REPORT ON PERFORMANCE REVIEW OF RICE RESEARCH AND DEVELOPMENT INSTITUTE BATALAGODA, SRI LANKA

12th, 13th, 19th September and 17th October, 2017

National Science and Technology Commission
Ministry of Science, Technology and Research
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The Review Team

1. **Professor S J B A Jayasekera (Chairman)**
   Senior Professor of Horticulture
   Department of Horticulture and Landscape Gardening
   Faculty of Agriculture and Plantation Management
   Wayamba University of Sri Lanka
   Makandura Gonawila (NWP)

2. **Professor J M R S Bandara (Member)**
   Environmental and Life sciences,
   Faculty of Science
   University of Brunei, Darussalam
   Former Senior Professor of Agric. Biology Department of Agric. Biology
   University of Peradeniya
   Peradeniya, Sri Lanka

3. **Professor R B Mapa (Member)**
   Professor Emeritus
   University of Peradeniya
   Peradeniya, Sri Lanka

4. **Dr. D S P Kuruppuarachchi (Member)**
   Head, Department of Biosystems Engineering
   Faculty of Agriculture and Plantation Management
   Wayamba University of Sri Lanka
   Makandura Gonawila (NWP)

Abbreviations

ADA	Assistant Director of Agriculture
AFACI	Asian Food & Agriculture Cooperation Initiative
BOD	Board of Directors
BR	Breeders' Rights
CARP	Council for Agricultural Research Policy
CEO	Chief Executive Officer
DDR	Deputy Director (Research)
DOA	Department of Agriculture
DSSAT	Decision Support System for Agrotechnology Transfer
ERP	Eppawala Rock Phosphate
GIS	Geographic Information System
HARTI	Hector Kobbekaduwa Agriculture Research and Training Institute
HRM	Human Resources Management
IAEA	International Atomic Energy Authority
IPR	Intellectual Property Rights
IRRI	International Rice Research Institute
ISI	International Science Index
KOPIA	Korea Project on International Agriculture
LCWZ	Low Country Wet Zone
M&E	Monitoring and Evaluation
MIS	Management Information System
NASTEC	National Science and Technology Commission
NRC	National Research Council
NRMC	Natural Resources Management Center
NSF	National Science Foundation
PA	Program Assistant
PAS	Principal Agricultural Scientist
PDOA	Provincial Department of Agriculture
PGIA	Postgraduate Institute of Agriculture
PGRC	Plant Genetic Resources Center
PTWG	Provincial Technical Working Group
R&D	Research and Development
RRDI	Rice Research and Development Institute
RRRDC	Regional Rice Research and Development Institute
RRS	Regional Research Station
S&T	Science and Technology
SMA	State Management Assistant
SPMDC	Seed and Planting Material Development Center
TSP	Triple Super Phosphate

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1. Introduction

The Rice Research and Development Institute (RRDI) was established in 1952 as the Central Rice Breeding Station under the Department of Agriculture with a mandate to develop high yielding rice varieties with multiple resistance to major biotic and abiotic stresses. The Central Rice Breeding Station was upgraded as the Rice Research and Development Institute (RRDI) and entrusted with the multidisciplinary approach in all aspects of rice research and development with special emphasis on variety development, with the restructuring of the Department of Agriculture (DOA) in 1994. The main research and administration unit of RRDI is located at Batalagoda in Kurunegala district.

The seven satellite stations of RRDI are Regional Rice Research and Development Center (RRRDC) Bombuwela, Rice Research Stations (RRS) at Bentota, Ambalantota, Labuduwa, Sammanthurai, Paranthan and Murunkan (Annex. 1). RRRDC Bombuwala was originally established in 1952 as a research unit to cater to the needs of problem soils in the Wet zone. In 1977, this center was upgraded to a Regional Agricultural Research Centre. In 2002, it was further upgraded to RRRDC to develop varieties and associated technologies exclusively for rice and act as an outreach station of RRDI.

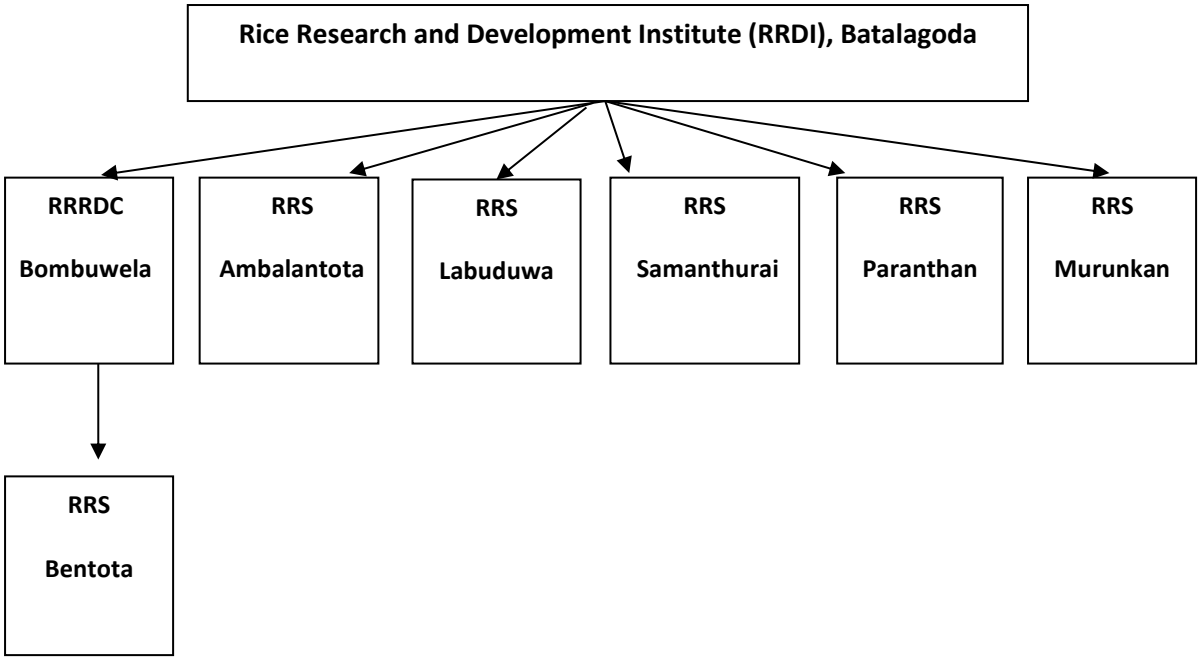
The Director, Rice Research and Development Institute is responsible for overall research and development of the rice sector. The Deputy Directors of Research at Batalagoda, Bombuwela and Ambalantota, and Assistant Directors of Agriculture in charge at RRSs in Bentota, Labuduwa, Sammanthurai, Paranthan and Murunkan are responsible for the research and administrative functions at their respective centers/stations. The head quarter at Batalagoda is responsible for the development of rice varieties and associated technologies for Dry and Intermediate zones. The Regional Agricultural Research and Development Center, Bombuwela has the mandate to develop high yielding both red and white varieties particularly tolerant to iron toxicity and associated technologies for Low Country Wet Zone (LCWZ) problem soils and ecosystems. Labuduwa and Bentota stations also cater to the needs of the LCWZ. RRS Labuduwa is required to develop rice varieties suitable for soils of the LCWZ. RRS, Bentota is responsible for the identification of adaptable rice varieties and associated technologies for flood prone rice-eco systems. Rice Research Station, Ambalantota holds the responsibility for the development of high yielding short age varieties, salinity tolerant varieties and associated technologies, with special emphasis on red pericarp varieties. The Rice Research Station, Sammanthurai, Paranthan and Murunkan conduct field testing of new varieties and associated technologies of the rice eco systems in the respective regions.

The headquarters of RRDI at Batalagoda, formulate and implement the national rice research program with the assistance of sub-stations established for specific tasks. One of the major objectives is to help farmers to improve their productivity, farm income to enable them to alleviate poverty. Following are the main thrust areas undertaken.

a) Breeding of new rice varieties adaptable to varying Agro-ecological zones (incorporation of major biotic and abiotic tolerance/resistance into new varieties)
b) Generation of new technologies to exploit maximum productivity from new improved varieties with minimum cost and drudgery
c) Dissemination of information and technologies to field officers, trainee students, and farmers
d) Production of basic and breeders' seeds of recommended varieties
e) Liaise with international institutes working on rice research and development

f) Coordinate with inter-provincial and provincial extension officers on dissemination of technologies and varieties
g) Serve as a training/resource center for agricultural students from universities, technical colleges, schools of agriculture, and even for school children
h) Liaise with other divisions of DOA, especially, Seed Certification Service, Plant Protection, Seeds and Planting Material Development Center (SPMDC), Plant Genetic Resources Center (PGRC), Natural Resources Management Center (NRMC), Plant quarantine etc.
i) Coordinate with private sector agencies handling agrochemicals, plant machineries, fertilizers and other production inputs with the objective of providing farmers with reliable and genuine inputs

Organizational Chart of RRDI



Scope of RRDI and its Substations:

RRDI, Batalagoda: Multidisciplinary approach in all aspects of rice research and development with special emphasis on variety development

RRRDC, Bombuwela: Develop high yielding, both red and white varieties particularly tolerant to iron toxicity and associated technologies to LCWZ problem soil ecosystems

RRS, Bentota: Identify adaptable varieties and associated technologies for the flood prone rice ecosystem

RRS, Ambalantota: Development of high yielding short aged varieties, salinity tolerant varieties and associated technologies, with special emphasis to red pericarp rice

RRS, Labuduwa: Develop rice varieties and associated technologies for mineral soils of LCWZ

RRS, Samanturai: Develop rice production technologies for the rice ecosystems in the Eastern region

RRS, Paranthan: Field testing of new varieties and proven technologies for Northern irrigated rice systems and *manawari* rice system

RRS, Murunkan: Field testing of new varieties and proven technologies in the irrigated rice eco system with special reference to Grumsols

2. Purpose of Review

The main purposes of this review were,

a. To obtain information on how to improve activities of the institute.
b. To induce a self-reflection by the scientists on the results and outcomes of science and technology (S&T) activities, the way they are performed leading to strategic orientation towards the desired goals.
c. To assess effectiveness of the activities.
d. To encourage good management of S&T in the institute.
e. To improve internal and external transparency.
f. To recommend future resource commitments.
g. To gather information for policy change.
h. To inform the stakeholders about the institutional competencies

3. Procedure Adopted for Performance Review

The 'Science & Technology Development Act No. 11 of 1994' mandates the National Science and Technology Commission to review the progress of S&T institutions in relation to objects set out in Section 2 of the Act. The NASTEC in consultation with the Rice Research and Development Institute, Batalagoda (RRDI), decided on a schedule for the review. This was followed by NASTEC requesting a Self-Assessment Report from the Chief Executive Officer (CEO) of the Institute. The format for the Self-Assessment Report was provided to the institute.

