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PERFORMANCE REVIEW REPORT
2014-2016

HORTICULTURAL CROP RESEARCH AND DEVELOPMENT INSTITUTE
GANNORUWA
PERADENIYA
SRI LANKA
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1. INTRODUCTION

Horticultural Crop Research and Development Institute (HORDI) is the National Institute, responsible for research and development (R & D) activities of the Horticultural Crop sector, managed under the administration of the Department of Agriculture of Sri Lanka. The institute was first established as the Central Agricultural Research Station in 1958. Subsequently, along with the restructuring of the Department of Agriculture in 1994, the institute was renamed as HORDI. The main objective of restructuring was to offer a broader service to the horticulture sector of Sri Lanka through the implementation of well planned R & D programs. Since then it has been considered as the national centre for research and development for the horticultural crop sector. The mandate of HORDI also includes the economic and social development of vegetable crop growers, and other stakeholders, while contributing to national prosperity in agriculture and the food sector. The Head Office of the institute is located at Gannoruwa, Peradeniya while three Regional Agricultural Research and Development Centers that deal with vegetable production are located at Makandura, Seetha Eliya and Bandarawela. The Food Research Unit at Gannoruwa, which deals with post-harvest aspects of fruits and vegetables, is also administered by HORDI.

The aim of HORDI is to generate and disseminate cost-effective and eco-friendly crop production technologies that will increase the productivity, improve quality, reduce postharvest losses and add value to the products of mandated horticultural crops such as vegetables, root and tuber crops. Given below are the specific objectives upon which HORDI has been established, to reach its ultimate aim during the past 25 years.

- Utilization of domestic and global bio-diversity to develop high quality and high yielding varieties of vegetables and root & tuber crops.
- Generation of technologies for sustainable and productive developments of horticulture crops through basic, applied and adaptive research.
- Development of capacity on postharvest technology, agro-processing, product development, value addition and optimum utilization of horticultural produce.
- Undertake on-farm research through farmer participatory approaches to strengthen research, extension and farmer linkages.
- Strengthen the collaborative research work with all stakeholders including universities, public and private sector institutions while sharing resources and expertise.

Vegetable crop output from commercial and subsistence level cropping systems contributes to a significant portion of the vital food and nutritional needs of all Sri Lankans. Furthermore, postharvest management and value-addition of perishable crops is a priority area in the contemporary world, and where postharvest losses in fruits and vegetables have been estimated as 30-40% in Sri Lanka. The HORDI has been instrumental in considering and addressing the issues related to above aspects in planning its R & D activities since the livelihoods at the primary production and connected service provisions are the only source of income of several hundred families all over the island who are involved in vegetable crop and nursery plant production.

The records kept at HORDI and the publications made by its research staff reflect the number of research conducted under the themes of crop breeding, agronomy, plant propagation, integrated pest management, plant protection, plant disease management, soil fertility management, greenhouse crop production, development of organic crop production strategies and technology development for minimizing post-harvest losses and value-addition during last 3-5 years. It is obvious that the driving force behind the above mentioned research outcome of the institute during this period was predominantly the treasury funds (Annex 1). Some project funds that have been allocated in the form of research budgets as well as the annual allocations were being used for maintaining and upgrading of its human and physical resources.

This institutional review was conducted with several objectives as specified by National Science and Technology Commission of Sri Lanka (NASTEC). Among these, the key objective was to assess how effectively public funds had been utilized to achieve institutional objectives and its long and short-term co-operate plans on the regional or national issues related to sustainable production and post-harvest management of its mandatory crops. Secondly, it was aimed to assess the efficiency of resource use, smooth functioning of the institution and the long-term institutional stability. Guidelines provided by NASTEC and the knowledge and experience of the Panel of Reviewers were utilized to generate the facts mentioned in subsequent chapters of this report regarding the performances of the institution. Visits to HORDI and its regional research stations, observations on research facilities and infrastructure, interviews with different categories of cadres and stakeholders and the observations on the institutional records were the basic strategies employed for this review. Further, panel discussions were held at various stages of the review process to obtain clarifications on controversies and for confirmation of inferences made by panel members. As a result, it was possible to make final observations leading to a series of commendations

and recommendations which could be utilized by the institution for identifying its weaknesses and planning for better future performance.

Plate 1- Meeting with the Officers of the HORDI on 16th August 2018

2. PROCEDURE ADOPTED FOR PERFORMANCE REVIEW

Science & Development Act No. 11 of 1994 mandates the National Science and Technology Commission (NASTEC) to review the progress of S&T institutions in relation to objectives set out in Section 2 of the Act. The NASTEC in consultation with the institution to be reviewed decides on a review team as well as a schedule for the review. The team was guided by the directions given in the guidelines prepared by NASTEC for the performance review of S&T Institutions.

The Horticultural Crop Research and Development Institute (HORDI), Gannoruwa, invited NASTEC to review the institution. NASTEC in consultation with the HORDI entrusted the review task to a team of 5 members selected based on their expertise. The self-assessment report of the HORDI was made available to NASTEC. NASTEC met the review team on 13 June 2018 explained the objectives of the review and identified lines of inquiry as well as further information and documentation necessary for the review. The team also identified individuals as well as groups they wished to meet during the site visit and submitted a time table for the review (Annex 2 and 3).

The site visit to HORDI, Gannoruwa, was conducted on the16thand 17thof August 2018 (Annex 4). The Regional Agricultural Research Station Makandurawas was visited on 16th October 2018 and the Regional Research Stations at Sita-Eliya and Bandarawela on 17thOctober 2018. The review team explained the objectives and purpose of the review, to the Director HORDI and the scientific staff of the institute at the initial meeting at Gannoruwa (Annex 5). It was an opportunity to brief the institute staff on the purpose of the exercise and clarify why and for whom the evaluation was being carried out. The benefits of the exercise were explained to the HORDI staff at this meeting, so as to obtain their support for the evaluation. This was followed up by a presentation made by the Director of the institution based on the submitted self-assessment report.

The review panel held discussions with members of different categories of staff (Assistant Directors (Research), Technical Officers, Administrative and Support staff). The review team visited all the divisions of HORDI (Soil Science, Pathology, Plant Breeding, Entomology Divisions and Food Research Unit) and held discussions with the officers attached to each divisions and the unit. In addition, the review team observed the facilities available in each

division and went through their records on procedures and the periodical output indicators (annual reports, log books, research publications).

A stakeholder meeting was held on 27th September 2018 for getting their feedback on the institutional support, in the presence of representatives of HORDI. During this meeting, information on services provided by the HORDI to different categories of stakeholders (Farmers, Scientists, Private sector, University students and academic staff) was obtained (Annex 6). Furthermore, suggestions from different categories of stakeholders were also collected. Based on the information received, a report was drafted, following the guide lines provided by NASTEC.

Plate 2- Stakeholders Meeting on 27th September 2018

3. MANAGEMENT ASSESSMENTS

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

The external environment of an institution (e.g. consumer/industry needs, government policies, market conditions, partners, and competitors) critically affects its performance. Science & Technology institutions need to regularly assess these aspects in order to plan and respond effectively to challenges and opportunities, and to deliver results that are relevant and useful. It is important for an institution to periodically review and adjust its directions and goals, to meet these challenges, in turn may require significant actions, such as changes in focus and programs, organizational structure, and management strategies.

Table 3.1 Assessment of Institutional Response to External and Internal Environment in Planning Organizational Strategy

Management practice	**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	Strong	Cooperate plans and annual research agenda are developed based on national research priorities. Ministerial directions especially on development and extension are followed.
The organizational mandate (as specified by the relevant Act) is considered in strategic planning	Strong	
The institution is responsive to changes in Government policies and strategies	Strong	Annual Reports clearly indicate the changes in institutional activities in response to new directions according to government policies and strategies

Factors such as strengths, weaknesses, threats and opportunities are considered in strategic planning	Moderate	This is not well addressed due to inadequate number of senior Scientists and lack of trainings on relevant subject areas.
Stakeholders' needs are taken into consideration in strategic planning	Moderate	Not all stakeholders are treated with equal attention. Once again, staff shortage contributes to this issue and DOA should establish relevant protocols for stake holder consultations.
The Board of Governors is involved in strategic planning	Not Applicable	The board of directors, headed by the Director General of Agriculture makes Administrative decisions.
The extent to which staff members are involved in strategic planning	Strong	Research officers, RAs and AIs are invited for the Regional Technical Working Group Meetings (RTWG). Research planning is basically carried out by the technical working group. All researchers participate in these meetings. In addition research programme discussions are held at Institution level
Government allocations and alternative funding opportunities (donor funding) are considered in strategic planning	Strong	
The extent to which policies and plans of the organization are reviewed and updated	Strong	

Additional observations (if any)

Not all stakeholders, requiring the services of the institute, are given equal priority. A more robust system that engages all stakeholders needs to be developed with 'out of the box' thinking i.e., apart from past procedures and practices and precedents previously embraced. This is to ensure that policies, goals and targets championed by the institute will work as engines of positive economic growth and not merely a means of dispensing/facilitating government handouts/subsidies etc., as this cannot be considered a sustainable procedure in the long-term.

ii) Planning S & T programs and setting priorities

A program is "an organized set of research projects, activities or experiments that are oriented towards the attainment of specific objectives". Programs are higher in research hierarchy than projects. Program objectives should reflect user needs and development goals and be consistent with organizational strategies.

The national development goals within the mandate of Horticultural Research and Development Institute (HORDI) is considered when planning S&T programs and setting up priorities. The programs are discussed at each division of the institute and discussed at the HORDI before presenting at Working Group Committee meetings. Director, the Heads of Regional Agricultural Research Stations at Makandura, Seetha-Eliya and Bandarawela and all the Assistant Directors of Research are involved in program planning. When programs are planned, the stakeholders' interests (e.g. Farmer problems) are taken into consideration up to a certain extent. However, most of the programs are planned based on the mandate given to the HORDI by the Ministry of Agriculture.

The equipment and other requirements are considered during allocation of budget to each division for each program planned. In addition, the grants obtained from external donors (international and local agencies) are used for buying equipment and chemicals required for S& T programs.

Usually HORDI provides many services to farmers (e.g. soil analysis, fertilizer recommendations, plant protection and other advisory services), private sector organizations (variety evaluations, testing of chemicals before releasing them) and Higher Education Institutes (industrial/research trainings for students). However, all of these activities are performed as a service, without considering their commercial values. The transfer of results obtained from S & T programs are carried out by the extension staff (AIs) attached to the Provincial Departments of Agriculture and lack of coordination between Provincial Departments and HORDI makes difficulties in disseminating the outcomes of the S & T programs.

Table 3.2 Planning S & T programs and setting priorities

Management practice	Level of Practice (Performance Indicators Strong/Moderate/ weak))	Comments / Evidence
National development goals are considered in planning programs & setting priorities	Strong	In planning programs and setting priorities, relevant national development goals are considered by the higher authorities of the Department of Agriculture.
Board of Governors participate in planning and priority setting of program	Strong	There is no Board of Governors for HORDI. However, Board of Directors of the Department of Agriculture, Director HORDI and the senior staff involve in planning and setting priorities of research programs.
The extent to which the staff of the institution participate in programme planning and priority setting	Strong	Senior members are consulted and discussions are held during planning and priority setting when requested.
Stakeholder interests are considered in programme planning	Moderate	Farmer needs are considered in program planning. Attention to the needs of commercial growers appears to be poor.
The extent to which programmes are planned and approved through appropriate procedures	Strong	Programs are planned at institutional level, considering the issues raised at Provincial Technical Working Group meeting, and discussed at working group committee meetings in which external expertise are involved and approvals are obtained from the relevant authorities before executing them.
The extent to which the availability of funds (government allocations and other funds) generating funds are taken into consideration in planning programmes	Strong	Budgetary requirements are taken into consideration based on the estimated treasury provisions. Generating external funds is not considered adequately in planning programs.

The obtaining of necessary equipment is considered in planning programmes	Strong	Equipment needed for specific purposes are considered during planning process and obtained from grants written by officers and by using the financial allocation through the treasury. Fund allocation is done on need/priority basis.
Stakeholders are represented in the institution's planning and review committees	Moderate	All the stakeholder groups (e.g. farmers) are not represented in the planning or review committees.
The extent to which socio economic and commercialization aspects are considered in programme planning.	Weak	Commercialization and Socio economic aspects are poorly considered in program planning. Furthermore, the institute does not have an economist despite the existence of a vacancy.
Effectiveness and efficiency of institutional procedures in approving new S& T programmes.	Moderate	As HORDI is not an independent institute the effectiveness and efficiency of approving and implementing new S & T programs are hindered.

Additional observations (if any) –
With respect to identification of S & T needs, the entire supply chain of respective crops needs to be taken into consideration as a whole. This becomes incomplete when different horticultural crops/crop groups are handled by other institutions of the DOA as well as other institutions outside the DOA.

iii) Planning S & T / R & D Projects

A project is a set of activities designed to achieve specific objectives within a specified period of time. A project includes interrelated research activities or experiments, schedule of activities to be completed within a specific time period, budget, inputs and outputs, focused towards intended beneficiaries. Projects are the buildings blocks of programs. For an institution to achieve its objectives, it is necessary for projects to be well planned in terms of their expected outputs, activities, and input requirements.

