



# National Research Priorities in Agricultural Biotechnology

## 2017-2021

National Committee on Agricultural Biotechnology

Sri Lanka Council for Agricultural Research Policy  
Ministry of Agriculture



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**National Research Priorities in  
Agricultural Biotechnology  
2017-2021**

**National Committee on Agricultural Biotechnology**

**Sri Lanka Council for Agricultural Research Policy  
No. 114/9, Wijerama Mawatha,  
Colombo 07  
Sri Lanka**

**Ministry of Agriculture**

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## **Message from the Chairman**

### **Sri Lanka Council for Agricultural Research Policy**

Application of Biotechnology in agricultural production has increased over years due to rapid advances made in this field. The use of Biotechnology is also considered to be the option to increase food for the growing population in the world. This is of particular importance as the land and water availability is gradually shrinking in most of the developing countries. As in many other Asian countries in Sri Lanka the land: man ratio has decreased. This calls for increased production through modern intensive technologies to enhance agricultural production. Aggravating this situation is the high cost of production due to increased cost of labour, agrochemicals, seeds and other planting materials. The green revolution, which was a costly package of technologies, will not be applicable in today's context and other modern tools have to be adopted in farming systems.

Sri Lanka, similar to other developing countries has been pinning great hopes on the use of biotechnology as a solution to several problems, including enhancement of food production and escalating socio economic problems. Therefore, the use of biotechnology has a huge potential if it is properly integrated with other technologies and used to address food security and other key agricultural challenges. It is necessary to harness biotechnology for the poor, majority of the people who are vulnerable and live in fragile ecosystems. Therefore, it is too valuable to be ignored and must work towards the promotion of this technology through a participatory approach which will utilise indigenous knowledge, conventional research and cutting edge technology. Achieving productivity through biotechnology would be possible only if right type of research is undertaken with right human resources under an enabling environment.

Sri Lanka Council for Agricultural Research Policy (SLCARP) is the apex body for formulating Agricultural Research Policies and Priorities of Agricultural Research in Sri Lanka. It also prepares the National Agricultural Research Plan for the country and recommends to the government for funding. Council identifies Research Priority Areas based on the current needs of the country and appoints National Committees accordingly. Agricultural Biotechnology is one such priority area identified by the Council. The National Committee on Agricultural Biotechnology consisting of expertise in various sectors in Biotechnology make their contributions for better utilization of biotechnologies for the enhancement of the agriculture sector.

The setting of priorities for biotechnology was assigned to the National Committee on Agricultural Biotechnology by the Council. This priority document was based on the current needs identified at the Stakeholder Workshop on "Current Status and Future Directions in Agricultural Biotechnology in Sri Lanka", held in August 2016. Previous 5 year programmes were reviewed and paralled advancement in the field of Biotechnology was taken into consideration. Private Sector involvement was harnessed to ensure application of Biotechnology. The information on research priorities has been comprehensively documented to include all sectors of agriculture.

On behalf of the Council, I am pleased to thank the members of the National Committee on Agricultural Biotechnology for their valuable contributions to develop this priority document which will shape the agricultural research in this country. I am particularly thankful to Dr PadminiGiriagama, Secretary / Coordinator of the Committee representing the Council for documenting this information and making it available to the scientists of this country.

**Dr S. D. G. Jayawardena**

Chairman

Sri Lanka Council for Agricultural Research Policy

## **Message from the Secretary**

### **Sri Lanka Council for Agricultural Research Policy**

The Sri Lanka Council for Agricultural Research Policy (SLCARP), the umbrella organisation of the National Agricultural Research System (NARS) in the country, has formed a number of National Committees with the experts in relevant subjects, to look into the matters related to researches of national and current importance. The National Committee on Agricultural Biotechnology is one such committee working on the research issues related to agricultural biotechnology to achieve desired goals according to the needs of the country.

Agricultural research plays an important role in achieving food security and ensuring higher and sustainable income for farmers. Identification and prioritisation of national-level agricultural research thrusts are important steps in the process of agricultural research to cater to the needs of the development of the agriculture sector in the country while ensuring rational allocation of resources including human, physical and financial.

The setting of priorities for agricultural biotechnology was assigned to the National Committee on Agricultural Biotechnology by the Council. This priority document was based on the current research needs identified Stakeholder Workshop on “Current Status and Future Directions in Agricultural Biotechnology in Sri Lanka”, held in August 2016. The information on research priorities has been comprehensively documented by the National Committee on Agricultural Biotechnology, to include all sectors of agriculture.

On behalf of the Council, I take this opportunity to thank the members of the National Committee on Agricultural Biotechnology for their tireless efforts in developing this priority document. This will be very useful to the National Agricultural Research System and other stakeholders, particularly the emerging private sector investors. I also would like to thank Dr Padmini Giriagama, Secretary/Coordinator of the Committee representing the Council for her efforts in documenting this information and publishing it.

