugenia caryophyllus*) due to occurrence of extreme weather during flower bud development stage

5.3.7. Nutmeg

- Management of nutmeg leaf fall disease and its control
- *In vitro* propagation of Nutmeg (*Myristica fragrans*)
- Effectiveness of measure taken to control nutmeg leaf fall disease.
- Molecular biological sex determination of Nutmeg
- Natural colour preservation in mace
- Development of Nutmeg manual Halving tool
- Field evaluation of seedling and air layered planting materials originated from different sized lateral and upright branches of high yielding nutmeg (*Myristica fragrans* houtt)
- Synchronisation of flowering and fruiting behavior of Grafted nutmeg (*Myristica fragrans*) in the context of climate change effects

5.3.8. Goraka

- Investigation of chemical properties of *Garcinia quesita* L. (Goraka) fruit
- Development of technology to produce value added products of *Garcinia* (Goraka)
- Exploration of Goraka (*Garcinia quesita* pierre and *Garcinia zeylanica* Roxb.) accessions based on chemical properties and establishment of a field gene bank
- Collection and Investigation for growth, yield and chemical properties of different goraka (*Garcinia quesita*) selections in Sri Lanka

5.3.9. Betel

- Studies on effect of partially burnt paddy husk as an alternative nutrient source for growth and yield of betel (*Piper betle* L.)
- Breeding of ‘Maneru (*Piper betle* L.)’ and ‘Mala bulath (*Piper chuvya*)’ with ‘Ratadalu (*Piper betle* L.)’ and comparison of the yield parameters of their subsequent generations with ‘Ratadalu’,
- Evaluation of department fertilizer mixture for single supporting system in betel (*Pippper betle* L) cultivation
- Investigation on use of indigenous techniques for controlling Bacterial Leaf Blight in Betel (*Piper betle* L.)
- Rock Phosphate solubility improvement using mycorrhizae and commercial sulfur powder for (*Piper betle* L.) under coconut
- *In vitro* propagation of Betel
- Collection, Establishment, evaluation and conservation of germplasm of Betel, Ginger, and Turmeric
- Development of value added products using waste betel (*Piper betle*) leaves.

5.3.10. Ginger

- Effect of rhizome scales on germination and subsequent yield of ginger
- Sustainable methods of growing potted ginger for household consumption
- Management of major diseases of ginger (*Zingiber officinale* Rosc.)

5.3.11. Turmeric

- Effect of the size of planting material on the yield and quality of turmeric (*Curcuma longa*)

- Development of market preferable turmeric powder from local turmeric cultivars and isolation of curcumin from turmeric rhizomes
- Effect of different types of mulches on growth and yield of turmeric

5.3.12. Arecanut

- Evaluation of areca nut germplasm for dry zone
- *In vitro* Propagation of Areca nut
- Evaluation of growth performances of seedlings for selected arecanut lines

5.3.13. Other

- Growth and yield performances of Macademia VP plants at different spacing levels
- Evaluation of the insecticidal properties of the oil and oleoresin of cinnamon fruit (*Cinnamomum zeylanicum* L) Nutmeg pricarp (*Myristica fragrans*) Pepper stalk (*Piper nigrum* l.) and Clove stalk and leaves (*Syzegium aromaticum* L.) against mealy bugs (*Palanocccus* spp.)
- Measuring and compiling diversity of crop species handled by the Department of Export Agriculture (DEA) and development of a Biodiversity Reregister for the DEA
- Investigation of below - ground soil biodiversity at three selected sites in three agro ecological zones of Sri Lanka (BACC - DEA)
- Design a fabrication and evaluation of solar green house dryer
- *In-vitro* propagation of Export Agricultural Crops (Goraka, Wallapatta, Pepper-Hybrids, Betel)

5.4. Progress of Other Activities of the Research Division

5.4.1. Development Activities at National Cinnamon Research Station at Pllolpitiya

- In year 2016, 868 cinnamon stakeholders were successfully trained. Ten sessions of one week cinnamon peelers training programs, one session of three days programs, Eight sessions of two days programs, 11 sessions of one day programs and five half day programs were conducted and 1325 man-days of training were completed. Furthermore, 128 persons visited the station and obtained advice and information regarding the cinnamon Industry.
- Rs. Mn 3.627 was spent for repairing of the internal roads.

- About 4,000 Sri Gemunu and Sri Wijeya Vegetative propagated plants were produced and also 8,000 seedlings of the same accessions were produced.
- Rs. 777,600.00 and Rs 15,98000.00 were spent to repair of Agronomy and crop improvement laboratory and the existing office complex respectively.
- Officers of the Cinnamon Research Station participated in plant certification program of Galle, Matara and Hambantota.
- Officers of the Cinnamon Research Station participated training programs organized by AD's and EOO's
- Obtained Rs. 1,150,000. 00 from tendering of existing 10 acres of cinnamon lands.
- Constructed main gate and another gate at the entrance of the internal road
- Required all new equipment were purchased by spending more than 50 Mn. Rs.
- Five hundred Sri Gemunu vegetative plants were field established
- Two quarters were colour washed by utilizing department labours
- New agronomy and crop improvement laboratories began to be functioned

5.4.2. Development Activities at Research Station Matale

- Purchase of paint to repair the Laboratories, New lab building, Farm office and the residential quarters.
- The renovation of the internal road network of the Central Research Station – Matale was completed
- Purchase of material to renovate the fences in EARS – Matale
- Erecting three new net houses for the nursery

5.4.3. Development Activities at IBRS, Naramamala

- Fixed two water tanks of 2000 L capacity to solve severe water problem in IBRS
- Repaired the dometry, specially by fixing the windows and roof
- Repaired the 3 A and 3 B quarters by fixing the windows and roof
- A pineapple project was initiated

- About 320 coconut palms were established in front of IBRS
- Twelve turmeric beds were established for the demonstrational purpose
- Three hundred betel supporting sticks were planted to obtain planting materials.
- Three hundred Areca nut palms were established and maintained in marshy land of IBRS
- Eight hundred Areca nut plants were established and maintained in both side of research fields
- Front fence of IBRS was repaint
- All dead and unproductive 132 coconut trees in IBRS were removed