Planning of the R and D projects is basically done based on the identified research priorities at the national level. Increasing productivity, reduction of post-harvest losses, protection from dominant biotic factors (pest and diseases) etc. are some of them. These research priorities are thoroughly considered in determining the objectives of the overall research program. Feedback of the stakeholders which is communicated directly through farmers or indirectly through extension workers (AIs) are incorporated to the proposal formulation process. Resourcefulness of the researcher or teams of researchers usually develops hypotheses for individual research steps within the overall project or series of research projects. These projects are screened and revised with the expertise of the higher officials of the Agriculture Department, scientists from related scientific fields within HORDI at the working group committee meeting with the participation of the external experts. The inputs or the feedback of Regional Technical Working Group (RTWG) meetings where invited experts (from universities or other research institutions) are involved, are considered during the planning process of R & D. Hence the planning process is theoretically well done, subjected to some deviations time to time.

Table 3.3 Planning S & T / R & D Projects

Management practice	Level of Practice (Performance Indicators Strong/Moderate/weak))	Comments / Evidence
The staff is provided with guidance for project planning	Moderate	The external funded projects are not well guided at the time of proposal formulations. However, the projects funded by line ministry are determined to match with the research thrusts and previous research programs. Adequate guidelines are given to the researchers for planning of the projects.
Previous research results / data are used for planning projects	Strong	During the Working Group Committee (WGC) meetings, the progress of the previous research is reviewed and the new research steps are planned according to the progress made.
The extent to which the institution follows a formal process for preparation, review and approval of projects	Moderate	Proposals are formally formulated only for ministry funded research programs. Projects are reviewed internally at the institute level. Even though, external expertise is harnessed to all research programs during technical working group sessions, their active involvement in research programs are very low.
The extent to which the organizational plans (e.g. medium term plan, corporate plan, strategy etc.) are used to guide project selection and planning	Strong	The institutional research plans (Five year plans) are made largely based on the national research priorities. When the annual research programs are revised, they are matched with the above research plans (in the WGC meetings) and also when all the proposals come to the approval stage, their compatibility with the long/medium-term research plans of the institution is matched.
Multidisciplinary projects /activities are encouraged and incorporated in planning	Weak	Both Sri Lankan academic and research institutions do not have a strong research culture. Thus, the much-needed healthy multi-disciplinary collaborative approach to tackling research problems is not visible, and needs to be introduced and encouraged.

Foreign collaborations are encouraged and incorporated in planning	Moderate	There is one international project with the Korean government (KOPIA). Earlier there were projects on vegetable production with the SAARC countries and Korea (AFACI). However, the situation is not appreciable compared to the general history of the Agriculture Department on foreign collaborations. This need to be improved by developing projects with foreign institutes enabling local and foreign scientists to share technologies and expertise with each other.
Partnership with private sector is encouraged by the institution	Weak	The private sector use HORDI as a service provider for the registration process of their imported agricultural inputs. However, they rarely have long/medium term collaborative research programs with the private sector organizations. Therefore, research programmes should be developed to cater to the needs of the private sector and a private public research culture needs to be established.
The extent to which development research / activities are considered in planning projects	Strong	Development research / activities are considered in planning projects.
The extent to which basic research are considered when planning projects	Moderate	Lack of collaboration with other divisions and institutions and lack of library use results in basic research being given low priority. Exposure to recent literature is very low and facilities need to be improved within the DOA premises for all researchers.
The degree to which adverse effects on environment are considered in planning projects	Strong	There is on-going research on the impact of agrochemicals on the soil, water and plant materials. The concerns on eco-friendly fertilizer and pest control strategies and also soil conservation needs in agriculture are being addressed.

Additional observations (if any)-
While valuable research is conducted with tangible output, this does not seem to percolate down to farmers and large-scale producers very effectively. This situation negatively influences the purpose of the investments made, and the hardwork put into practice for obtaining useful research findings. Furthermore, the multi-disciplinary approach for resolving research problems needs to be promoted more aggressively.

iv. Project management and maintenance of quality.

Proper project management and quality assurance/improvement practices are needed to ensure effective research operations, the quality of output and achievement of desired objectives.

HORDI receives funds through the Ministry of Agriculture, under the administration of Department of Agriculture from the treasury. It was noted that HORDI receives sufficient funds as per the requests made by different regional research stations and HORDI. Therefore it can be concluded that resources are allocated fairly among regional research stations, and among divisions of research stations. The practice of resource allocation is strong and fair.

Instruments, and equipment are generally purchased through the treasury money as well as foreign projects e.g. KOPIA. Basic laboratory facilities are available and equipment, housed in the laboratories, is in good working order. However, some of the equipment is outdated and requires replacement or improving of safety features e.g. Fume-hood facility. Having considered the overall facility in HORDI and other regional stations, this aspect could be judged as moderate. It is important to make a long-term plan for laboratory improvement. The purchase of equipment should be based on a rationalized priority agenda. It is also important to use the equipment at optimum capacity to maintain the good working conditions and the best use.

Administrative support for project implementation is adequate and affective. There is a well-established procurement procedure as per the financial regulations (FR). Most of the purchases are done at institute levels and adequate support systems are available. Adequate transport facility is available; however, distance factor as well as excessive travelling for administrative matters and developmental activities is a concern of researchers. This aspect is considered as strong.

Project monitoring and review process are limited to the meetings at institute levels, and to a very few meetings (two meetings per year). Participation of external expertise or senior researchers of other institutes within DoA was not evident; hence, this aspect should be improved significantly. The current practice is considered as moderate.

Technical/ field staff support is not adequate as the technical staff is loaded with the routine works, in addition to the research support work. Most of the newly recruited research assistants are degree holders, and they have a good capacity to support research programs. Mobility of the human resources (HR) is the matter. This aspect is considered as moderate. Standard laboratory protocols are used and the researchers are aware on standard

methodologies etc. This standard is considered as strong. Projects are completed on time or with a short extension.

Researchers have internet access but do not have access to scientific journals or international data bases. This aspect is considered as weak. There is no formal quality control practices in place; hence, this aspect is considered as weak.

Researchers have access to computers either through their office or through the computer unit. Internet facility is available at the institute level but not sufficiently at division level. The basic software is also available. However availability of registered software is inadequate. This quality standard is considered as moderate.

In addition to research work, the researchers are involved in general administration, attending to general queries such as pest and disease identification, general farmer inquiries as well as participation in meetings. This appears to be hindering the progress of their planned R & D work within the institute.

Table 3.4 Project Management and Maintenance of Quality

Management practice	**Level of Practice (Performance Indicators Strong/Moderate /weak))**	**Comments / Evidence**
The effectiveness of the procedures for resource allocation at different levels (organization, Departments, program etc.)	Strong	Treasury money is being allocated among research institutes, research divisions and programmes as per the request in a fair manner. The available human resources in research divisions, research institutes are poor due to delays in recruitment.
Ensuring that instruments, equipment and infrastructure facilities are sufficient for implementation of projects	Moderate	Basic laboratory facilities to implement the projects are available. Long-term plan for improvement of laboratory facilities is not apparent.

The effectiveness of administrative procedures and support for project implementation (procurement and distribution of equipment and materials, transport arrangements, etc.)	Strong	Well established procurement procedure is in place; adequate transport facilities are available for researchers; delay in paperwork has been a concern.
Formal monitoring and review processes are used to direct projects towards achievement of objectives	Moderate	Monitoring and review of project is limited to a few meetings at institute levels; no external parties are involved; no adequate technical evaluations at monthly progress review meetings.
The extent to which the researchers are supported by the required technical / field staff.	Moderate	Sufficient numbers are available; however, technical staff is involved in too much of routine work; hence, time allocation for research activities is limited.
Ensuring that established field / lab methods, and appropriate protocols are used	Strong	Standard methodologies are being practised for research work; Regular review sessions are held to upgrade the technology
Research projects/ S& T activities are completed within the planned time frame.	Strong	Most of the research projects are completed within the planned time frame or with short extension. Sometimes it is beyond the control of the institute.
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	Access to scientific journals, international databases is limited. No inter-institutional or international collaboration or exposure.
The extent to which quality assurance practices are followed by the institutions	Weak	There is no apparent formal quality assurance procedure in place. Laboratories need to be accredited

Ensuring that researchers/scientists have access to computers and necessary software	Moderate	Researchers have access to computers/internet; access to e-literature sources is very limited and registered statistical software is not available.

Additional observations (if any) Accreditation and Standardization of all research laboratories is a requirement to maintain the quality of the research data. This will greatly improve and facilitate project management. The Food Research Laboratories are particularly in need of refurbishment, given that food security is a national priority.

v. Human Resource Management

Availability of an adequate number of qualified staff and effective management of human resources are key determinants of organizational performance. Establishing a cadre of qualified staff takes many years. To keep pace with new developments in science, technology, and management, it is also essential to upgrade staff regularly. Staff planning, selection, recruitment, evaluation, and training are key components of human resources management that need to be in place for effective performance of an institution.

The Institute follows the guidelines set forth by the Ministry of Agriculture in recruiting all the permanent cadres. The Head Office of the Department of Agriculture recruits staff members and assigns them to each institute, and also transfers them whenever a need arises. The Director of the Institute is not empowered in recruiting and/or transferring permanent cadres. Even though Director (HORDI) and all DDR (Deputy Director Research) positions at Regional Agriculture Research and Development Centers (RARDC) are filled, they are unable to work efficiently and effectively due to unavailability of sufficient number of Assistant Directors (Research). For instance, out of the 10 Assistant Director (Research) cadres at RARDC, Seetha-Eliya, only one cadre is filled. Moreover, few Assistant Directors at all the centers is compelled to handle too many projects in addition to attending to too many meetings and too much report writing. Furthermore, because of the too much of workload on the shoulders of DDRs and those few Assistant Directors, they are unable to adequately guide other staff members such as Research Assistants and Technical Assistants. All these drawbacks affect the delivery of outputs and have created a serious problem within the institute, which has to be resolved as soon as possible.

Even though sufficient numbers of opportunities are available for staff training, the type of training they receive does not always contribute to improvement in job performance. Therefore, it is important to identify training programs that are relevant to the staff member to enhance the essential skills and develop transferable skills, which subsequently improve on-the-job performance of trainees. Staff training programs are identified by the Head Office while staff members are nominated, based on seniority and/or taking a subject-oriented approach by the directors of the institute. A formal procedure adopted for appraising staff performance was not evident. Clearly identified rewarding systems and incentive schemes for motivating the staff were also not evident, other than the awards presented at ASDA. Working environment of most of the places in the institute, which includes both physical environment and relationship among the superior, subordinates and peer groups, appears to be conducive enough to encourage employees to work. However, extremely poor physical environment of the Food Research Unit severely de-motivates employees. Moreover, as stated above, overload of work on DDRs and Assistant Directors (Research) disturbs the working environment at times, discouraging them to work. Furthermore, as the libraries are not adequately updated and without having access to full papers published in indexed journals, employees who are engaged in research often get discouraged. Even though Human Resources Management (HRM) aspect of the institute is essentially adequate, it would be advantages if succession planning and knowledge transfer is introduced for minimizing the risks associated with employees leaving, whether through retirement, overseas training or for other reasons.

Table 3.5 Human Resource Management

Management practice	Level of Practice (Performance Indicators Strong/Moderate/ weak))	Comments / Evidence
The institution maintains and updates staff information in a database (including bio data, disciplines, experience, publications, projects)	Strong	Staff information is well maintained and updated.
The institution, plans and updates its staff recruitments based on programme and project needs	Weak	Even though programmes and projects are identified in a methodical manner, less than 50% of research officer vacancies are filled.
The effectiveness of the selection procedures and the schemes of recruitment	Strong	Even though selection procedures and schemes of recruitment are effective, efficiency of staff recruitment is questionable.
Training is based on institution and program objectives and on merit.	Moderate	The staff members receive adequate training. However, it appears that training does not always meet the programme objectives and more biased towards seniority.
The effectiveness of the procedures in promoting a good working environment and maintaining high staff morale.	Moderate	On-the-job performance should be considered when making promotions etc.
The effectiveness of staff performance appraisals	Moderate	A formal procedure, which is sufficiently transparent, needs to be established for staff performance appraisal.
The effectiveness of rewards and incentive schemes in motivating the staff	Weak	A more strategic procedure needs to be established to motivate the staff through rewards and incentives.

The effectiveness of managing staff turnover, absenteeism and work interruptions.	Moderate	Need to assure continuation when staff goes on long leave. Recruitment backlog has not been cleared

Additional observations (if any) Immediate action must be taken to resolve promotion and staff recruitment disputes. Recruitment for different divisions (e. g. Plant Pathology, Plant breeding etc.) does not seem to be based on expertise in many cases. Training needs should be allocated on performance and according to respective research expertise needs. A transparent procedure for recognizing staff performance needs to be put in place.

vi. Management of organizational assets

Organizational assets include not only staff buildings, equipment, and finances, but also include assets such as knowledge, technologies developed, intellectual property, and even credibility and reputation. A continuous effort is needed to protect all of these assets, because they are the basis for the sustainability of the institution and allow it to continue delivering quality research and service outputs.

The Horticultural Research and Development Institute has infrastructure and human resources except the Assistant Director Research positions to achieve its mandate reasonably satisfactorily. In general, HORDI at Gannoruwa as well as the Regional Centres at Makandura, Bandarawela and Seetha-Eliya maintain their buildings, fields and equipment in very good condition. However, some sections such as the Food Research Unit need urgent refurbishment. Review team observed that Soil Science Laboratory is applying for accreditation. While this is commendable, buildings and infrastructure of the Food Research Unit at Gannoruwa are in poor condition, need urgent attention for upgrading and should also work toward obtaining accreditation as it is essential to provide a good service to private sector food companies.