A review team comprising of 4 members, identified by NASTEC in consultation with the RRDI were formally appointed to review the progress of the institute. The team was guided by the directions given in the guidelines for the review of S & T Institutions (Section 7).

The review process had 4 distinctive phases as below.

1. Preparation for review
2. Visits of review team to the institute
3. Meeting with the stakeholders
4. Preparation of draft report by Review Team
5. Preparation and submission of the final review report by the Review Team to NASTEC

A. Preparation for the review

1. After identification of the institute to be reviewed, NASTEC forwarded a copy of the format of Self–Assessment report to the relevant CEO (Director, RRDI).

2. The institute completed the Self–Assessment Report and submitted to NASTEC.

3. NASTEC and the institution agreed on the composition of the review panel identified from the pool of trained reviewers and appointed them.

4. Copies of Self-Assessment Report were sent to the members of the Review Team to study.

5. Director, NASTEC met the Review team and the CEO of the institution to be reviewed, separately, in advance of the visit to the institute, to identify lines of inquiry and further information and documentation they need during the review visits. The team also identified individuals and groups they wish to meet during the visit and agreed with the CEO on dates and time schedule for the review visits. The dates were as follows:

   12th and 13th, September, 2017 - Visit to RRDI, Batalagoda (Assistant Directors from Smanthurai and Paranthan were present representing their stations)
   19th September, 2017 - Visit to RRDC, Bombuwela (DDR from Ambalantota, Assistant Directors from Labuduwa and Bentota were present representing their stations)

17th October, 2017 - Meeting with the stakeholders (at HARTI, Colombo)

B. Visit of Review Team to the Institute

i. Initial meeting of review team with the Director (CEO) and a group of representative staff was held for a briefing by the Review Team and Director regarding the objectives of the review, clarifying why and for whom the evaluation is being done, describing the benefits to the institute and cultivating rapport and support for the evaluation.

ii. A presentation was made by the Director of the RRDI on management, operation, organization, major scientific activities of the institution and contributions to national development.

iii. Verification of the judgments was done in the institute's self-evaluation report by the review team through following methods.

a) Visiting divisions, laboratories , workshops, fields, training center and farms
b) Discussions were held with members of different categories of staff (scientific staff, technical staff, administrative staff, training staff, finance staff, farm staff and clients who obtain services of the institution and other relevant stakeholders.)
c) The uses of multiple methods and crosschecking or 'triangulating' the results were adopted during the review. Triangulation refers to the use of different information sources, methods, types of data, or evaluators to study an issue from different perspectives and thereby arriving at more reliable findings.
d) Studying the supporting documents submitted by the officers of the institute
e) Discussions were held from time to time among members of the team on the overall observation, findings and conclusions before preparation of the final report.

4. Management Assessment

a) Institutional response to external and internal environment in planning organizational strategy:

RRDI, being a government institute directly administered by the Department of Agriculture (DOA), it is the responsibility of the institute to follow government policies and development goals already in place. The Director of the Institute is a member of the Board of Directors (BOD) of the DOA and attends meetings regularly to discuss and take necessary actions and decisions in planning and implementation of the research and development activities of the institute. Further, the mandate of the institute is clear to all and is responsive to changes in government policies and strategies. The institute has identified its own strengths, weaknesses, opportunities and threats and they are being always considered in planning out the activities of the institute in consultation with BOD (Annex. 2). The Director and the divisional heads will be involved in planning activities of the institute. However, the stakeholders do not get involved in setting up strategic plans of the institute. Over 90% of the funding for the institute is allocated from the treasury funds and less than 10% is obtained from donors. Donor funds mostly come through research projects handled by the researchers and the amounts may vary from year to year depending on the nature of the project. The International Rice Research Institute (IRRI) and several other international organizations too, provide funds for rice research (Annex. 3). It was observed that government allocations for capital items had been declining and part of the requirements were fulfilled by using the project funds. Neither a strategic plan nor an action plan of the institute was available at the institute. Even though these plans were not available at the institute in a documented form, the review team was made to understand that the technological strategies and thrust areas had been identified by the Director, Additional Director, Deputy Directors and all the Research Officers in rice research sector at a meeting held on 22-23, September, 2015 at RRDI, Bathalagoda. Further, the institute had not been reviewed previously. Present review is the first review of RRDI, which is conducted by an independent body.

Assessment of Institutional Response to External and Internal Environment in Planning Organizational Strategy

Management practices	Level of Practice (Performance Indicators) Strong/ Moderate/ Weak	Comments / Evidence
Government policies and development goals are used/ considered to establish goals and plan organizational strategy for the institution	*Moderate*	*Government policies are changing often with short notice. No indication how government policy and development goals incorporated to rice breeding programs – issues such as how much brown rice needed?*
The organizational mandate (as specified by the relevant Act) is considered in strategic planning	*Weak*	*No strategic plan developed for the institute*
The institution is responsive to changes in Government policies and strategies	*Strong*	*Whenever, the relevant government policies are conveyed to them they have responded*
Factors such as strengths, weaknesses, threats and opportunities are considered in strategic planning	*Moderate*	*The weaknesses and threats as lack of research officers, training opportunities not considered. Only the strengths and opportunities considered*
Stakeholders needs are taken into consideration in strategic planning	*Weak*	*No link to consider stake holder requirements. After decentralization of extension services, these links with farmers through extension workers are weakened and no opportunity to get private sector needs in planning*
The Board of Directors is involved in strategic planning	*Moderate*	*No strategic plan developed for the institute and no evidence of BOD involvement available*
The extent to which staff members are involved in strategic planning	*Moderate*	*The priorities are decided at the staff meetings (among Heads of Departments) and carries to PTWG meetings for ratification. The mechanism for sub-stations is not so strong*

Government allocations and alternative funding opportunities (donor funding) are considered in strategic planning	*Strong*	*Good planning to use alternate funding when government funds are lacking. But when projects end, funding too ends and continuation of project activities suffers. Although there is potential to generate funding by the institute financial procedures adopted by DOA prevents it.*
The extent to which policies and plans of the organization are reviewed and updated	*Moderate*	*No evidence to show updating in policies. It is the high yielding varieties still targeted, and not the stakeholders' needs especially nutritional quality of grains.*

b) Planning S&T programs and setting priorities:

The BOD of DOA considers the national development goals when planning S&T programs and setting up priorities. The decisions are taken at both Ministerial and Departmental levels. The Director and the Heads of Substations and Divisions take the responsibility in program planning in line with Ministerial and Departmental decisions. Having its substations scattered throughout the country, the Heads of substations take a heavy burden in deciding priorities for their regions. When priorities are discussed and decided, the inputs from stakeholders take into consideration on *ad hoc* basis but it is not a regular phenomenon. During the planning stage, requirement of funds and equipment are considered and all measures are taken to request necessary amounts. As a principle, the institute does not generate funds and service oriented in all the activities performed.

As institute has not been reviewed before, there had not been any participation of stakeholders in the review process. When planning programs, the ultimate objective is to develop rice varieties and technologies that can be given to the stakeholders (principal stakeholder is the farmer and there are many others). Hence, once a recommendation is developed and proved to be acceptable and economical to the stakeholder, it needs to be commercialized quickly. However, acceptance of new technology is a slow process as the present extension programs do not provide sufficiently efficient service to make them popular quickly and enhance acceptance level. (The institute depends on provincial extension services which are not under the administrative control of DOA, for feedback and outreach). The efficiency of the institutional procedure in approving new S&T programs is moderately effective.

Assessment of Planning S & T programs and setting priorities

Management practices	Level of Practice Strong/ Moderate/ Weak	Comments/ Evidence
National development goals are considered in planning programs & setting priorities	*Moderate*	*Not much evidence to show*
Board of Governors participate in planning and priority setting of program	*Moderate*	*The Director of the institute has a say in priority settings*
The extent to which the staff of the institution participate in programme planning and priority setting	*Moderate*	*The ROs participate in these meetings but not many of these are given priority (it could be closely linked to the fact that the strength of the PhD level trained staff available in the institute is less (03!).*
Stakeholder interests are considered in programme planning	*Weak*	*No evidence to show stake holders other than farmers' ideas (through extension officers). No private sector participation*
The extent to which programmes are planned and approved through appropriate procedures	*Moderate*	*Projects are approved at respective commodity/discipline working groups*
The extent to which the availability of funds (government allocations and other funds) generating funds are taken into consideration in planning programmes	*Moderate*	*Government allocations and other funds considered in planning programmes, but generated funds are not considered mostly due to lack of mechanism in using funds thus generated.*
Obtaining of necessary equipment is considered in planning programmes	*Moderate*	*It is considered but not adequate. More emphasis should be given as rice is the staple food*
Stakeholders are represented in the institution's planning and review committees.	*Moderate*	*Public stakeholders are considered but not from the private sector*
The extent to which socio economic and commercialization of aspects are considered in programme planning.	*Weak*	*The mandate do not allow for commercialization. The Director has the access to socioeconomic information that are provided by the Agri-Economics Division.*
Effectiveness and efficiency of institutional procedures in approving new S&T programmes.	*Moderate*	*There is room for improvement in approval procedures*

c) Planning S&T/R&D projects:

Part of the planning of R&D projects derived from identified thrust areas and the rest from the extension through Provincial Technical Working Group (PTWG) discussions held twice a year (for *yala* and *maha*). At these PTWG meetings, the requirements and problems of stakeholders (mainly farmers) in relation to rice research and production are discussed in detail and research projects are planned accordingly. These are mostly short term projects, only few long and medium term projects are discussed. Further, the departmental working groups discuss, prioritize and decide on individual projects. The requirements may be proposed by different groups and depending on the type and the problem, to arrive at a solution or a recommendation may take little more time. At this stage, multidisciplinary approach is followed and researchers of different specializations work together in achieving a common goal. Though majority of researcher's carryout applied research, there are a few who work on basic research. The projects are carried out on many different disciplines such as, breeding, pathology, entomology, soil and plant nutrition management, climate change, irrigation, etc. The review team was informed that, all rice researchers in the DOA meet twice a year at Program Discussion Meetings, prior to cultivation seasons, and discuss the progress of projects and intended research programs. Further these are also discussed at multi-disciplinary working group meetings (discussed along with other crops) conducted by the DOA. Research priorities published by the CARP are also being taken in to consideration when planning the projects. Formation of formal committees or establishment of research clusters would help to plan and implement individual projects efficiently and allocate resources effectively.