5.4.4. National Exhibitions and workshops

- Exhibitions in collaboration with the Ministry of primary industries and PHTD were offered a at districts level as well as at national level. Ex. “Prime-expo” Exhibitions (Kandy, Embilipitiya), Pro food pro pack Exhibition, BMICH, Colombo, Ayurvdaexpo2016 at BMICH, Colombo at Inco 2016 at BMICH, Colombo, Food and Agriculture Exhibition, at Ampara etc..
- Officers participated in meeting of review of the Sri Lanka Standard specification for Whole and ground Chili, Turmeric, Coriander and Curry powder (6 meetings) as a review committee member at Sri Lanka Standards Institute, Narahenpita.
- Officers participated in workshop on Accreditation program of food and agriculture sector in Hotel Galadari organized by Sri Lanka Accreditation Board.
- Officers participated in the PGIA congress 2016 in PGRC, Gannoruwa
- Workshop on effect of climate changes on export agriculture crops production was conducted
- Oral Presentation on A preliminary study on abundance of selected soil organisms in prominent land use systems at mid-country of Sri Lanka was presented at 1st international Agro- biodiversity congress held from Nov.6th to 9th in NewDellhi , India

5.4.5. Training Programs carried out by the research staff at Research Station Matale
Agronomy Division-

Training Program			
Crop	Topic	No. of Programs	No. of participants
Pepper	Nursery management	8	378
Pepper	Crop management	2	160
Coffee	Crop management	1	120
Vanilla	Crop management	1	12
EACs	Crop management	5	434
Spice Garden	Agro based Tourism	2	57

Post-harvest Division-

1. Two farmer training programs (at Kothmale and Walapane) in collaboration with Regional Economic Development Authority, Central Province, Kandy were conducted
2. Training Programs for Extension Officers and other officers of Export Agriculture Department, University students (University of Wayamba, University of Uva Wellassa, University of Peradeniya, University of Rajarata University of Ruhuna), farmer groups coordinated by Vidatha Training centers, other farmer training programs for students of school and farm schools were also conducted

Awareness and training programs offered by the research staff of the Central Research Station : Matale

1. T. Liyanage participated a training program on Value Addition and herbal drug formation in ITI, Colombo 07
2. Two technological officers were participated training program on Laboratory Equipment precision at ITI, Colombo 07
3. Officers attend to short course on multivariate data analysis at PGIA – Peradeniya
4. Officers participated in training program on scientific writing which was organized by Sri Lanka CARP

5. Training on biodynamic farming In service- Matale
6. Workshop on effect of climate changes on export agriculture crops production- Oak Ray Resort, ,Peradeniya
7. Training Program at CRI (Coconut Research Institute) on Intercropping EACs with Coconut, 23,24 February 2016
8. COSTI training on Intellectual Property Rights, 13,14 September 2016
9. Training on Public Procurement at Inservice Institute, Matale – 03.06.2016
10. Training on Nozzle technology organized by the Department of Agriculture – 15.03.2016 at Inservices institute of Agriculture – Gannoruwa
11. Soil Science Society of Sri Lanka Mid-term workshop – August 26th at University of Peradeniya.
12. Organic Agriculture and Certification on December 22 at Tree of Life hotel Kandy

Research projects and other training programs conducted by the research staff of the Central Research Station , Matale

- Potential of EAC in Plantation sector on 3/28/2016 for the benefit of Planter's Association, Badulla District
- EAC cultivation and it's economic importance for agricultural entrepreneurs on 8/25/2016 at Youth Camp, Batangala, Kegalle
- Potentials of EACs in plantation sector on 11/4/2016 at Youth Camp, Sammanthurei, In-service T.C., Matale- NIPM students
- Pepper Cultivation on 6/11/2016 at Kosgoda for Pepper farmers

Knowledge and Technology Dissemination of Betel through IBRS in Year or 2016

The number of training Programrs conducted	- 25
The number of participants in training programrs (Farmers, growers)	- 835
The number of personnel who acquired advice over the phone	- 348
The number of personnel who visited to IBRS for seeking advice	- 570

5.4.6. TV and Radio Programs

- Two Radio programs and Three ‘Sagauna Kahawanu’ TV programs were recorded at Post harvest Division of Matale research station
- Potentail for EACs as cash crop was recorded at kandurata sevaya
- Pepper planting material production from Terminal branches was recorded kandurata Sevaya Crop Management Black Pepper, Vanilla, Coffee was recorded Kandurata Sevaya
- Research and Development Program -DEA 2017 was broad cast Subharathi - Swadeshiya sewaya and Kandurata Sevaya,
- Crop Management -Pepper cultivation was recorded for ‘Segawunu kahawanu’ TV Program
- Planting material Production from Terminal Branches for ‘Sengawunu Kahawanu’ TV Program was recorded

5.4.7. Local/foreign training programs and workshops attended IBRS

- S. I. C. Silva (Assistant Director/ Research) A training program on phenotyping and genotyping mutants for abiotic stress during 18th – July 2016, held at rice Research and Development Institute, of Department of Agriculture, Bathalegoda.
- K. D. N.Priyadarshani (Assistant Director/ Research) A work shop on plant physiology on 4th November in 2016 held at Matale research Station.
- A workshop on changing climate on 08th December in 2016 held at peradeniya.
- D.M.P.V. Dissanayaka (Assistant Director/ Research) A workshop of 22 days on capacity building program was started 20th in April in 2016, organized by SLIDA.
- A Training programme on spice processing, quality control System and value addition Techniques, during 21st - 23rd September in 2016 held at Industrial Technical Institute.
- Certificate course on herbal drugs and Cosmetics Value addition Techniques, during 5th November -24th December in every Saturday held at Industrial Technical Institute.