The institute generates funds by analyzing farm soils and testing new varieties imported by the private sector companies. However, no proper strategy is implemented to generate funds effectively. Review team observed that HORDI conducts many training programs annually and also provides many services to public and private sector organizations free of charge. Thus, HORDI can investigate the possibility of using these avenues for generating funds. At present all the generated funds are deposited in the consolidated fund and HORDI does not have any opportunity to utilize those funds to its own improvement.

A mechanism should be drawn to utilize the generated funds by the HORDI efficiently and effectively e.g. by directing to a Trust Fund managed by a Board of Trustees.

Even though HORDI has released many vegetable varieties, achieving sustainability and self-sufficiency of vegetable production in Sri Lanka, breeders rights have not been acknowledged or appreciated. Therefore, it is essential to develop a scheme for intellectual property rights, giving due recognitions to the scientists.

Table 3.6 Management of Organizational Assets

Management practice	**Level of Practice (Performance Indicators Strong/Moderate/ weak)**	**Comments / Evidence**
The ability of the institution to carry out its mandate and the assigned statutory powers	Moderate	Even though, HORDI has reasonably adequate infrastructural facilities to carry out its mandate the staff availability is a problem. The Institute needs more autonomy to take decisions.
Infrastructure (buildings, stations, fields, roads) is satisfactorily maintained.	Moderate	Even though, majority of the facilities are maintained satisfactorily some laboratories are not well maintained. Further improvements can be achieved specially in out stations.
Vehicles and equipment (lab, field, and office) are properly managed and maintained.	Moderate	Some of the equipment and infrastructure facilities (e.g. Food Research Unit) need repair and upgrading.
The effectiveness of procedures to ensure that equipment are in working order	Moderate	Repair and replacement of equipment seems to take some time. A proper training for selected staff members on maintenance of respective equipment, and advanced technologies would overcome this problem.
The effectiveness of the institution's overall strategy in generation and proper utilization of funds	Weak	Institute utilizes treasury allocation and funds received from external organizations (e.g. FAO) effectively. Institute is not involved in generating funds at the moment but there is a great potential for generation of funds.

The extent to which the institution identifies opportunities for income generation and cost recovery	Weak	Even though there is a high potential to generate funds, institute has no benefit since generated funds cannot be utilized by the institute.
The extent to which the intellectual property rights of the institute are protected	Weak	Intellectual property rights are an essential item to be introduced with regard to development of new varieties and technologies by the Institute.

Additional Comments (if any)
The Institute needs experienced researchers to lead their respective research laboratories. A system for developing human resources to ensure continuity and sustainability of research programmes needs to be put in place. Many laboratories are in poor condition and need to be refurbished as soon as possible e.g., the Food Research Laboratory. Procedures aligned with accreditation of laboratories need to be adopted.
Many opportunities and avenues for income generation are being overlooked. In many cases private sector bodies who can afford to pay for the Institutes services are obtaining such services free of charge at great cost to the institute. Researches need to be motivated to perform at international levels. Participatory research programs with small farmers need to be expanded in order to exploit the resources of the institute to the fullest extent. The organizational plan of the Institute needs to be revisited to optimize use of its human and other valuable resources to meet the needs of the national goals and priorities

vii. Coordinating and Integrating the Internal functions / units / activities

The planning and coordination of units (departments, divisions, committees, research stations, etc.) and interaction among them are often neglected and it affects the overall performance of the institution. The organization of these units and the overall structure need to be reviewed from time to time to ensure smooth and efficient operations. The planning and coordination of units, logistics, resources, and information flows are necessary to achieve integration and smooth functioning.

Coordinating and integrating internal functions are practiced through the staff meetings of Head of the Divisions; Research (Executive) staff as well as the workers (at divisional levels). However, the decisions made are not fully implemented all the time. Lack of facilities such as research staff, supporting staff, e-libraries and computerized data management and transport facilities at divisional levels have been fueling this situation. Assignment of different tasks and responsibilities for different sections (Divisions) is a blessing for proper coordination of the internal functions, units as well as and also the activities. RTWG

meetings based sharing responsibilities also provide enough grounds for coordinating activities among units (Divisions).

Table 3.7 Coordinating and Integrating the Internal Functions, Units and Activities

Management practice	**Level of Practice (Performance Indicators Strong/Moderate /weak))**	**Comments / Evidence**
The extent to which institution is evaluated internally and restructured based on current needs	Moderate	The internal evaluations on the institutional management are rare. Restructuring is not based on long term outputs.
The effectiveness of internal communication and coordination mechanisms	Moderate	The grievances of some divisions are not heard by the institutional management (e.g. Food Research Unit)
Institution's overall direction and coordination are provided by a central planning committee / unit	Weak	Not practiced. No such committee.
The extent to which different units are assigned clearly defined functions	Strong	The divisions are based on the subject areas. Their tasks lists are well defined.
Responsibilities of research / management staff are clearly identified	Strong	Yes. All are assigned with crops or disciplines. However, they are not always provided with adequate resources.
Effectiveness of using appropriate reporting procedures and feedback in management at different levels	Moderate	Second hand information flow is there as the feedbacks of agricultural instructors are voiced at the regional technical group (RTWG) meetings. Reporting procedures have many gaps mainly due to lack of computerized data management systems in many divisions, except the Soil Science Division .There needs to be a transparent system in place.

Additional observations (if any)-
Some co-ordination does exist. However, procedures need to be re-visited and the human resources in particular placed in positions so that the expertise developed by individuals can be exploited effectively. Fragmentation of existing administrative units could be damaging to the overall output of the institute. Also development of new units must not be made at the expense of neglecting existing regional institutions which have previously been put in place for meeting regional agro-climatic requirements and optimizing productivity in these zones. Wherever possible the original broad framework with its simplicity of structure should be adhered to. Fragmentation can result in unwieldy increase in administrative procedures.

viii. Partnership in managing information dissemination.

The management of dissemination of technology and information to users is an important requirement of all S & T or R & D institutions. The partnership / linking up with other actors in Science & Technology and information system (including, universities, industries, private sector, international research organizations, extension, farmers etc.) promotes information exchange, collaboration, and cost sharing, and ultimately improves the quality and relevance of research.

Dissemination of information is being done through many informal channels such as training of candidates on diploma/ undergraduate level and at farmer level. Certain procedures such as ASDA programmes, websites and publishing in Tropical Agriculture, TV programmes, Radio programmes have been formalized. This aspect is considered as moderate.

The linkage with key partners appears to be informal such as private sector organizations that are involved in supplying of agricultural inputs. Diffusion of key information to stakeholders as well as getting feedback from key partners is also not formal and appears to be very weak; hence, this aspect in general is considered as weak.

It appears that there is no formal and established institutional procedures for technology transfer except through the committees at DOA levels e.g. varieties release committee. Sharing of knowledge on key finding is taking place through the training of field extension. Training of extension staff is also not formally organized by the HORDI. No strong link was observed between the Extension divisions of DOA and the HORDI. There is no effective system to obtain feedback from different types of stakeholders. There is no standards or set procedures to take the feedback from the stakeholders.

Table 3.8 Partnership in managing information dissemination.

Management practice	Level of Practice (Performance Indicators Strong/Moderate/ weak))	Comments / Evidence
The institution systematically plans and performs dissemination of information	Moderate	Not all stakeholders are considered; some information dissemination mechanisms are in operation in collaboration with other sister organizations within DOA.(e.g. NICC)
The extent to which the institution plans and maintains linkages with key partners for sharing and dissemination of information	Weak	Not all stakeholders are considered; most of the channels used by the Institution is informal; no direct linkages with key partners, operated by the institute.
The effectiveness of institutional procedures for technology transfer	Weak	There is no strong extension service operated by HORDI; it was the mandate of the extension division of DOA.
The effectiveness of the system to obtain feedback from different types of stakeholders	Weak	Not all stakeholders are considered; not all have the access to HORDI, there is no formal system to get feedback from stake holders except RTWG meetings.

Additional observations (if any)
The Institute needs to recognize the importance of horticulture crop production in terms of the economies of scale. Assistance is needed for not only lead farmers at village / regional level but also commercial farmers who work without-grower systems. Technological assistance is reaching the farmers to some extent but more strong initiative from the institute is necessary.

ix. Monitoring, evaluation and reporting procedures

Monitoring (assessing ongoing S&T / research activities) and evaluation (evaluating the value, quality and results of research) [M&E] are key management processes of public S&T institutions. Monitoring and evaluation are also important for determining whether the institution is learning from its earlier achievements and failures. Monitoring, evaluation, and reporting procedures need to be properly designed (i.e. integrated into project planning and implementation) and periodically reviewed, in order to provide useful information for decision-making and accountability.

The institute holds regular meetings at the stages of planning and executing R&D activities. The progress of each activity is effectively monitored and results and other outputs are adequately reported through presentations, reports, brochures and booklets, publications in the form of abstracts and full papers etc. However, quality of such reporting can be improved if the institute provides facilities on statistical analysis and takes measures on improving skills on scientific writing. Such approaches could better reflect the activities performed by scientists, thereby contributing to achieve the desired goals of the institute. Moreover, as monitoring and evaluation and reporting procedures are not adequately supported by a PC based Management Information System (MIS), establishment of such a system is beneficial. Furthermore, MIS can facilitate smooth and efficient running of the institute while ensuring dissemination of the benefits of S&T activities to all sectors and strengthening S&T cooperation among scientists & technologists of Sri Lanka and those abroad. Even though strong links with farming communities exist, the need for establishing links with more private sector organizations is vital. Such links could contribute to continuously planning R&D activities and decision making based on priority areas that are beneficial and also to getting the stakeholders effectively involved in M&E process of the institute.

Table 3.9 Monitoring, Evaluation and Reporting Procedures

Management practice	Level of Practice (Performance Indicators Strong/Moderate /weak))	Comments / Evidence
The institution monitors and evaluates (M&E) its own activities periodically	Strong	Formal internal evaluation is practised periodically. However, outcomes are not visible.
M&E is supported by an adequate management information system (MIS), which includes information on projects (e.g. costs, staff, progress, and Results).	Weak	Financial monitoring is done at the progress review meetings of the DOA. However, no effective mechanism exists for research progress evaluation by divisions and scientists. Therefore, establishing of an MIS is an absolute necessity.
The extent to which S&T results and other outputs are adequately reported internally (e.g. through reports, internal program reviews, seminars).	Strong	Results and other outputs are adequately reported internally. However, no progress thereafter and information remains internal.
External stakeholders contribute to the M&E process in the institution	Moderate	The private sector is involved in the process to some extent and needs further improvements.
The extent to which the results of M&E are used for project/research planning and decision-making.	Moderate	The results are used to some extent, thus needs improvement. Allocation and use of resources is weak in many cases.

Additional observations (if any)

M&E system is in place but implementation and follow-up action needs to be improved. Reporting of research output is also not adequately addressed. Publication in International Journals as well as journals published outside the DOA and patents needs to be treated as an output indicator.

4. OUTCOMES OF THE STAKEHOLDER MEETING

As a part of the reviewing process of HORDI, the review team had a one-day meeting with the stakeholders of HORDI on 27th September 2018 at the Institute of Continuing Education in Animal Production and Health (ICEAPH), Gannoruwa. The 35 participants who attended this meeting represented Universities (Academic Staff and Students), Agricultural Schools, Government Institutes, Private Sector Companies and Farmers (Annex.6). A questionnaire (Annex. 7) was circulated to all participants to gather information on quality and the customer satisfaction on services provided by the HORDI to the Agriculture Sector in Sri Lanka. Besides the information collected through the questionnaire, the meeting included a discussion session where participants had the opportunity to introduce themselves and share their individual experience on their interactions with HORDI. The majority of stakeholders who attended the meeting had obtained training and advisory services from the HORDI (Annex 8 -Fig 1 and Fig 2)

It was apparent that stakeholders expected a wide range of services from HORDI, where many of the expected services were business/profession oriented (Annex 8 Table 8.1). The majority of the stakeholders indicated that they visited HORDI frequently (Annex 8 Fig 3) to obtain the required services and were very satisfied with the services provided by the Institute (Annex 8 Fig 4). Furthermore, 28% of the stakeholders preferred to obtain the service by visiting the HORDI followed by, telephone calls (22%) and emails (11%) (Annex 8 Fig 5). The stakeholders were highly satisfied with the way they were received by the Institute (Annex 8 Fig. 6) and the information/guidance or services provided to them were considered as highly useful (Annex 8 Fig. 7). At the end of the discussion, many suggestions were made by the stakeholders to improve the quality of the services provided by the Institute.

4.1 Suggestions and Recommendations to improve the services provided by the HORDI

1. A close collaboration between HORDI and all the stakeholders is an essential requirement. Even though stakeholders prefer to obtain services by visiting or contacting through telephones or emails, the high workload assigned to HORDI officers made it difficult for them to attend to such requests under the prevailing shortage of research staff. Therefore, it is essential to develop a close link with the Extension Division of the Department of Agriculture to provide required services. Furthermore, HORDI can develop an online help service to relieve the burden of

Research Officers. It also appeared that the public awareness about the services provided by HORDI was inadequate and needed to be addressed.

