

REPORT

EXTERNAL REVIEW OF THE FRUIT CROP RESEARCH AND DEVELOPMENT INSTITUTE

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Signatures of External Review Team

Vidya Nidhi Prof. H.P.M. Gunasena (Chairman)

Prof. D.K.N.G. Pushpakumara (Member)

Prof. Jeevika Weerahewa (Member)

Mrs. Malani Baddegamage (Member)

Mr. Siriweera Gamage (Member)

The image shows five handwritten signatures, each written on a set of horizontal lines. The signatures are: 1. Vidya Nidhi Prof. H.P.M. Gunasena (Chairman), 2. Prof. D.K.N.G. Pushpakumara (Member), 3. Prof. Jeevika Weerahewa (Member), 4. Mrs. Malani Baddegamage (Member), and 5. Mr. Siriweera Gamage (Member). The signatures are written in black ink and are somewhat stylized.

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The review team sincerely thanks Dr. (Mrs) P.W. Alahakoon, Director of the Fruit Crop Research & Development Institute (FCR&DI), Horana and its staff for facilitating this review by discussions, providing documents and related information and making excellent logistical arrangements.

Thanks are due to Dr.(Mrs) E.R.S.P. Edirimanne, Additional Director, FCR&DI for submitting the Self-assessment Report (SAR) on the activities of the FCR&DI, 2012 - 2016 and providing other related information during the past five years to facilitate this review.

We also appreciate the support and cooperation extended by Dr.Kalyani Ketapearachchi, Deputy Director, Fruit Crop Research & Development Station (FCR&DS), Gannoruwa, Dr. B.M.V.S. Basnayake, Deputy Director, PVIC, Homagama, Mr. H.M. Seneviratne Banda, National Fruit Variety Conservation Center, Kundasale, Mr. M. Jayawardena, Horticulture Research Farm, Ambatenna and Mr. I.K.R.P. Deepal Bandara, Officer in Charge(OIC) Rambuttan Research Unit, Eraminigolla during the visits to the respective stations. Thanks are also due to Ms. Nilusha Amarasinghe, ROIC, Madurukatiya, Mr. S.O Silva, RAOC, Bibila and Mr. Wijesinghe, AI in-Charge Mutukandiya for providing information on the respective stations.

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COMPOSITION OF THE REVIEW TEAM

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EXTERNAL REVIEW OF THE FRUIT CROP RESEARCH AND DEVELOPMENT INSTITUTE

1. INTRODUCTION AND BACKGROUND TO THE REVIEW

Established in 1987 as the apex body for agricultural research the Sri Lanka Council for Agricultural Research Policy (SLCARP), under the Ministry of Agriculture has been mandated to review the institutes of the National Agricultural Research System (NARS) at regular intervals to assess their performance and suggest improvements.

As stated by SLCARP, there are several objectives of these external reviews:

- To assess the quality, cost effectiveness, relevance and impact of the scientific programs carried out by the institute to ensure that funds allocated are effectively utilized to address the sector needs.
- To assess the appropriateness of the research agenda of the institute to meet the emerging future challenges, particularly with the view of achieving Sustainable Development Goals (SDGs). (SDGs: Transforming our world: the 2030 agenda for sustainable development adopted by the UN General Assembly in September 2015) and the national targets for ensuring food and nutrition security.
- To examine all aspects of the research and development programs, extension, advisory consultancy and other services offered by the institute and their effectiveness, impact and timeliness to the stakeholders.
- To identify the deficiencies and shortcomings in the procedures adopted in recognizing the research needs of the sector by the institute and
- To provide advice and guidance on effective planning and implementing of future programs of the institute.

1.1 Review Team and Review Process

The Council of the SLCARP at its 201st Board meeting held on 28th March 2017 has appointed a team of five experts listed above to carry out an external review of the above institute.

The Terms of Reference (TOR) for this review is given in Annex 1.

A self –assessment Report submitted by Dr. (Mrs.) E.R.S.P. Edirimanne, Addl. Director of FCR&DI was used during the review of this institute.

The review was carried out during August – October, 2017. The review team visited the FCR&DI, Horana on 11th August 2017 and held discussions with the Director and staff and observed its laboratory and building facilities including the field germplasm bank. The

review team also visited the sub stations at Kundasale, Ambatenna and Eraminigolla on 30th August, 2017 and met the relevant staff, held discussions and observed the facilities. On 31st August 2017, the review team visited the FCR&DS, Gannoruwa and met the Director and Additional Director of FCR&DI and Deputy Director, FCR&DS and held further discussions and clarified certain issues. On the same day the review team met Ms. M.A.W. Malkanthi, Assistant Director (Development), FCR&DI who is in charge of the Fruit Villages Development Program and discussed its progress. Two members of the review team visited the Plant Virus Indexing Centre (PVIC) on 21st September 2017 for discussions and collection of information on its activities.

2. THE FRUIT INDUSTRY OF SRI LANKA: AN OVERVIEW

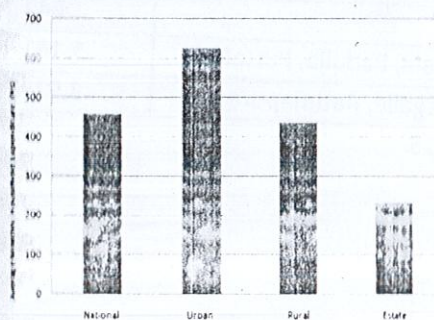
Fruits are rich sources of micro-nutrients and carry numerous health benefits. Regular intake of fruits is usually associated with reduced risks of several micro nutrient deficient diseases and functional declines associated with aging. Taking into account the nutritional content and health benefits of fruits, World Health Organization (WHO) and Food and Agricultural Organization (FAO) have recommended a daily intake of minimum of 400g of fruits and vegetables per person. The food pyramid developed by the United States Department of Agriculture recommends 2-4 servings of fruits per day. This section provides an overview of fruit consumption, trade, and production and institutions and policies supporting the fruit industry in Sri Lanka.

Fruit Consumption:

According to the Food Balance Sheets of the Department of Census and Statistics (DCS), per capita availability of fruits in Sri Lanka is 85.30 g per day in 2013/14. This is far below the 200 g per day target of the Government of Sri Lanka. According to the same report, fruits provide 86.74 calories, 1.09 g of protein and 0.26 g of fat per head per day.

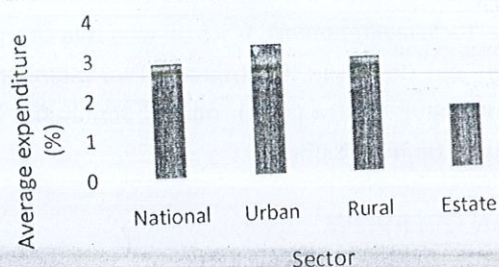
According to Household Income and Expenditure Survey (HIES) in 2012/2013, an average Sri Lankan household expenditure on food is Rs 15,651 of which Rs. 461 is on fruits indicating that the budget share is 2.9%. There exists significant differences in different expenditure across sectors; the fruit share of food budget of urban, rural and estate sector households were 3.3%, 2.9% and 1.6%, respectively.

Fig 1: Average Monthly Expenditure on Fruits , 20012/2013



Source: HIES 2012/2013

Fig 2: Percentage of Average Expenditure on Fruits – 2012/2013



Source: HIES 2012/2013

Fruit Production:

Fruit farming in Sri Lanka spreads around 150,000 ha and around 90% of fruit crops come from home gardens where a mixture of fruit trees is cultivated in small land holdings largely for non-commercial purposes. However, there is a growing trend to cultivate pineapple, banana, papaya and rambutan on medium scale as commercial cultivations. The total annual production is about 647,000 metric tons according to the statistics reported by the Fruit Crop Research and Development Institute.

Table 1: Extent, Major Cultivation Areas and Production of Fruit Crops (2015)

Crop	Major cultivation areas	Extent (ha)	Production (mt)
Banana	Jaffna, Hambantota, Kalutara	53,246	683,976
Lime	Moneragala, Badulla, Puttalam, Anuradhapura	11,394	10,792
Mango	Kurunegala, Anuradhapura, Hambantota, Puttalam, , Matale, Jaffna	27,786	148,422
Orange	Moneragala, Badulla, Matale, Jaffna, Puttalam, Anuradhapura, Rathnapura	7,847	6,792
Papaya	Puttalam, Jaffna, Hambantota	6,666	92,018
Passion fruit	Colombo, Kalutara	642	895
Pineapple	Gampaha, Kurunegala, Moneragala, Badulla, Puttalam	5,161	54,886
Rambuttan	Gampaha, Colombo, Kalutara, Kegalle, Rathnapura	3,923	12,332

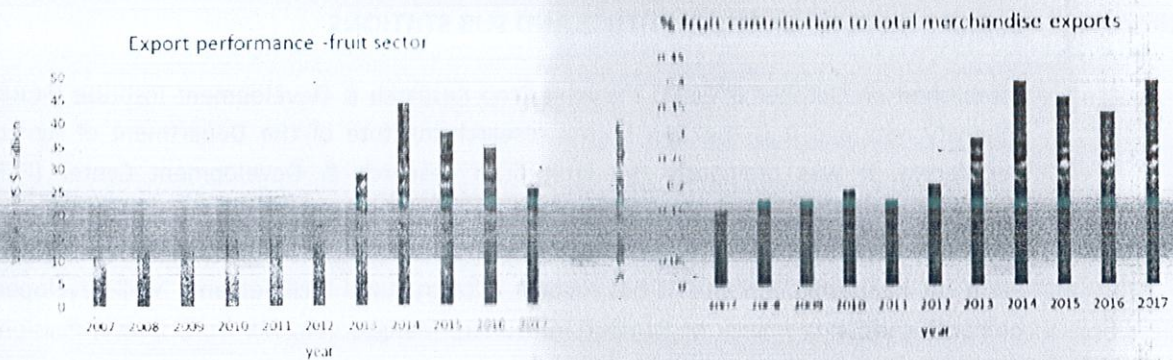
Source: Department of Census and Statistics, 2015

Fruit Trade:

Sri Lanka is among the top countries in Asia which grows the best varieties of fruits like mango, jack fruit, Papaya, pineapple, banana, avocado, orange and guava. In addition to these commonly found fruits, there also under-utilized fruits in Sri Lanka which are of rich nutrient value but without a well-established market.

Processed food and fruits & vegetables sectors have been identified as a sector with high potential in the world due to the increasing demand from end consumers and for value added products in the world market. Sri Lanka exports both fresh and processed fruits and vegetables and 65% of the fresh products are targeted to the Middle East and the Maldivian market. United Arab Emirates, Saudi Arabia, Maldives, India, Kuwait, India, Germany, Qatar, Pakistan have been enlisted as top fruit and vegetable importing countries from Sri Lanka (Export Development Board, 2017). According to the Central Bank Annual Report (2016) Sri Lanka has exported 33,300 metric tons of fruits in 2016 which was valued around US \$ 5,045 million.

Fig. 3: Exports of Fruits by Sri Lanka (2007 – 2017)



Source: Export Development Board, 2017

Policy and institutional framework related to fruit sector:

The Ministry of Agriculture has been providing a wide range of assistance and development programs for the fruit sector. The Export Development Board also has initiated a number assistance programs to assist export oriented agriculture project at regional level. The plan includes awareness programs on different varieties of horticultural crops, soil testing, crop selection, crop protection, poly house and post harvest technologies including pack houses and quality certifications, Interrelated Agriculture Projects, GMP centers etc. Premier quality institutions like SLSI, SGS etc. also run awareness programs on Global gap and other market access requirements of the developed world. The government has initiated a few support programs for integrated farming basically meant for a group of farmers with intent to do contract farming. The scheme also offers cash subsidy/grants to the beneficiaries.

Opportunities and challenges of the fruit sector:

Diverse climatic conditions, skilled labor, unique characteristics in selected fruit varieties such as Pineapple, Passion Fruit, Rambuttan etc., and existence of an institutional arrangement that maintains quality standards (SLSI, HACCP, GAP, GMP, EU standards for fresh fruits & vegetables, organic, ISO 22000) are the opportunities in the fruit sector. The fragmented production by small and marginal farmers, seasonality in supply, insufficient awareness on quality standards, inadequacy of infrastructure, high cost of production due to high cost of labor, packaging, transport, air freight, electricity etc., inadequate availability of quality seed and planting materials, inadequate investments, are the challenges facing the fruit sector of Sri Lanka. Future challenges in the fruit sector will be the reduction of present postharvest losses, improvement of postharvest handling systems, introduction of quality management, improvement of safety standards, promotion of export through better postharvest management, management of surplus production, availability of technology and skilled labor, improved techniques on crop cultivation, changing consumption to frozen or preserved forms and production and postharvest management under climate change.