5.4.8. Plant Protection Services

- Eight training classes , three field days and 21 field visits were conducted on the request of stakeholders and it was given the appropriate solutions for their plant protection problems (Table 01)
- Scale insect outbreak reported for Goraka and clove cultivations at Beliatta extension officer range in Hambanthota District, was successfully controlled by implementing a special pest management project in collaboration with extension staff of Hambanthota District.
- Technical advisory service and monitoring of activities of Nutmeg Leaf Fall Disease Management Project (NLFD) was in function in Kandy, Kurunegala, Matale and Kegalle Districts
- Appropriate solutions were given for more than 1000 plant protection problems raised via direct telephone lines of the Department and 1920 “ Govi Sahana Sarana Sevaya”

Table 5.4.8.1: Number of farmer field visits, training classes and field days conducted in year 2016 by the plant protection service

Crop	Disease/ Pest	Number of Trainings	No. Participants for training	Number of Field Days	Number of Field Visits
Pepper	Little leaf disease	03	280	02	01
	Slow wilt				04
	Quick wilt				06
	Leaf blight				
	Other				02
Clove	Shoot borer				01
Nutmeg	Leaf fall disease	02	225		02
	Fruit fly				01
Ginger	A biotic stress				01
Turmeric	Turmeric disease				01
Gliricidia	Root rot				01
Goraka	Scale insect	02	375	01	01
All EACs	Pesticide usage	01	50		
Total		08	930	03	21

Table 5.4.8.2 Plant Protection Service given by Entomology division, Research Station, Matale

Program	No. of sessions
Foreign group training program	01
EO training program	01
Farmer training program	05
Student training program	05

5.4.9. Plant production program

Table 5.4.9.1: Planting material issued by the Research Division

Type of Plant	Number
Pepper rooted cuttings	1,01382
Arecanut seedlings	35,540
Grafted nutmeg	100
Nutmeg seedlings	2200
Bush pepper	500
Cardamom	6000
Cinnamon	160,000
Betel	5500

5.4.10. Collaborative research and development project

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

5.4.11. University Students research

Two university students from Sabaragamuwa University were guided for their research studies on following topics.

1. Comparison of Novel Planting Material Production through Terminal Branches with other Rapid Multiplication Techniques of Black Pepper (*Piper nigrum* L.)
2. Effect of Different Substrates on Sprouting and Subsequent Growth of Ginger (*Zingiber officinale* Rosc.)
3. As external supervisors 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.

5.5. Economics and Market Research on EAC

5.5.1. Studies and Surveys

5.5.1.1. Market Behaviour of Pepper Farmers

Marketing of EAC is solely handled by the private sector and the market behaviour is entirely depends on the interests of buyers and sellers. Among EAC, pepper shows the most divergent marketing pattern as it has different uses at different maturity stages. Recommendation for harvesting and processing is at 7-8 months maturity after fruit setting followed by adequate sun drying. However in- practice a special market exists for immature berries, which is used for oil and oleoresin extraction, locally and internationally. Therefore farmers are used to harvest immature berries or lease out their cultivations to organized harvesting groups. Even after maturity there are number of harvesting practices as farmers face a number of difficulties in harvesting and processing.

DEA has designed it's post harvest assistance program assuming that farmers are harvesting pepper at correct maturity and process by themselves. Based on that assumption, farmers are assisted to purchase equipments needed for harvesting and processing. However it must be worth to understand different harvesting and processing behaviours of pepper sector and find out who need to be assisted. To find out that situation a survey was started to find out marketing behaviours of pepper farmers and influencing factors for such behaviours. Sample of farmers, who are randomly selected from main pepper growing areas in Matale and Kandy districts, are being surveyed using a pre tested questionnaire. Survey is continued for 2017.

5.5.2 Extent of EAC

Extent of EAC was previously computed based on the 2002 Agriculture census data and the newly planted acreage, which was qualified to be paid 2nd installment of the New Planting Assistance Scheme of the DEA (successfully established extent after 18 months). However, home gardening program was the prioritized development program in 2016 and systematic new planting activities were done at minor scale. Therefore it was difficult to count the correct field established extent of EAC in 2016. Also there were many home garden programs of EAC in past few years and that extent too could not be accounted in the DEA procedure of estimating the EAC extent. Therefore it was decided to adopt the extent figures collected and published by Department of Census and Statistics in 2016 and EAC extent for 2016 is presented in the annex 1.

5.5.3 Estimated Production of EAC in 2016

The annual production of main EAC is usually estimated considering exports, local consumption in different sectors in the economy (house hold consumption based on per capita annual consumption reported by the Dept. 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 2013-2016 is given below (table 5.5.3.1).

Table 5.5.3.1: Estimated Production of EAC (mt.) – 2013/2016

Crop	2013	2014	2015*	2016**
Cocoa	515	500	457	649***
Coffee	2,580	2,674	2,639	2,824
Cinnamon	17,500	17,600	17,707	18,945
Pepper	28,686	18,660	27,232	18,475
Cardamom	50	87	91	120
Clove	6,190	3,225	5,253	1,823
Nutmeg &Mace	2,545	2,960	2,673	2,723
Arecanut	22,279	22,385	22,869	23,082
Betel	24,145	24,123	22,524	22,292
Citronella oil	21	35	31	54***
Ginger	14,075	15,481	17,273	23,184
Turmeric	11,282	11,351	14,387	25,204

Source: Dept. of Census and Statistics and DEA data base

* Revised data ** Provisional data ***Annual harvest forecast

5.5.4 Exports and Export Earnings of EAC in 2016

2016 was not an impressive year for both export volumes and earnings of EAC as both declined considerably from the same in 2015. Total export volume of EAC had declined to 44,861mt. from 71,588mt. in 2015 and export earnings had declined to Rs.51,739mn. from Rs.61,558mn. of the previous year (Annex II).

Sharp decline of black pepper export was one major reason for the drawback in the EAC sector. The Export volume of black pepper had declined from 16,656 mt. in 2015 to just 7,876 mt. in 2016 and export earnings had declined by 46% over previous year from Rs 19,542.mn to Rs. 10,531mn. in 2016. Poor harvest of black pepper was experienced throughout the country in 2016 due to abnormal weather patterns experienced in 2015 Maha season resulting extremely low export volumes. However, high volume of pepper oil and oleoresin has exported in 2016 which could be another reason for declined pepper exports as local pepper had used for the bulk of value addition.