2. HORDI has very good relations with State Universities in Sri Lanka. Many undergraduate and postgraduate research projects are conducted at different institutes in collaboration with HORDI, and HORDI provides the fullest support and commitment in conducting such research projects. The majority of these research projects are established by research officers through personal contacts with the academic staff. Thus it is essential to formalize this system by developing an MOU with the Institutes involved in such projects. Furthermore, HORDI laboratory facilities could be improved to conduct more advanced studies. Proper guidance from senior researchers would be essential to improve the quality of the work done by students.
3. HORDI conducts numerous workshops and organizes comprehensive discussion and training programs for all categories of people engaged in fruit and vegetable production (farmers, teachers, students, private sector organizations). Stakeholders expect sharing of research information related to pre and post harvest management of seasonal fruits and vegetable, proper guidance & information on characteristics of newly released varieties and the direct involvement of HORDI in solving problems that arise at the field level (e.g. pest and diseases). This may be achieved by improving the extension services or by establishing adequately staffed field research units in each district.
4. HORDI is involved in programs to empower self-employment (e.g. Mushroom cultivation, Vegetable cultivation). Stakeholders expect a thorough training at the beginning, with continued advisory services during the venture. Such services need to be budgeted and clients should be charged accordingly for the services provided as often such services are provided gratis to large commercial companies. Schemes need to be developed to provide this service to small and medium level at a nominal cost.
5. During the stakeholder meeting it was emphasized that HORDI should have formal links with other institutes that are involved in similar activities (ITI at Colombo, IPTH Anuradhapura etc.) to share the knowledge and to avoid repetition of the work.
6. Fruits and vegetables are considered to be an essential component of human nutrition, and therefore it is essential to develop formal link with Ministry of Health and share the knowledge generated by the HORDI with the health sector.

5. OUTPUT ASSESSMENT

5.1 TECHNOLOGIES DEVELOPED AND TRANSFERRED TO INDUSTRY

HORDI and its regional stations have developed many agro-technologies (Annex 9) to improve the productivity of the Horticultural crop sector in Sri Lanka, in accordance with the Vision and the Mission of the Institute.

The most outstanding outputs are the efficient fertilizer management packages developed for almost all vegetables grown in Sri Lanka. Furthermore, a considerable number of research projects, undertaken by the Institute, have focused on germplasm conservation leading to the development of new varieties (Annex 10) which contribute to increase in horticultural crop production in Sri Lanka.

While HORDI is engaged in recommending new hybrid vegetable varieties for importation by private sector organizations, the performance of such recommended varieties must be followed-up under farmer field conditions to verify the recommendations given by suppliers. It is noted that the, financial contributions made by the seed importers for these activities is minimal. It is recommended that these rates should be revised to meet the basic cost of the service provided to these private sector companies. The payment schemes and procedures are needed to be revised in way that both parties are benefitted.

New recommendations have been made on new pest problems (e.g. Root Knot Nematodes of Guvava) and alternative environment-friendly technologies have been developed for pest and disease management and such activities are highly appreciated. Papaya mealy bug outbreak has been a serious issue in the country and the staff of HORDI has taken adequate measures to resolve the problem by introducing a parasitoid species, which is a case example of addressing a national issue by the HORDI.

However, HORDI needs to plan its research programs and projects towards the upcoming needs of some important stakeholder groups such as vegetable consumers, value-chain managers, exporters, protected culture growers, ecological (i.e. organic) farmers, vegetable smallholders to provided acceptable answers to their burning needs

Meanwhile, a new technology developed by HORDI that is of commercial value was not evident, except for the newly released varieties. HORDI has mainly focused on uplifting horticultural crop production in Sri Lanka based on its mandate by providing services to the farming communities, while catering to the needs of the input suppliers. The Institute needs to develop and adapt new technologies which have the potential for making a commercial impact on the fruit and vegetable industry for the long-term sustainability of the institute.

5.2 INFORMATION DISSEMINATION

The institute has prepared several advisory leaflets with technical information for distribution among stakeholders (Annex 11, Table 11.1). Furthermore, the institute has organized exhibitions, media discussions (Radio/TV), open days, demonstrations for stakeholders including farmers, school students, university students and the general public and Research/Extension Dialogues (Annex 11 Table 11.2-11.5). Involvement of university students in research projects and training programmes is an important feature of the Institutes activities with respect to collaboration with other research and academic institutions (Annex 12). New technologies reach a certain group of stakeholders through the DOA website. However, it is necessary to update this information on a regular basis and also provide the complete set of information that is needed for the resolving of field problems.

It is essential to encourage officers to produce more horticultural leaflets and posters along with training manuals including necessary production practices for all respective crop groups as well as manuals on integrated pest management (IPM) programs for horticultural crops for dissemination of technologies so as to enhance horticultural crop production in Sri Lanka.

HORDI provides a large number of training programs to different categories of stakeholders. It would be useful to formalize these extension programmes in collaboration with the In-Service Training Institute and the NICC.

5.3 SERVICES

HORDI provides a range of services to the farming community as well as to private sector organizations in Sri Lanka (Annex 13). Among them the soil analytical services provided by HORDI and its regional research stations are highly commendable. HORDI has developed soil testing laboratories in each of 20 districts respectively, with the objective of providing quick and efficient services to farmers. It is noted that the Soil Science Laboratory is applying for accreditation with the objective of providing a better, more professional and internationally recognized service to the farmers. In addition, HORDI provides diagnostic services to the farming community for screening of plant materials for disease (Viral/fungal/bacterial) through new technologies (e.g. ELISA technique). Entomological problems brought by the farmers to the institute are also resolved with researchers providing necessary advice to the clients. Other crop production issues requested by farmers and other stakeholders through the toll free phone service (1920) are resolved and advice is given as per the need. Food Research Unit provides analytical services to the industry (Annex 13).

The contribution of HORDI for seed and planting material production is also much appreciated (Annex 14) by growers and consumers. Seed potato production is mainly looked after by the Regional Agricultural Research Station at SeethaEliya and their contribution to seed potato production is highly appreciated. Expansion of this service is necessary for the country and as such is highly recommended.

5.4 RESEARCH GRANTS AND PUBLICATIONS

HORDI Researchers have some published research findings in local and international journals. Most of them have presented their findings in international and national conferences, symposia, workshops and seminars. However, it was noted that only a few publications are in SCI journals. Therefore, it is essential to encourage officers to publish their finding in indexed journals. Compared to the number of research officers in the institute, the number of publications is very minimal.

Table 5.4 Number of publications and the source
(Source- Self Assessment Report Provided to NASTEC)

Source	No. of Publications
No. of SCI Journals	1
International Journals	0
Local Journals	9
Proceedings of International symposia	1
Proceedings of Local symposia	6
Local Symposium (Abstracts)	3
News letters	5
Research news	12
Newspaper articles	2
Booklets	3

The whole research programme and the development programmes of HORDI are conducted using the funds received through the Ministry of Agriculture and the NARP projects. There were very few research grants obtained from the national level donor agencies such as National Science Foundation and National Research Council and other sources of international funding. When negotiating international grants it is very important to ensure that practical on ground realities are taken into consideration when equipment is assigned to respective beneficiaries inside and outside the DOA. This would avoid the perpetuation of mismatching as for example the very valuable micro-vacuum dryers originally handed over to lead farmers in rural areas with no knowledge or even necessary electrical connections to use

these facilities effectively. As per the data given, most of the research programmes or development programmes have not utilized the total allocated funds (Annex 1). The reviewers found it difficult to assess the research programmes as the project objectives, project outcomes and the fund allocations are not linked clearly.

5.5 PATENTS

None of the researchers have obtained any kind of patent for their efforts. Even though, institute has developed many vegetable varieties and many recommendations on management practices, patent rights are not received either by the researcher or the Institute. Furthermore, all the developed varieties and technologies have been distributed among the stakeholders either free of charge or with a minimum charge which is not even enough to cover the cost of the development of the particular technology. Therefore, it is essential to develop procedures for securing intellectual property rights and royalty payments for researchers as well as the institute. It is noted that Plant Variety Protection (PVP) Act is under preparation in the Department of Agriculture.

5.6 STAFF STRENGTH AND TRAININGS

It was clearly indicated by the research staff that the recruitment for Sri Lanka Agriculture Service is being delayed by many years creating a serious shortage of staff for smooth running of the research programmes. Many of the newly recruited Research Assistants and the Agriculture Instructors have sufficient academic qualifications to share the responsibilities of the research work. It is highly recommended to take appropriate measures to fill the cadres of Agriculture Service as soon as possible.

The technical and other support staff (except the newly recruited staff) has gone through adequate training to carry out their duties in the work place. New staff requires going through suitable well planned induction programs.

Almost all the members of the research and technical staff have attended overseas training programs especially in China, despite its meager contributions towards upgrading the knowledge and skills of the trainees. The number of researchers who have overseas training at Postgraduate levels (PhD/MPhil/MSc) is not adequate. However, it was noted that the CARP has initiated a programme in 2018 for such training.

6. CONTRIBUTION TO NATIONAL DEVELOPMENT

The HORDI has played a significant role in development of the horticulture sub-sector of the Sri Lankan economy from the time of its inception. Many technologies have been adapted, developed and disseminated to the farming community. The institute has played an important role with regard to achieving self-sufficiency in vegetable production in Sri Lanka. The country produces sufficient vegetables to meet its requirement except for few imports by hotels. The production and productivity in the country is assured owing to technologies developed by the DOA in crop management together with the varieties released. Though many imported varieties are present, those varieties are also carefully selected for local adaption and the technology packages available to keep them producing good yields.

The most outstanding output of the HORDI is fertilizer recommendations made for all the respective vegetables grown in the different agro-ecological regions in Sri Lanka.

Furthermore, the institute has developed recommendations on pest management which works very well with controlling common pests as well as newly introduced pest species of vegetable crops e.g. the recent incidence of the newly introduced papaya mealy bug and leaf miner to Sri Lanka. Integrated pest management packages for management of fruit fly populations as well as for managing the yellow bean syndrome are recent tangible key outputs of HORDI entomologists.

In addition, HORDI's Plant Breeding Division developed new varieties of vegetables (e.g. tomato, brinjal, luffa, sweet potato etc.). These researchers work with various individuals (farmers, other researchers, private sector) to improve the productivity of horticultural crops through breeding programs. These programmes contribute towards farmers' accessibility to quality seeds as well as improving their income. Sri Lanka is considered as one of the world's biodiversity hotspots and has large number of germplasm, which are important especially for the agriculture sector. In general, Sri Lanka possesses many land-races and traditional cultivars of many fruit and vegetable species, providing an important gene pool for crop improvement. The availability of the large number of germplasm can also play a very important role as a source of resistance to biotic (pests and fungal diseases) and abiotic (e.g salt tolerance) stresses in crop varietal improvement programmes. However, at present the wealth of this variable gene pool has been only marginally exploited, leaving a great deal of opportunities for the future development of improved cultivars via national breeding programmes. Thus, HORDI can take the initiative to promote commercialization and

popularization of underutilized horticultural crop species in many parts of the country, preferably in collaboration with the private sector.

The involvement of Regional Agricultural Research Stations at SeethaEliya and Bandarawela in seed potato production is one of the most important contributions of the HORDI to National Development. The institute is involved in supplying more than 50% of the country's requirement of seed potato production by providing parent population (G_o) using new technologies such as plant tissue culture techniques for multiplication of seed potato and development of planting materials through tower methods. Furthermore, all the regional stations (Makandura, Bandarawela and Seetha-Eliya) contribute to national development by providing advices or recommendations on pest management, nutrient management and irrigation management for specific crops growing in the particular region.

Even though, mandate of HORDI is for vegetable crop production, farmers engaged in the production of floricultural crops and fruit cultivation (e.g. strawberry) around Bandarawela and Seetha-Eliya regions request the services from these two stations and researchers provide advices/recommendations to them as much as possible. Thus it is essential to improve these activities by considering the location of the research station and crops growing in the region without limiting to vegetable crop production only.

Likewise, the Regional Research Station in Makandura has previously made a significant contribution to pineapple production and floriculture and is currently promoting the expansion of the home garden mushroom production industry. These regional centers need to continue their role more aggressively generating and disseminating agronomic protocols to optimize yields particularly with the decrease in availability of arable land.

Researchers at HORDI provide many services of national importance on a regular basis. They are involved in breeder seed production, analytical services for site-specific fertilizer recommendations, evaluation of new pesticides and fertilizers before releasing to farmers, evaluation and screening of new hybrid varieties imported by the private sector and screening of varieties for pest and diseases.

HORDI makes a remarkable contribution to science popularization programs throughout the country. They conduct exhibitions and training programs targeting different stakeholders such as farmers, teachers, students and the general public. Furthermore, HORDI also contributes significantly to the teaching and academic programs of the National Universities in Sri Lanka. Researchers attached to the institute publish and present their research findings in international as well as local journals and conferences contributing to the development of science and technology in Sri Lanka. Thus it can be concluded that contribution of HORDI to

National Development is substantial and that the Institute plays a very big role in vegetable sector in Sri Lanka by providing technologies for sustainable agriculture for the farming community as well as providing innumerable services to all the stakeholders of the institute.