Assessment of Planning S& T / R& D Projects

Management practice	**Level of Practice**	**Comments/ Evidence**
	Strong/ Moderate/ Weak	
The staff is provided with guidance for project planning	*Weak*	*No indication of any workshops or training programs on project planning. None of the staff is trained in research management.*
Previous research results/data are used for planning projects	*Moderate*	*This is considered at PTWG meetings and Program Discussion Meetings level*
The extent to which the institution follows a formal process for preparation, review and approval of projects	*Moderate*	*Considered at the Heads of Department meetings, PTWG meetings and Program Discussion Meetings. Not clear how much influence each research officer has in this regard.*

The extent to which organizational plans (e.g. medium-term plan, corporate plan, strategy etc.) are used to guide project selection and planning	*Moderate*	*These plans change from time to time at short notice and difficult to keep track*
Multidisciplinary projects/ activities are encouraged by the institutions	*Moderate*	*When a new variety is introduced it is not only the plant breeder but others also participate to see its performance. But no recognition to the team but only to breeder. Not much inter-institute projects.*
Foreign collaborations are encouraged and incorporated in planning.	*Weak*	*Not much consideration given*
Partnership with private sector is encouraged by the institution	*Weak*	*Not much consideration given may be due to the "closed nature" of the national policies adopted by the DOA*
The extent to which development research/activities are considered in planning projects	*Moderate*	*At present there is no sufficient mechanisms to incorporate views of the stakeholders*
The extent to which basic research are considered when planning projects	*Strong*	*Basic research is considered adequately*
The degree to which adverse effects on environment are considered in planning projects	*Strong*	*Recent pest and disease problems, effects of climate changes, soil related problems etc. are considered*

d) Project management and maintenance of quality:

Project management and quality assurance aspects of the institute can be categorized as moderate. The effectiveness of administrative procedures, governed by the head office of the DOA, found to be strong. However there are areas such as resource allocation at different levels, availability of equipment, technical staff, capacity building and infrastructure facilities are not at optimum level in RRDI and other substations.

Furthermore, there is a shortage of research officers trained at PhD level. At each division/discipline there should be at least one research officer trained at PhD level. The support staff also lacks training and updating on new techniques and equipment handling. Program reviews and discussions are held from time to time. Every effort is been taken to complete projects on time as scheduled. However, due to above mentioned factors and insufficient availability of facilities to access scientific literature, data bases, journals and other electronic material through internet, and printed information, the projects have suffered to a certain extent. Present international links among institutes and scientists rest mostly with IRRI. It would be advisable to seek broader scientific linkages among national and international universities and research institutes in planning and implementation of R&D.

Assessment of Project management and maintenance of quality

Management Practices	**Level of Practice** **Strong/ Moderate/ Weak**	**Comments/ Evidence**
The effectiveness of the procedures for resource allocation at different levels (organization, departments, program etc.)	*Moderate*	*Need more attention in resource allocation at organizational level*
Ensuring that instruments, equipment and infrastructure facilities are sufficient for implementation of projects	*Weak*	*Improvement in instruments, equipment and infrastructure facilities needed*
The effectiveness of administrative procedures and support for project implementation (procurement and distribution of equipment and materials, transport arrangements, etc.)	*Strong*	*Procedures are in place and funds from both local and external funding sources are used for transport and consumables*
Formal monitoring and review processes are used to direct projects towards achievement of objectives	*Weak*	*No meetings to assess final outcomes and no rewards as seniority is the main criteria for promotions*
The extent to which the researchers are supported by the required technical / field staff.	*Strong*	*The available support staff gives strong support but the numbers are not sufficient and their knowledge should be updated by allowing them to participate in training programs*

Ensuring that established field / lab methods, and appropriate protocols are used	*Strong*	*The standard laboratory methods and protocols are used.*
Research projects/ S& T activities are completed within the planned time frame.	*Moderate*	*Some projects are extended due to reasons beyond control as climatic factors*.
Ensuring that scientists / researchers have access to adequate scientific information (scientific journals, internet, international databases, advanced research institutes, universities etc.) that strengthens the quality of research.	*Weak*	*No adequate internet facilities and access to scientific information No access to current research publications.*
The extent to which quality assurance practices are followed by the institutions	*Moderate*	*No formal system in place*
Ensuring that researchers/ scientists have access to computers and necessary software	*Weak*	*Access to computers and necessary software not adequate*

e) Human resource management:

The institute does not recruit staff directly (for all permanent carders). All recruitments are done by the Head Office of the DOA and sent to each institute. Even the transfers of permanent carders are done in a similar manner, by the Head Office. Director of the institute has no authority or power to recruit or transfer any staff member. Within the past three years three senior officers heading research on breeding, Soil & Nutrition and Weed science were retired and few others got transfers out without replacements creating a huge vacuum. This has created a serious problem within the institute as no recruitments were done during the past year or two. It has resulted in shortage of staff in all categories as many carder vacancies exist in the institute. Further, training of staff and retaining them have become a serious problem, as the available opportunities for training are little. The Human Resources Management (HRM) aspect of the institute is not strong but can be identified as moderate. The selection procedure for training is based on seniority and/or subject oriented. However, most of the officers are nominated by the Head Office. The working environment is maintained reasonably well and staff is provided with moderate facilities. Absenteeism is not a serious problem in the institute. Staff performance appraisals have not been conducted in the past. There is no formal system for such appraisal established in the institute. It was evident that when officers go on leave (overseas, maternity etc.), retirement and transfers no prompt action is taken to appoint suitable people to continue the work and therefore, the whole division suffers.

Assessment of Human Resource Management

Management Practices	**Level of Practice** **Strong/ Moderate/ Weak**	**Comments/ Evidence**
The institution maintains and updates staff information in a database (including bio data, disciplines, experience, publications, projects)	*Moderate*	*Need to identify the staff vacancies to keep the head office pressed to fill the vacancies by new recruits or by transfers*
The institution, plans and updates its staff recruitments based on programme and project needs	*Moderate*	*The need to identify the importance of Food Science and Technology division*
The effectiveness of the selection procedures and the schemes of recruitment	*Moderate*	*The Director to have a say in selection of candidates specialized in the areas required.*
Training is based on institution and program objectives and on merit,	*Moderate*	*Need to consider the merit also in selecting for training programs*
The effectiveness of the procedures in promoting a good working environment and maintaining high staff morale.	*Moderate*	*Merit should come in as a parameter when making promotions etc.*
The effectiveness of staff performance appraisals	*Moderate*	*Need to establish a formal procedure for staff performance appraisal*
The effectiveness of rewards and incentive schemes in motivating the staff	*Moderate*	*Need to develop an award scheme to recognize the officers, other than waiting for ASDA to recognize them*
The effectiveness of managing staff turnover, absenteeism and work interruptions.	*Moderate*	*Need to assure continuation when staff goes on long leave.*

f) Management of organizational assets:

The ability of the institution to carry out its mandate is well recognized and equipped with necessary background, support and powers. The RRDI has become a leading rice research institute in the Asian region and well recognized by the researchers and experts in the rice growing countries. It was possible to earn that recognition through delivery of goods not only within Sri Lanka but also to the farmers in other rice growing countries in Asia and Africa. However, the other assets such as buildings, roads, housing, laboratories, fields, equipment, etc. need to be upgraded and improved. Some substations have been provided with funds for improvement of infrastructure, while some have not been provided sufficient funds for development of infrastructure.

Steps have not been taken to protect Intellectual Property Rights (IPR) or Breeder's rights (BR). Though the institute has produced many rice varieties that are already been cultivated by the farmers in Sri Lanka and elsewhere, IPR or BR have not been obtained by the authorities of the DOA. Seeds of some varieties have even been given to private sector for them to multiply and sell to the farmers with a bigger profit margin.

Income generation is not a mandate of the institute. Therefore, funds are not generated (or no programs are designed to generate income) at the institute. Whatever the funds collected is mostly to cover the actual costs of such programs especially for residential training programs.

Assessment of Management of organizational assets

Management Practices	**Level of Practice** **Strong/ Moderate/ Weak**	**Comments/Evidence**
The ability of the institution to carry out its mandate and the assigned statutory powers	*Strong*	*Institute should be given more autonomy*
Infrastructure (buildings, stations, fields, roads) is satisfactorily maintained.	*Strong*	*In the main station, but not adequate in sub-stations*
Vehicles and equipment (lab, field, and office) are properly managed and maintained.	*Strong*	*The fuel requirements mostly met by research projects with external funding*
The effectiveness of procedures to ensure that equipment are in working order	*Moderate*	*Repairs for the equipment takes time, training is needed for technical staff on maintenance and minor repairs*

The effectiveness of the institution's overall strategy in generation and proper utilization of funds	*Moderate*	*Utilizing funds allocated is good but no incentive for fund generation as the institute cannot use such funds*
The extent to which the institution identifies opportunities for income generation and cost recovery	*Weak*	*Income generation has no direct benefit to the institute as those cannot be utilized. There is high potential for such activities, but no legal framework in place to generate funds and use them for the benefit of the institute*
The extent to which the intellectual property rights of the institute are protected	*Weak*	*No system is in place in the DOA to protect IPR and BR*

g) Coordinating and integrating the internal functions/units/activities:

No formal evaluations or restructuring of the institute has taken place during the past years. However effective internal communication and coordination mechanisms are in place. Director and DDRs of substations regularly meet and discuss overall direction and coordination of the institute. The different units and substations are assigned with functions and responsibilities that are clearly defined. The R&D activities done and results achieved during cultivation seasons are reported in writing as '*yala*' and *'maha'* research reports. The research outputs are presented and discussed at different forums including PTWG, where officers of all divisions of DOA and Provincial DOA are present.