3. BRIEF HISTORY OF THE INSTITUTE AND SUB STATIONS

Established on October 6th 2011, the Fruit Crop Research & Development Institute (FCR&DI) is relatively new and it is the fourth crop research institute of the Department of Agriculture, Peradeniya. It was previously the Fruit Crop Research & Development Center (FCR&DC) established in 2006 under the Horticultural Crop Research and Development Institute (HOR&DI), Gannoruwa and upgraded in 2012 as the FCR&DI. The institute is located on 120 ha Horticulture Farm at Kannawila, Horana. It has modest infrastructural facilities and well-developed fruit orchards consisting mainly of Rambuttan, Durian, Mangosteen, Jak fruit, Guava, Passion fruit, papaya and several underutilized fruit species.

FCR&DI is engaged in developing technologies for improving the productivity of variety of fruit crops, many of which are suitable for the low country wet zone. It has given high priority for the development of high yielding of good quality fruit varieties, improved management practices including nursery techniques and quality planting material production and training. Establishment of fruit villages and biodiversity gardens also major programs implemented by this institute.

Under this institute there are eight (08) sub stations variously designated as research stations, centers, units and farms, all of which previously belonged to the Department of Agriculture. With the establishment of FCR&DI these stations were assigned under the FCR&DI. These stations are spread across the country providing support for R&D programs, germplasm conservation, planting materials production and extension and training at national and regional levels.

The sub stations with the major functions are listed in Table 2.

Table 2. Sub-stations of FCR&DI

Name of Sub Station & Major activity	Location/Zone
1. Plant Virus Index Centre (PVIC), R&D (Virus indexing, Pathological research)	Homagama /Wet
2. Fruit Crop Research & Development Station (FCR&DS), R&D, Planting material production, training	Gannoruwa/Wet
3. National Fruit Variety Conservation Center (NFVCC), Germplasm conservation, Plant material production and Training	Kundasale/Intermediate
4. Rambutan Research Unit (RRU), Plant material production, training	Framinigolla/Wet
5. Horticulture Research Farm (HRF), Plant material production, training	Ambatenna/Intermediate
6. Agricultural Research Station (ARS), Madurankatiya R&D, Plant material production	Madurankatiya /Inte/dry
7. Citrus Research Station (CRS), R&D, Plant material production	Bibila /LC.Int.Dry
8. Agricultural Research Station (ARS), R&D, Plant material production	Muthukandiya/ LC Dry

3.1 Brief Description of Sub Stations

1. Fruit Crop Research & Development Station (FCR&DS), Gannoruwa

Before the establishment of FCR&DI, this station was part of the Horticulture Research & Development Institute (HOR&DI) of the Department of Agriculture at Gannoruwa. With the establishment of the FCR&DI, 65 ha of land and buildings which was originally used for fruit crop research and development were transferred to establish the FCR&DS.

This station is housed in a recently constructed and well maintained administrative building which is modestly equipped. It has another office building, a library with a small collection of books, stores, field houses, quarters for farm manager and assistant farm manager and driver. For transport and field work, 2 cabs and 4 and 2 wheel tractors and field equipment respectively are available. It lacks research laboratories, but if a need arises for analytical work HORDI provide technical assistance.

This station conducts breeding research on banana, papaya, Guava, Avocado, Longan and Durian. Evaluation trials on underutilized fruits such as Aonla, Longan and Jamun are also conducted to identify promising varieties. Also, agronomic studies are in progress on

highly demanded underutilized fruits such as Bale fruit, Ber, Longan, Aonla, soursap and Biinay.

Planting material production is also a major activity of this station. In 2016, it has produced 9,988 grafted and seedlings of different fruit varieties for the SPMDC, Gannoruwa. In the same year 1,100 Avocado grafts, 4500 sour sap seedlings have been produced for the Fruit Village Development Program and 1,110 wood apple seedlings for the Food Production Program.

Regular education and training programs on fruit crop cultivation and management are conducted by this station for diverse clients such as farmers, officials of government departments, university students, those of technical colleges and other stakeholders. The major areas of training include; nursery management, orchard management, cultivation of underutilized fruit species, container planting and landscaping.

2. Plant Virus Indexing Center (PVIC), Homagama

Plant Virus Indexing Center (PVIC) was established in 1999 at Homagama on 5 ac of land under the Horticulture Crop Research & Development Institute (HOR&DI), Gannoruwa of the Department of Agriculture. It is mandated to conduct investigations on plant viruses and other pathogenic organisms infesting fruit, vegetables, root & tuber crop, foliage & flowers and other agricultural crops. Since, 2012, it is listed under FCR&DI.

This institute nearly two decades since establishment has performed well. It has a Vision: "To contribute to prosperity of the nation by ensuring virus & other pathogen free agricultural crops.

Its Mission is to be the national center to improve the economic & social status of the farming community. This will be achieved by developing & improving the available technology to minimize crop losses due to plant viruses & other pathogenic diseases. PVIC has 06 research divisions: Virology, Molecular Virology, Tissue Culture, Epidemiology, Microbiology and Farm division. Besides research, it is engaged in extension and training of various groups of stakeholders.

3. Rambutan Research Unit, Eraminigolla

This unit is situated in Kegalle District along Polgahawela Road on an extent of 2.9 ha to undertake R&D programs on Rambutan. Although it is named as a research unit, research is not conducted as it has neither research staff nor facilities.

It has a collection of germplasm of fruit varieties. Twenty (20) trees of certified mother plants of Malwana Special rambutan variety and two trees each of certified Jak (Rosa Kos and Father Long) have been planted. These are used to take planting materials for propagation.

There are other uncertified fruit varieties such as Malayan Red and Malayan Yellow rambuttan, Dedigama, Singojan, B 148, Jaya, Fatuketata and Seedless planted in this unit which are used to produce planting materials.

It also produce planting materials of anona, ber, sapota, carambola, jambo and minor fruit species. It also implements a program for rehabilitation of aged rambuttan trees and conducts occasional training programs for farmers in the area.

In 2016, this unit has produced 3,000 grafted rambutan plants, 5,000 rambutan root stocks, 190 grafted ber plants and 10,000 soursap seedlings for the Fruit Village Development Program.

4. Horticulture Research Farm (HIRI), Ambatenna

Located on an extent of 1.9 ha of land in the Kandy District at Ambatenna, this farm originally belonged to the Department of Agriculture. After 1968, this farm was listed under HOR&DI for planting material production. Although it is designated as a research farm, it does not undertake any research due to lack of staff and facilities. It is essentially a planting material production farm.

It has a collection of certified mother plants of jak, rambuttan and durian which are used for propagation. The historical details such as origin and dates of planting of these varieties are not available. Other fruit crops such as mango (Tomic), Karthacolomban, Vellaicolomban, Gira, Willard, Malwana, sapota, avocado, jambu, veralu) are also available in this farm.

The certified fruit varieties available at this station are:

1. Jak fruit : Kotmale, Mandoor, Father Long, and Maharagama,
2. Durian: Ambatenna
3. Rambuttan: Malayan Red and Malayan Yellow,

It is devoted mainly for the production of planting material of many fruit crops. It has bare minimum facilities: an office building, a green house, 2 net houses, potting shed, stores and farm managers' quarters. In 2016, this center has produced 11,663 of different fruit crops. It also implements a training programs on pruning and management of aged rambuttan trees. *Ad hoc* training programs are also conducted at the request for NDT students and other stakeholders.

5. **National Fruit Variety Conservation Center (NFVCC), Kundasale**

This center at Kundasale, 8 km away from Kandy was established on 8th November 2012 on 40 acre extent of land adjoining the Kundasale seed farm.

It has been designated as the National Fruit Variety Conservation Center for recommended fruit varieties. Currently, 109 varieties of 44 fruit crops have been established in this center of which 3493 are field planted and 493 in pots.

The facilities of this center are also used to conduct training programs for farmers, students of universities, Schools of Agriculture, school teachers and other officers.

Agricultural Research Stations in Moneragala district

Moneragala is one of the leading districts in fruit production which have high consumer preference and citrus is one of the main crops in commercial cultivation. When considering the climatic and soil conditions, Moneragala district is most suitable for the fruit growing and quality fruit production. Moneragala district is the second largest fruit growing district of the country. Within the district, there are several agro-ecological zones and due to this diversity, it has been identified for off-season fruit production and tastiness of fruit is very good due to high Total Soluble Content. There are three substations involved in fruit production in this district.

Objective of these centers is to undertake R&D on fruit crops, mainly, agronomy & plant breeding, planting materials production and germplasm conservation. Limited training is also conducted at the request by the government institutes, farmers and other stakeholders. These stations have certified varieties of citrus (Bibile Sweet (Selection), Bibile Seedless and Madurankatiya Orange).

These stations are listed below:

6. **ARS, Mutukandiya** is situated in Moneragala district in Low Country Dry Zone on an extent of around 18 ac.
7. **CRS, Bibila** is situated in Low country Intermediate Zone and has around 16 ac of land extent with water resources which can be adequate year around irrigation.
8. **ARS, Madurankatiya** has around 36 ac situated in the margin of LCDZ and LCIZs.

Reviewer's Observations

The review team observed that the main center implementing R&D programs is the FCR&DI headquarters at Horana where staff and facilities are concentrated. It is proposed this status quo should be maintained to develop it as a full-fledged research institute for fruit crops with laboratory and field facilities, similar to the previously established institutes such as RR&DI, FCR&DI and HOR&DI.

Considering the potential, FCR&DI should consider the best options for its sub stations and mandates for each of them should be developed. Some suggestions of the review team are presented below:

FCR&DS, Gannoruwa: Considering the historical background, location in close proximity to HCR&DI (staff and laboratories) and the availability of large extent of land including a fruit orchard with certified germplasm, FCR&DS has the potential to continue as at present to undertake some research on selected fruit crops, besides the plant material production and training functions.

PVIC, Homagama: This sub-station was listed under FCR&DI since 2012. However, its original mandate to undertake viral and pathological research on all agricultural crops should be maintained. Due to its past track record, this station should be further strengthened as a national center by investing on staff and facilities for virus indexing and plant pathological research of all agricultural crops, training and extension.

NFCCC, Kundasale: This National Fruit Crop Conservation Center should be developed and maintained exclusively for germplasm conservation and management of all fruit crops, including underutilized fruit species, production of certified planting materials and training in plant material production.

RRU, Eramingolla & HRF, Ambatenna : As at present, these two sub stations can be used as planting material production and training centers.

ARS, Moneragala: The sub stations at Muthukandiya and Madurukatiya should be designated for adaptive research and plant material production centers/training centers while Bibila ARS can be dedicated exclusively for citrus research.

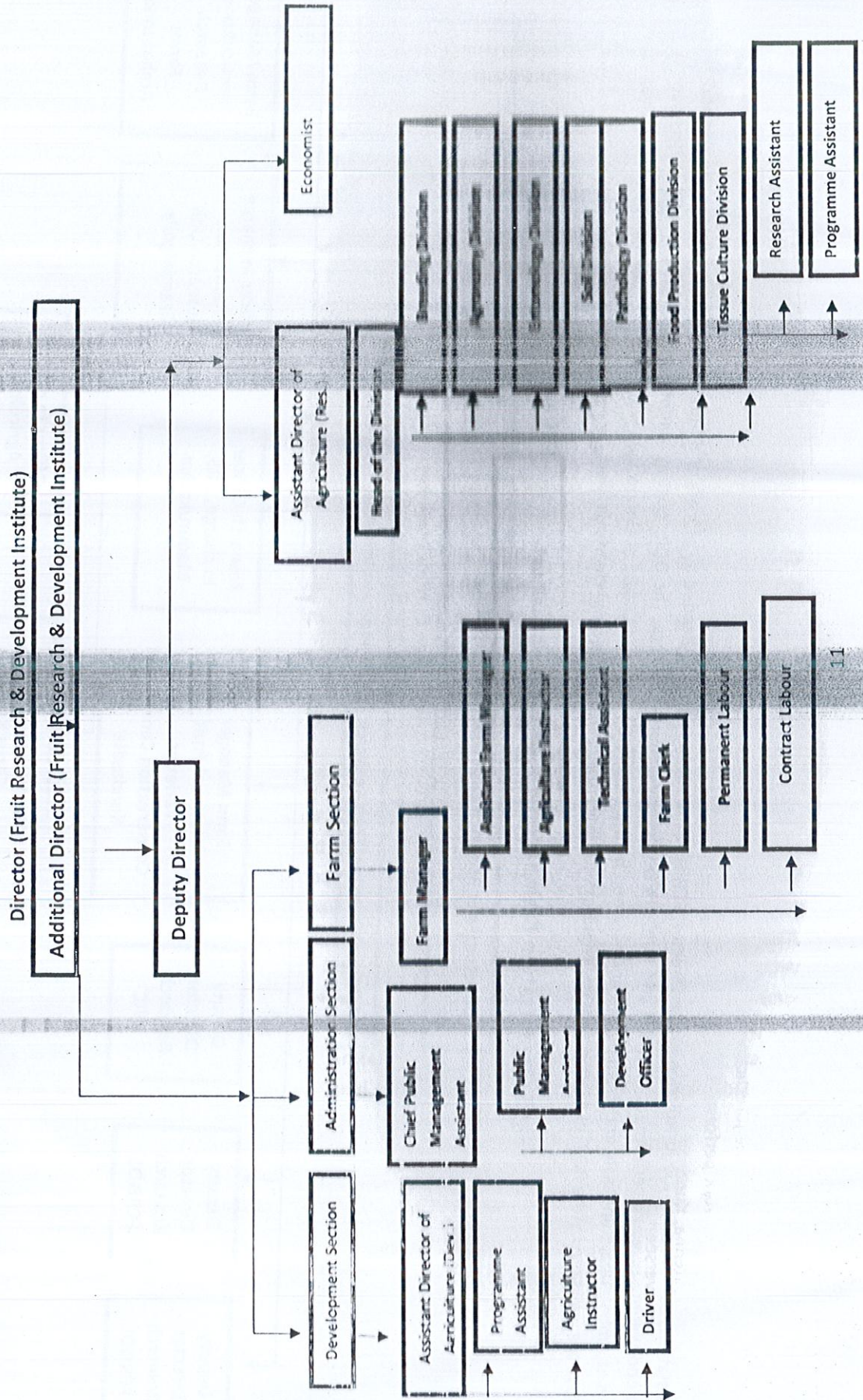
4. ORGANIZATION AND MANAGEMENT OF THE FCR&DI