7. Recommendations

1. HORDI needs a cooperate plan with a time-bound action plan. It is also good to adopt the practice of deriving an annual action plan for each division, stemming out of the Corporate Plan. The Corporate Plan development to be done through an integrated approach with an appropriate level of consultation at divisional levels and also with the contributions of direct stakeholders and collaborative R&D institutions outside. It is important to ensure proper involvement of the staff at all levels when annual action plans are developed.
2. Proper planning and implementation of work programmes is mandatory within the institute. It would be possible to improve the effectiveness of Research Programs by establishing a central planning unit with experienced scientists to guide research and development projects and also to monitor and review the projects.
3. The establishment of a Management Information System (MIS) covering the entire institution with networking, connecting all divisions of HORDI with a suitable service providing mechanism for its sustainable and efficient operation is recommended.
4. Intellectual property rights (IPR) management is an essential activity in plant breeding programs and protecting the rights of plant breeders. It is useful to get assistance from a hired qualified person in this regard if it is not possible to appoint permanent officer to deal with such matters. In addition to IPR matters, preparation of material transfer agreements (MTAs) for collaborative research, Plant Variety Protection (PVP) issues and other related legal aspects could be handled by such a person.
5. The lack of a quality control strategy of research work was noted, apart from the progress review meetings and working group committee meetings. Hence, it is recommended to discuss this matter within the institute and come up with an effective procedure acceptable to all parties concerned. The procedure should facilitate the improvement of the quality, output and outcome of the research. It is better if an annual research review is conducted so that the stakeholders and others can discuss and contribute.
6. Access to new knowledge/ scientific data bases/ journals is lacking in Department of Agriculture as well as many other institutes; therefore, HORDI management authority may convince the higher authority to address this issue at national level in collaboration with other national institutes/ universities.
7. It is recommended to have a long-term plan for the upgrading of laboratory facilities acquiring basic equipment to match with international standards as per the need as well as a

plan for the best use of the equipment. A laboratory instrument maintenance unit needs to be established by appointing of an experienced electronics/instrument maintenance engineer in charge of the unit.

8. There is an accumulated body of knowledge/ practices/ recommendations within institutes but not properly disseminated to the farmers and other stakeholders. The effectiveness of already established procedures such as Techno Park, TV programmes, informal training of different groups, ASDA, web based information appears to be not strong enough. There is no monitoring system of such approaches. The extension staff is now attached with provincial DOA and Central DOA has no commanding power to properly and effectively disseminate the technology to the farmers; hence, it is recommended to re-establish an extension network, creating a new cadre parallel to Agriculture instructors.
9. It is recommended to hold planned and well-coordinated forums which are open to stakeholders on a regular basis at least once in six months, regionally to deliver the new technology relevant to the area / industry and to get the feedback on current cultivation problems. This could be an official channel of DOA sharing knowledge in addition to already established mechanisms.
10. Establish a common portal to access the DOA information in addition to the free services and web based information system. Web based information is also not complete and not updated on regular basis.
11. It is recommended to prepare a long-term research programme for each division with clear objectives aligned with national needs and policies. The research programme should be implemented irrespective of change of researchers / administrative staff etc. Address of current farmer problems and national issues / issues of private sector are to be continued in parallel to the implementation of research programme.
12. Establishment of a teleconferencing facility in each station to facilitate meetings with other Institutional staff is recommended as per the concern of researchers who spend valuable time, travelling to attend official meetings.
13. It is recommended to collaborate with universities to conduct the basic research requirements of the research projects. Even though this is taking place partly, via undergraduate and post graduate training programmes the procedures should be formalized via a memorandum of understanding (MOU) of participating institutes.
14. Newly recruited researchers should be trained in basic research methodologies/ data analysis related to the assigned subject area. Newly recruited researchers should be encouraged to

obtain postgraduate qualifications in relevant field at their earliest and a certain level of incentives should be granted.

15. A performance based appreciation system is recommended to motivate researchers.
16. The productivity of the institute can be improved by employing cost-effective management practices. One of the ways of achieving this is to develop income generation activities. By employing proper management practices, income could be increased by providing services to outside organizations (consultancy/ analytical and testing services). The money generated by such activities needs to be directed to a Trust Fund managed by a Board of Trustees.
17. Strong long/medium term collaborations can be recommended to be brought in with sister institutions in S&T for covering the stakeholder demand in less attended R&D programs with a proper "road-map" for developing appropriate S&T to address the burning issues in food safety, postharvest food losses, environmental sustainability etc. in crop production and cropping systems and produce handling within the horticulture sub-sector.

Annex 1. Budget Allocation for HORDI for year 2014-2016
(Source: Performance Reports 2014-2016, Department of Agriculture, Sri Lanka)

Table 1.1 Total budget allocation -2014

	Total Allocated	Total Expenditure	Expenditure (%)
HORDI-2014	170,153,592	141,632,480	83
FRU-2014	12,757,250	7,121,582	56
ARS-Bandarawela	28,712,900	21,439,788	80
Makandura	16,769,975	9,831,045	59
Sita-Eliya	27,998,401	17,523,976	63

Table 1.2 Total budget allocation -2015

	Total Allocated	Total Expenditure	Expenditure (%)
HORDI-2014	150,656,443	142,940,186	95
FRU-2014	30,328,364	7,301,025	24
ARS-Bandarawela	14,671,219	9,327,857	64
Makandura	39,508,204	32,559,619	82
Sita-Eliya	26,448,563	24,350,657	92

Table 1.3 Total budget allocation -2016

	Total Allocated	Total Expenditure	Expenditure (%)
HORDI-2014	230.780,000	175,830,000	76%
FRU-2014	66,485,630	34,902,149	52%
ARS-Bandarawela	40,252,758	21,901,343	54%
Makandura	23,108,419	17,126,724	74%
Sita-Eliya	73,269,455	69,181,841	94%

Annex 2. Minutes of the first Review Panel Meeting

1	Event	1st Review Panel Meeting
2	Date	13th June 2018
3	Venue	Department of Crop Science, Faculty of Agriculture, University of Peradeniya
4	Discussion Points	
4.1	Professor Janakie P. Eeswara was appointed as the Chairperson	
4.2	Review Panel decided to follow below mentioned documents before the review visit and request them from HORDI within 2 weeks period. 1. Act with latest amendments 2. Corporate Plan 3. Action plan for the current year	
4.3	Review Panel agreed that Section 2.1 (a,b,c) of the SAR was not according to the instruction given in the review manual. Panel requested to reorganize that section as instructed in the manual. Panel members wished HORDI to reschedule this section before the review visit or at the time of review visit.	
4.4	Regarding the review visits to the substations, the panel members suggested dividing the places among themselves and visiting separately.	
4.5	Following facts were discussed regarding the stakeholders meeting • Get a list of stakeholders representing Farmers Organizations, Experts, Vendors, Input suppliers, entrepreneurs , university students, other research institutes, other government institutions, exporters, funding agencies • Decided to have mini meetings (depending on the categories of participants) within the day and present the summary at the end. The panel is expected to get more inputs in this way than conducting a single session. • Tentative Location : In-service Training Institute, Peradeniya	

Annex 3. Action Plan for the Performance Review of the HORDI

ACTION PLAN

Activity	Date
1. First Meeting of the review panel	13/06/2018
2. First review visit to the institute	16th and 17 August 2018
3. Review visit to the Substations Regional Agricultural Research Station, Makandura Regional Agricultural Research Stations SeethaEliya and Bandarawela	 16th October 2018 17th October 2018
4. Stakeholders meeting at the institute	27th September 2018
5. Meeting of the review panel to discuss the preparation of the draft report	Discuss through emails
6. Submission of the draft report to NASTEC	3rd January 2019
7. Finalization of the report after receiving the comments from the institute	7th May 2019

Annex 4. Schedule for HORDI Site Visit 16th and 17th August 2018

Reviewing of HORDI- Review Programme (Tentative)

Day 1- 16th August 2018

Time	Programme
9.00	Arrival to the institute
9.30 a.m. – 11.00 a.m.	Presentation on general overview of the institute by Director, HORDI followed by discussions with senior officials of the institute
11.00 a.m. – 11.15 a.m.	Tea break
11.15 a.m. - 12.15 p.m.	Visit- Plant breeding research fields
12.15 p.m. – 1.00 p.m.	Lunch
1.00 p.m. – 3.00 p.m.	Visit – Agronomy research fields
3.00 p.m. – 3.15p.m.	Tea break
3.15 p.m. – 5.15 p.m.	Visit – Extension and Home garden

Day 2- 17th August 2018

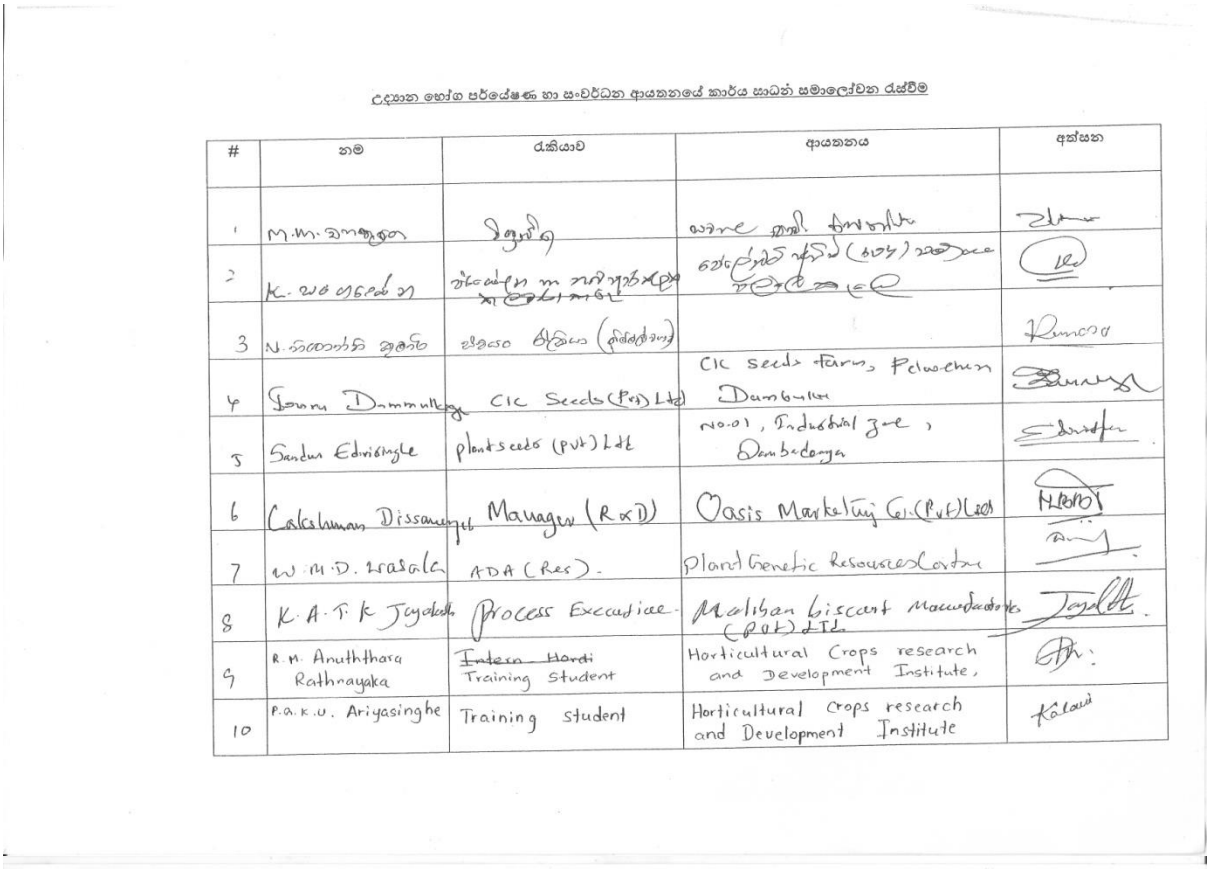
Time	Programme
9.00 a.m. - 10.30 a.m.	Visit - Chemistry Division
10.30 a.m.- 10.45 a.m.	Tea break
10.45 a.m.-12.30 p.m.	Visit – Pathology & Mushroom Division
12.30 p.m. – 1.30 p.m.	Lunch
1.30 p.m. – 3.30 p.m.	Visit – Entomology Division
3.00 p.m. - 3.15 p.m.	Tea break
3.15 p.m. - 4.30 p.m.	Visit the Administration and Finance Division
4.30 p.m.	Observations/Study of Documents

Annex 5. Attendance Sheet for the Meeting with the Officers of the HORDI

No.	Name	Designation	Signature
1	P. Weerasinghe	Director	[signature]
2	P. Malathy	Addl D/R, PS(Bot)	[signature]
3	S K Waradana	Add/D/Dev.	[signature]
4	Geethani Weeraratne	PS - Pathology	[signature]
5	D.P. Karunananda	PS. Agronomy	[signature]
6	N.C.A.T.S. Nanayakkara	ADA (Res)	[signature]
7	S.S. Weligamage	PS - Entomology	[signature]
8	Renuka Silva.	ADA(Res) - SO	[signature]
9	Kumudu Nawarathne	ADA (Res)	[signature]
10	K.A.D.S.D. Kahandawa Arachchi	ADA (Res)	[signature]
11	H.M.P.S. Kumari	ADA (Res)	[signature]
12	K.G.C. Wijewardhana	ADA Res	[signature]
13	M.S.W. Fernando	ADA (Res)	[signature]
14	N.B.U. Dissanayaka	ADA (Res)	[signature]
15	HMVT Welegama	ADA (Res)	[signature]
16	H.R.P. Fernando	DDR (Res)	[signature]
17	K.M.D.W. Prabath Nishantha	ADA -(Res)	[signature]
18	Y.G. Seneviratne	ADA (Res)	[signature]
19	Rasitha Perera.	Scientist (NASTEC)	[signature]
20	Palitha Weerakkody	Professor, UoP	[signature]
21	K.S. Hemachandra	Sen. Lecturer	[signature]
22	R.S. WILSON	Former AD HRDI, currently Consultant	[signature]
23	J. P. Eeswara.	Amerigah prgm UoP	[signature]