Assessment of Coordinating and integrating the internal functions/ units/activities

Management Practice	**Level of Practice** **Strong/ Moderate/ Weak**	**Comments/ Evidence**
The extent to which institution is evaluated internally and restructured based on current needs	*Weak*	*No periodic external or internal evaluation has been done*
The effectiveness of internal communication and coordination mechanisms	*Moderate*	*Need more facilities to have meetings via "Skype" to reduce travelling of outstation staff*

Institution's overall direction and coordination are provided by a central planning committee / unit.	*Moderate*	*No formal 'Central Planning Committee or Unit' formed*
The extent to which different units are assigned clearly defined functions	*Strong*	*Need to promote interactions among the units*
Responsibilities of research / management staff are clearly identified	*Strong*	*Responsibilities have been assigned but without proper authority*
Effectiveness of using appropriate reporting procedures and feedback in management at different levels	*Moderate*	*No regular reporting procedures were observed*

h) Partnership in managing information dissemination:

The institute does plan and disseminate information generated by them either directly to the stakeholder or through the extension arm of the DOA and PDOA. The linkage between the institute and the extension staff is not strong and sometimes it does not work efficiently and stakeholder requirements are not met on time. The only formal system to get the feedback and deliver the solutions to the stakeholder is the PTWG, where researcher-extension worker meet and discuss researchable problems and solutions on a common platform. However, stakeholders do not participate at these meetings. If solutions cannot be given, then and there, the institute will be committed to undertake an in-depth study before providing a solution to the problem. Further, the institute has taken necessary measures to disseminate information and recommendations to their secondary stakeholders, i.e., undergraduate and postgraduate students, students from Schools of Agriculture, school children, national and international researchers, industries, NGOs etc.

Assessment of Partnership in managing information dissemination

Management Practices	Level of Practice Strong/ Moderate/ Weak	Comments/ Evidence
The institution systematically plans and performs dissemination of information	*Moderate*	*Links with inter provincial extension and agrarian services more prominent than provincial extension service.*
The extent to which the institution plans and maintains linkages with key partners for sharing and dissemination of information	*Moderate*	*Only with the farmers through extension personnel in the PDOA and need to develop a formal link with farmers. Need to use website effectively.*
The effectiveness of institutional procedures for technology transfer	*Moderate*	*More demonstration programs, field days needed*
The effectiveness of the system to obtain feedback from different types of stakeholders	*Weak*	*Only from the farmers through extension service but not much from millers, and private sector.*

i) Monitoring, evaluation and reporting procedures:

The institute does monitor and evaluate its own administrative, accounting and R&D activities. However, monitoring and evaluation procedures are not fully supported by Management Information System (MIS). The institute and the substations are not interconnected among each other or with the head office through MIS. There is an understanding of activities within the divisions and substations of the institute. The results of projects are adequately discussed internally and procedures are in place to report them through reports, seminars, conferences etc. The results further used in future project planning and decision making. The services of stakeholders are not entertained in monitoring and evaluation process.

Assessment of Monitoring, evaluation and reporting procedures

Management Practices	Level of Practice Strong/ Moderate/ Weak	Comments/ Evidence
The institution monitors and evaluates its own activities periodically	*Moderate*	*Formal internal evaluation should be practised routinely*

Monitoring and Evaluation (M&E) is supported by an adequate management information system (MIS), which includes information on projects (e.g. costs, staff, progress, and results).	*Moderate*	*Need to establish an MIS*
The extent to which S&T results and other outputs are adequately reported internally (e.g. through reports, internal program reviews, seminars).	*Moderate*	*More internal information disseminations as newsletters staff seminars etc. needed*
External stakeholders contribute to the M & E process in the institution	*Weak*	*Not much involvement of the private sector*
The extent to which the results of M&E are used for project/research planning and decision making.	*Moderate*	*Need to improve*

5. Output assessment

a) Technologies developed:

Many technologies have been developed by the institute and by its substations. The most outstanding outputs are development of high yielding improved rice varieties with different characteristics to fit into the needs of different rice based farming systems in different regions of the country. The breeding programs of the institute are commendable and approximately 95% of the varieties cultivated by the Sri Lankan paddy farmers are products of the institute. The characteristics of the varieties range from short age to long age, as well from red pericarp to pink and to white. There are varieties to fit into problem soils with high salinity, iron toxicity, and tolerance to pest and diseases, drought and temperature. Research on the improvement of varieties to meet the required nutritional qualities has been initiated. All varieties developed are capable of giving over 120 bu/ac (6 t/ha) under farmers' field conditions, while some farmers have obtained over 200 bu/ac (10 t/ha). There are also many improved lines already in the pipeline, tested to be released in the near future. Breeding is a continuous process and institute has made its significant contribution to maintain its mandate as in the past by developing high yielding rice varieties to suit the rice farmers' requirements (Annex. 4a and 4b). Further, the institute has developed many other recommendations on pest management, plant nutrient management, irrigation management, rice based food products etc. It has also developed recommendations at regional level based on problems identified in different regions (Annex. 5).

b) Technologies transferred to industry/entrepreneurs:

The DOA has established systems and procedures to transfer recommendations to the farmers and other stakeholders (improved varieties and other research outputs) through its extension arm. Once the varieties are recommended, breeders produce necessary quantities of breeders' seed and hand them over to the Seeds and Planting Material Development Center (SPMDC) of the DOA for multiplication and distribution of seed. Further the institute distributes certain quantities of breeders' seed to private sector seed producers who are involved in seed production and sale marketing.
Similarly, the other recommendations and technologies developed by the institute are transferred through the extension arm of the DOA and PDOA. The officers of the institute will organize training programs for the extension staff as well as for the farmers (Annex. 6). These programs are conducted regularly by the training center of the institute. The training center is well equipped with board and lodging facilities to cater to the trainees. The research staff serves as the resource persons for these programs. However, the costs incurred by the participants are reimbursed from the program organizers.

c) Information dissemination/extension:

The institute has prepared several reports, training manuals and advisory leaflets (Annex. 7) to be distributed among stakeholders. These documents give detail description of recommendations and technologies developed by the institute. Further the institute organizes exhibitions, media discussions, open days, demonstrations for the stakeholders. They also disseminate their recommendations by participating in events organized by other organizations such as, schools, universities, provincial councils, other departments and ministries.

d) Publications:

The researchers in the institute have published their research findings in International Scientific Indexed (ISI) journals and other journals. Most of them have presented and published their findings in international and national conferences, workshops and seminars. Some have developed their recommendations and technologies into monographs and reports (Annex. 8).

e) Patents:

None of the researchers have obtained any type of patent for their efforts (such as varieties and other recommendations). Being a government organization, all technologies developed and released are given to the stakeholders free of charge. Though the institute has developed varieties and distributed all over including some foreign countries, patent rights of neither the breeder nor the institute has been secured. It was also observed that breeders' seeds of some popular varieties are sold to the private sector seed producers at a nominal fee. The same private sector seed producers sell the seed at a higher price to farmers after multiplication. Institute does not operate as a 'fund generating' organization as it is the policy of the DOA.

f) Services:

Since the institute is funded by the treasury funds, it has no mandate to review other institutes, award research grants, and release funds to S&T activities. However, several services are being carried out regularly on demand. Among them, development of relevant data bases, conducting surveys, analytical services such as site specific soil test for fertilizer recommendations, services rendered to Office of the Registrar of Pesticides on evaluation of new chemicals, evaluation of new products of liquid fertilizers, involvement in science popularization programs especially for school children, environment impact assessments, free consultancy services on rice cultivation and technology, breeder seed production and distribution, rice germplasm conservation and distribution to relevant institutions, training university students at undergraduate and postgraduate level, training school teachers and children, farmers, extension workers, and

other stake holders on rice related research, technological and development activities (Annex. 6).

g) Staff training:

Training of staff at all levels had been poor in the recent past. Little training opportunities were available for research staff at postgraduate level. Hence HRD aspects of the institute had been at moderate level (Annex. 9a and 9b). Though short term training on technological aspects had been effective, researchers' training needs on research management, HRM, project management etc. have not been looked after. Training for technical officers on handling and calibration of scientific instruments and their maintenance, laboratory maintenance, Labor management and farm management are areas to be considered. Financial officers need to be trained on financial management.

h) Other:

Awards - Officers have won several awards for their contribution in the field of rice research during the past few years. They were at departmental level, provincial level, national level and international level (Annex. 10).

Welfare – The welfare facilities provided to the staff by the institute were at moderate level. Newly renovated rest rooms for drivers and workers, health facilities, and staff quarters have been provided, but not in all stations. New staff quarters need to be constructed, and prevailing ones are to be renovated.

Incentives – A research allowance of 30% of their basic salary is given to the staff that attracts external research funding.

Delays in Promotions – It was noted that several staff members have not got their promotions on time due to some administrative problems at the Head Office.

6. Staff strength of the institute

The present situation of the staff strength is not satisfactory. It is important to maintain a strong core of PhD level researchers in each salient areas of research. Since all recruitments and transfers of all permanent staff are done by the Head Office of the DOA, the institute has not been able to maintain its full capacity of the carder during the past few years (Annex. 11a and 11b). This situation has adversely affected the research and development programs of the institute. Further, transfer of experienced researchers from 'rice' to 'other crops' and vice versa, has aggravated the situation. This procedure of transferring officers resulted in losing some well experienced officers to the institute. The recruitment of staff for all categories had been delayed. The promotions to higher grades, too, had been delayed leading to frustration among the officers which is detrimental for the national development in the long run.