As stated above, FCR&DI functions as one of the four institutes of the Department of Agriculture (Rice Research & Development Institute (RR&DI), Hatalagoda, Horticulture Research & Development Institute (HORDI) (Gannoruwa) and Field Crop Research & Development Institute (FCR&DI), Mahallupallama. Therefore, FCR&DI operates with a well established and time-tested management system under good governance.

FCR&DI operates under the overall management of the Director, supported by an Additional Director (R&D) and Deputy Director and functions under the guidance and direction of the Director-General of the Department of Agriculture, Peradeniya.

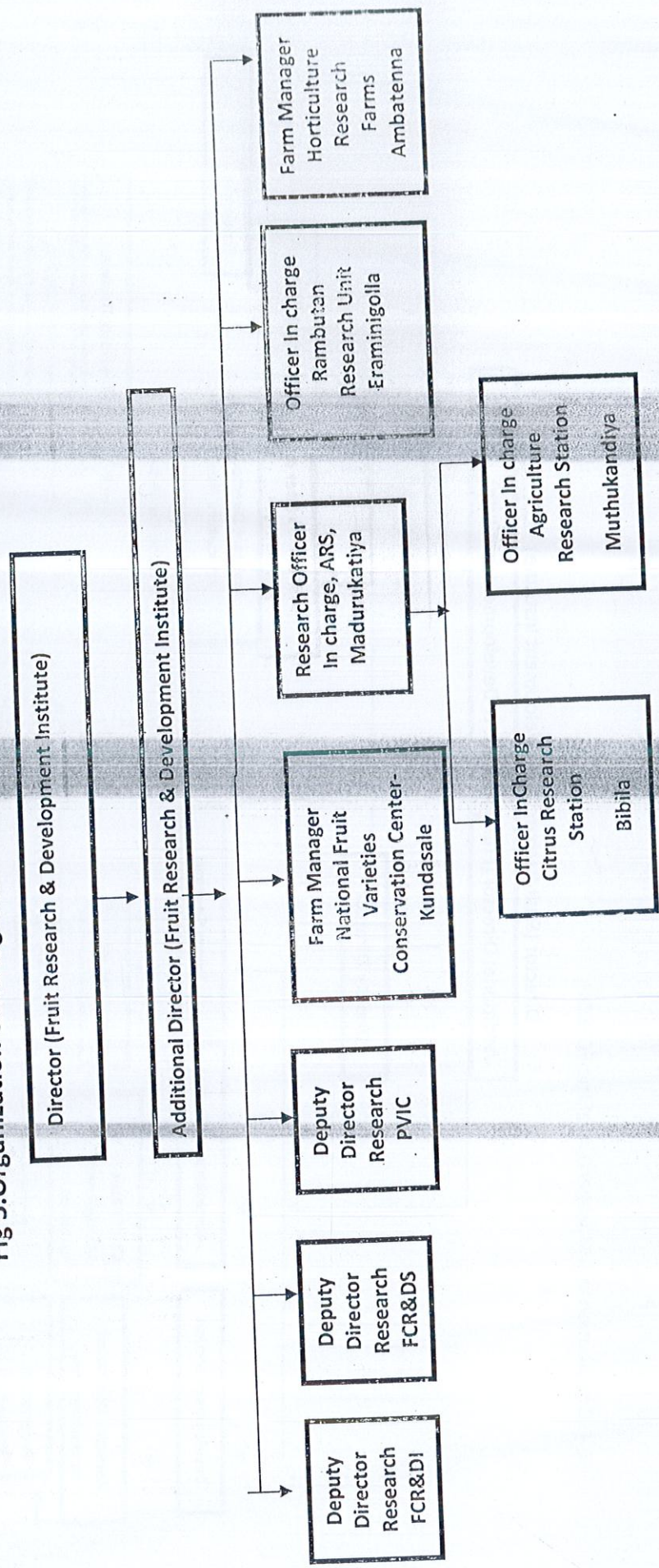
As shown in the Organogram (Fig 4) the Development, Administration and Farm Sections are directly under the Additional Director of the institute. The 07 research divisions; Plant Breeding, Agronomy, Entomology, Soils, Plant Pathology, Food Production and Tissue Culture divisions each with a Head of is organized and managed by the Deputy Director and Assistant Director (Res). The Economist is directly responsible to the Additional Director and Deputy Director of the institute.

Fig 4. Organization and Management of the FCR&DI



All sub stations comes under the jurisdiction of the Director, FCR&DI. The sub stations are headed by officers of different grades according to the size and nature and volume of work performed. FCR&DS and PVIC are headed by Deputy Directors. The DDR post at Madurankatiya remains unfilled. The sub stations at Ambatenna, Kundasale and Eraminigolla are overseen by the Deputy Director at FCR&DS at Gannoruwa while the sub stations at Mutukandiya, and Bibila are overseen by the ROIC of Madurankatiya. Therefore the lines of authority have been clearly defined.

Fig 5. Organization & Management of the Sub Stations of the FCR&DI



The recruitment and promotion, dismissals, disciplinary actions and financial matters are conducted according to the existing government administrative (AR) and financial (FR) regulations which are implemented by the Ministry/Department of Agriculture. All acceptable procedures of good Governance are followed by this institute.

However, a specially designed Code of Ethics for all employees is not available for this institute. Similarly, no evidence of a Code of Research Ethics for scientists. FCR&DI has also not developed a scheme for recognizing the outstanding achievements and reward system for its employees.

The review team noted that although an enormous volume of research and extension information produced by this institute, it has not established a Technology Transfer Division to transfer research outputs and other information to the stakeholders. This can be considered as a serious shortcoming of this institute.

A website (www.I) is available, but it is incomplete and not regularly updated.

4.1 Plans for Future Expansion of the Institute

FCR&DI has an ambitious plans to develop and expand this institute to cover the entire island by establishing research stations in the dry zone, intermediate zone and arid zone with laboratory facilities, technology transfer divisions, finance divisions, e-library facilities etc.

Reviewer's Observations

In regard to this proposal, the review team observes that there are already eight (8) sub stations under the FCR&DI located in various zones which were inherited from the DOA. Except the PVIC, Homagama and FCR&DS, Gannoruwa which are modestly staffed and developed are engaged in some research, the others are highly under developed with few staff and meager facilities. They are basically plant material production and training stations. Therefore, it may deem necessary to consider whether any of these stations could be further upgraded meet the future aspirations of the institute. Alternatively, FCR&DI may explore the possibility for setting up working arrangements with the existing research institutes and centers such as FCR&DI, Mahalluppallama, ARSs at Makandura, Aralaganwila, Vanathavilluwa, Bandarawela and other such as Institute of Postharvest Technology (IPHT), Anuradhapura and private sector organizations. This will be the best and the most cost-effective process at present. Hence, this proposal to expand the institute at the present stage will be too premature and may be considered after the institute at Horana and potential sub stations are fully developed for mandated purposes.

4.2 Vision and Mission of the FCR&DI

FCR&DI has developed Vision and Mission statements for its future development.

Vision :*To achieve national prosperity through excellence in fruit crop production*

Mission: *To take leadership for enhancing local fruit production and uplifting the living conditions of the people in the sector through research and development activities to the economic and social development of the country.*

4.3 Objectives of the FCR&DI

FCR&DI has set three (3) objectives to achieve its mission:

1. To develop efficient, environmentally friendly sustainable and economically viable production, harvesting and post harvesting technologies on major fruit crops.
2. To disseminate technologies in collaboration with state and private sector extension organizations on fruits.
3. To collaborate with other public and private organizations to develop the fruit industry

Reviewer's Observations

Although the FCR&DI has developed its Vision and Mission statements, they are not adequately focused and precisely presented. The review team is of the view that the FCR&DI should revisit these two key statements particularly in view of the prominence given by the government to develop the fruit crop sector.

For instance, its Vision should focus on becoming a Center of Excellence in fruit crop production in the future. Similarly, the Mission statement is grossly inadequate and should be redrafted to indicate how it plans to promote the fruit industry as a national and global entity. The Goals of this institute are totally absent and lack of Goals assures failure of any institution. Therefore, arising from the Mission statement, 5-6 goals should be carved out followed by set of clear, specific and achievable Objectives to achieve the goals. The Strategies for achieving the Objectives and Key Performance Indicators (KPIs) should be stated.

FCR&DI has listed three (3) Objectives as shown above, but the review team is of the view that they are highly superficial and does not cover the mandate of this recently established national research institute. Basically, the objectives are to develop production, harvesting and processing technologies, Disseminate information through public and private sector extension organizations and collaborate with public and private organizations to develop the fruit industry. However, it was evident that the private sector involvement is totally absent, although the private sector has a prominent role to play in the development of the fruit industry of Sri Lanka.

As the FCR&DI is relatively a new institute, the review team suggests as most important and timely to develop a time-bound Strategic Plan as the major instrument to guide the destiny of this institute. Annual Action Plans have to be followed based on the Strategic Plan to check the progress of each activity with KPIs.

5. AVAILABILITY HUMAN RESOURCES

The staff of this institute is spread across stations located in different parts of the country and the numbers vary according to the size and workload of each station. The total number of staff is around 175 but due to non-filling of vacancies there is serious dearth of staff at FCR&DI and all sub stations.

FCR&DI, Horana: Most of the scientific staff is concentrated at the institute's headquarters at Horana. The total approved cadre for this institute is 102 of which only 51 positions (50%) is filled (Table 3.). The Director and Additional Director are Ph.D holders in Plant Pathology and Plant Breeding respectively. The Deputy Director is an M.Sc holder in Soil Science. Of the 18 research officers only 9 positions are filled and include 4 M.Phil and 4 B.Sc degree holders. Of the 35 research assistants only 19 positions are filled. The research assistants include 7 B.Scs, 3, HNDTs, 1 NDT, 02 BIS (Agric) 01 B.Tech and 03 Diploma holders. The post of Agricultural Economist has been filled with a B.Sc. graduate.

Plant Virus Index Center (PVIC), Homagama: The current staff position of the PVIC appear satisfactory. The institute is headed by a DDR holding a Ph.D in plant virology, another officer is undergoing Ph.D in a foreign university, 03 M.Scs., 09 B.Scs. and 12 diploma holders. It has a total staff of 57.

PVIC also operates a Eco friendly Agriculture Technology Unit at Diyagama worth a staff of 04.

FCR&DS, Gannoruwa: This station is headed by a Deputy Director holding Ph.D. It has an Assistant Director (M.Sc), Program Assistant (M.Sc) and 03 Research Assistants (01 M.Sc and 02 Diplomas) and 09 farm assistants. The total scientific staff of this station is 15. The total staff including minor grades is 101.