After a long stagnation period, export volumes of cinnamon had shown a significant growth in 2016 with around 1000mt. exports over total cinnamon exports in 2015. Export volume of cinnamon was 14,693mt, in 2016 with Rs. 23,176mn, export earnings. Export earnings of cinnamon had increased by 29% from Rs.17, 958 mn, in 2015 to Rs. 23,176mn. in 2016 and the amount contributed to 45 % of total export earnings of EAC. Public investment schemes, operated by the DEA is a major reason for increased production of cinnamon and further increase is expected in coming years.

Among export of spices more noticeable feature is increased exports of cardamom. Export of cardamom was 120mt. in 2015 and it has increased to 779mt. in 2016 and 85% had gone to India. It is well known that local cardamom production is very small and imports had increased from 60mt. in 2015 to 570mt. in 2016. Above facts suggest that imported cardamom is exported to India may be under FTA terms between Sri Lanka and India.

Both export volumes as well as earnings of clove had declined sharply mainly due to very poor harvest season experienced in early 2016. Also export volumes as well as earnings of of nutmeg had declined slightly but mace exports had shown significant decline both in exports volumes as well as earnings. Export of ginger and turmeric had shown slight increases in export volumes and values but more exports are needed to stabilize the local production situations.

Export volumes of cocoa and cocoa products had increased from 911mt. in 2015 to 1,345mt. in 2016. The bulk of cocoa exports are re-exports of imported cocoa beans or semi finished products since local cocoa production is very small. Export earnings of cocoa had increased by 34% over 2015 from Rs.469mn. to Rs.630mn. in 2016. As usual export of coffee was low and total export was 14mt. with Rs.21mn. export earnings.

Areca nut export in 2016 declined to 13.468mt. in 2016 from 29,645mt, in 2015. However no imports of areca nut is reported in 2016. With the current information and past data Sri Lankan origin areca nut supply cannot exceed over 4000-5000mt. hence the larger proportion of 2016 areca nut exports may have included imports of the previous year. A gradual decline of export of betel has been noted in past few years and same happened in 2016 with 18.6% decline in export than the previous year.

Total export volume of essential oils had shown a marginal increase from 430mt. in 2015 to 437mt. in 2016. However export earnings in 2016 had considerably increased than 2015 values. Export volumes of cinnamon leaf oil, clove oil, pepper oil, cardamom oil, vanilla oil and lemon grass oil had declined while export volumes of cinnamon bark oil, nutmeg oil, mace oil and ginger oil had increased. Export of oleoresin had shown a remarkable growth from 301mt. in 2015 to 559mt. in 2016 mainly due to activities of the Indian owned company “Plant Lipids” (annex II).

5.5.5 Exporting Countries of EAC from Sri Lanka

No noticeable shift was seen in main importing countries of EAC from Sri Lanka in 2016 and traditional buyers had played the main role in the market. As usual, Mexico had purchased around 40% of total cinnamon export and many Latin American countries had purchased large bulks. During the period of 2012-2016 purchase of cinnamon by USA had increased from 31% and amount increased to 2170mt. in 2016. India was the main buyer of pepper, cloves, cardamom, mace, cocoa products and areca nut from Sri Lanka in 2016 and purchases comprised 60% of pepper, 85% cardamom and 35% of clove exports from the country. Almost all areca nut, imported from Indonesia, had been exported to India as re-exports under SLFTA and India alone contributed to 13,195mt. of areca nut out of 13,469mt. of total areca nut export volume of Sri Lanka in 2016. Pakistan was virtually the only buyer of Betel in 2016 but the quantity is gradually declining over time.

5.5.6 Behaviour of Prices

Average annual farm gate prices of EAC, except areca nut and ginger, had increased in 2016 over 2015 but in varying degrees (Annex III). Changes in exchange rate (US\$) may be one reason for slight increase of some commodities like nutmeg, mace, and cardamom. Nutmeg prices had slightly recovered and shown 2.27% increase over 2015 but not received to attractive level as before 2013. Average annual local prices of citronella oil had further

shown and unusual increase from Rs.6381 in 2015 to Rs.9668 in 2016 mainly due to increased local demand for value addition activities. Areca nut prices were high in 2015, mainly due to higher re-export business in 2015, but declined in 2016 with declined re-export activities. As shown in the “Public Ledger”, the document reports international prices, increase of world prices during 2015-2016 was always lower than increase of Sri Lankan prices. Except citronella, no unusual drift was seen from international prices, and always followed the same pattern (Annex III).

5.5.7 Trends in EAC Imports in 2016

Import of EAC had further declined in 2016 over 2015. Total EAC import was 19,582mt. in 2015 but declined to 11,771mt. in 2016 (annex IV). However Import expenditure which was Rs. 6,149mn. in 2015 had increased by 6% to Rs.6,378mn. in 2016. One main reason for declined total import in 2016 was no reported import of areca nut. Import volume of cocoa and cocoa products had increased by 23.3% in 2016 over 2015 and expenditure for cocoa import had increased by 32%. Cocoa is largely imported for further processing either for re-export or making processed products for local consumption. Around 61% of cocoa products had exported to India, may be under the FTA terms hence cocoa import is beneficial for the country.

Black pepper is mainly imported for value addition purposes when local raw material is inadequate and in 2016 around 598mt. of black pepper had imported as there was no adequate local supply for the oil and oleoresin industry. Large bulk of local requirement of turmeric is usually imported and 4,660mt. of turmeric had imported in 2016 worth Rs. 1039mn.. All other EAC except, clove, nutmeg, mace and betel, had imported to Sri Lanka in 2016 at least in minor quantities (annex IV)

5.6. Research Publications

Abeyasinghe A.H.M.T.B. , Liyanage, T., Wimalasiri, K.M.S., 2016, Comparative Study of Roasted Coffee (*Coffea arabica*) with Different Origin, Proceedings of Faculty of Agriculture undergraduate research symposium, Faculty of Agriculture, University of Peradeniya.