7. Outcomes of the stakeholder meeting

As part of the review process, the Review Team had a meeting with stakeholders representing several organizations. The meeting was held at Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI), Colombo, on 17th October, 2017 (Annex. 15). Representatives from following organizations were present at the meeting.

a. Alli Pvt. Ltd.
b. Commercial Fertilizer Company
c. Consumer Protection Authority
d. Department of Agrarian Services
e. Harischandra Mills Pvt. Ltd.
f. Ministry of Agriculture
g. Ministry of Health
h. Paddy Marketing Board
i. Plant Genetic Resources Center, Gannoruwa
j. Plenty Foods Pvt. Ltd.
k. Rice Research and Development Institute
l. Seed Certification Service of Dept. of Agriculture, Gannoruwa
m. University of Peradeniya (excuse letter with a written submission on issues)
n. Wayamba University of Sri Lanka

The stakeholders discussed matters pertaining to their own organizations and came up with suggestions how RRDI can make changes to its outlook by making significant contribution to develop cordial and beneficial collaboration with the stakeholders. Every stakeholder actively participated in the discussion which was carried out in a cordial manner. Although certain areas highlighted by the stakeholders were not within the mandate of RRDI, the key points that have direct relevance to RRDI are highlighted below.

a. Close collaboration between RRDI and stakeholders is necessary. Most of them experienced difficulties in contacting RRDI officials for advice or assistance. Hence a mechanism needs to be developed to create more coordination between RRDI and stakeholders. Most activities are carried out on an informal basis using their personal contacts.
b. It was highlighted that, '*Nadu*' type (both par-boiled and raw) has a higher demand than others, and also white over red rice. Due to heavy demand for '*Nadu*' and white, there is a shortage of these in the market. '*Nadu*' and white types are used in making '*thosai*' mix, *stringhopper* mix, and noodles. Present '*nadu*' types are of good quality for making above products. These factors need to be considered when future research activities are planned.
c. BG 352 is ideal for making '*Samaposha'* and MA 2 is good for biscuit industry. However, MA2 is a poor yielder and contract farmers who grow this variety complain about the yield. Measures need to be taken to improve/increase yielding ability of MA2, to keep the price of biscuit products stable.

d. BG 350 (*Nadu*) was identified as best for making flour by the millers, while BG 352, AT 362 (red) and BG 358 (*samba*) were also recognized as superior in quality.
e. It was also highlighted that more research need to be carried out on detection of heavy metals in grains as there had been no comprehensive study done on Sri Lankan rice. The information already available at RRDI on this issue need to be disseminated to the relevant stakeholders for their information.
f. In many occasions it has been experienced that there had been incidences where poor quality rice at a cheaper price being imported. This rice is neither preferred by the consumer nor the processor. However, importers get together with the millers and mix them with local rice and sold to the consumers at a higher price. There is a difficulty in detecting such rice in the market and it has become a serious problem in the country. Measures need to be taken to stop this. RRDI may take a lead role at national level through its line ministry to educate the general public and other groups involved in rice industry. Consumer protection authority representative highlighted that there is a need to develop methods for easy identification of such rice, rather than sending each and every sample to RRDI.
g. RRDI need to recognize the importance of traditional rice varieties and take necessary measures to popularize them. Research programs need to be established to study useful characters of traditional varieties and on areas such as, bioinformatics, gene identification, and promote collaborative research with other institutions and organizations (foreign, local, universities etc.). Since considerable amount of information is available at RRDI, steps should be taken to disseminate research and other information available with them on traditional rice varieties and practices, to the stakeholders interested in traditional rice production systems and marketing.
h. Presidential Secretariat is working to popularize organic agriculture and traditional varieties and there is a necessity for RRDI to make the public aware about the comparison of new and traditional varieties, quality comparisons, etc.
i. Future research may need to concentrate on developing 'quality rice' with high nutritive value. Rice fortification is another area needs focus.
j. Storage studies too need to be carried out, as requirements may differ for different types of rice, such as, par-boiled and raw, white and red, '*samba'* and '*nadu*' etc.
k. As RRDI is the apex body of rice research and development in the country, it should play a dominant role in recommending varieties for cultivation in different parts of the country. For example, when the crop is harvested, there is always an excess production of red rice and a shortage of white. This may be due to extents cultivated were not planned based on the demand. There is a heavy demand for BG 352. BG 94-1 is not popular and a slow release variety. May be it is suitable for Northern Province but not in the east. Therefore, as the apex body, RRDI should get involved in deciding and planning the types of varieties and extents to be cultivated in different districts in the country, in future.
l. RRDI is successfully conducting training programs for all categories of people involved in rice cultivation – farmers, officers, teachers, school children, NGOs, undergraduate and postgraduate students etc. They have also designed custom made training programs for certain groups, on demand. Stakeholders who obtained training from RRDI are satisfied and wanted them to continue.

m. Research projects carried out jointly by RRDI and universities have resulted in valuable outcomes but due to some reason, continuation of such projects does not happen. It has affected on final outcome. In general, universities have collaborated well with RRDI in the past and many postgraduate research projects have been completed. Many undergraduate research projects too, have been completed. RRDI has given its fullest cooperation and commitment in conducting such projects. However, implementation of most of these projects was possible due to personal contacts established between the researchers and the academia. This system need to be more formalized by developing a better understanding between RRDI and other institutions. Further certain improvements need to be done as the laboratory facilities are inadequate in some divisions to conduct advanced studies. Guidance of senior researchers would be much helpful to produce successful research outcomes. Exposure to novel research techniques/technologies is essential for the newly recruited research staff to be in par with present day research culture. PhD level training is a must and publications need to be targeted towards peer reviewed national/international journals.
n. There is a need for the researchers of Food Science Division of RRDI to join hands with Food Processors' Association, which all companies manufacturing rice based foods are represented.
o. Representative from the Nutrition Division of the Department of Health showed the necessity of fortification of rice with iron. Can RRDI support such interventions? As the consumers always prefer to wash rice before cooking, need to develop a mechanism to hold it.
p. Need for a more interactive web site and it should be closer to normal people.
q. Since mixing of similar paddy varieties is done by the millers before milling, quality of a particular variety cannot be appreciated by the consumers. Hence measures should be taken to release varieties with attractive names (Eg; *Keeri Samba* for BG 360, *Neeroga* for At 311) instead identifying them as, *samba, nadu, rathu kekulu, sudu kekulu* etc.
r. Improve relationships with Paddy Marketing Board and fertilizer companies

8. Overview of the institution's performance and contribution to national development

The RRDI has taken a lead role in rice research and development in the country since its inception. During the past 65 years, it has developed many technologies that have made a significant impact on rice production in Sri Lanka. The most outstanding output has come from varieties developed for different farming situations and problem soils in different agro ecological regions in the country. The breeding programs conducted by the institute is commendable and presently over 95% of the varieties cultivated by the farmers have been developed by the RRDI and its substations. As a result of adoption of these varieties for cultivation by the farmers, national yields have increased by six fold, thus reporting a significant decrease in rice imports (less than 1%) during the past 4-5 decades (Annex. 12 and 13). The varietal characteristics developed by the breeders had exhibited a wide range from white to red pericarp, 2.5 months to 4 months in age, tolerance to iron toxicity, high salinity, flood, drought etc. Further more recently, varieties have been developed to be used in biscuit manufacturing, and for making *thosai* mix, *stringhopper* mix, noodles and *samaposha*. The potential yields of some of these varieties have reached 200 bu/ac. Due to their high yielding ability and stress tolerance characteristics, some of these varieties have been recommended by several countries in Asia, Africa and South America recognizing the favorable attributes suited for these countries.

Further, the institute has developed many other recommendations on pest management, plant nutrient management, irrigation management, etc. It has also developed recommendations at regional level based on problems identified in different regions. Some examples are, recommendations made on zero tillage, seedling broadcasting, deep ploughing, fertilizer application including organic, nano and micro nutrient fertilizers, Zn application, use of leaf color charts, and on application of herbicides, insecticides and fungicides. Further, RRDI had been able to identify some lines having anaerobic germination ability. Recommendations were also developed to use single super phosphate produced from ERP as a source of phosphorous to replace TSP in rice cultivation, to cut down Chemical fertilizer usage by ¼ by application of organic manures (4 t/ha compost, 5 t/ha straw and 1 t/ha green manure), to improve and maintain productivity of marginal paddy fields, site specific nutrients to give a 20% yield increase while increasing the income and profit for farmers.

About 128 weed species were identified in rice fields, island wide, out of which 28 species were considered as economically important. Row seeding by drum seeder, water seeding, seeding to stale beds and parachute planting, were found to be environmentally safe and cost effective weed control methods. Parachute establishment method reduced emergence and growth of grasses, broadleaf and sedge weed biomass and gave higher yields. Maintaining saturated conditions in lowland rice paddies from 3 weeks after sowing until heading, decreased irrigation water requirement by about 30%, increased water productivity by 29% in *yala* and 164% in *maha*.

These recommendations are generally transferred to the farmers and other stakeholders through the existing network of the extension system of the DOA and the PDOA. Officers

of the Institute and the extension division conduct regular training programs for stakeholders on continuous basis. RRDI maintains a well-equipped training center at Batalagoda and officers may go out to the field if field level training is necessary. Field days are also conducted to facilitate transfer of technology to the stakeholders.

The institute has taken all measures to maintain the breeder seeds of all recommended and other varieties and make arrangements to distribute them to the SPMDC and private sector seed producers to multiply and sold to the farmers. The institute has also developed training manuals, reports, and leaflets etc. to a certain extent for distribution among stakeholders. Further, the institute plays a significant role in training school children and university students.

The researchers in the institute have published their research findings in International and local journals. Most of them have presented and published their findings in international and national conferences, workshops and seminars. Some have developed their recommendations and technologies into monographs and reports.

The institute carries out many services of national importance on regular basis. They are mainly conducting surveys, analytical services for site specific fertilizer recommendations, evaluation of new chemicals and liquid fertilizers, conducting science popularization programs, environmental impact assessments, free consultancy services on rice production technology, breeder seed production, germplasm conservation, and providing necessary information and training on other rice related issues when requested.