Rambuttan Research Unit, Eraminigolla: This unit is managed by a Farm Manager (OIC) and Agricultural Instructor, both holding Diploma in Agriculture and a Development Office (BA), and support staff of 04 permanent labours, 01 budder and 02 watchers, totaling 10.

Horticulture Research Farm, Ambatenna: There are 08 officers in this farm: Farm manager (B.ScAgric), 02 assistant farm managers (Diploma), an Agricultural Monitoring Officer (BSc, Agric), a farm clerk, Technical Assistant and 12 permanent labours, 01 budder, and 03 watchers totaling 25 employees.

National Fruit Germplasm Conservation Center (NFGCC), Kundasale: This center is managed by a Farm manager (Diploma), one technical assistant and a farm clerk, 21 permanent labours and 5 watchers totaling 31.

ARS, Maduruketiya: Of the 12 staff positions,,09 are filled. The post of Deputy Director remains vacant. Similarly, of the 04 only one post of Research Officer has been filled with a graduate in Agriculture.

ARS, Muthukkandiya: This station has only 02 officers, both are Diploma holders..

Citrus Research Station, Bibila: It has a cadre of 05, currently only 02 are filled with Diploma holders.

Table 3. Staff of FCR&DI and Sub Stations with Qualifications

Table 3 a. FCR&DI Headquarters, Horana

No of employees	Cadre	No filled	Qualification of present staff
Director	01	01	Ph.D,
Additional Director	01	01	Ph.D,
Deputy Director	01	01	M.Sc,
Research Officer	18	09	5-BSc, 4-Msc
Administrative officer	01	01	BA
Agriculture Officer	03	02	2-B.Sc.
Economist	01	01	B.Sc
Programme Assistant	09	03	3-B.Sc [1-PG. (Diploma)]
Development Officer	05	01	B.Sc, Business Administration
Research Assistant	35	19	7-B.Sc, 3-HNDT,1-NDT, 2-BIS(Agri), 1- BTech5-Diploma
Agriculture Instructor	07	16	2-B.Sc Diploma-14
Economist Assistant	01	01	1-B.A (Special) Economics
Technical Assistant	04	04	4-Diploma
Research sub Assistant	04	0	-
Engineering Assistant	01	0	-
Public Management Assistant Services	10	10	2-B.Sc in Business Administration, 1- BLE, 7- A/L
Farm Clark	01	01	Diploma

Table 3 b. FCR&DS, Gannoruwa

Designation	No. Existing	Education qualifications
Deputy Director	01	Ph.D
Assistant Director of Agriculture	01	M.Sc
Program Assistant (Agriculture)	01	M.Sc
Research Assistant	03	M.Sc -01 Diploma -02
Farm Manager	01	Diploma
Agricultural Instructor	01	Diploma
Technical Aid	05	Diploma
Research Sub Assistant	02	Diploma

Table 3 c. Plant Virus Index Center (PVIC), Homagama
(Availability of human resources during last 5 years)

Post	2012	2013	2014	2015	2016
ROIC/ DDR	01	01	01	01	01
Research officer	04	04	04	04	05
Agriculture Officer	-	-	01	01	01
AMO	01	-	-	-	-
Program Assistant	07	04	03	03	03
Farm manager	01	01	01	01	01
Agriculture Instructor	09	09	09	08	06
Research assistant	04	06	05	05	05
Public Management Assistant	04	04	03	04	04
Sub RA	-	01	01	01	-
Technical Assistant	-	-	-	01	01
Office Attendant	-	-	-	-	01
Store man	01	01	01	01	01
Driver	02	03	03	03	03
Watcher	02	02	03	02	03
Laborer (Permanent)	03	02	02	17	17
Laborer (Contract)	12	12	05	05	05
Total	52	56	62	50	57

Table 3 d. Rambutan Research Unit(RRU)- Eraminigolla

Designation	No. Existing	Qualification
Agriculture Instructor	02	2-Diploma
Development officer	01	BA
Total	03	

Table 3e. Horticulture Research Farm (HRF), Ambatenna

No of employees	Cadre	No Existing	Qualification
Agriculture Monitoring Officer	01	01	B.Sc.(Agri)
Agriculture Instructor Farm clerk 01	03	03	B.Sc. (Agri) (FM) ,Diploma (AFM)
Farm Clerk	01	02	G.C.E (A/L)
Technical Assistant	02	02	Diploma

Table 3 f. Agriculture Research Station (ARS), Madurukatiya

Post	Approved Cadre	No. existing	
Deputy Director of Research	01	0	
Assistant Director of Agriculture (Research)	04	01	
Research Assistant (Special Grade)	01	0	
Development Officer	01	0	
Agriculture Instructor	02	01	
Research Assistant	02	01	
Management Assistant	02	0	
Farm Clerk	01	01	
Technical Assistant (Agric. Extension)	0	04	
Technical Assistant (Civil)		01	
Driver	01	01	
Tractor Driver	01	02	
Store keeper	0	01	
Budder	01	01	01
Research Sub Assistant	01	0	
Watcher	04	05	02
Laborer – Permanent	26	22	10
Total	48	40	

Table 3 g. ARS, Mutukandiya

Designation	Approved Cadre	Qualification
Officer in Charge	01	Diploma
Technical Assistant	01	Diploma

Table 3h. Citrus Research Station (CRS), Bibile

Post	Approved cadre	Present Status	
Assistant Director of Agriculture (Research)	02	0	
Research Assistant (Special Grade)	01	0	
Development Officer	01	0	
Agriculture Instructor	01	0	01
Research Assistant	02	01	01
Farm Clerk	01	0	01
Technical Assistant (Agric Extension)	0	01	02
Driver	01	0	
Budder	02	02	
Watcher	03	04	01
Laborer – Permanent	21	20	05
Laborer – Contract	0	01	04
Store keeper			01
Research Sub Assistant			01
Total	35	29	17

Table 3i. Agriculture Research Station – Mutukandiya

Post	Approved cadre	No. existing
Assistant Director of Agriculture (Research)	01	0
Development Officer	01	0
Agriculture Instructor OIC	01	01
Research Assistant	01	0
Farm Clerk	0	0
Technical Assistant (Agric. Extension)	0	01
Tractor driver	0	0
Watcher	03	03
Laborer – Permanent	15	09
Laborer – Contract	0	01
Budder	0	0
Total	22	19

Table 3j. National Fruit Variety Conservation Center, Kundasale

Post	Approved Cadre
Farm Manager , Diploma	01
Farm Clerk	01
Driver	01
Research Sub Assistant	01
Watchers	05
Labourers(Permanent)	22
Total	31

5.1 Staff Development and Training

Staff development: The staff is the most important and valuable resource for any research institute. This has to be recognized as the most critical issue in the development and implementation of vibrant research and development programs. Staff development should be a planned activity and the major cornerstone of institution development. The staff development implies the development of capacity of all categories of staff of an institute including the directors, administrators, research managers/researchers, technical staff, extension officers, financial and support staff. Thus, a continuous staff development program is necessary for the development of productive, vibrant and prestigious research institutes. At the present stage of development this should receive top priority of the FCR&DI.

Staff Training: Staff training means the up gradation of the required knowledge and skills of the staff of any institution from time to time. This is important to maintain high professional standards of the institute using the advances in scientific knowledge that expands continuously worldwide. Therefore, staff has to be trained and retrained at regular intervals to update their knowledge and skills in local and overseas institutions.

During the past 05 years (2012 – 201), few staff has been trained by the FCR&DI as shown in Table 4. This include 02 officers from FCR&DI at Ph.D level and 01 officer at B.Sc level and from PVIC 01 Ph.D and 01 M.Sc level. A few officers have received short term training in local and overseas institutions. These have been based on the availability of training slots offered by foreign agencies. There has been no planned training of staff at any level at FCR&DI and sub stations.

Reviewer's Observations

The major problem confronting this institute is the acute shortage of qualified and experienced research staff and support to conduct effective, long term research and development programs. This has been highlighted by the Directorate and heads of sub stations repeatedly at the discussions held with the review team. The review team noted that the inability to fill vacant positions is due to a pending court case which has taken well over three years up to now and how long it will take is also not clear. This problem applies to the recruitment of officers of the Sri Lanka Agricultural Service (SLAS) of the entire Department of Agriculture. This is a serious situation which unless rectified soon will bring adverse consequences to implement future R&D programs of the entire Department of Agriculture.

As a result of non-recruitment of staff many of the senior staff has retired or about to retire creating vacancies at top level of research /administration. This has created a wide gap between the present senior level staff and staff at the next layers. This is likely to create several administrative level problems, unless the authorities take quick action to resolve the current state of legal impediments in the recruitment of staff.

The discussions with Directorate and staff of the FCR&DI and sub stations revealed the absence of a consciously planned effort for staff development. FCR&DI has no clear idea about the type of staff to be recruited and required levels of qualifications to implement the planned R&D programs. To date, FCR&DI has not developed a staff development program. As FCR&DI is at the

stage of institutions building stage. It should address the whole chain of staff development from the stage of recruitment to identifying the type of staff required to implement the planned R&D programs, the level of qualifications and experience needed, the type and levels of training- retraining needed for each and every staff for career advancement. This will apply to all technical, administrative and financial officers. Therefore, it is proposed to formulate and implement a long term **Staff Development Program**.

The review team also noted the absence of a formal system for research management in this institute and none of its officers are exposed to ARM training. This is also an area that has been ignored by the national agricultural research system (NARS). Good researchers are always not good research managers. Therefore, to strengthen the research process of this institute, at least the directors and senior researchers should be exposed to research program management training in reputed training institutes .

Table 4. Staff trained during 2012 – 2016

Table 4 a. FCR&DI, Horana

Postgraduate level	Ph.D, 02, 01 local 01 foreign M.Phil , local	
Degree	B.Sc, 01, AI Local	
Short term	DD, 01 Foreign, 01 local ADA, Res , 05 Foreign , 03 local Als, Local 07, foreign 07 RA, Local 36, Foreign 01 Prog. Assistant foreign 02 Local 02	AI, 01, Productivity
Total	71	01

Table 4 b. PVIC - Homagama

No of employees trained	S & T staff	Other
Postgraduate level	Ph.D. -01(ADA Research)-2013 M.Sc.-01(ADA Research)-2016	-
Diploma	-	-
Short-term trainings	(Foreign) ADA Research -05 (Foreign) Agriculture instructors-05	(Local) Management course- (45 days)-05 -AI Bee keeping-01- RA Production of budded plants-01-RA
Study tours/conferences	(Foreign) ADA Research -01	-
Total	13	07

Table 4 c. Citrus station, Bibila

No of employees trained	S & T staff	Other
Study tour	01	-
Total.	01-	-

6. AVAILABILITY OF INFRASTRUCTURAL FACILITIES

FCR&DI, Horana

As stated earlier, the institute is located on a farm land of about 300 acres or more in extent at Kannawila, Horana in the Kalutara District (wet zone) of Sri Lanka. According to the Director of FCR&DI this land was originally (1929) a School of Agriculture during the British period and presently state an owned property. Negotiations are currently in progress to legally acquire this land to develop FCR&DI as a research institute and germplasm conservation center and extension and training facility on fruit crop production.

At present FCR&DI has very limited infrastructural facilities and this is a major concern of the staff. The Directorate of the FCR&DI and its staff has shown considerable interest and commitment to develop infrastructural facilities since its establishment in 2012. Under heavy constraints a lot has been achieved in the improvement of the existing farm buildings by converting them as plant houses, nurseries and repair and rehabilitation of buildings for training purposes. During the short period of four (4) years substantial amount of development activities has taken place which the review team considers as a commendable achievement.

There is one 2-storey administrative building in which the ground floor is used for administrative purposes (offices/conference rooms) and upper floor as laboratories and staff rooms. There are six (6) laboratories for Entomology, Pathology, Tissue Culture and Biotechnology, Agronomy and Food Science. These laboratories are shared for research and the space for some research such as Food Science is highly inadequate. The laboratories are moderately equipped, mostly through research grants obtained by the staff.

Accommodation for staff is not available except for two quarters for the farm manager and the assistant farm manager. As a result the staff either travels from home or find accommodation in nearby private homes. Even for the Director an official quarters is not available. The inadequacy of facilities for staff is a major concern which affects its output, hence need immediate attention of the authorities.

The library has a total collection 763 books, 222 journals. These are highly inadequate to cater to the wide range of research undertaken by this institute.

Internet facilities are available for research staff.

PIVC, Homagamaha has 01 Administrative building, 5 research laboratories; shared laboratory for Virology and Microbiology, Molecular Biology Tissue culture, Epidemiology ,01 staff accommodation, Its Library has a collection of 683 books and 114 journals. It lacks a fully automated green house for screening plant samples, stores and rest room for minor employees. The laboratories of this institute needs improvement specifically with equipment required for research in virology related disciplines. The communication and computer facilities of this institute should be improved.