No.	Name	Designation	Signature
1	DCK Meenakshi	Professor	

Annex 6. Attendance Sheet for the Stakeholders meeting conducted on 27th September 2018



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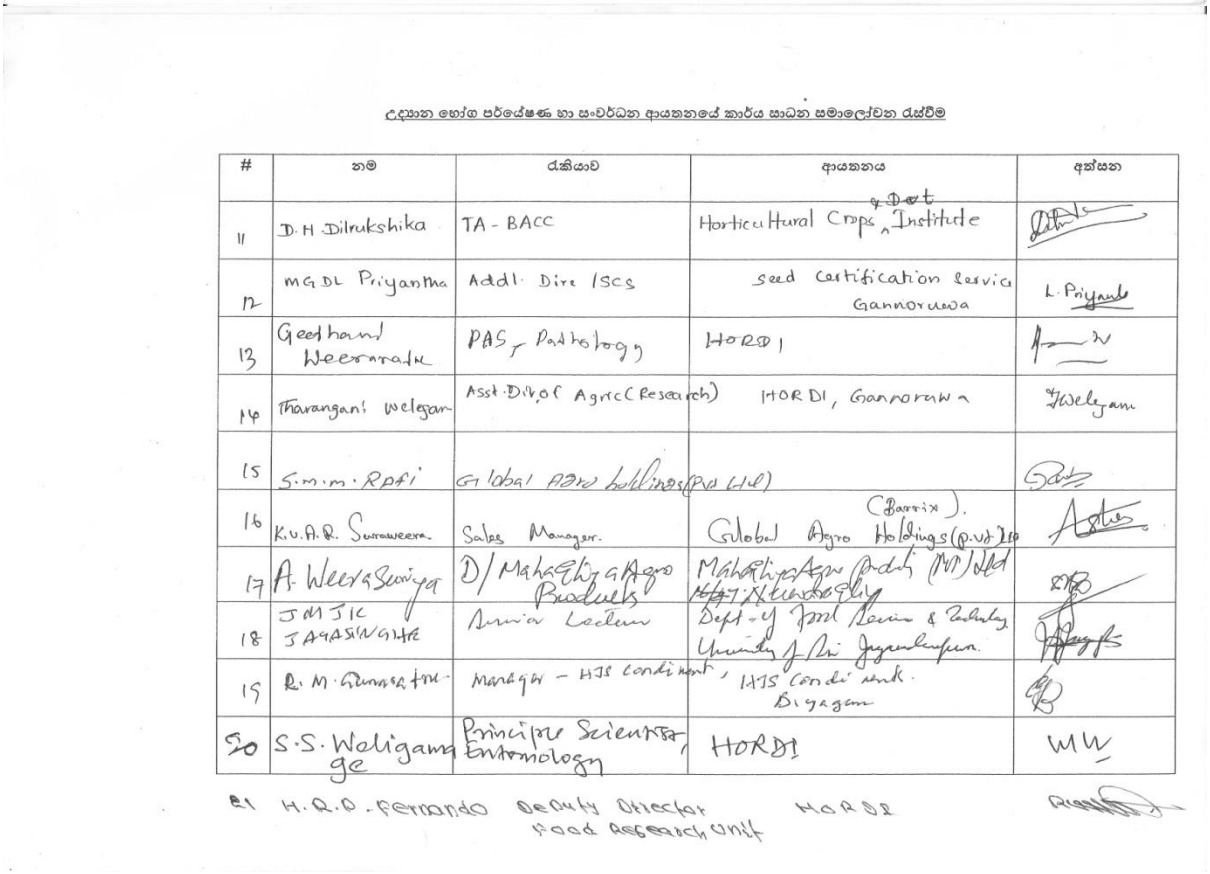
#	නම	රැකියාව	ආයතනය	අත්සන
1	M.M. [illegible]	[illegible]	[illegible]	[illegible]
2	K. [illegible]	[illegible]	[illegible]	[illegible]
3	N. [illegible]	[illegible]	[illegible]	[illegible]
4	Seeya Dammulla	CIC Seeds (Pvt) Ltd	CIC seeds farm, Polwehera Dambulla	[illegible]
5	Sandun Edirisinghe	plant seeds (PVT) Ltd	No.01, Industrial zone, Dambadeniya	[illegible]
6	Lakshman Dissanayake	Manager (R&D)	Oasis Marketing Co.(Pvt) Ltd	[illegible]
7	W.M.D. Prasala	ADA (Res).	Plant Genetic Resources Centre	[illegible]
8	K.A.T.K Jayakody	Process Executive	Maliban biscuit Manufacturers (PVT) Ltd.	[illegible]
9	R.M. Anuththara Rathnayaka	~~Intern~~ Hardi Training Student	Horticultural Crops research and Development Institute,	[illegible]
10	P.A.K.U. Ariyasinghe	Training student	Horticultural Crops research and Development Institute	[illegible]



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11	D.H Dilrukshika	TA - BACC	Horticultural Crops Research & Development Institute	[illegible]
12	MGDL Priyantha	Addl. Dire /SCS	seed certification service Gannoruwa	L. Priyantha
13	Geethani Weerasinghe	PAS, Pathology	HORDI	[illegible]
14	Tharangani welegama	Asst. Dir, of Agric (Research)	HORDI, Gannoruwa	Welegama
15	S.M.M. Rafi	Global Agro Holdings (Pvt Ltd)		[illegible]
16	K.V.A.R. Suraweera.	Sales Manager.	Global Agro Holdings (Pvt) Ltd (Barrix).	[illegible]
17	A. Weerasooriya	D/ Mahaweli Agro Products	Mahaweli Agro Products (Pvt) Ltd [illegible]	[illegible]
18	JMJC JAYASINGHE	Senior Lecturer	Dept. of Food Science & Technology University of Ruhuna, Mapalana.	[illegible]
19	R.M. Gunasekara	Manager - HIS condiments	HIS Condiments, Biyagama	[illegible]
20	S.S. Waligamage	Principle Scientist, Entomology	HORDI	[illegible]
21	H.A.D. Fernando	Deputy Director Food Research Unit	HARTI	[illegible]

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#	නම	රැකියාව	ආයතනය	අත්සන
22.	Dr. Niranjan Rajapakse	Senior Lecturer Dept. of Food Sc. & Tech. Fac. of Agri, UOP.	~~Sri Lanka~~ Institute of Food Science & Technology, Srilanka	
23	Asela Manamperi	Chairman (Businessman)	Hela Govi Viyaparaga	
24	Dr. Pasan Jayasinghe	Regional Epidemiologist.	Regional Director of Health Services - Kandy	
25	Dr. J. W. Damunupola	Senior Lecturer Dept. of Botany ~~University of Peradeniya~~	Department of Botany University of Peradeniya	
26	[illegible]	S.M. Department of Agriculture (CP)	Department of Agriculture Central Province	
27	Dhanushka Rajapaksha	Agriculture Monitoring Officer.	Department of Agriculture Central Province	
28	W. D. A. Samarakoon	green house	[illegible], Bowela, Welimada	
29	Dr. Ilmi Hewajulige	Senior Deputy Director	Industrial Technology Institute	

Annex 7. Questionnaire Provided to the Stakeholders on 27th September 2018

Meeting of the stakeholders of Horticulture Research and Development Institute (HORDI)
උද්‍යාන බෝග පර්යේෂණ හා සංවර්ධන ආයතනයේ පාර්ශවකරුවන්ගේ රැස්වීම
Survey on satisfaction of the HORDI service
උද්‍යාන බෝග පර්යේෂණ හා සංවර්ධන ආයතනයේ සපයන සේවාවන්ගේ තෘප්තිමත්භාවය පිළිබඳ සමීක්ෂණය

1. නම..... දූරකථන අංකය.....

2. Briefly explain your relation to HORDI as a stakeholder. පාර්ශවකරුවකු ලෙස උද්‍යාන බෝග පර්යේෂණ හා සංවර්ධන ආයතනයට ඇති ඔබගේ සම්බන්ධතාවය කෙටියෙන් සඳහන් කරන්න.

3. Briefly explain the service that you expect from HORDI for your business/profession/ activities. ඔබගේ ව්‍යාපාරයට/ වෘත්තියට/ක්‍රියාකාරකම්වලට උද්‍යාන බෝග පර්යේෂණ හා සංවර්ධන ආයතනයෙන් ඔබ බලාපොරොත්තු වන සේවාව කෙටියෙන් සඳහන් කරන්න.

4. How many times that you connect with HORDI per year. ඔබ උද්‍යාන බෝග පර්යේෂණ හා සංවර්ධන ආයතනය සමග අවුරුද්දකට සම්බන්ධ වන වාර ගණන.

5. State the level of your satisfaction about the service you received from HORDI as a percentage. ඔබට ලැබුනු සේවාව පිළිබඳ ඔබගේ තෘප්තිමත්භාවය සඳහන් කරන්න: .....%

6. If you are not satisfied with the service that you received from HORDI, provide the possible reasons in your opinion. ඔබට ලැබුනු සේවාව පිළිබඳ ඔබ තෘප්තිමත් නොවූයේ නම් ඔබගේ දැනීමේ හැටියට ඒ සඳහා හේතු වූ කරුණු සඳහන් කරන්න.

7. State your suggestions to improve the service provided by HORDI to you. ඔබට ලැබුනු සේවාව දියුණු කිරීම සඳහා ඔබගේ යෝජනා සඳහන් කරන්න.

8. What is the nature of the service that you received? ඔබ ලබා ගත් සේවාවේ ආකාරය කුමක්ද?

   අ. Advices for the problems in crop production. බෝග නිෂ්පාදන ගැටළු සඳහා උපදෙස්
   ආ. Guidance for business. ව්‍යාපාරය සඳහා මාර්ගෝපදේශ
   ඇ. Training පුහුණු
   ඈ. Research needs for the business / profession ව්‍යාපාරයේ/වෘත්තියේ/කාර්යයයේ පර්යේෂණ අවශ්‍යතා
   ඉ. Collaborative research. පර්යේෂණ සහයෝගිතාවය
   ඌ. Other (specify). වෙනත් .....

9. In which way you would like to connect with HORDI. උද්‍යාන බෝග පර්යේෂණ හා සංවර්ධන ආයතනය සමග සම්බන්ධතා පැවැත්වීමට ඔබට පහසු ක්‍රමය

   අ. Telephone දුරකථනය මගින්
   ආ. Emails විද්‍යුත් තැපෑල මගින්
   ඇ. Visiting the HORDI පැමිණ හමුවීම මගින්

10. When you visit HORDI, what level of welcome you received. ඔබ උද්‍යාන බෝග පර්යේෂණ හා සංවර්ධන ආයතනයට පැමිණි අවස්ථාවලදී ඔබට ලැබුණු පිළිගැනීමේ තත්ත්වය සඳහන් කරන්න.

11. When you are in HORDI, did you receive the clear guidance/directions to get the required service. උද්‍යාන බෝග පර්යේෂණ හා සංවර්ධන ආයතනය තුළදී ඔබට පැහැදිලි මග පෙන්වීම් හා උපදෙස් ලැබුනේද?

12. Comment on the usefulness of the advice that you received from HORDI to solve your problem. උද්‍යාන බෝග පර්යේෂණ හා සංවර්ධන ආයතනය මගින් ඔබට ලැබුණු උපදෙස් පිළිබඳ ප්‍රයෝජනවත්භාවය සඳහන් කරන්න.

13. Suggest the new services that you expect from HORDI. ඔබ උද්‍යාන බෝග පර්යේෂණ හා සංවර්ධන ආයතනයෙන් බලාපොරොත්තු වන නව සේවාවන් පිළිබඳ යෝජනා සඳහන් කරන්න.