9. Recommendations

A. On Management

a. Develop an action plan and a strategic plan for the institute with inputs from all relevant parties.
b. Develop awareness among all staff members, on institute's mandate and responsibility and to act accordingly. The institute has a bigger responsibility and a major role to play at national level in all aspects of rice research & development.
c. Maintain a constant dialogue with the administrators, stakeholders (farmers and private sector), rice researchers, extension workers, policy makers etc. and get their inputs in strategic planning and prioritizing research.
d. Develop a mechanism to review, evaluate and update the institute's policies and plans periodically, either externally or internally.
e. Develop a mechanism to generate funds from programs conducted by the institute. Programs are conducted regularly for different groups and funds generated should be used for future research and development activities of the institute.
f. The services rendered to the different divisions of the DOA (E.g. varietal evaluation, pesticide testing, soil analysis for farmers for site specific fertilizer recommendations, testing of liquid fertilizers etc.) need to be accounted as services provided.
g. Encourage scientists to, carryout multidisciplinary projects/activities, foreign collaborative projects, apply for external research grants from NSF, NRC, IAEA, CARP, develop partnerships with private sector and give due recognition to researchers involved in such projects.
h. Develop a formal monitoring and review process on project basis towards achievement of objectives.
i. Ensure that projects are not suffered due to inadequate infrastructure, equipment, instruments, facilities, space etc.
j. Ensure scientists/researchers have access to adequate scientific information that strengthens the quality of research.
   NASTEC may take the initiative in establishing a national resource centre for downloading important scientific publications from organizations such as Science Direct, Springer, Blackwell etc., and make them available to the researchers.
k. Develop a mechanism to train staff regularly at all levels. Postgraduate training at PhD level is critical for researchers. One or two PhD level trained officers for each division are a must. None of the research personnel at Bombuwela are PhD holders.
l. Board of Directors should take necessary steps to make promotions on time. Delaying of promotions has adversely affected the output of the officers.
m. Board of Directors need to fill all vacancies with qualified staff or implement a crash program to train the existing staff at PhD level. Vacancies have not been filled for several years and many positions are vacant.
n. Encourage staff located in satellite stations to attend meetings via Skype to reduce extensive long travel time involved and also to reduce cost and risk involved.
o. As the apex body of rice research and development in Sri Lanka, develop a mechanism to maintain strong and efficient links with key partners and stakeholders for sharing and dissemination of information and also to obtain feedback.

p. Develop an outreach programme directly reporting to the institute to upgrade the research planning of all regional centres and the main station at Batalagoda. It was noted that feedback from the researchers at regional stations are the main guidelines in planning S&T. Lack of direct outreach activities appears to be a major constraint regarding a realistic feedback for S&T planning. More interactions are needed with provincial level extension services.
q. Improve the existing management information system (MIS) of DOA to enable all administrative, managerial, executive and other staff to get the full benefit.
r. Publish newsletters periodically in all three languages and disseminate research information throughout the country.
s. Initiate a system to obtain IPR, BR and patent rights for all technologies developed by the institute, including varieties.
t. Procure an auto operated generator to meet the frequent power failures. It will remove the dependence on supplies of Molecular biological chemicals especially enzymes and other thermolabile chemicals for the continuation of research.
u. Recruit agriculture diploma holders to the farms divisions who could be trained to assist the breeders in maintaining Breeders' seed production to ease the work load involved (Annex. 14).

B. On Research:

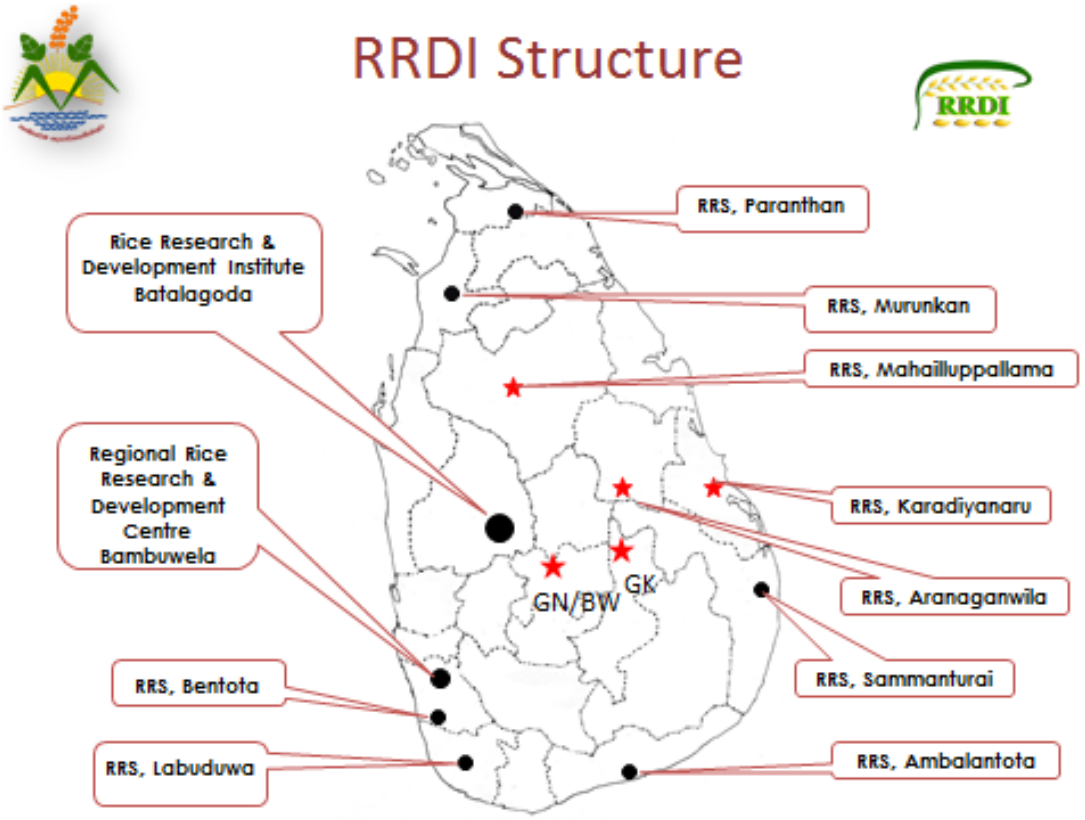
a. Maintain vision of individual divisions in line with the institute's mission in order to design and plan for potential problems that could emerge in the near future.
b. Introduce staff development programs to meet the requirements urgently needed, in view of the fact that future threats on rice production are not assessed or predicted.
c. Develop a closer collaboration between Plant Protection, Plant Physiology and Biotechnology in the application of oligochitosan as a plant vaccine in rice fields. Former Plant Pathologist at HORDI stated that the Oligochitosan is effective in **prevention** of many diseases in crops. Oligochitosan's effectiveness in the prevention (vaccination of rice plant) is well established by the Chinese Scientists. The principle involved is both ETI and PTI (Elicitor triggered and Pathogen associated Molecular Pattern triggered Map Kinase Kinase Kinase activity) triggering immunity. However it depends on the frequency of application and just one or two application is not sufficient to trigger immunity. Since it's effectiveness is already established by the Pathologist at HORDI, it is useful to evaluate the application of Oligochitosan as a **preventive** (vaccination type) application. It is of course not suitable as a curative measure.
d. Emergence of insecticide resistant Black Bug, otherwise not an aggressive pest, is the direct impact of continued use of species specific insecticides (one can refer to extensive work done by Dr Dekker of University of Wageningen on emergence of resistance with specific reference to use of Metalaxyl and formulation of Ridomil thereafter). However the only way to eliminate emergence of Black Bug is to use a broad spectrum pesticide along with the present application of species specific pesticide that leads to emergence of pesticide resistant Black Bug. A suitable combination of pesticide should be tested and evaluated by the RRDI scientists and

recommend the outcome, of course with regular changes in the combinations, to prevent emergence of Black Bug problem.

e. It is absolutely imperative for the development of the Crop Improvement program and, by and large, the development of the RRDI research activities, the institute should have PhD level scientists in the fields of Biometry who will serve the whole RRDI, Bioinformatics, Hybrid Rice Production, Molecular Biology.
   Take immediate action to initiate PhD level training of the existing staff in above areas.
f. Procure an Induction Couple Plasma Mass Spectrophotometer (ICPMS) for analysis of minerals and heavy metals etc.
g. Establish a simple domestic level RO unit coupled with ion columns to obtain Nano pure water with specification needed for ICP/MS analysis (Purity up to 18.2 M-cm — exceeds ASTM, CAP, and NCCLS Type 1 requirements) as well.
h. Staff should be trained in scientific writing and encourage researchers to publish their findings in ISI journals.
i. Make available the information on application of Eppawala Rock Phosphate, ERP, (unprocessed) to meet the P requirement of rice grown in acid sulphate soils. Since ERP is very low in Cd (max about 1.2mg/kg) it is an ideal substitute for P requirement. This finding would be useful to other scientists in Asia where acid sulphate soils are a major constraint in rice production purely due to difficulties in supplying available P.
j. Adopt crop modelling approach for forecasting of flood and drought with special reference to crop age. The review team has provided information on use of DSSAT model in crop modelling approach to the Research officer involved. It would be desirable to use GIS technology at RRRDC Bombuwala, Amabalantota and Labuduwa in their research projects. Expertise and resources for GIS technology could be obtained from NERM project at NRMC, Peradeniya. Masters programme in GIS technology is available at PGIA, Peradeniya. RRRDC at Bombuwala has developed a soil map for the center and it would be useful to extend this approach to the whole region.
k. Need for more emphasis on rice cultivation with less amount of water as water becoming a scarce resource
l. Need for research to reduce chemical fertilizers and save foreign exchange by using nanotechnology, use of rice husks, coated urea etc. Ways of increasing efficiency of local sources of plant nutrients such as Eppawala apatite and more efficient ways of using straw.
m. Emphasis on mechanization is needed as labour is getting scarce to make rice farming attractive to younger generation, through use of seeders, transplanters, weeders, combined harvesters etc.