FCR&DS, Gannoruwa has 01 Administrative building, research laboratory, 01 staff accommodation and small library with 250 books and 21 journals .Access to internet is available.

HRF, Ambatenna has 01 administrative building, one staff quarter.

ARS, Madurukatiya has one Office building with space for laboratory ,Building for store,03 assigned quarters, Circuit bungalow,03 Rain shelters, Double cab, 4- wheel tractor, 01 hand tractor.

ARS, Mutukandiya has one Office building, 01, store, 03 quarters, 02 Rain shelters ,01 Jeep and 01 hand tractor

CRS, Bibila has 01 Office building, store, staff quarter, rain shelter, 4- wheel tractor and 01 hand tractor.

Reviewer's Observations

The review team noted the inadequacy of infrastructural facilities as a major problem facing FCR&DI and its sub stations. Even the bare minimum facilities for R&D are not available in some sub stations. Residential quarters are not available even for its Director, laboratories of the FCR&DI, PVIC and FCR&DS at Gannoruwa should be provided with up to date equipment, lands and buildings, and roads are not well maintained and remains in a neglected state. It is very essential to develop infrastructure of this recently established institute to enable to function efficiently.

It is the responsibility of the institute to identify the needed infrastructure and facilities in terms of administration offices, conference halls, laboratories with scientific equipment, plant houses, computers and communication facilities(internet, WIFI, e mail) ,transport, library and books and journals, staff housing, recreation and other specific needs. Using this information, FCR&DI should develop a **Master Plan for Improvement of Infrastructure and Facilities** and implement it on phased-out basis. The development of a Master Plan for Infrastructure will need the inputs of expert/s in institution planning.

7. RESEARCH PROGRAM

The mandate of this institute is to undertake appropriate and cost effective research and development activities for the development of the fruit crop sector. As envisaged in its Vision statement, this institute should be fully committed to achieve excellence in fruit crop production research for meeting domestic fruit consumption requirements for healthy living of its population, enhancement of employment and increase export earnings. As FCR&DI is the only agricultural research institute mandated for the development of the fruit crop sector in this country, it has to develop comprehensive development oriented and forward looking long term **Research Plan** to achieve national targets.

7.1 Research Thrusts

FCR&DI conducts research under eight (8) Trust Areas as given below:

- i. Development of good quality high yielding varieties of popular fruit crops for fresh market and industrial purposes
- ii. Selection of good quality under-utilized fruit crop varieties and popularization for cultivation
- iii. Generate profitable crop management practices for fruit orchard and technology for quality planting material production
- iv. Development of cost effective, environmentally sound, effective pest and disease management practices for major fruit crops
- v. Development sustainable weed management systems for orchards
- vi. Development effective nutrient management packages to increase yield and quality of fruit crops and development of organic fruit production technology
- vii. Increase fruit production through technology transferring
- viii. Development of database on fruit crops

The review team also noted that the PVIC has also developed 05 Research Thrusts areas relating to disease management of crops, including a Technology Transfer and Delivery service.

Reviewer's Observations

The review team is of the view that the FCR&DI should revisit the research thrusts as they are limited in scope, not specific and highly vague. For instance, Thrust ii – vi are on the development

of fruit crop management (agronomic) packages. The major thrust area of this institute should be the development of high yielding fruit varieties by utilizing appropriate breeding techniques, including potential underutilized fruit varieties with desirable quality parameters for domestic consumption and export markets. The other important thrust area should be the development of production packages using good agricultural practices (GAPs) (agronomic, pruning & training, pest and disease management, irrigation water management, harvesting etc.) for different agro-ecological regions (see Thrusts ii – vi). Technology transfer, training and extension of stakeholders are other important thrust areas to be considered.

FCR&DI holds the most valuable collection of fruit germplasm of the country. Hence, it is a national asset which is valuable resource for the present and future development of fruit crops. Therefore, the management and maintenance of field germplasm banks of diverse fruit crops, including those of underutilized fruits should also be considered as a thrust area of research.

7.2 Research Process and Identification of Research Priorities

The primary stage of R&D is the identification of most significant problem areas to commence investigations. It is an intellectual process which requires attention of this institute. This is of tremendous importance as many researchable problems exist in the fruit crop sector. Among the many, most significant problems have to be identified and prioritized as research is a time consuming and costly investment, particularly because of the long term nature of fruit crop research.

Procedures to identify research problems are many and among them comprehensive literature reviews, field visits and discussions with fruit growers, scientific discussions with fellow scientists and university academics, attending seminars/ conferences, research – extension dialogues, discussions with policymakers, meetings with stakeholders, primarily the fruit growers, exporters and fruit industry will be of primary importance.

FCR&DI identifies research problems and sets priorities through discussions at the Provincial Technical Working Group (PTWG) meetings which are held in each province and Mahaweli system twice a year with the participation of researchers, provincial extension officers and other relevant officers of the department. This is the main forum at which the farmers field problems are also discussed. At this forum extension progress of the previous season and programmes of coming season are also discussed. Problems faced by extension officers when achieving their targets and research needs are also presented at this forum. Researchers formulate the research programs based on the above information. Apart from these, sometimes researchers directly communicate with farmers and other stakeholder to identify the research problems. Priorities are set on the basis of importance of crop and severity of the problem. More priority is given for high value crops. In the above procedure the main stakeholders are not directly involved in research problem identification and prioritization and program formulation. This is a major shortcoming in the research prioritization process as identification of research problems and research prioritization is dependent on the views of limited group of extension personnel and staff of the institute representing the PTWG.

Reviewer's Observations

The review team finds that the above process of research problem identification and prioritization is unsatisfactory. Alternatively, considering long term nature fruit crop research and

the heavy investment in terms of funds and staff time, the FCR&DI should develop an effective broad-based consultative process involving relevant research institutes, line departments, universities, extension personnel, fruit growers, private sector fruit processing industries and marketing agencies involved in exports to identify research priorities. Such a procedure will strengthen the research process, while vesting more responsibilities on the research staff and the Institute for greater dedication and commitment to produce output oriented public good research.

As there are many fruit crops, research problems should be carefully identified using reliable methodology to identify the most significant problems that deserves investigation. A scoring system assigning weights using different criteria such as: Expected research outputs, technical feasibility and commercial viability of the output, impact of research outputs on economy and society and availability of resources (skilled human resources, laboratory equipment and funds) may be considered to identify the research priorities. It should give priority to demand driven research in order to achieve significant outputs and be accountable for the use of public funds. The weighing and scoring should be presented to the Research Committee to base their decision on research prioritization.

Therefore, FCR&DI should appoint a **Research Committee** which should include the Director (Research) of the DOA, University academics conversant in fruit crop research , Biometrician/Economist, industry representatives, directorate of the institute and substations and any others as may be appropriate. The outcomes of preliminary discussions at PTWG meetings and above consultative process, the potential research areas should be placed before the Research Committee to sieve out and identify the most significant problems in order to develop the above mentioned long term **Research Plan** (to include Research Thrusts/Programs, and projects) for the fruit crop sector.

The full research proposals from the staff should be entertained following the above research plan for consideration by the Research Committee of the institute. The potential research proposals should be then referred to two external referees for further improvement before final approval by the Research Committee.

7.3 Monitoring and Evaluation of Research Projects

Monitoring and evaluation (M&E) is a universally accepted procedure in conducting research. Its purpose is to strengthen the research process through monitoring and evaluation of a research projects at frequent intervals using external evaluators through site visits and discussions with researchers in order to make suggestions and mid- term corrections, if necessary for improving the research project.

Reviewer's observation

The review team noted the absence of a Monitoring and Evaluation (M&E)mechanism and feedback system in this institute for research projects of scientists. This is an essential tool for conducting good quality research universally accepted by recognized research institutes. Furthermore, institute should conduct regular reviews/presentations on all research projects to make midterm corrections and develop researcher confidence where necessary and to move towards building a research culture.

8. Dissemination of Research Outputs & Other Information

Technology development and technology dissemination are the two major pillars of any research institution. However, the FCR&DI has not established a formal mechanism for the dissemination of research outputs and other information to the stakeholders.

The institute produces few research articles annually and they are published in local journals and proceedings of symposia/conferences etc. Most of the research articles are published in the proceedings of the Annual Symposium of the Department of Agriculture (ASDA) and in annual research symposia of universities. Very few articles are published in international indexed journals. None of the scientists of this institute has received national/international recognition for their research. There is also no evidence of the institute obtaining patents for high quality research outputs.

According to the information made available to the review team the highest number of research publications and scientific communications have been made by the PVIC (53). This could be attributed to its nature of work which basically is research on indexing viruses and pathological problems of crop plants and the fact that it was established nearly two decades ago in 1999. It also has well developed laboratory facilities and a group of qualified research officers.

During the same period FCR&DI and the FCR&DS at Gannoruwa has published 06 and 05 research publications and scientific communications respectively. Both these institutions have also published books and other occasional publications.

FCR&DI and sub stations has published several leaflets on fruit crops, and fruit crop management systems to achieve high yields. These are distributed among the growers and other interested stakeholders to popularize fruit cultivation and to promote fruit consumption. In most of these publications, the authorship has been acknowledged. Many extension leaflets have been published even with limited resources available at this institute. This can be considered as a commendable achievement (Table 5, a - c).

Reviewer's Observations

The review team observed that based on the number of research publications over a 5 year period, the research outputs of this institute, except the PVIC is grossly inadequate. It is also important that R&D information is disseminated to the stakeholders/end users at the earliest opportunity as they could make decisions based on such information. For effective information dissemination, a formal mechanism should be available in any research institute. The dissemination of R&D information also links the institute with the public, mainly the stakeholders and improves the visibility of the Institute. The absence of such a mechanism such as a **Technology Transfer Division (TTD)** was highly evident and this serious shortcoming should be rectified by the FCR&DI early.

Table 5. Research Articles & Scientific Communications Published by FCR&DI and Sub Stations, 2012 - 2016

Table 5a. FCR&DI, Horana

Type of publication	Number
Research publication and scientific communications	06
Seminars and conferences proceedings	04

Newsletters	01
Occasional publications	03 Books on Durian, Papaya and Passionfruit)
Poster	13
Articles in magazine (Krushi) / Newspaper Articles	17
Leaflets	06

Table 5b.PVIC- Homagama

Type of publication	Number
Research publication and scientific communications	53
Seminars and conference proceedings	Local- 30 Foreign-03 15-(“Gewatta Radio program”)
Newsletters	20 10-(Silumina govigetalu)
Occasional publications	01 02 :IDIsfnda. iIydmglfrdamK fmd; ^msgq 103&
Poster	-

Table 5 c. Fruit Crop Research and Development Station - Gannoruwa

Type	Number
Research publication and scientific communications	05
Seminars and conference proceedings	-
Newsletters	-
Occasional publications	-
Poster	-

9. SPECIAL DEVELOPMENT PROJECTS

The institute implements two special fruit development projects: the Fruit Village Development Project and Biodiversity Fruit Garden Project .

Fruit Village Development Project: The Fruit Village Development Project under the National Food Production program was initially implemented by the Fruit Research and Development Institute (FCR&DI) as a three year program during 2013-2015 as part of the “strengthening of home-gardens” program of the Department of Agriculture. The intension was to increase fruit cultivation and promoting fruit production activities at village level as a mean of ensuring village empowerment. Under this program, it was planned to establish 100 fruit villages in different agro- ecological zones in the country. More than 1120 fruit villages were established island wide under this program.

The fruit village development project aims to minimize the wastage of fruit during peak seasons, increase availability of local fruit varieties, provide incentives to local entrepreneurs through

creating direct and indirect market place and enhance the fruit production in the country. To achieve this, planting material of identified fruit such as jack fruit, rambutan, durian etc. have been distributed in villages to develop their own mechanism in order to promote planting material production and marketing and collection of fruits. It was reported that Rs. 30 million was allocated in 2015 for this project. During 2013-2015, 117 fruit villages were established in 19 districts and 526,224 plants of 14 local fruit crop varieties were distributed among the 7,096 beneficiaries (Post evaluation report of establishment of fruit villages in 2013-15, FCR&DI, 2015). According to the above report, Jamanaran, sweet orange, pineapple, durian, grapes, woodapple, pears, soursop, mangosteen, rambutan, avocado, mango and pomegranate were the fruit crops established under this programme. The highest number of fruit villages were established in Matale (13) followed by Anuradhapura (11), Ampara (10) and Hambantota (10) districts during 2013-15. The majority of fruit villages were under sweet oranges and pomegranate. From the total sample, 64% of the plants grew well while 36% of plants failed mainly due to the drought conditions, pest and wild animal attacks or impediment of irrigation due to rural development activities. It was also reported that out of the total amount of plants, only 80% of the fruit plants have survived in the field during the evaluation period in 2015. Lack of adequate knowledge and technology by beneficiaries, inadequate usage of technology for maintenance and cultivation of high climatic sensitive crops, less attention given to cultivate fruit crops, inadequate water conservation and water supply during the drought period were observed as weaknesses or constraints faced by the beneficiaries of this project.