Annex 8. Results obtained through the questionnaire provided to the stake holders

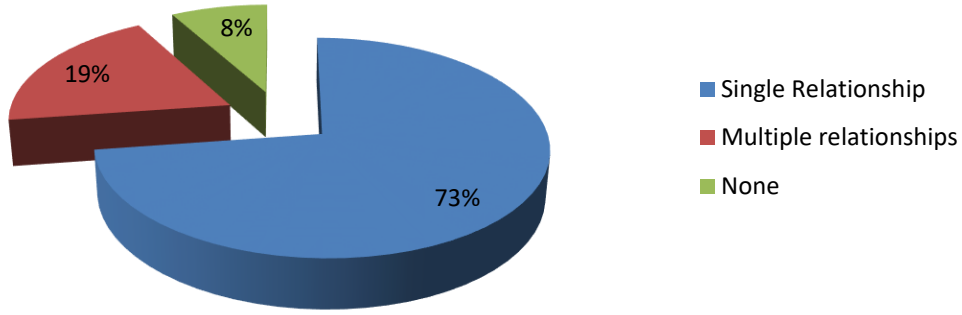

Fig. 1 Nature of the Relationship to HORDI as a stakeholder

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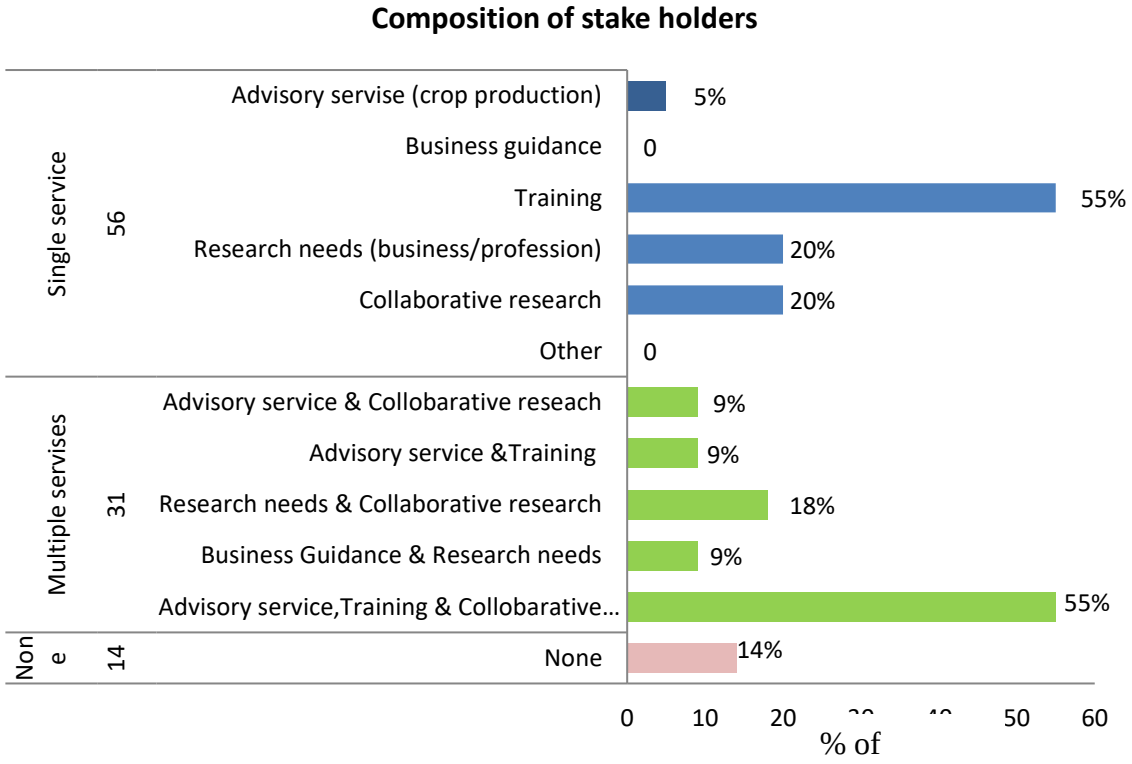

Fig 2. Type of Services obtained by the stakeholders from HORDI

Table 8.1 Services Expected from HORDI

No	Relationship to HORDI	Expected service/Information	
01	As a training student/Research student	I.	To successfully complete the training program
		II.	To obtain knowledge, technical information and facilities
		III.	Guidance and supervision
		IV.	Broad exposure to the activities carried out by the HORDI
02	Farmers/Private Sector	I.	Protection of plant from pest & disease
		II.	Guidance to identify characteristics of new varieties
		III.	To start food processing industries
		IV.	To get advisory service(during seed production, field problems , herbs, post-harvest management aspects, organic farming of vegetables)
		V.	Seed certification
		VI.	Get information and training on new varieties
		VII.	To engage in Good Agricultural practices
03	As employee	I.	Empowerment of self-employees e.g., providing capital requirements
		II.	To promote products

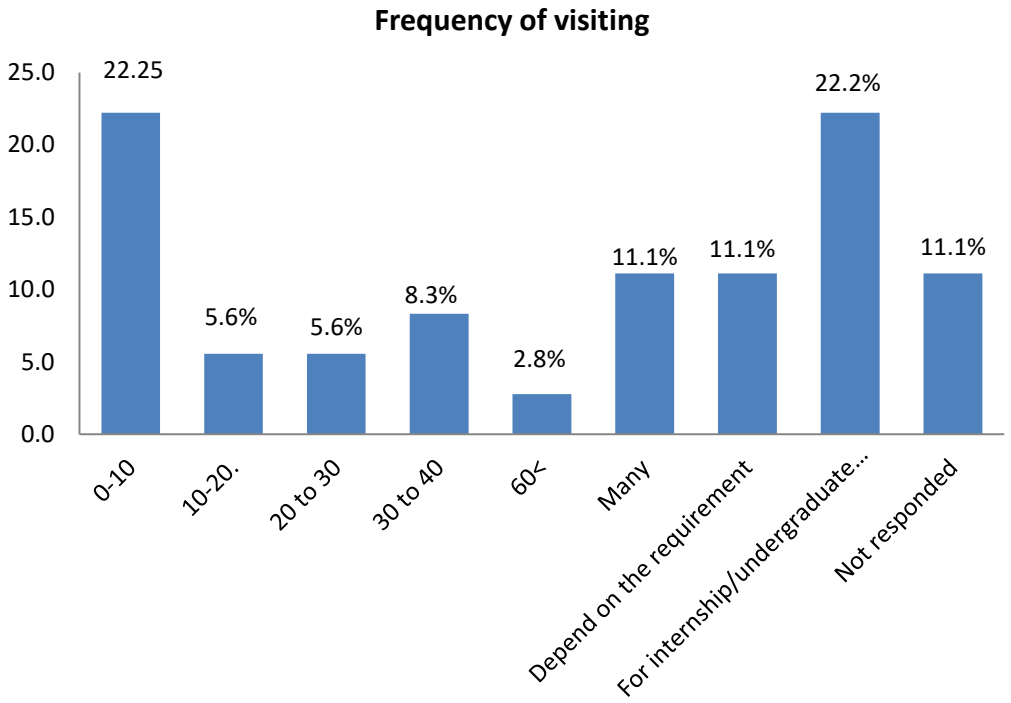

Fig. 3 Frequency of Visiting by stakeholders to HORDI

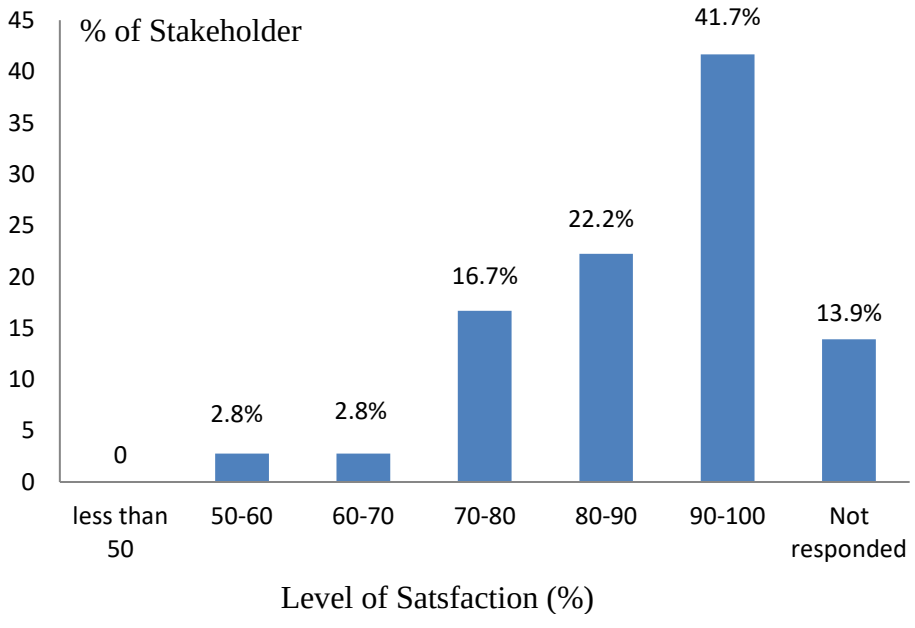

Fig. 4 Level of satisfaction about the service received from HORDI

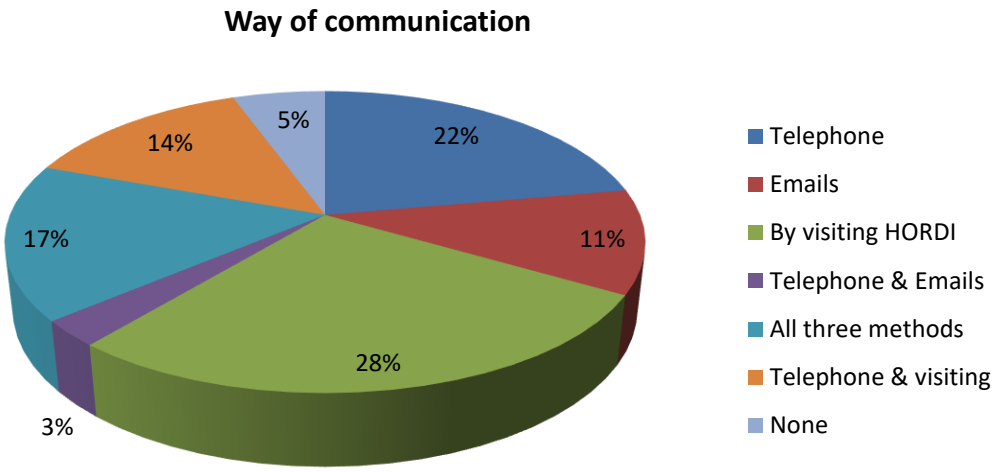

Fig. 5 Preferred way of communication

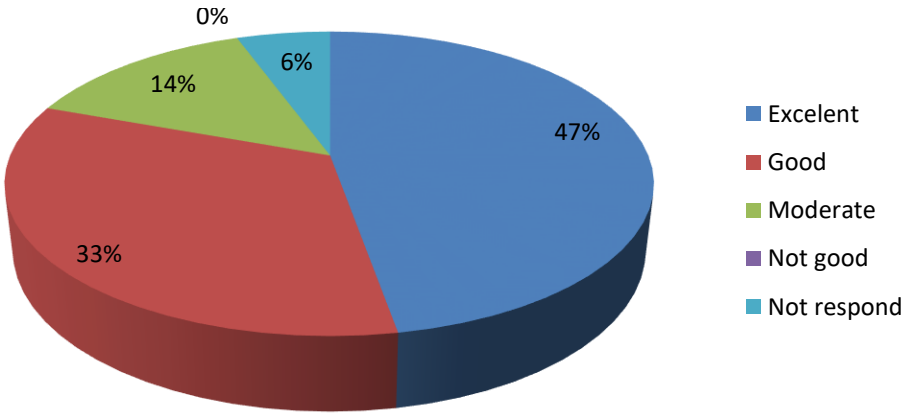

Fig. 6 The satisfaction of the stakeholders regarding the way of they are received by HORDI

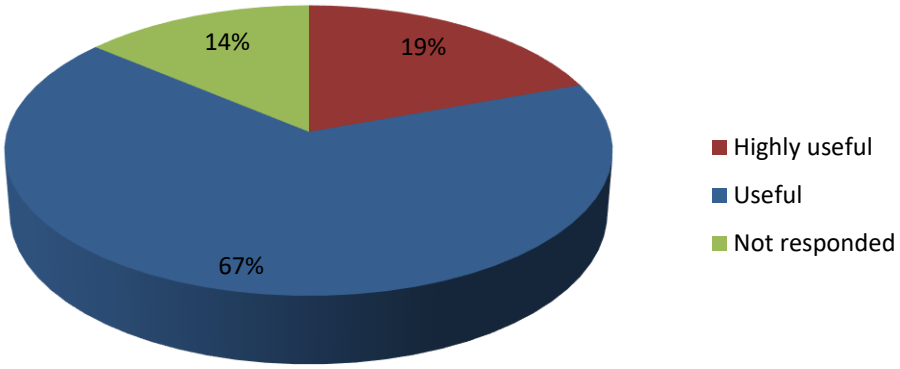

Fig. 7 The usefulness of the services received by the stake holder

Annex 9

List of Technologies Developed and transferred to the Industry
(Prepared based on presentation made by Director/HORDI on 16th August 20018)

1. Development of an efficient nutrient management package for and application of leaf trimming practice to enhance the productivity of pineapple grown in Sri Lanka
2. Development of correct fertilizer management practises for vegetables under KOPIA project
3. Determination of toxic trace metal contamination in rice cultivated in different regions of Sri Lanka
4. Determination of toxic trace metals content in the vegetables in the market
5. Determination of trace metal contents and bioaccumulation factors in soil and vegetables in the upcountry
6. Promotion of Organic Farming in Sri Lanka to popularize organic farming and establishment of organic farming villages/farmer groups
7. Implementation of organic standards/participatory guarantee system (Organic Certification system) for vegetables
8. Determination of nitrate accumulation in soils
9. Determination of soil fertility levels in different cropping systems in ASC region
10. Total heavy metal content in soils in different cropping system in ASC region
11. New fertilizer recommendation for hybrid Luffa (Naga F1)
12. Identification of suitable vegetable varieties for low input farming
13. Development of rapid bioassay method for the analysis of insecticides residues in Agricultural products
14. Development of *Munroniapinnata* (Binkohomba) as a potted ornamental
15. Development of alternative growth media for soilless cultivation of bell pepper
16. Development of model home gardens and public awareness programs
17. Development of a simple technique for sweet potato production in home gardens
18. Development of an efficient seed potato production through potato tower method
19. Productivity improvement of oyster mushroom cultivation
20. Introduction of sterilization machine
21. Development of an effective nematode management program for Guava nematode
22. Development of biological and ecological based studies for the management of root knot nematodes
23. Recommendation for root knot nematode management for leafy vegetables
24. Development of management techniques for insect pests of vegetables (e.g. wax scales, melon fruit flies, mealy bugs etc.)
25. Development of bio control methods for vegetable diseases
26. Recommendation of new safe fungicides for vegetables such as tomato, cucurbits, capsicum and brinjal
27. Development of IPM techniques for controlling pest and diseases of tomatos
28. Introduction of GAP system for quality assurance in the export market
29. Development of dried fruit and vegetable products such as tomato powder, mango powder using microwave assisted vacuum drying and awareness and promotion programs
30. Extension of shelf life of vegetables using low cost activated charcoal and vacuum dehydration techniques