10. Annexures

Annexure 1: Map showing RRDI and locations of its substations



Red Stars – Collaborating Institutes of DOA (not under RRDI)

Annexure 2: SWOT Analysis of the RRDI

STRENGTHS:

Well qualified and trained senior research scientists
Laboratory and screen house facilities at main research stations
Well defined national goals
Well focused result oriented research programs to fulfill national goals
Training center with residential facilities for technology dissemination
Mutually beneficial links with national and international institutes
Well defined network of stake holders for testing and dissemination of proven technology

WEAKNESSES:

Non availability of required number of research scientists (vacancies not filled)
Non availability of sufficient funds at required time
Lack of facilities for advanced research
Inadequate recognition for scientists
Confinement of junior scientists of the system to post graduate programs in a single country
Limited opportunities to get short term exposure to global scientific advancements
Less developed research culture due to unconducive working environment
Inadequate library, laboratory and field facilities for research in sub stations
Lack of supporting staff for research activities
Inadequate recognition for scientists

OPPORTUNITIES:

Being the staple food in the country, assured market for the produce
Increasing demand for rice cultivation due to social cohesiveness with the culture
Market creation of rice based value added products (untapped market)
Strong international research network and collaboration
Achieved self-sufficiency in rice production
Avenue creation for rice export
External sector incentives (regional trade agreements and bi-lateral/multi-lateral agreements) for rice trade
Constructive farmer feedback
Research networking with universities, private sector and NGOs
Window for career development by research staff

THREATS:

Government policy change in the subsidy scheme
Environmental factors (floods and droughts) affecting the cultivation
Crop diversification due to biotic and abiotic stresses
Younger generation shifting from rice farming
Research experts leaving the institution
Increasing cost of production with inflation
Changing consumer demand / preference and instability in production performance in the country
Private sector competition (for rice export, new product development)
Trace elements threatening the paddy cultivation (eg. Cadmium/As)

Annexure 3: Collaborative projects with International Organizations

1. Green Super Rice – 2009 -2016 with IRRI
2. Closing Rice Yield Gap – 2013-2020 with IRRI
3. Increasing Productivity of Direct Seeded Rice Areas - 2013-2016 with IRRI
4. Weed and Weedy Rice Management – 2008-2017
5. Establishment of Model Farming Village – 2016-2018 with KOPIA
6. Increasing Productivity of saline areas – 2013-2015 with AFACI

Annexure 4a: List of varieties released by RRDI (2010 – 2014)

Variety	Year of Release	Pedigree
Ld 408	2010	At 01/Ld 98-152
Bw 367	2011	Bg 358/Bw 361
Ld 368	2011	Ld 4-9-11/Ld 99-17-4
Bg 369	2012	Bg 94-1/Nonabokra
Bg 370	2013	IR 555178/9-3R/IR 65515-47-2-1-91
Ld 371	2013	Ld 99-11-48/Bg 96-1520
Bw 372	2013	Bg 359/Bw 267-3 (Short mutant of Bw 267-3)
At 309	2013	IR 70422-66-5-2/Bg 98-2571
At 373	2014	IR 70422-66-5-2/Bg 98-2571
Bg 251GSR	2014	Introduction from China
Bg 310	2014	Bg 300/Pokkali
Bg 455	2014	Ob2547/CR9413/IR46/Ob2552

Annexure 4b: Distribution of RRDI varieties in other countries

Sri Lankan rice cultivars with given names in different countries

Annexure 5: List of recommendations made by RRDI

A. Lines developed
   - Rice lines having flood tolerant ability
   - Rice lines having anaerobic germination ability
   - Line suitable for sprouted rice for consumption and dry soup mix
   - Varieties suitable for use in biscuit industry and in making '*samaposha', 'thosai mix', 'string hopper mix', and* 'noodles'.
   - Varieties tolerant to iron toxicity, salinity, water logged conditions

B. Recommendations given
   - Recommendation on Zero tillage
   - Recommendation on Seedling broadcasting
   - Recommendation on Deep ploughing
   - Fertilizer recommendation – NPK
   - Recommendation for use of nano fertilizer
   - Micro nutrient recommendation – Zn
   - Recommendation of organic fertilizers
   - Recommendation on use of leaf color charts
   - Recommendation on AWD

- Herbicide recommendation
- Insecticide recommendation
- Fungicide recommendation
- Single super phosphate produced from Eppawala phosphate can be used as a source of phosphorous to replace TSP in rice cultivation
- Chemical fertilizer usage can be cut down by ¼ if organic manures are applied (4 t/ha compost, 5 t/ha straw and 1 t/ha green manure)
- Mechanisms and rice lines suitable to improve the productivity of salinity affected paddy fields were identified. Productivity of saline paddy fields could be increased up to 8 t/ha
- Mechanisms were identified to improve and maintain productivity of marginal paddy fields.
- Site specific nutrient management gives 20% yield increase while increasing the income and profit for farmers
- Recommendation on leaf color chart based N application
- 128 weed species were identified in rice fields Island wide. Of them 28 weed species can be considered as economically important
- Row seeding by drum seeder, water seeding, seeding to stale beds and parachute planting were found to be environmental safe and cost effective weed control methods
- Parachute establishment method reduced emergence and growth of grasses, broadleaf and sedge weed biomass and give higher yield
- Maintaining saturated conditions in lowland rice paddies from 3 weeks after sowing until heading decreased irrigation water need by about 30% increase water productivity by 29% in *yala* and 164% in *maha.*
- Hermetic storage method

Annexure 6: Training programs conducted by RRDI

Year	**No. of Training Programs**
2012	22
2013	06
2014	25
2015	15

Annexure 7: List of documents developed by RRDI for information dissemination (from 2013 to 2016)

a. Rice Blast disease (in Sinhala)
b. Rice cultivation without Poison (in Sinhala)
c. Environmental Factors affecting spikelet sterility in rice (in Sinhala)
d. Fertilizer recommendations for rice (in Sinhala and Tamil)
e. Usage of nitrogenous fertilizer for rice cultivation (in Sinhala)
f. The role of Potassium as a nutrient in rice cultivation (in Sinhala)
g. Importance of chemical fertilizers (in Sinhala)
h. How to improve sandy soils for rice cultivation? (in Sinhala)
i. Popular traditional rice varieties of Sri Lanka
j. Water management for successful rice cultivation under water limited conditions in *yala* season: Alternate wetting and drying (in Sinhala)
k. Breeding of new rice varieties – *Dakshina Krushi Navodaya* (in Sinhala)
l. Think before using pesticides (in Sinhala)
m. Our traditional rice varieties
n. Quick guide to herbicide use in Sri Lanka
o. Paddy bug damage in rice (in Sinhala)
p. Protection of Soil by the least usage of agrochemicals (in Sinhala)
q. Special documents for field days held on 20.8.2014 and 13-14.08.2015 at Ambalantota
r. Leaflets carrying information on newly released rice varieties

Annexure 8: Publications made by RRDI staff

Type of Publication	**No. of Publications**		
	2013	**2014**	**2015**
Technical reports / Research Papers/Abstracts	36	46	37
Consultancy reports	-	-	-
Advisory materials/ Information leaflets	-	-	4
Newsletters	1		-
Other publications (Training manuals, Scientific databases, Books, etc.) Newspaper articles	5	4	-

Annexure 9a: Number of trained officers (S&T) at RRDI

Qualifications	**2013**	**2014**	**2015**
PhD	3	3	3
MPhil	5	5	4
MSc or equivalent	20	20	19
Basic Degree or equivalent	15	14	12

Annexure 9b: Number of training positions available for staff

No of employees trained	2013		2014		2015	
	S & T staff	Other	S & T staff	Other	S & T staff	Other
Postgraduate level	0		0		01	
Diploma	0		0		00	
Short-term training	9		15		19	
Study tours/conferences	15		17		13	
Total	24		32		33	

Annexure 10: List of awards received by the staff

No.	Name	Year	Award
01	Dr. AP Bentota	2011 2013 2014	Best Scientist Award – ASDA President's Award for Scientific Publication Outstanding IRRI Alumni Award in Recognition of Achieving Rice Research Management
02	Mr. DN Sirisena	2014 2015 2016	President's Award for Scientific Publication Best Presenter in ASDA – Soil & Water Mgmt. AFACI Project Award, Best Paper in ASDA, Best Presenter in ASDA
03	Ms. MMASK Abeysekara	2012	Best Scientist Award – ASDA
04	Ms. WMUK Rathnayake	2014	President's award for scientific publication (2011) and Best Presenter in ASDA – Soil & Water Mgmt.
05	Ms. MARA Mandanayake	2014	Best Presenter in ASDA – Natural Resource Mgmt. and Climate Change
06	Mr. DM Vithanawasam	2014	Best Presenter(ASDA) – Plant Breeding
07	Ms. MGN Rupasinghe	2014	Best Poster (ASDA)
08	Ms. RF Hafeel	2016 2017	President's award for scientific publication Best Scientist (ASDA)
09	Ms. KRD Gunapala	2017	Best Presenter (ASDA) – Agriculture Extension
10	Ms. IWMIWTK Illangakoon	2016 2017	Best Presenter (ASDA) – Agronomy and Socio Economics, Best presenter at 28th Annual Congress of PGIA (Agronomy), Allumni Association Award – PGIA

			Best Presenter (ASDA) – Agronomy and Physiology
11	Ms. Jenat Rathnayake	2014	President's award for scientific publication (2011)
12	Ms. HMS Herath	2014 2015	Best Paper at Annual Scientific Conference of Pest Mgmt. Council, Philippines Best Student Award, Philippine University
13	RRS, Ambalantota	2015	National Productivity Award