Ariyaratne, H.B.M.A, Weerasuriya, S.N. and Senarath, W.T.P.S.K. (2016) Determination and comparison of morphological and chemical characteristics of two selected cultivated accessions and six wild species of Genus *Cinnamomum* schaeff. Third global conference on Entomology. August 22-24, 2016, Colombo, Sri Lanka.

Ariyawansa P.G.A.N., Subasinghe H.M.P.A. and Kumara J.B.D.A.P. (2016) Effect of Different Substrate on Sprouting and Subsequent Growth of Ginger (*Zingiber officinale* Rosc.), Proceedings of the Annual Symposium, Sabaragamuwa University of Sri Lanka.

Attanayaka A.M.C.I.M; Dharmaparakrama A.L.S; Yapabandara Y.M.H.B; Hennayaka H.M.R (2016). In-vitro clonal propagation of Black pepper (*piper nigrum* L.) local selections with high yield and quality. Published in journal of “Focus on Pepper”. International Pepper Community Session 2. Volume III, January – June 2016. 27 - 38 pp

Gunaratne, H.D.A.K., A.P. Heenkende, P.R. Idamekorala and W.M.M.L. Karunaratne. Impacts of leguminous cover crops on soil properties and early growth of Black Pepper (*Piper nigrum* L.). “Focus of Pepper”. 1-10 .International Pepper Community, Jakarta , Indonesia. (2016)

Jayasinghe, G. G., Ketakumbura, K. H. M. P. K., Wijesinghe, K. G. G., Hemachandra, K. S. and Weligamage, S. (2016) Relationship between pest and disease incidences and agronomic operations implemented by farmers in cinnamon (*Cinnamomum zeylanicum* Blume) fields in Southern Sri Lanka. *Sri Lanka Journal of Food and Agriculture*, 2(1): 33 – 38

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Kodithuwakku RD, Madhushani, NWKS, Fonseka ,WAND and Sumanasena HA (2016). A Preliminary Study on Abundance of Selected Soil Organisms in Prominent Landuse Systems at Mid Country of Sri Lanka. Abstract book, 1st International Agrobiodiversity Congress held in India from 6th to 9th November 2016, pp.253.

Kumara, D.G.N.S., Fernando, A.P.S., Seneviratne, M.A.P.K. and Ginigaddara, G.A.S. (2016). Economics of ginger production and marketing in Kurunegala District. 8th Annual Research Symposium Proceedings, Faculty of Agriculture, Rajarata University of Sri Lanka

Liyanage*¹, T; Madhujith² T; and Wijesinghe³ K.G.G. ; 2016, Comparative Study on Major Chemical Constituents in Volatile Oil of True Cinnamon (*Cinnamomum verum* presl. syn. *C. zeylanicum* blum.) and Five Wild Cinnamon Species Grown in Sri Lanka, 28th Annual Postgraduate Institute of Agriculture, Peradeniya, pp 7

Rumana Azad, R.A.A.K. Ranawaka, Gamini Senanayeka, K.L.Wasantha Kumara, D.K.N.G. Pushpakumara, K.G.G. Wijesinghe and Sudarshane Geekiyanage (2016), Morphological variation of cinnamon (*Cinnamomum verum* Presl) germplasm in Matara District of Sri Lanka; *International Journal of Minor Fruit, Medicinal and Aromatic Plants*, vol 2, No 1, 2016 (pp6-14)

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Subasinghe H.M.P.A., Sarojani W.N. and Yapa P.I. (2016) Comparison of Growth Performances of Planting Material Through Terminal Shoots with Plants from Other Rapid Multiplication Techniques of Black Pepper (*Piper nigrum* L.), *Journal of Focus on Pepper, International Pepper Community*, VIII-1, 19-26.

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Yapa, S.S., Mohotti, A.J. and Seneviratne, M.A.P.K. (2016). Effect of mistletoe infestation on fruit quality of nutmeg (*Miristica fragrans*). Proceedings of the Peradeniya International Research Sessions, Sri Lanka Vol. 20: 301.

Annexure 11: Estimated Extent (ha) of EAC by Districts - 2016 *

District	Cinnamon	Pepper	Clove	Cardamom	Coffee	Cocoa	Nutmeg	Arecanut	Betel	Citronella	Total (EAC)	Ginger	Turmeric	Grand Total (including Ginger & Turmeric)
Kurunegala	171	2,306	119	2	593	169	50	1,059	1,156	-	5,625	467	52	6,144
Putthalam	1	35	-	-	25	-	-	45	86	-	192	52	3	247
Matale	351	6,938	765	263	757	761	74	1,194	45	-	11,148	67	59	11,274
Kandy	132	7,543	3,238	337	1,872	423	827	2,731	70	-	17,173	484	289	17,946
Nuwaraeliya	35	979	398	377	923	9	4	593	8	-	3,326	171	222	3,719
Badulla	203	3,472	43	4	393	37	-	1,342	43	-	5,537	64	54	5,655
Moneragala	93	3,151	-	-	226	720	1	1,000	45	-	5,236	12	8	5,256
Hambantota	3,319	2,092	53	-	39	-	-	532	17	809	6,861	15	11	6,887
Matara	8,581	1,528	185	28	801	3	5	1,593	107	-	12,831	120	86	13,037
Galle	11,312	1,104	19	2	55	-	2	711	7	-	13,212	65	38	13,315
Kalutara	3,435	718	18	15	156	-	4	765	198	-	5,309	135	34	5,478
Colombo	248	390	4	-	131	-	2	394	94	-	1,263	113	9	1,385
Gampaha	298	1,131	35	2	235	7	6	1,019	513	-	3,246	221	65	3,532
Kegalle	268	2,399	1,742	157	1,060	96	45	2,763	186	-	8,716	173	114	9,003
Ratnapura	4,230	5,337	223	55	247	9	9	2,034	126	543	12,813	83	41	12,937
Anuradhapura	-	-	-	-	-	-	-	137	27	-	164	219	880	1,263
Polonnaruwa	-	127	-	-	-	-	-	121	88	-	336	17	10	363
Ampara	-	182	-	-	14	6	-	358	40	-	600	7	10	617
Other Districts	5	83	-	-	7	-	-	403	111	-	609	2	1	612
Total	32,682	39,515	6,842	1,242	7,534	2,240	1,029	18,794	2,967	1,352	114,197	2,487	1,986	118,670

Source: Department of the Census & Statistics.