With the initiation of the National Food Production Programme 2016-2018, it was targeted to establish 15,000 fruit villages in 25 districts of the country. The programme has been named as "One Village, One Fruit Programme" and it was targeted to enhance the availability of fruits even during off seasons. Measures have been taken to provide 1,000 plants to each village and the fruit varieties are selected considering the soil and climatic conditions of the area. Priority has been given to cultivate mangoes, orange, papaw, banana, wood apple, anoda, nelli and passion fruit. Twenty families from each village were chosen for the programme. Under this project fruit processing factories will also be set up and the first such unit will be established in Ipalogama divisional secretariat division in Anuradhapura.

Biodiversity Fruit Garden Project: This is a major development project of the institute. The project consisted of the maintenance of already established fruit orchard, establishment of new fruit orchards and improvements to infrastructure. Using these funds (Rs.7 mn), 2.5 ha fruit orchard and an open training facility was constructed at the National Germplasm Conservation Center at Kundasale. To improve fruit productivity 330 pruning kits were also distributed to the beneficiaries.

Reviewer's Observations

The fruit village development project is an innovative concept of the Ministry of Agriculture which could have considerable impact for the development of the national fruit industry.. Therefore, it should be expanded with the collaboration of other institutes such as the Coconut Research Institute/Coconut Cultivation Board where potential exists for intercropping with commercial fruit varieties. In order to achieve success the beneficiaries should be provided with essential technological knowledge and monitored in the initial stages. Also, this venture should be implemented as a business model and postharvest processing, value addition and marketing should be included as components.

10. R&DLINKS WITH OTHER INSTITUTES

Establishment of links with other similar institutions is essential to foster R&D. These links will provide scientific interactions in developing technologies, sharing of staff and facilities and exchange of staff and information. Such links also provide opportunities for collaborative research, extension and training programs etc. Establishment of linkages also elevates the image of the institute.

Reviewers' Observations

The review team noted that the FCR&DI has several informal linkages with agricultural research institutes, schools of agriculture and national universities. However, none of these are formal linkages; hence interaction is irregular and ineffective. FCR&DI should attempt to develop some formal links with institutes undertaking similar R&D programs such as Faculties of Agriculture and Science, Institute of Postharvest Technology, Industrial Technology Institute, private sector food processing industries.

11. STAKEHOLDER SERVICES

FCR&DI and its sub stations provide a multitude of services for various stakeholders. Its stakeholders are mainly fruit growers, small-holder agriculturists owning mixed farms and home gardens, private nurserymen, school teachers and children, students of universities, technical colleges and schools of agriculture, government officers and others.

The main services provided include plant material production and training of stakeholders. FCR&DI also provide advisory services for planning and development of fruit orchards, assistance in pest management, soil testing and attending to other field problems, capacity building of entrepreneurs in collaboration with NGOs and promoting fruit cultivation and consumption by holding fruit exhibitions.

11.1 Plant material production:

The most important service is the production and supply of quality planting materials for the fruit growers. Table 6 shows the details of plant material production and income earned by the FCR&DI during 2012 - 2016. The sub stations also have produced planting materials of certified, recommended varieties of fruits for the establishment 100 (of 1380) fruit villages program, maintained targets and this is a commendable achievement.

Table 6a. Production of Planting Materials by FCR&DI, Horana, 2012 – 2016

Year	Seed & Planting material division		Projects and research	
	No. of plants sold	Income earned	No of plant sold	Income earned
2012	12,298	1,872,730	7,400	1,088,775
2013	7,191	1,161,355	6,300	1,118,320
2014	8,868	1,415,420	5,448	654,525
2015	12,658	1,966,825	7,185	821,262
2016	13,679	2,165,945	5,630	645,590

Table 6b. Planting Materials Produced by FCR&DS, Gannoruwa, 2016

Type of Plant	No. Of Plants
Sapota, grafted	500
Durian, grafted	245
Jak fruit, grafted	1095
Carambola, grafted	500
Butter fruit, grafted	3121
Uguressa, grafted	250
Veralu, grafted	200
Bael fruit, grafted	300
Others, grafted	1500
Soursap seedlings	2000
Others	277
Total	9988

FCR&DS has also produced 5600 of avocado (1,100) and soursap plants (4,500) for the Fruit Village Development Program in 2016 and 1,000 wood apple seedlings for the Food Production Program.

Horticulture Research Farm at Ambatenna has produced 8,663 grafted and seedling plants in the same year. It has produced soursap seedlings (8,000) and 150 Rambuttan grafts for the Fruit Village program and 16,000 soursap seedlings for the food Production Program in 2016.

6c. Planting Material production in ARS Madurukatiya, Bibila and Mutukandiya, 2012 - 2016

Station	Sweet orange	Wood apple	Mandarin	Thumbakarawila	Sour sap	Pomogranate	Pannicum	Pineapple
ARS Madurukatiya	24600	10550	4240	500	2500	2500		100
ARS Bibila	41450		4250					9500
ARS Mutukandiya	3050	8500	100	2900	100	50	6000	

These stations also produce the following fruit plants in small quantities (<500); Pomegranate, Lemon, Mango, Passion fruit and Lime) for the fruit growers.

11.2 Training of stakeholders

This is the other important service of the FCR&DI. Virtually FCR&DI and all the sub stations undertake regular training programs for fruit growers, officers of government departments, students of Universities, technical colleges, school teachers and children covering a wide range of stakeholders. PVIC also provides industrial training for students of various stakeholders such as students of Schools of Agriculture, Technology Institutes and national universities.

Training is an activity that does not require sophisticated equipment or advanced facilities, except the skills of officers. Therefore, FCR&DI and its sub stations with minimum infrastructure have conducted effective training programs on various aspects of fruit crop production from establishment to management of orchards. This is also a commendable achievement of this institute.

Reviewer's Observations

The planting material production is a regular activity of the FCR&DI and sub stations. All types of fruit varieties are produced by different stations and freely available at various sales points. However, it is necessary to formalize the plant material production system by the use of only the certified fruit germplasm for the production of planting materials to ensure that growers could get the best quality plants.

Although training programs are conducted by some individuals of these institutes, these can be considered as informal and often organized at the request of institutions/ trainees. There are no published training manuals or any other documents that could be used by the trainees after completing the training. The review team is of the view that the FCR&DI should encourage the current set of trainers to develop training manuals/modules on different aspects of training , subject them to a thorough review, publish and make them available to the trainees. As training of stakeholders is an important activity for the development of the fruit industry, FCR&DI should consider this as one of its priority obligations. Then these training programmes could be conducted on regular basis by advertising in the website and public media.

12. ANNUAL BUDGET AND ALLOCATION OF RESOURCES

The annual budget of the FCR&DI is allocated based on the annual work plans. The annual budget allocation for FCR&DI (2016) is given in Table 7. The total allocation is Rs. 343,750, 780 and the expenditure is indicated as Rs.310,799,054, showing an unspent balance of Rs. 32,353,900. From the total budget funds are allocated for sub stations based on requests.

The annual budgets for sub stations are given in Annex Tables 5(a – h). However, the criteria for allocation is not clear. The expenses are submitted to the Director, FCR&DI for reimbursement by the Accountant of the DOA.

Reviewer's Observations

The absence of a clear policy for allocation of funds and the absence of a dedicated financial officer and a Finance Committee to control financial transactions were noted as deficiencies by the review team.

Table 7. Annual Budget of the FCR&DI, 2016

Votes/ Activities	Budget for 2016	
	Allocated	Spent
Capital expenditure.	13,206,000.00	9,697,530.00
Recurrent expenditure.	246,850,780.00	246,188,668.68
Development of fruit village.	15,000,000.00	12,123,126.98
Bio diversity Project.	25,000,000.00	14,616,379.59
Breeding Project	9,910,000.00	4,626,442.75
NARP Project	15,383,800.00	10527035.32
Food Production Programme	18,400,000.00	13,020,854.19
Total	343,750,580	310,779,054

13. MAJOR PROBLEMS AND CONSTRAINTS

13.1 Inadequate staff:

The major constraint identified by the review team is the lack of qualified research and technical staff at the institute and all sub stations including those designated for research such as FCR&DS, Gannoruwa and PVIC, Homagama. FCR&DI has two Ph.D. degree holders in administrative positions, and 13 Assistant Directors (ADs) of Research, including the Economist. This staff consists of 3 soil scientists and 2 plant breeders, and one each in other major disciplines. They are qualified at M.Phil/M.Sc level.

At FCR&DS, Gannoruwa a Deputy Director (D.D.) and an Assistant Director, a Program Assistant and a Research Assistant is the only available staff (see for details Under 5. Human Resources, Table 2). Only the PVIC, Homagama headed by a Ph.D holder has at present satisfactory compliment of staff.

The other sub stations have also reported inadequate staff for research and field work. Some like Madurankatiya, Mutukandiya and Bibila has also reported shortage of support staff for field operations and training.

13.2 Infrastructural facilities:

Limited availability of infrastructural facilities is a major constraint at FCR&DI and sub stations, much less than that expected of a research institute. The research laboratories are inadequate, not well equipped and the space in some labs is insufficient for implementing effective research programs. Residential and recreational facilities are not available even at the headquarters of FCR&DI.

Reviewer's Observations

The review team finds that there is a serious dearth of scientific staff and technical in the FCR&DI and sub stations. There are only 08 Ph.D degree holders in the FCR&DI and sub stations and majority of senior staff are approaching retiring age. The other research staff is qualified at lower levels, having limited experience and will not be able to provide leadership to this institute. However, it was brought to the notice of the review team that a legal case is pending preventing staff recruitment and the Department of Agriculture is unable to fill the post that are currently vacant.

The review team also noted the absence of a **Human Staff Development Program** which is an essential tool for building capacity of this institute.

The limited availability of infrastructure such as laboratory and residential facilities was also noted by the review team; however, no Master Plan has been developed by this institute for the development of the required infrastructural facilities.

14. COMMENDATIONS AND RECOMMENDATIONS

14.1 COMMENDATIONS

1. FCR&DI has made considerable progress in the development of the newly established headquarters at Horana and its farmland and the National field germplasm bank at Kundasale as evident from the improvement to the expansion of planting extents with certified fruit varieties, infrastructure and field facilities during the brief period of its existence.
2. Considerable achievements have been made by the FCR&DI and its substations in the production of quality planting materials of different fruit trees for development projects such as the Fruit Village Development Program, Food Production Program, private nurserymen and the general public. This institute also produces planting materials of underutilized fruit crops for its stakeholders.
3. In spite of various constraints such as limited staff, commendable progress has been made in extension and training of various stakeholders such as the fruit growers, farmers, school children, students of technical colleges, universities and personnel of the food industry. This has been appreciated by farmer groups.
4. More than dozen of extension leaflets on fruit cultivation to educate the fruit growers and promote fruit consumption have been published during the review period.

14.2 RECOMMENDATIONS

1. Maintenance of Good Governance

- i. Develop a time – bound **Strategic Plan**, preferably over 05 years, with clear **Vision and Mission** statements. Identify the Goals, "SMART" Objectives, and Strategies to achieve the set goals, and indicate Key Performance Indicators (KPIs). With this an **Annual Action Plan** has to be developed and implemented.
- ii. To promote good governance, develop a Code of Ethics for employees of the institute and a Code of Research Ethics for researchers.

2. Organization and Management

- i. FCR&DI should be developed as a full- pledged institute for fruit crop research
- ii. For the sub stations, separate mandates should be developed according to their potential for different activities

3. Infrastructure Development

- i. Identify the infrastructural requirements of FCR&DI and each of the substations to meet specific needs for which they are mandated: (research, extension, training, plant material production, germplasm conservation etc.), including housing, transport and recreation facilities for staff.
- ii. Develop a long-term **Master Plan** for development of physical infrastructure of the Institute and sub stations and commit funds annually on priority basis.

4. Research Problem Identification and Prioritization

- i. Develop a broad-based consultative process involving relevant staff from research institutions, universities, fruit growers, private processing industry, marketing agencies

and exporters, in addition to **selected** members of the DOA, FCR&DI, PTWG and farmer groups for research problem **identification** and prioritization.