**Dr J D H Wijewardena**

Secretary

Sri Lanka Council for Agricultural Research Policy

## **Message from the Chairman**

### **National Committee on Agricultural Biotechnology**

The current world population is nearly seven billion people which is expected to be nine billion by year 2050. At least a 70% increase in agricultural productivity is needed to feed and fuel this ever expanding world leaving no alternative but to exploit technological advances to obtain more produce from existing agricultural lands. Global agricultural productivity is mainly threatened by the climate, pests and diseases and loss of soil fertility. Therefore, the challenge of improving agricultural productivity while conserving natural resource base is the key for the sustainable development and ensuring food security.

Agricultural biotechnology is the use of biotechnology in agriculture. In general, it is the use of organisms or their products to make or improve products or processes in agriculture. Agricultural biotechnology represents a range of technologies including production of genetically improved plant and animal varieties having resistance to biotic and abiotic stresses and enhanced nutritional qualities, propagation of such developed plant and breed stock, disease diagnosis, vaccine and feed development, bio-control, bio-fuel and bio-fertilization, and conservation of genetic resources. Although Sri Lanka is slow to pick up certain advanced biotechnologies, some of them are increasingly used such as tissue-culture based techniques and use of marker assisted selection (MAS) for breeding purposes. With the strong commitment of the Government to improve Sri Lankan agriculture sector, increased use of biotechnology directed research has been anticipated. As Sri Lankan agriculture falls under the purview of a number of different Ministries, fragmented research programmes funded by the statutory funds resulted in isolated contributions to national development. Additionally, research duplication strained the limited public funds further. Therefore, streamlining the agricultural research towards a national goal has become an imminent task. Identification of research priorities in agricultural biotechnology provides the framework necessary for the prioritization of research programmes by assessing their contribution to the development of agriculture sector and channelling funds properly to make a collective contribution towards the development and adoption of novel technologies to enhance productivity. Hence, this publication is a timely action undertaken and successfully completed by the Sri Lanka Council for Agricultural Research Policy. Publication of national research priorities defines the current research trends of the country and personnel engaged in agriculture research can gain an insight in planning their future programmes. The thanks are due to the members of the SLCARP National Committee on Agricultural Biotechnology for their strenuous work in collecting, screening and compiling information to produce this key document

With the national research priorities for different trust areas in agriculture in place, the other key factors contributing to the successful development of research should also be addressed appropriately. These factors include the appropriate policy development and timely upgradation, strengthening research and extension institutions, enhancing capacity building and timely dissemination of new knowledge developed to the interested parties. It is highly satisfying to note that SLCARP is already engaged in some of those activities recognizing the urgent need for a multi-disciplinary programme for the sustainable development of agricultural sector in Sri Lanka.

Dr. W.L.G. Samarasinghe  
Chairman  
National Committee on Agricultural Biotechnology  
Sri Lanka Council for Agricultural Research Policy

## **PREFACE**

Research is the main source of technological innovations and is, thus, very important in strengthening the country's agricultural potential. It is only through continued agricultural technological breakthroughs that sustainable growth in agricultural productivity and hence the competitiveness of Sri Lanka's agricultural capability can be achieved or improved.

Application of Biotechnology in Agriculture has assured the achievement of global dimensions and advances in this field that are taking place at much rapid pace now, even in the developing countries. It is also a strategically significant tool to improve national food security, a means to raise agricultural productivity and create a competitive position in international agriculture markets. Most of the NARS and Agricultural Research Institutions in the region have recognized the importance of biotechnology to meet the future demands for food to fight hunger and malnutrition and have taken initiatives matching with their capacity. Sri Lanka Council for Agricultural Research Policy (SLCARP) has identified Agricultural Biotechnology as a thrust area for agricultural research and development.

In times of tightening national budget as a result of structural adjustment requirements especially due to the impacts of the 30 year period of war, the need to make choices in Sri Lanka's publicly funded research is heightened. Prioritization of agricultural research activities results in the selection of the optimal research portfolio given the resource constraints. Thus, resource allocations based on identified research priorities will be more efficient and responsive to the research system objectives than when resource allocation is not based on research priorities.

Through the process towards developing a National Programme in Agricultural Biotechnology Research and Development, national needs were identified by relevant stakeholders. Existing Priority Document "National Research Priorities Agricultural Biotechnology: 2017-2021" was revised by the National Committee on Agricultural Biotechnology, based on the priorities identified at the Stakeholder Workshop on "Current Status and Future Directions in Agricultural Biotechnology in Sri Lanka", held in August 2016.

On behalf of the National Committee on Agricultural Biotechnology, I am pleased to thank the members of the National Committee on Agricultural Biotechnology for their contribution to develop this priority document. The information produced in this document will be very useful to the National Agricultural Research System and other stakeholders, particularly the emerging private sector investors to focus attention on priority research areas in Agricultural Biotechnology and allocation of funds by the government and other funding agencies as well.