* Provisional

Cinnamon, Nutmeg & Citronella - DEA Data

Annexure 11: Export Volume and Value of Export Agriculture Crops – 2015 & 2016

Commodity	Unit	2015	2016 *	Growth % 2015-2016
Cinnamon	Vol (MT)	13,548.78	14,692.69	8.4
	Val (Rs.Mn)	17,958.55	23,176.95	29.1
Cinnamon leaf Oil	Vol (MT)	264.65	226.40	-14.5
	Val (Rs.Mn)	704.02	905.89	28.7
Cinnamon Bark Oil	Vol (MT)	14.39	27.32	89.9
	Val (Rs.Mn)	436.23	890.13	104.1
Cloves	Vol (MT)	4,782.53	1,378.90	-71.2
	Val (Rs.Mn)	6,239.11	1,869.52	-70.0
Clove Stems	Vol (MT)	741.21	463.78	-37.4
	Val (Rs.Mn)	166.43	90.37	-45.7
Clove Oil	Vol (MT)	9.88	6.24	-36.8
	Val (Rs.Mn)	52.67	52.75	0.2
Cocoa & Cocoa Products	Vol (MT)	911.25	1,345.00	47.6
	Val (Rs.Mn)	469.11	630.04	34.3
Coffee	Vol (MT)	23.60	13.70	-41.9
	Val (Rs.Mn)	24.03	20.51	-14.6
Pepper	Vol (MT)	16,656.64	7,875.54	-52.7
	Val (Rs.Mn)	19,542.52	10,530.53	-46.1
Pepper Oil	Vol (MT)	61.37	42.74	-30.4
	Val (Rs.Mn)	543.24	429.54	-20.9
Oleoresine	Vol (MT)	301.19	559.60	85.8
	Val (Rs.Mn)	2,035.87	3,257.22	60.0
Cardamom	Vol (MT)	119.87	779.39	550.2
	Val (Rs.Mn)	146.64	843.25	475.0
Cardamom Oil	Vol (MT)	1.42	0.71	-50.0
	Val (Rs.Mn)	27.16	25.96	-4.4
Citronella	Vol (MT)	7.83	8.27	5.6
	Val (Rs.Mn)	75.86	114.29	50.7
Nutmeg	Vol (MT)	1,575.62	1,509.19	-4.2
	Val (Rs.Mn)	1,525.81	1,603.10	5.1
Mace	Vol (MT)	313.41	195.33	-37.7
	Val (Rs.Mn)	522.13	358.15	-31.4
Nutmeg Oil	Vol (MT)	67.98	122.36	80.0
	Val (Rs.Mn)	449.99	595.39	32.3
Mace Oil	Vol (MT)	0.02	0.12	500.0
	Val (Rs.Mn)	0.66	0.92	39.4
Arecuanut	Vol (MT)	29,645.52	13,468.58	-54.6
	Val (Rs.Mn)	9,234.62	4,948.98	-46.4
Betel	Vol (MT)	2,403.73	1,955.67	-18.6
	Val (Rs.Mn)	1,235.32	1,126.13	-8.8
Vanilla	Vol (MT)	0.80	2.06	157.5
	Val (Rs.Mn)	8.91	22.29	150.2
Vanilla Oil	Vol (MT)	0.20	0.05	-75.0
	Val (Rs.Mn)	0.76	0.07	-90.8
Lemongrass Oil	Vol (MT)	0.81	0.26	-67.9
	Val (Rs.Mn)	3.75	1.11	-70.4
Total EAC	Vol (MT)	71,452.70	44,673.90	-37.5
	Val (Rs.Mn)	61,403.39	51,493.09	-16.1
Ginger	Vol (MT)	66.34	115.03	73.4
	Val (Rs.Mn)	72.20	128.95	78.6
Ginger Oil	Vol (MT)	1.41	2.73	93.6
	Val (Rs.Mn)	28.05	45.14	60.9
Turmeric	Vol (MT)	67.86	70.00	3.2
	Val (Rs.Mn)	54.73	72.23	32.0
Total (Ginger and Turmeric)	Vol (MT)	135.61	187.76	38.5
	Val (Rs.Mn)	154.98	246.32	58.9
Total (with Ginger and Turmeric)	Vol (MT)	71,588.31	44,861.66	-37.3
	Val (Rs.Mn)	61,558.37	51,739.41	-16.0