- ii. For prioritizing research, an **established** methodology such as a system of scoring by assigning weights based on **criteria such as** (a) expected outputs (b) technical feasibility and commercial viability (c) **impact on economy** and (d) availability of resources.
- iii. In order to strengthen the research base at institute level, establish a **Research Committee** with appropriate membership including external experts to scrutinize the proposals submitted by staff.
- iv. To promote high quality and public good research, refer the full research proposals approved by the **Research Committee** to two external experts for comments and further improvements before final approval by the **Research Committee**.
- v. Develop a 5 year **Research Plan** for the fruit crop sector.
- vi. A **Research Monitoring and Evaluation (M&E) Committee** should be established with M&E qualified staff and assigned **specific** responsibilities to assist decision making at management level.
- vii. Establish collaborative research partnerships by entering into **Memoranda of Understanding** through the Department of Agriculture, with local research institutes, (eg: Coconut Research Institute(CRI), Institute of Postharvest Technology,(IPHT), Faculties of Agriculture/ Food Science of national Universities and private sector fruit processing industries and where appropriate with international research centers to strengthen and consolidate the R&D programs.
- viii. Collect, classify, characterize and establish a complete collection of **certified fruit germplasm** for the future fruit crop improvement programs, including underutilized fruits at the National Fruit Crop Conservation Center at Kundasale.

5. Human Resources Development

- i. Develop a procedure and establish a **Staff Development Program** with an officer in charge to plan for staff requirements for **research**, extension, training and other activities, to identify areas/disciplines, levels of **training** needed in order to strengthen institutional capacity for R&D and career advancement.
- ii. Organize and conduct training programs on **Agriculture Research Management** for directors and senior research staff in **recognized** training institutes.
- iii. Establish a **Scheme to Recognize and Reward Outstanding Achievements** of all staff of the institute on regular basis.
- iv. As quality planting material production is the key to the development of the fruit crop sector, establish a rigid **Certification Procedure** for all planting materials issued by the institute.

6. Information Dissemination and Enhancing institutes' Visibility

- i. Establish a separate **Technology Transfer Division** with a qualified officer in charge to effectively process and facilitate the dissemination of research and other information to the stakeholders and improve the visibility of the institute.
 - ii. A mandate for this division should be developed in consultation with the DOA and other partners of the fruit crop sector.
 - iii. For training of stakeholders and effective follow-up, Training Manuals for different programs should be published and made available to the trainees.
7. The fruit village project, an innovative concept should be strengthened through active private sector partnership and connect the growers to markets.

7. Financial Management

- i. As the current procedure is inadequate, a policy and transparent system should be developed for the financial management of FCR&DI and the sub stations. The establishment of a **Finance Committee** and a dedicated Financial Officer at the institute may be considered.

ANNEXES

Annex 1. Terms of Reference of the External Review of the Fruit Crop Research & Development Institute

Scope

1. To achieve the objectives of the review, the review panel is expected to play particular attention to the following aspects:
2. Mission of the institute and its interpretation with respect to:
Research R&D focused on immediate and long term fruit crop R&D needs in Sri Lanka:
 - Policies and directive of the SLCARP and the Ministry of Agriculture regarding the appropriateness of FCRDI's Mission in the light of important changes taking place in agricultural production and product development in Sri Lanka
 - Appropriateness of the roles of relevant partners in the formulation and implementation of FCRDI's research strategy and priorities
 - Conservation of natural resources, impact of FCRDI's practices on natural environment and long term environmental sustainability.
3. The objectives and relevance of the present program of work, budget and forward plans for the next 5 years in relation to:
 - The FCRDI's mandate and its criteria for allocation of resources and planning procedure adopted by FCRDI and the mechanism for their formulation
 - The FCRDI's rationale for its present allocation of resources among research, extension information exchange and other activities.
4. The content and quality and relevance of scientific work with particular reference to:
 - The results of research during the past 5 years and their practical applicability and economic feasibility and impact on the agricultural sector
 - The current and future research plan and the role of various scientific disciplines therein
 - The degree and extent to which the specific needs of various stakeholders were studied and analyzed in the formulation of the past and present research plans
 - The information exchange and extension programs and the participation of research staff therein
 - The adequacy of research support and facilities
 - The management of the scientific and financial resources of the FCR&DI
5. Impact and usefulness of institutes' activities in relation to:
 - The record and potential impact of the FCR&DI's research
 - Cooperation with other research institutes and with national development programs, private sector organizations and other stakeholders
6. Examine the extension program of the FCR&DI to determine:
 - Its effectiveness in the agricultural sector
 - The effectiveness of the information exchange program and timeliness, quality and relevance of the technologies generated and its publications
 - Mechanisms adopted to get the feedback of stakeholders in planning future R&D
 - The identification of problems and constraints impeding the extension program
7. The quality and effectiveness of the management of the FCR&DI in relation to:
 - The constitution of research, advisory or sub committees of the Board
 - Adequacy of coordination to ensure excellence of the research program and related activities
 - Competency and professionalism of the directorate and senior management of the FCR&DI and the definition of roles, organization and quality of the leadership of the FCR&DI and rapport with the staff

- Nature of the budgetary review and evaluation process and the involvement of important stakeholders in the above, stability of funding and the relationship budget, institutes policies and plans and the effectiveness of utilization
 - Procedure for determining staffing requirement at all levels for selection evaluation and compensation of staff
 - Administration of fiscal, purchasing and supply of personal computers, housing and other facilities including transport and general management services and their effectiveness in supporting scientific staff.
8. Services provided by the FCR&DI:
- Consultancy and advisory services
 - Laboratory services
 - Pest control and fumigation of warehouses
9. Overall analysis through:
- A SWOT analysis to identify internally controllable and uncontrollable factors

Annex 2. Research program 2017- Titles of Research projects, FCR&DI, Horana

Title of the Research Project
1. Crop Improvement and Breeding
Selection of high yielding & good quality Mango varieties adaptable for different agro ecological zones
Development of Mangohybrids
Development of high yielding good quality Citrus (Sweet orange & mandarin) varieties (Hybrid development)
Development of high yielding good quality citrus (Sweet orange, Mandarine, Pummelo and lime) varieties
Collection establishment & evaluation of citrus germplasms from Hamabantota District
Development of mandarin & Orange varieties through mutation
Development of high yielding good quality papaya varieties/hybrids
Breeder's seed production papaya (variety Rathna)
Hybrid seed production of papaya (Horana Papaya Hybrid -1)
Development of high yielding good quality durian varieties through hybridization.
Development of high yielding good quality Rambutan varieties through induced mutation
Selection and development of high yielding Rambutan varieties
Establishment of Avocado gene Bank for selection of high yielding, good quality varieties
Development of new hybrids through interspecific hybridization with in a family (Passifloraceae, Annonaceae & Bromeliaceae)
Development of Passion fruit varieties through hybridization and varietal selection
Studying inheritance of self-compatibility and Passion fruit mottle virus resistant in Passion fruit.
Characterization of flowering behavior and floral biology of Beili (<i>Aeglemarmelos</i>), Wax apple (<i>Syzygiumsamarangense</i>), Ceylon olive (<i>Elaeocarpusserratus</i>), Soursop (<i>Annonamuricata</i>), sapodilla (<i>Manilkarazapota</i>) for improvement of productivity and quality.
Development of Longan varieties with high yielding and good quality
Development of seedless/less seeded Guava variety
Development of Annona varieties with high yield and good quality.
Collection, Evaluation, Characterization & Selection of Beli (<i>Aeglemarmelos</i>) Germplasm
Study the floral biology & Flowering behavior of Beli (<i>Aeglemarmelos</i>)
Evaluation of Salak / snake fruit (<i>Salacczalacca</i>) varieties.
Identification and selection of potential crops / varieties (Almond, Wal Del, and Kos del) for nut purpose
Collection, evaluation and selection of Gaduguda (<i>Baccaureamotleyana</i>)

Development of new varieties of Guava, Annona and Sapota through mutation breeding
Development of high yielding good quality Jamun, Ceylon olive, bale fruit, Aonla and Nam nam varieties
Development of high yielding good quality durian varieties for commercial cultivation
Collection, evaluation, conservation, characterization & selection of local accessions
Development of high yielding good quality fruit varieties through mutation (Mangosteen, Bell)
2. Agronomy
Improvement of the yield and quality of banana (Musa spp.) Var. MillewaSuwandel by some specific management practices
Study the behavioral changes of reproductive and productivity parameters of major fruit crops, under a changing and variable climate in different agro-ecological regions in Sri Lanka
Technological intervention to improve production and productivity of selected fruit crops (Citrus)
Technological intervention to improve production and productivity of selected fruits (Strawberry)
Testing of different root stock on controlling root knot nematode and growth and yield of Guava
Effect of pre-seed treatments on Ceylon olive (<i>Elaeocarpus serratus</i>) to reduce time taken for seed germination and germination percentage.
Effect of stargooseberry (Rata nelli) as a root stock on grafting Aonla (<i>Phyllanthus emblica</i>) for the propagation of Aonla
Evaluation of different budding methods compared to wedge grafting for sour sop (<i>Annona muricata</i>)
Evaluation of vegetative propagation methods for the planting material production of Nam nam (<i>Cynometra cauliflora</i>)
Evaluation of the cultivation possibility of promising underutilized fruit crops in containers
Ex-situ evaluation of promising accessions of existing underutilized fruit species under field conditions
Testing of different chemicals for flower initiation and fruit retention of Rambutan
Testing different IAA concentrations for improvement of fruit retention in Mango cultivars under wet zone
Effect of stem diameter of root stock & maturity status of scion on success of wedge grafting of Annona
Effect of 4 different suckers on quality & planting material production of pineapple
3. Soil Management
Use of biopore infiltration technique to reduce disorder in Mangosteen
Identification of nutrient management practices to enhance quality & quantity of watermelon
Identification of agronomic practices to control yellow sap disorder & translucent disorder in mangosteen
Identification of critical N level for papaya
Effect of time & rate of application of Ca on yellow sap disorder & translucent disorder
Nutrient status of the soil in research fields of Fruit Research & Development Institute
Identification of nutrient management practices to enhance fruit quality & quantity of pineapple
Effect of different type of fertilizer on growth yield and quality of papaya
4. Tissue culture and Bio Technology
Development of <i>in vitro</i> techniques for healthy planting material production of Mandarin
Development of technologies for the production for virus-free planting material through propagation techniques for selected fruit crops (Papaya, Citrus, Pineapple- special variety)
Development of promising pomegranate lines through <i>in vitro</i> mutation induction
Optimization of Micro propagation protocol for DOA recommended Banana variety "Agra"
Identification and confirmation of phytoplasma diseases and their host range in cultivated crops
Study the effect of LED on growth and multiplication of TC plants
Confirmation of seed borne ability of phytoplasma
Micro propagation of DOA recommended banana var. MillewaSuwandel
Micro propagation of underutilized fruit crops (Masan, Mora)

Crop improvement through induced mutation in Banana
Production of planting materials using nodal culture from selected Pomegranate plants with good characters for promising lines
Production of new pineapple variety by using cross pollination and tissue culture technology
Production of tissue cultured hybrid papaya planting material using local hybrid seeds
Production of apple planting material using seed culture from imported fruits.
5. Entomology
Development of a protocol for trunk injection of pesticides as part of an IPM programme for controlling of Stem Borers in Mango and Durian
Enhancement of the Productivity of fruit crops by managing major pest problems
Testing of nematicides and other management practices for guava cultivation and nursery plants
Identification of causal factors for immature fruit drop in ridge gourd & give recommendations for the management (Farmer field evaluation in Colombo & Kalutara)
6. Plant Diseases
Development of control measures of commonly found post-harvest fruit-rot diseases of Avocado and Annona
Identification and management of virus and virus like diseases in chillie, cucurbits, and legumes in southern dry zone region in Sri Lanka
Potential use of soil antagonisms for successful management of panama diseases of banana caused by <i>Fusarium oxysporum f. sp.</i>
Management of root disease of perennial fruit trees through integrated approaches (specifically Jack Fruit)
Management of pineapple wilt virus (PWV) in pineapple with different fertilizers
Control of papaya ring spot virus (PRSV) in papaya through induced systemic resistance using Plant Growth promoting rhizobacteria (PGPR).
Use of natural and artificial antiviral compounds to manage papaya rings spot virus (PRSV) in papaya
7. Post Harvest and Food Technology
Regulation of fruit set and post-harvest life and investigation of the variability of bioactive compounds in edible <i>Annona muricata L.</i> accessions found in Sri Lanka
Development of a package to minimize post-harvest losses of selected fruit crops (Annona, Pineapple, Avocado, Passion fruit)
Increase shelf life of passion fruit using modified atmosphere storage
Production of a veg. sausage from jackfruit

Annex 3. Research program of the PVIC

Plant Virology

Production of polyclonal antiserum for chili VMV

Identification and management of virus and virus like diseases in cucurbits, legumes and chili in southern dry zone region.