Annex 10

New Crop Varieties Released by HORDI
(Source Performance Reports 2014-2016, Department of Agriculture, Peradeniya and Directors Report)

Year	Crop	Name of the New Variety
2017	1. Bean	PB 161 (KekuluBonchi)
	2. Pomegranate	KalpitiyaPom Hybrid
	3. Passion Fruit	Bandarawela Purple
2016	1. Pumpkin Variety	Pathma
2015	1. Capsicum	Prathana (F1 Hybrid
	2. Bitter gourd	Nirogi (F1 Hybrid
	3. Yard Long Bean	Gannoruwa A9 Mae
	4. Mushroom	Makandura Milk
2014	1. Sweet Potato	HORDI Malee
New Varieties to be released	1. Tomato	HT 01
	2. Pole Bean	PB151
	3. Egg plant (Elabatu)	EB 10
	4. Egg plant(Elabatu)-	EB 02
	5. Brinjal	EGH 10
	6. Ash Pumpkin	
	7. Luffa Hybrid	

Annex 11

Details of the Information Dissemination by HORDI
(Source Performance Reports 2014-2016, Department of Agriculture, Peradeniya)

Table 11.1 Details of the information dissemination- in year 2016

Service	Number	Remarks
Leaflets Distributed	8,210	145 variety of leaflets are available
Advisory service	38	Written answer
	200	Technical advice by telephone
	136	Verbal advise for visitors
Diagnosis	43	Nematode infections; advises given
	75	Insect damage; advises given
Training on vegetable breeding	38	Agriculture Professionals
Training on hybrid seed production	42	Extension agents, seed producers of government seed farms and private farms
Training on soil sampling and soil testing	200	Department of Agrarian Services
Provincial Technology Working Groups	10	
Radio Programs	10	On different topics

Table 11.2 Details of exhibitions/ training programs conducted in year 2016

Program/Station	Date	Target Group
Madeena National School, Siyambalagaskotuwa	2016.01.31- 2016.02-01,02	All category
Rajasinghe College, Ruwanwella	2016.02.10	All category
Kalugamuwa Central College, Gelioya	2016.02.04	All category
Crop Clinic Program	2016.02.24	All category
Gonakelle Junior College, Kandapola	2016 .05 -27,28,29	All category
Rajarata University of Sri Lanka	2016 .05 -18,19	All category
Labuduwa Farm	2016 .09 -01, 02,03,04,05,06,07	All category
Yaqeen Model School, Akurana	2016 .09 -28,29,30	All category
Agriculture exhibition, Ampara	2016.08-29,30	All category

Table 11.3 Details of Research – Extension dialogues-2014

Province	Discipline	No.
Central	Plant Pathology, Mushroom, vegetable cultivation, Soil fertility, Entomology	09
Western	Plant Pathology	01

Table 11.4 Details of research extension dialogues conducted 2016

Program/ Station	Date	Target Group
Pupuressa, Kandy	2016.10.13	Farmers, Field officers
Kegalle	2016.12. 08	Farmers, Field officers
Thenna, Kandy	2016.12.16	Farmers, Field officers

Table 11.5 Radio and TV programmes conducted by the officers of the HORDI

Name of the Officer	Topic	Radio/TV Station
N.R.N. Silva	Soil test Based Fertilizer Recommendation	KanduratаSewaya
PriyanthaWeerasinghe	Chemical Fertilizers diversity and Uses	Sri Lanka Broadcasting Corporation
S. Ratnamalala	Water management in Home Garden Sri Lanka	Broadcasting Corporation
	Utilization and value addition of fruits and vegetables grown in home garden	Sri Lanka Broadcasting Corporation
	New Technology for Home Garden	KanduratаSewaya
	Ways of improving vegetable consumption	RangiriDambuluSewaya
	Time Management in home garden	Sri Lanka Broadcasting Corporation
S. Ekanayaka	Antioxidant properties of Vegetables	Sri Lanka Broadcasting Corporation
K.H. Sarananda	Post harvest loss reduction of fruits,	KanduratаSewaya
	Product development of sesame -2 programs	Sri LanakaRupavahini Corporation.
KOPIA activities on mushroom development in Sri Lanka		GovibimataArunalu
Compost tea production and Successful Organic farmer		MihikathaDinuwo
Sarthaka kola lawaluwagawaksadahaupades		GovithenataPeyak radio programme
Annasiwagawenawabhawitha		
Dragon fruit pruning, Management of pomegranate tree for preventing Anthracnose and on Compost tea		
TV programme on compost tea production 17/08/2014		GoviBimataArunalu
TV programme on successful organic farmer 26/08/2014		
		MihikathaDinuwo

Annex 12

Industrial training programs provided to University/Agriculture School Students (Source- Performance Report, Department of Agriculture, Peradeniya)

Degree sought	**University**	**Training period**	**Number of Students**		
			2014	**2015**	**2016**
B.Sc.	University of Kelaniya	6 months	34	37	33
	University of Peradeniya	6 months			
	University of Ruhuna	6 months			
	University of Jafna	6 months			
	University of UvaWellassa	6 months			
	Open University -Kandy	3 months			
	Open University -Matara	3 months			
Diploma NVQ Level 6	School of Agriculture - Kundasale	6 months	17	31	51
	School of Agriculture - Angunakolapelessa	6 months			
	Advance Technology Institute -Naiwala	6 months			
	Advance Technology Institute -Ampara	6 months			
Diploma NVQ Level 3/4/5	Technical College - Embilipitiya	6 months		45	75
	Technical College - Anuradhapura	6 months			
	Technical College - Aruppola	6 months			
	District Agriculture Training Center - Galpalama	6 months			
	District Agriculture Training Center - Nawayalathenna	6 months			
	School of Agriculture Wariyapola	6 months			
	School of Agriculture- Bibile	6 months			
	National Youth Services Council	6 months			
Total			**51**	**113**	**159**

Annex 13 Services provided by HORDI
(Source- Performance Report, Department of Agriculture, Peradeniya)

Table 13.1 Laboratory analytical services conducted by HORDI Gannoruwa

Commodity	**Purpose**	**No. of Samples**			
		2014	2015	2016	2017
Soil Testing Programs	Soil test based recommendation	870	391	1061	947
Soils	Research analysis	1042	635	1059	442
Compost	Analytical Service	155	165	193	186
Water	Analytical Service	17	1	12	
Testing of imported Fertilizer	Analytical Service Green House testing		06	20	14
Testing of imported Fertilizer	Analytical Service Field Testing		13	10	15
plant samples			19	150	
Crop disease diagnosis and advisory service		700	500		
Screening of exotic hybrids for pest and disease Seed potato health testing		59 curcubita 19 Tomato			

Table 13.2 Laboratory analytical services conducted by Fruit Research Unit-Gannoruwa

Quality assurance testing was performed on following products during the period under review.

Product/Commodity	**Number**		
	2014	2015	2016
Vegetables	309	241	139
Fruits	81	62	61
Yams	20	16	
Spice powder	47	37	23
Flours	18	26	
Processed products of fruits & Vegetables	93	139	
Milk products	07	01	04
Bites	05		
Soya products	07	01	
Mushroom		04	05
Coconut oil		02	06
Confectionaries		16	
Treacle and Bee Honey		18	19
Microbiological Analysis		49	18
Other			56

Annex 14. Seeds and Planting Material Production
(Source- Performance Reports 2014-2016, Department of Agriculture, Peradeniya)

HORDI- Gannoruwa

Crop	Variety	Seed/Planting material type	Quantity kg 2014	Quantity kg 2015	Quantity kg 2016
Bean	Gannoruwabil	breeder	66.4	29.0	37.7
Luffa	Gannoruwa Ari	breeder	3.0	13.4	4.5
Mae	Plon Mae	breeder	6.0	13.0	
	Gannoriwahawari	breeder	6.0	14.75	39.75
	Hawari Mae	Breeder seed		2.5	
	Sena	Breeder seed		15.0	
	Gannoruwa A9 Mae				46.45
Winged bean	SLS 44	Breeder seed		5.0	8.2
	Krishna	Breeder seed			6.2
Amaranthus	Gannoruwathampala	Breeder seed		6.0	
Bitter Gourd	Matale Green	breeder	7.5	1.6	3
	Thinneweli white				2
Cucumber	Kalpitiya white	breeder	7.0	0.9	2
	Champion	breeder	2.0	1.3	
	R2	parental	6.6	6.6	3
Tomato	Ravi	breeder			0.175
	T 245	breeder			1.5
Mushroom	Paddy straw	commercial	157 packets	223 packets	
	Oyster	commercial	547 packets	1552 packets	
	Abalone	commercial	307 packets		
Manioc	Mu 51 &Kirikawadi	Pre basic		12,500 cuttings	
Traditional vegetables		commercial	1200 kg	1200 kg	
Sweet potato	Wariyapola Red	Pre basic		8000 cutting	
	HODI Malee	Pre basic		4500 cuttings	

ARDC- Bandarawela

Seed/planting Material type	Crop	Variety	Quantity 2014	Quantity 2015	Quantity 2016
Breeder	Pole bean	Bandarwela Green	42kg		27.2 kg
	Pole bean	Balangoda nil	80kg	30 kg	
	Pole bean	Keppetipola nil			23 kg
	Bush bean	Sanjaya		20 kg	21.5 kg
		Wade		2.7 kg	
Parental seed material	Tomato	HT-2123	0.72kg	0.374 kg	
		Thilina	0.195kg		
	Carrot	Lanka carrot	0.90kg	1.125 kg	0.225 g
G0	Potato	Granola	43000 tubers	56,000	
G1	Potato	Granola	700kg		
Rooted stem cuttings	Potato	Granola		160,000	
Tissue culture	Potato	Granola	28751 plants		3363
Certified or commercial	Mandarin	Rahangala	7500 plants		6400 plants
	Mandarin	Ehime	4500 plants	2387	
	Gerbera		5464 plants		
	Pear	Rahangala	1500 plants	75	
	Orange	Sisila/ Arogya		1835	1200 plants
	Carambola	Honey Sweet		12	300 plants
	Macademia			30	
	Peach			92	
	Passion fruit	Rahangala hybrid			100 plants
	Grapes	Isabella			75 plants
Mother plants	Mandarin	Ehime	100 plants	464	
Vegetable	Home garden pack			10,148	

ARDC: Makandura

Crop	Type	Production-2014	Production-2015	Production-2016
Dragon Fruit	Commercial	500 plants	1000	3200
Banana	Commercial	500 plants 350 TC	260	5000
Pineapple	Commercial	12000 suckers 5000 TC	20,000	8000
Vegetables	Commercial	Red mae-60 k		
Anthurium	Commercial	1000 plants	1200	1300
Idda	Commercial	100 plants		
Mushroom	Commercial	300	915 packets	350 packs
Cassava	Commercial	300 meters	1000 m	1200 m
Sweet potato	Commercial	20 kg		

Breeder seeds and Nucleus planting materials

Crop	Variety	Quantity (kg)		
Snake Gourd	TA 2	5.3 kg		
Bitter Gourd	Thinnaweli white	4.0 kg		
Cucumber	LY 58	1.5 kg		
	Kalpitiya White		08 kg	
Pumpkin	Villacchhiya	3.0 kg	14 kg	4.5kg
Yard long bean	Red mae		168 kg	
Winged bean			4 kg	
Hybrid Brinjal parental line				500g
Naimiris				300 pods

ARDC: Seetha-Eliya

Crop /Variety	**Type**	**Quantity - 2014**	**Quantity - 2015**	**Quantity - 2016**
Potato	Pre basic seeds (G0)		217,500	196,323
	Mini tubers	0.2 million	178,148	
Granola	*In vitro* plantlets	16,898	12,559	12,105
- Golden Star	*In vitro* plantlets	60		
Raja	*In vitro* plantlets	10		
Desiree	*In vitro* plantlets	10		
Arnova	*In vitro* plantlets		323	162
Red La soda	*In vitro* plantlets		116	156
Hill star	*In vitro* plantlets		440	
Strawberry	*In vitro* plantlets	Approx 5000	470	3,463
Baby‟s breath	*In vitro* plantlets	4503	5835	12,118
Madonna Lilly	*In vitro* plantlets	484	170	375
Gerbera	*In vitro* plantlets	101	67	73
Chrysanthemum	*In vitro* plantlets	1396	4028	2,506
Limonium	*In vitro* plantlets	315		112
Statice	*In vitro* plantlets	161	159	29