Source :- Sri Lanka Customs

* Provisional

Annexure III: Average Prices of Export Agricultural Crops (Rs/Kg) in 2013/2016

Crop	Price	Annual Average Price				Growth % 2015/16
		2013	2014	2015	2016	
Cocoa	FG	193.97	234.84	244.38	297.47	21.72
	AU	361.63	339.21	369.81	403.58	9.13
	WM	315.35	402.23	473.39	491.66	3.86
Coffee	FG	220.7	218.86	251.19	362.65	44.37
	AU	249.39	263.13	301.72	414.32	37.32
	WM*	286.33	301.6	381.96	415.88	8.88
Pepper	FG	731.06	1,037.64	1,090.34	1,246.23	14.30
	AU	765.98	1,095.81	1,144.36	1,308.72	14.36
	WM	945.12	1,247.25	1,449.41	1,609.09	11.02
Clove	FG	1,233.93	1,400.89	1,046.11	1,053.14	0.67
	AU	1330.13	1457.68	1257.9	1246.63	-0.90
	WM	1,591.14	1,904.25	1,822.37	1,220.53	-33.03
Cinnamon - Quills	FG	1,109.41	1,172.79	1,246.06	1,544.58	23.96
	AU	892.6	1,284.66	1,365.86	1,805.51	32.19
	WM	-	-	-	-	-
Nutmeg	FG	683.88	642.17	511.28	522.88	2.27
	AU	777.85	692.31	556.65	562.5	1.05
	WM	2,798.13	2,257.58	1,776.92	1,567.80	-11.77
Mace	FG	1,536.27	1,741.52	1,423.59	1,478.08	3.83
	AU	1,825.41	2,024.80	1,619.73	1,743.07	7.61
	WM	2,650.38	2,169.48	1,996.08	1,986.27	-0.49
Cardamom	FG	1,731.68	1,642.08	1,610.78	1,638.50	1.72
	AU	1,925.00	1,804.56	1,755.61	1,967.55	12.07
	WM	1,864.16	1,187.48	1,576.12	1,331.15	-15.54
Betel (Rs./1000 leaves)	FG	1,922.22	2,166.15	3,583.89	4,151.63	15.84
	AU	-	-	-	-	-
	WM	-	-	-	-	-
Areca nut	FG	177.47	304.60	341.74	294.90	-13.71
	AU	213.83	305.11	364.74	394.55	8.17
	WM	-	-	-	-	-
Citronella	FG	1,751.63	2,754.50	6,381.12	9,668.99	51.52
	AU	-	3,000.00	-	10,500.00	-
	WM	2,874.23	2,713.23	2,459.08	2,457.29	-0.07
Ginger (Raw)	FG	214.40	289.59	137.72	127.12	-7.70
	AU	-	-	-	90	-
	WM	428.98	395.67	415.74	421.53	1.39
Turmeric (Raw)	FG	34.54	37.37	34.72	43.18	24.37
	AU	-	-	-	32.5	-
	WM	-	111.02	-	-	-

Source: ERU data base FG: Farm-gate Price; AU: Auction Price; WM: World Market Price

*Robusta coffee

Annexure 1V: Import Volume and Value of Export Agriculture Crops – 2015 & 2016

Commodity	Units	2015	2016 *	Growth% 2015/16
Cinnamon	Vol (mt.)	17.61	37.31	111.8
	Val (Rs.mn)	25.23	57.35	127.3
Cinnamon Leaf Oil	Vol (mt.)	0.22	3.10	1,289.5
	Val (Rs.mn)	0.29	0.48	68.2
Cinnamon Bark Oil	Vol (mt.)	0.07	0.02	-72.7
	Val (Rs.mn)	1.08	0.03	-97.2
Clove	Vol (mt.)	-	-	-
	Val (Rs.mn)	-	-	-
Clove Oil	Vol (mt.)	3.48	2.13	-38.8
	Val (Rs.mn)	11.58	6.86	-40.8
Cocoa & Cocoa Products	Vol(mt.)	4,364.07	5,380.75	23.3
	Val (Rs.mn)	2,906.56	3,845.13	32.3
Coffee	Vol(mt.)	48.84	94.74	94.0
	Val (Rs.mn)	63.65	103.57	62.7
Pepper	Vol(mt.)	79.60	598.96	652.4
	Val (Rs.mn)	68.92	679.74	886.3
Pepper Oil	Vol(mt.)	0.06	1.77	2,941.2
	Val (Rs.mn)	0.02	1.83	9,802.6
Oleoresine	Vol (MT)	1.75	1.94	10.9
	Val (Rs.Mn)	9.20	10.98	19.3
Cardamom	Vol(mt.)	59.83	570.13	852.9
	Val (Rs.mn)	67.49	408.21	504.9
Cardamom Oil	Vol(mt.)	2.65	0.51	-80.8
	Val (Rs.mn)	29.86	11.48	-61.6
Citronella	Vol(mt.)	1.47	1.83	24.7
	Val (Rs.mn)	4.33	5.14	18.6
Nutmeg	Vol(mt.)	-	5.00	-
	Val (Rs.mn)	-	8.94	-
Nutmeg Oil	Vol(mt.)	-	1.2	-
	Val (Rs.mn)	-	6.75	-
Arecanut	Vol(mt.)	9,742.39	-	-100.0
	Val (Rs.mn)	1,816.16	-	-100.0
Betel	Vol(mt.)	-	0.5	-
	Val (Rs.mn)	-	0.26	-
Vanilla	Vol(mt.)	12.25	1.90	-84.5
	Val (Rs.mn)	11.84	25.15	112.3
Vanilla Oil	Vol(mt.)	0.29	5.68	1,875.7
	Val (Rs.mn)	0.55	5.40	888.9
Lemon Grass Oil	Vol(mt.)	0.25	0.41	64.0
	Val (Rs.mn)	0.65	1.29	97.1
Total EAC	Vol(mt.)	14,334.83	6,707.88	-53.21
	Val (Rs.mn)	5,017.39	5,178.33	3.21
Ginger	Vol(mt.)	336.74	403.21	19.7
	Val (Rs.mn)	176.60	155.68	-11.8
Ginger Oil	Vol(mt.)	1.08	0.35	-67.4
	Val (Rs.mn)	12.21	5.10	-58.2
Turmeric	Vol(mt.)	4,909.41	4,660.49	-5.1
	Val (Rs.mn)	942.96	1,039.16	10.2
Total (Ginger & Turmeric)	Vol(mt.)	5,247.23	5,064.05	-3.49
	Val (Rs.mn)	1,131.78	1,199.94	6.02
Total (with Ginger & Turmeric)	Vol(mt.)	19,582.06	11,771.93	-39.88
	Val (Rs.mn)	6,149.17	6,378.27	3.73

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	Kandy	EO's Range Galagedara Udunuwara Kurunduwatte Harispattuwa Poojapitiya Udadumbara Rambukpitiya Yatinuwara Wattegama, Kundasale Hatharaliyadde Alawathugoda Medapitiya Gangawatakorale Udawalatha Teldeniya Talathuoya Minipe Galaha
Hambantota	EO's Range Okewela Beliaththa Middeniya Katuwana Walasmulla Sooriyawawa Weeraketiya Warapitiya Thangalle	Rathnapura	EO's Range Weligepola Kolonne Ayagama Godakawela Palmadulle Balangoda Rathnapura Embilipitiya Niwithigala Kealla Elapatha Pothupitiya Pallebadda
Nuwaraeliya	EO's Range Ginigathhena Helboda Hanguranketha Walapane Rikillagaskada Maldeniya		