Survey on occurrence of Ground nut bud necrosis virus (GNBV) in mungbean in third season.

Use of ecological engineering concept for management of viral disease in chili.

Management of pineapple wilt virus (PWV) in pineapple.

Molecular virology

Identification and confirmation of phytoplasma diseases and their strains in cultivated crops and other host plants.

Confirmation of seed borne ability of phytoplasma.

To identify the genetic diversity of *Fusarium Oxysporum f. sp. cubense* in kolikuttu banana.

Development of transgenic papaya through *Agrobacterium* mediated transformation. ...
Development of technologies for the production of virus free planting material through propagation technologies for selected fruit crops. (papaya, citrus and pineapple special varieties)

Tissue culture

Production of planting materials using nodal culture from selected pomegranate plants with good characters for promising lines.

Development of promising pomegranate lines through in vitro mutation induction and seed mutation induction using gamma radiation.

Production of new pineapple variety by using cross pollination and tissue culture technology.

Production of tissue cultured hybrid papaya planting material using hybrid seeds.

Micro propagation of department of agriculture recommended banana variety "Agra"

Creating new variants of exotic and local grape varieties through tissue culture technology for future varietal development.

Introduction of an effective and low cost lighting system for culture rooms.

Microbiology

Control of papaya ring spot virus (PRSV) in papaya through induced systemic resistance using plant growth promoting *Rhizobacteria* (PGPR)

Induced systemic resistance against chili viral mosaic virus in chili (Chi VMV) using *Pseudomonas fluorescens*.

Potential use of soil antagonisms for successful management of Panama disease in banana caused by *Fusarium Chrysosporium* f. sp. *cubense*.

Epidemiology

Enhancement of productivity of fruit crops by managing insects (Under food production National Program)

Development of package of practices for managing was scales in mango trees.

Development of a protocol for trunk injection of pesticides as a part of an integrated pest management program for controlling stem borers in Mango and Durian (NARP project)

Annex 4. Research Program- FCR&DS, Gannoruwa

1. Establishment avocado gene bank for selecting high yielding good quality varieties
2. Development of longan varieties for high quality and good quality
3. Development of high yielding and good quality Jamun, Ceylon Olive, Bale fruit, Aonla and Nam Nam
4. Study of the behavioral changes of reproductive and productivity parameters of major fruit crops under changing and variable climate in different agro-ecological regions of Sri Lanka
5. Testing of different rootstocks on root knot nematode and growth and yield of guava
6. Effect of pre-treatments on Ceylon Olive to reduce time taken for seed germination and germination percentage
7. Effect of star gooseberry (*Rata nelli*) as a root stock on grafting Aonla (*Phyllanthusembilica*) for the propagation of Aonla
8. Evaluation of different budding methods compared to wedge grafting for soursap (*Annonamuricata*)

9. Evaluation of the vegetative propagation methods for planting material production of Nam Nam
10. Evaluation of the cultivation possibility of promising underutilized fruit in containers
11. Ex-situ evaluation of promising accessions of existing underutilized fruit species under field conditions
12. Testing of different chemicals for flower initiation and fruit retention on of rambuttan

Annex 5. Annual Budgets of Sub stations

5.a. Annual Budget for PVIC, 2016)

5b. Annual Budget for FCR&DI, Gannoruwa

	Allocation	Expenditure	as%
Recurrent	5,077,384	4,246,530	84
Capital	2,075,000	1,662,999	80
Projects			
Fruit Village Development			
Establishment of demonstrations & research fruit orchards	500,000	474,432	95
Production of planting materials , Avocado, Anona	300,000	112,418	37
Special plant breeding project			
Selection of banana varieties	600,000	472,610	79
Development of longan varieties	700,000	675,000	96
NARP			
Development of durian varieties	400,000	395,090	99
Improvement of yield and quality of banana	200,000	191,495	96
Improvement of papaya varieties	769,000	626,731	82
Development of avocado	330,000	269,350	82
Food Production Program			
Effect of climate factors	4,000,000	1,478,698	39
Total	14,951,384	10,605,353	71

5c. Annual Budget for Horticulture Farm, Ambatenna

	Allocation	Expenditure	as %
Recurrent	776,850	714,615	92
Capital	575,000	430,635	75
Projects			
Fruit Village Program	1,000,000	904,607	90
Fruit Village Program	1,200,000	544,572	45
Total	3,551,850	2,594,429	74

5d. Annual Budget 2016 for Rambuttan Research Unit, Eraminigolla

	Allocation	Expenditure	as
%Recurrent	124,000	102,750	83
(Projects	323,000)		
Capital	300,000	300,000	100
Total	424,000	402,750	95

5e. Annual Budget 2016, NGCC, Kundasale To be Included

5f. Annual Budget, 2016

Agriculture research Station, Muthukandiya

Expenditure summary of Capital Allocations

Capital Allocations -

Vote number		Allocations	Extra allocations	Total Allocation	Expenditure	Expenditure %
2001	Maintenance of Building & Structures	200000	0	200000	197847	99
2002	Plant machinery & Equipments	50000	0	50000	49718.5	99
2003	Vehicle Repair	25000	0	25000	23750	95
2101	Vehicle		0	0	0	
2102	Furniture & Office equipment	50000	0	50000	49900	100
2103	Machinery	100000	0	100000	99880	100
2105	Land & Land Improvement	300000	0	300000	298870	100
2401	Training & Capacity Building		0	0	0	
Total		725000	0	725000	719965.5	99

Expenditure summary of Recurrent Allocations

Recurrent Allocations -

Vote number		Allocations	Extra allocations	Total Allocation	Expenditure	Expenditure %
1002	Overtime & Holiday pay	6850	0	6850	0	
1101	Traveling (Local)	5000	0	5000	0	
1201	Stationery	15000	0	15000	14074	94
1202	Fuel & Oil	30000	0	30000	30000	100
1205	Others	10000	0	10000	9995	100
1301	Vehicle Repair	0	0	0	0	
1302	Plant machinery & equipment	10000	0	10000	9851	99
1303	Building & Maintenance	40000	0	40000	39965	100
1402	Postage & telecommunication	15000	0	15000	9861.33	66
1403	Electricity & Water	40000	0	40000	39576.81	99
1405	Others	5000	6152.17	11152.17	11152.17	100
Total		176850	6152.17	183002.17	164475.31	90

Projects

Project	Allocation	Expenditure	Expenditure %
Fruit village	500,000.00	483260.04	
Fruit orchard	500000	469396.95	

5g. Annual Budget, 2016

Citrus Research Station, Bibila
Expenditure summary of Capital Allocations

Capital Allocations -

Vote number		Allocations	Total Allocation	Expenditure	Expenditure %
2001	Maintenance of Building & Structures	200000.00	200000.00	120670.00	60
2002	plant machinery & Equipment	50000.00	50000.00	0.00	0
2003	Vehicle Repairs	25000.00	25000.00	0.00	0
2101	Vehicle	0.00	0.00	0.00	
2102	Furniture & Office equipment	50000.00	50000.00	33500.00	67
2103	Machinery	100000.00	100000.00	46500.00	47
2105	Land & Land Improvement	300000.00	300000.00	289945.00	97
2401	Training & Capacity Building	0.00	0.00	0.00	
Total		725000.00	725000.00	490615.00	68

Expenditure summary of Recurrent Allocations

Recurrent Allocations -

Vote number		Allocations	Total Allocation	Expenditure	Expenditure %
1002	Overtime & Holiday pay	0.00	0.00	0.00	
1101	Traveling (Local)	5000.00	5000.00	5000.00	100
1201	Stationery	15000.00	15000.00	16673.00	111
1202	Fuel & Oil	30000.00	30000.00	26165.00	87
1205	Others	10000.00	10000.00	10145.00	101
1301	Vehicle Repairs	10000.00	10000.00	12336.00	123
1302	Plant machinery & equipment	10000.00	10000.00	12750.00	128
1303	Building & Maintenance	30000.00	30000.00	32646.00	109
1402	Postage & telecommunication	15000.00	15000.00	9871.90	66
1403	Electricity & Water	40000.00	40000.00	32967.90	82
1405	Others	5000.00	5000.00	11152.17	223
Total		170000.00	170000.00	169706.97	100

Projects

Project	Allocation	Expenditure	Expenditure %
Fruit village	1,200,000.00	1003803.23	84
Fruit orchard	500000	495972.25	99
National food production programme	1,400,000.00	1346435.00	96

5h. Annual Budget, 2016 Agriculture research Station, Madurukatiya

Expenditure summary of Capital Allocations

Capital Allocations -

Vote number		Allocations	Extra allocations	Total Allocation	Expenditure	Expenditure %
2001	Maintenance of Building & Structures	300000.00	0.00	300000.00	171700.75	57
2002	plant machinery & Equipment	100000.00	11500.00	111500.00	111230.00	100
2003	Vehicle Repairs	200000.00	0.00	200000.00	193910.00	97
2101	Vehicle	0.00	0.00	0.00	0.00	
2102	Furniture & Office equipment	50000.00	0.00	50000.00	49340.00	99
2103	Machinery	100000.00	0.00	100000.00	83860.00	84
2105	Land & Land Improvement	400000.00	0.00	400000.00	182700.00	46
2401	Training & Capacity Building	0.00	0.00	0.00	0.00	
Total		1150000.00	11500.00	1161500.00	792740.75	68

Expenditure summary of Recurrent Allocations
 Recurrent Allocations -

Vote number		Allocations	Extra allocations	Total Allocation	Expenditure	Expenditure %
1002	Overtime & Holiday pay	35000.00	0.00	35000.00	32100.00	92
1101	Traveling (Local)	20000.00	20557.50	40557.50	40557.50	100
1201	Stationery	30000.00	0.00	30000.00	26300.00	88
1202	Fuel & Oil	50000.00	0.00	50000.00	35000.00	70
1205	Others	20000.00	0.00	20000.00	18956.00	95
1301	Vehicle Repairs	130000.00	0.00	130000.00	129411.56	100
1302	Plant machinery & equipment	15000.00	0.00	15000.00	2997.50	20
1303	Building & Maintenance	40000.00	0.00	40000.00	35345.00	88
1402	Postage & telecommunication	25000.00	0.00	25000.00	26379.81	106
1403	Electricity & Water	75000.00	0.00	75000.00	63591.54	85
1405	Others	10000.00	0.00	10000.00	10000.00	100
Total		480000.00	20557.50	470557.50	420638.91	89

Projects

Project	Allocation	Expenditure	Expenditure %
Fruit village	800,000	786301.74	98
Fruit orchard	500,000	496068.58	99
National food production programme	500,000	424142.75	85

Capital Allocations -

Vote number		Allocations	Extra allocations	Total Allocation	Expenditure
2001	Maintenance of Building & Structures	200000.00	0.00	200000.00	120670.00
2002	plant machinery & Equipment	50000.00		50000.00	0.00
2003	Vehicle Repair	25000.00	0.00	25000.00	0.00
2101	Vehicle	0.00	0.00	0.00	0.00
2102	Furniture & Office equipment	50000.00	0.00	50000.00	33500.00
2103	Machinery	100000.00	0.00	100000.00	46500.00
2105	Land & Land Improvement	300000.00	0.00	300000.00	289945.00
2401	Training & Capacity Building	0.00	0.00	0.00	0.00
Total		725000.00	0.00	725000.00	490615.00

Expenditure summary of Recurrent Allocations

Recurrent Allocations -

Vote number		Allocations	Extra allocations	Total Allocation	Expenditure
1002	Overtime & Holiday pay	0.00	0.00	0.00	0.00
1101	Traveling (Local)	5000.00	0.00	5000.00	5000.00
1201	Stationery	15000.00	0.00	15000.00	16673.00
1202	Fuel & Oil	30000.00	0.00	30000.00	26165.00
1205	Others	10000.00	0.00	10000.00	10145.00
1301	Vehicle repair	10000.00	0.00	10000.00	12336.00
1302	Plant machinery & equipment	10000.00	0.00	10000.00	12750.00
1303	Building & Maintenance	30000.00	0.00	30000.00	32646.00
1402	Postage & telecommunication	15000.00	0.00	15000.00	9871.9
1403	Electricity & Water	40000.00	0.00	40000.00	3296
1405	Others	5000.00	0.00	5000.00	
Total		170000.00	0.00	170000.00	

Projects

Project	Allocation	Expenditure	Expenditure °
Fruit village	#####	1003803.23	
Fruit orchard	500000	495972.25	
National food production programme	#####	1346435.00	