Annexure 11a: Staff carder positions of RRDI

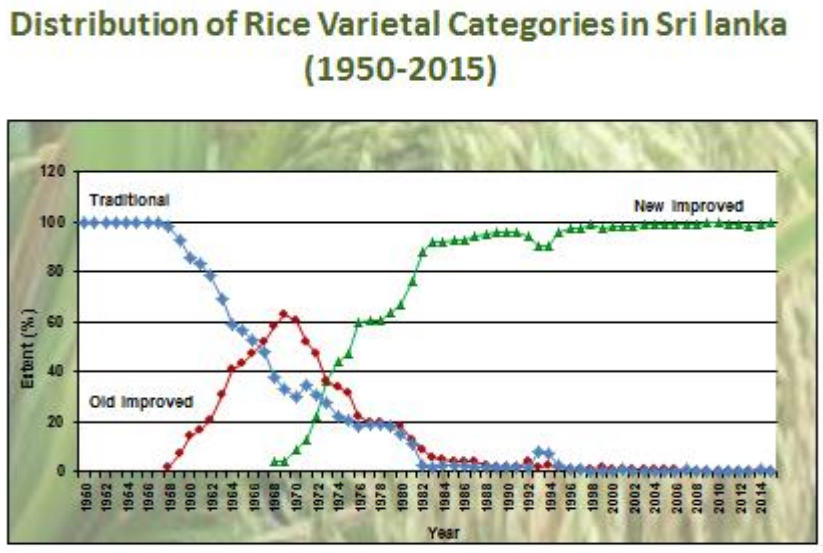
No of employees	**2010**			**2011**			**2012**		
	Cadre	**No. filled**	**Vacancies**	**Cadre**	**No. filled**	**Vacancies**	**Cadre**	**No. filled**	**Vacancies**
S & T personnel	55	33	22	55	47	08	55	41	14
Administrative staff	36	36	0	36	36	0	36	27	09
Technical staff	99	99	0	99	77	22	99	94	05
Supporting staff	45	45	0	45	45	0	45	45	0
Total	**235**	**213**	**22**	**235**	**205**	**30**	**235**	**207**	**28**

Annexure 11b: Number of officers available in each station for different disciplines (as at 2017)

Divisions of RRD System with No of Officers (31)								
Division	RRDI Bg	RRRDC Bw	RRS At	RRS Ld	RRS Bentota	RRS Samanthu.	RRS Paranthan	RRS Murunkan
Plant Breeding & Bio techno	7	3	1*	1				
Entomology	1P+1	0						
Pathology	1	1		1*,**				
Soil & Pl Nu.	1	1						
Water Mgt.	1	1						
Weed Science	1	0						
Agronomy & PP	1	1	0	1	1**	1**	1**	1*,**
Post Ha. & Ce. T	0							
Socio Econo	1							
Training	2							
Total	17 (12)	7 (5)	1*	3	1	1	1	

Key: Bg – Batalagoda, Bw – Bombuwela, At – Ambalantota, Ld – Labuduwa

Annexure 12: Distribution of rice varietal categories in Sri Lanka (1950 to 2015)



Source: Rice Research and Development Institute, Sri Lanka

Annexure 13:

Trends of Population growth Annual Production, Rice Extent, Average Yield and Rice Imports over past seven decades (1940 – 2015)

Decade	Population (MN)	Production (MMT)	Cultivated extent (Mn Ha)	National Av Yield (MT/HA)	Import%
1940	6.0	0.26	0.39	0.65	60
1950	7.5	0.60	0.41	1.56	50
1960	9.9	0.90	0.51	1.86	40
1970	12.5	1.62	0.61	2.63	25
1980	14.7	2.13	0.70	2.94	10
1990	16.3	2.50	0.70	3.18	5
2000	18.5	2.86	0.72	3.86	<1
2010	20.2	4.10	1.10	4.21	<1
2013	20.4	4.62	1.13	4.33	<1
2014	20.6	3.58	0.94	4.21	<1
2015	21	4.82	1.25	4.43	<1
Increase over 1940 decade	3.5 fold	18.54 fold	3.21 fold	6.82 fold	

Annexure 14: Number of varieties and quantity of Breeders' seed produced by RRDI

Year	No. of varieties	production (kg)
2013	33	4885.5
2014	37	6470.0
2015	35	6113.5

Annexure 15: List of officers and stakeholders participated in the review process

At Batalagoda:

12th -13th September, 2017

No.	Name	Designation	Division
01	Dr. AP Bentota	Director	
02	Dr. RSK Keerthisena	Addl. Director	
03	Dr. UAKS Udawela	ADA	Biotechnology
04	Mr. KA Thilakasiri	ADA (Dev.)	Training
05	Ms. IWMIWT Illangakoon	ADA	Agronomy
06	Mr. KGPB Karunaratne	ADA	Plant Breeding
07	Mr. WS Priyantha	ADA	Plant Breeding
08	Ms. KAK Wijesena	ADA	Plant Breeding
09	Ms. RMN Senanayake	ADA	Plant Breeding
10	Ms. DS Kekulandara	ADA	Biotechnology
11	Mr. RMUS Bandara	ADA	Weed Science
12	Ms. WMUK Rathnayake	ADA	Water Management
13	Ms. KR Gunapala	ADA	Plant Pathology
14	Mr. SR Sarathchandra	ADA	Entomology
15	Mr. RDMG Wijethilake	Farm Manager	Farm Office
16	Ms. LADS Wijesinghe	ADA (Dev.)	Training
17	Mrs. DMKPH Dissanayake	ADO	Administration
18	Mrs. SPSG Pathirana	ADA	Soil Science
19	Mrs. BMK Senarathne	ADA	Grain Quality
20	Mrs. GDSN Chandrasena	Principal Scientist	Entomology
21	Mrs. JK Galabada	ADA	Economics
22	Mr. YB Iqbal	ADA	RRS, Samanthurai
23	Mr. S Sivaneson	ADA	RRS, Paranthan

At Bombuwela:

19th September, 2017

No.	Name	Designation	Division
01	Ms. NPS de Silva	DD(R)	Bombuwela
02	Ms. Roshni Hafeel	DD(R)	Ambalantota
03	Ms. MHU Siriwardena	ADA (R)	Ambalantota
04	Ms. Susanthi Chandrasena	PAS (Ento.)	RRDI, Batalagoda
05	Ms. Kalani Vidumini Wickramasinghe	ADA (R)	Bombuwela
06	Ms. WDP Weerasinghe	ADA (R)	Bombuwela
07	Ms. MGN Rupasinghe	ADA (R)	Bombuwela
08	Ms. TGI Sandamali	ADA (R)	Bentota
09	Ms. JN Silva	PA	Bombuwela

10	Mr. DM Withanawasam	ADA (R)	Bombuwela
11	Ms. UAJ Ratnayake	ADA (R)	Labuduwa
12	Ms. MC Millawithana	ADA	Labuduwa
13	Ms. I Dissanayake	ADA	Bombuwela
14	Ms. J Ponnamperumaarachchi	ADA (In-Charge)	Labuduwa
15	Ms. AKR Roshenee	SMA	Bombuwela
16	Mr. MR Ruwanpathirana	Farm Manager	Bombuwela

Stakeholder Meeting:

Date : 17th October 2017
Venue : Hector Kobbekaduwa Agrarian Research and Training Institute, Colombo 07

No.	Name	Designation and Organization
01	Dr. Keerthi Hettiarachi	Additional Secretary, MOA
02	Dr. R.S.K. Keerthisena	Additional Director, RRDI
03	Dr. Gamini Samarasinghe	Additional Director (PGRC)
04	Dr. Erandi De Silva	Nutrition Division, Ministry of Health, Nutrition and Indigenous Medicine
05	Prof. N.S. Kottearachchi	Dept. of Biotechnology, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka
06	Dr. Jayantha Weerarathne	General Manager, Colombo Commercial Fertilizers Ltd.
07	Mrs. Chandrika Thilakarathne	Director - Consumer Affairs & Information Consumer Affairs Authority
08	Mr. M.U. Hathurusinghe	Assistant Director (Development) Seed Certification & Plant Protection Centre, Gannoruwa
09	Mr. N.S. Senanayake	Regional Manager (North), PMB
10	Mr. A.K.N. Wickramasinghe	Department of Agrarian Development
11	Mr. L.K.C. Preethiviraj	Plenty Foods (Pvt.) Ltd.
12	Mr. Rasika Kosgama	Harischandra Mills PLC
13	Mr. M.M. Illeen Riluwan	Alli Company (Pvt.) Ltd.

Annexure 16: Divisions visited by the review team

Day 01- 12th September 2017- Batalagoda Station

Time	Program
9.30 a.m. – 11.00 a.m.	Presentation on general overview of the institute by the Director followed by discussions with senior officials of the institute
11.00 a.m. – 12.00 p.m.	Discussion with satellite station officials (Samanthurai, Paranthan and Murunkan)
12.00 p.m. - 1.00 p.m.	Lunch
1.00 p.m. – 2.00 p.m.	Visit to Training Division
2.00 p.m. – 3.00 p.m.	Visit to Administration and Finance Division
3.00 p.m. – 4.00 p.m.	Visit to Farm Division

Day 02- 13th September 2017- Batalagoda Station

Time	Program
Visit to research divisions	
8.30 a.m. – 9.00 a.m.	Visit to Agronomy and Plant Physiology division
9.00 a.m. – 9.30 a.m.	Visit to Plant breeding and Biotechnology division
9.30 a.m. – 10.00 a.m.	Visit to Soil and Plant Nutrition division
10.00 a.m. – 10.30 a.m.	Visit to Water management and GIS division
10.30 a.m. – 11.00 a.m.	Visit to Entomology division
11.00 a.m. – 11.30 a.m.	Visit to Pathology division
11.30 a.m. – 12.00 p.m.	Visit to Weed Science division
12.00 p.m. - 1.00 p.m.	Lunch

1.00 p.m. – 1.30 p.m.	Visit to Post Harvest and Cereal Tech. division
1.30 p.m. – 2.00 p.m.	Visit to Socio-Economic division
2.00 p.m. – 2.30 p.m.	Visit to Development division
2.30 p.m. – 4.00 p.m.	Report discussion and compilation of the 1st draft of the review report

Day 03- 19th September 2017- Bombuwela Station

Time	Program
9.30 a.m. – 11.00 a.m.	Discussion with officials of the satellite stations (Bentota, Bombuwela, Labuduwa and Ambalantota)
11.00 a.m. – 11.30 a.m.	Visit to Farm division
11.30 a.m. – 12.00 p.m.	Visit to Agronomy and Soil Science Research division
12.00 p.m. - 1.00 p.m.	Lunch
1.00 p.m. – 1.30 p.m.	Visit to Plant Breeding & Bio-Technology Research division
1.30 p.m. – 2.00 p.m.	Visit to Entomology Research Division
2.00 p.m. – 2.30 p.m.	Visit to Pathology Research Division
2.30 p.m. – 3.00 p.m.	Visit to Soil and Plant Nutrition Research Division
3.00 a.m. – 3.30 p.m.	Visit to Water Management & GIS Research Division
3.30 p.m. – 4.00 p.m.	Brief discussion on compilation of the 1st draft of the review report