Gampaha	EO's Range Dompe Udugampola Gampaha Mahara Badalgama Pallewela Biyagama Meerigama Divulapitiya Minuwangoda Aththanagalle	Monaragala	EO's Range Bibile Monaragala Badalkumbura Madulle Hingurukaduwa Madagama Padiyathalawa Wellawaya Meegahayaya kotagama
Kegalle	EO's Range Mawanalle Ussapitiya Pinnawala Kegalle Warakapola Daraniyagala Dedigama Aranayake Ruwanwelle Yatiantota Bulathkohupitiya Galigamuwa Rambukkana	Badulla	EO's Range Badulle Haldummulle Nikapotha Uvapanagama Passara Ridimaliyadde Haliela Meegahakiula Kandaketiya Bandarawela
Colombo	EO's Range Avissawella Homagama Padukke	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
Udubaddawa
Wariyapola
Kuliyapitiya
Panduwasnuwara
Madampe
Naththandiya
Chilaw

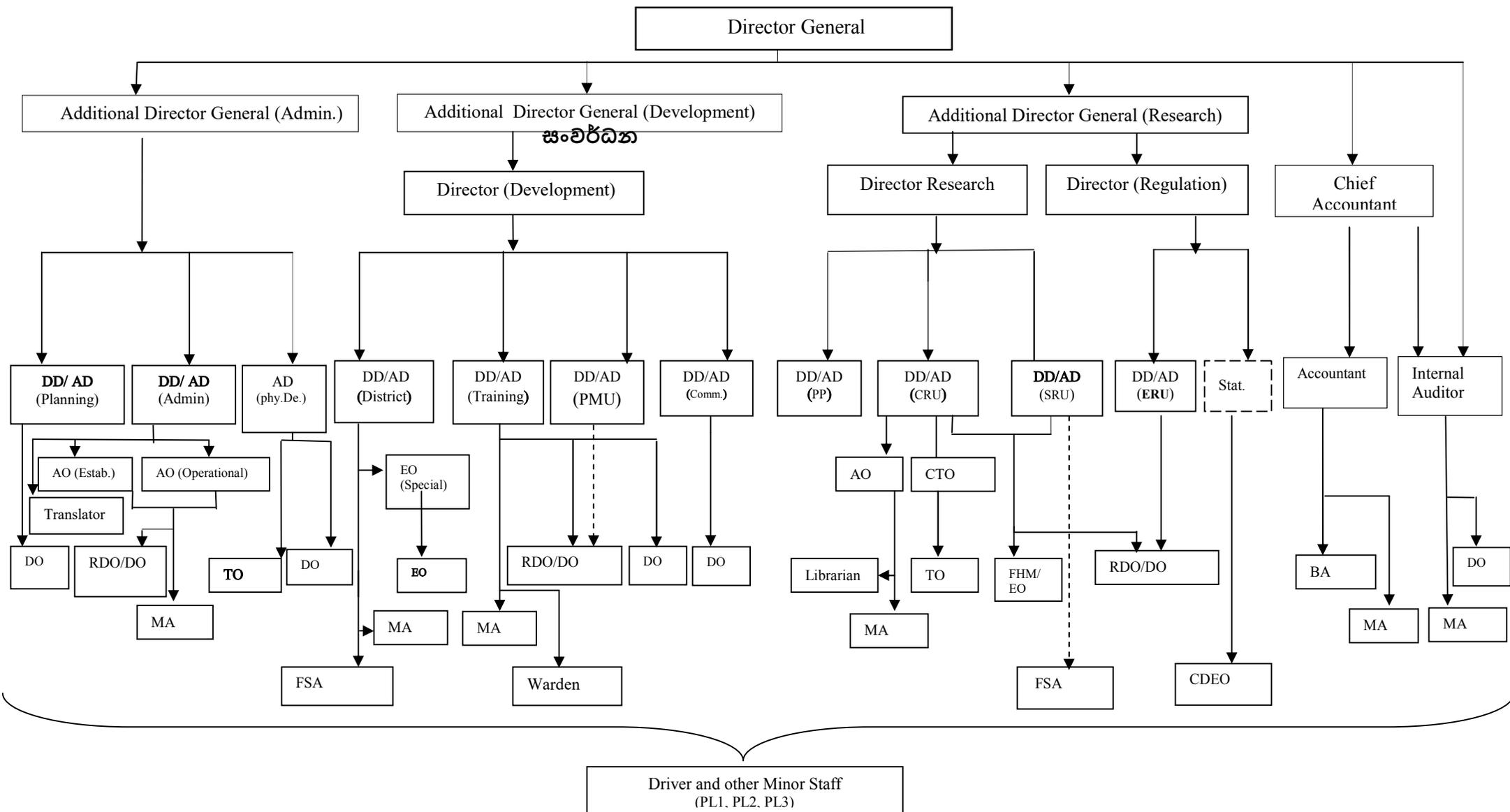
Kaluthara

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

Annexure VI: Organizational Structure of the Department of Export Agriculture - 2016



DD-Deputy Director AD-Assistant Director PMU-Progress Monitoring Unit PP-Plant Protection CRU- Central Research Unit SRU-Sub Research Unit ERU-Economic Research Unit Stat-Statistician AO -Administrative Officer EO-Extension Officer RDO-Research & Development Officer DO-Development Officer CTO-Chief Technical Officer TO-Technical Officer FHM-Farm House Manager BA-Budget Assistant MA- Management Assistant FSA-Farm Service Assistant CDEO- Computer Data Entry Operator

අපනයන කෘෂිකර්ම දෙපාර්තමේන්තුව - අනම්ම සරු හෙට දිනකට
ஏற்றுமதி விவசாயத் திணைக்களம் - வளமான எதிர்காலத்திற்கு



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