**Dr. Padmini C. Girihagama**

Secretary/Coordinator

National Committee on Agricultural Biotechnology

Sri Lanka Council for Agricultural Research Policy



## **Abbreviations**

<b>GDP</b>	Gross Domestic Product
<b>NARS</b>	National Agricultural Research System
<b>NCAB</b>	National Committee on Agricultural Biotechnology
<b>NCPBB</b>	National Committee on Plant Breeding and Biotechnology
<b>SLCARP</b>	Sri Lanka Council for Agricultural Research Policy

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## **Introduction**

### **Agriculture Sector in the Economy of Sri Lanka**

Agriculture sector which consists of several sub sectors including food crops, plantation crops, livestock and poultry, forestry, fisheries and aquaculture, is the cornerstone of the Sri Lanka's economy. Agriculture sector contributes nearly 8 % to the total Gross Domestic Product (GDP), 33% of employment opportunities (Central Bank of Sri Lanka, 2015) and 24% (Performance of Export Sector Sri Lanka) of total exports. Consequently, agriculture plays an important role either directly or indirectly in improving the livelihoods of the Sri Lankans.

Sri Lanka annually spends a considerable amount of the country's foreign exchange on importing a vast array of food items which could be produced locally. In 2015 nearly US\$ 18,935 million which accounts for 14% of the total import expenditure (Central Bank of Sri Lanka, 2010) has been spent on importing agricultural food commodities. It is thus evident that a rapid growth of the domestic food production is essential to achieve food security, increase farmers' income and the living standards, reduce rural poverty and save a significant amount of foreign exchange. In addition, the development of the plantation and export agriculture crop sectors contributes to increased foreign exchange earnings. Thus, the development of the agriculture sector in the country will pave way for improvement in the supply of food and nutrition for the people, enhanced employment opportunities and increased foreign exchange earnings while cutting down the foreign exchange spent on food imports. However, the assistance of the government to enhance agricultural production in the country is crucial and essential. In this context, the government has declared the year 2017 as the year for launching a sustainable programme for poverty alleviation and accordingly various policies, plans and programs are being implemented for sustainable increase of agricultural production.

### **Challenges of the Agriculture Sector**

The development of the agriculture sector in the country is vital for its economic development. The identification of the major challenges of the agriculture sector is important in addressing the problems and determining the appropriate approaches to achieve

agricultural development. In this regard, the followings are listed as the apparent and important challenges hindering such development in the agriculture sector.

- Continuous increase in demand for food due to increasing population growth
- Shrinking of cultivable land due to urbanisation and population growth
- Low crop productivity and production
- Increasing biotic and abiotic stresses due to climate changes
- High cost of cultivation due to escalating cost of inputs
- Declining overall soil fertility status
- Increasing demand for high-quality agricultural products
- Negative impact of indiscriminate use of agrochemicals on environment
- Inadequacy of improved varieties /other appropriate technologies
- Inadequacy of quality seed and planting material of improved varieties
- Inadequate supply of spice and beverage crops to meet the increasing demand in the export market
- Lack of stable government policies towards agriculture
- Limited allocation of government funds for agricultural R&D

### **Research and Development in the Agriculture Sector**

Research and development (R&D) activities of the different sub sectors of agriculture play a significant role in addressing the above-mentioned challenges. The R&D institutions and the relevant faculties of the national universities engaged in R&D on food and plantation crops, livestock and poultry, forestry, fisheries and aquaculture sub-sectors function under several cabinet ministries. These R&D institutes are coordinated by the Sri Lanka Council for Agricultural Research Policy (SLCARP) which is the apex body of the National Agricultural Research System (NARS) of Sri Lanka. Agricultural Biotechnology has been identified by the SLCARP as one of the major thrust areas to effectively address the key challenges in agriculture sector.



Considering the importance of Agricultural biotechnology, a National Committee on Plant Breeding and Biotechnology (NCPBB) was appointed by the SLCARP in 1998. Later, in mid-2009, this committee was abolished to form two national committees; Plant Breeding and Agricultural Biotechnology for focussing better on these two important disciplines in agriculture.

### **National Committee on Agricultural Biotechnology**

The National Committee on Agricultural Biotechnology (NCAB) was established on 31<sup>st</sup> July 2009 bestowing the mandate to identify and formulate policies and strategies related to Agricultural Biotechnology. It was also entrusted to set national research priorities following the agricultural development policies of the government. The national committee is responsible for the following:

1. To identify and formulate national policies, strategies and priority research needs required to develop the discipline
2. To evaluate research proposals, and make recommendations for funding
3. To monitor and evaluate the progress of the funded research for tangible outputs
4. To identify the institutes which could undertake such research, and support them to become Centers of Excellence and publish relevant information for wider use by the clients and other interested groups
5. To identify the human resource (HR) development needs and the mechanisms in Agricultural Biotechnology for the development of HR at various levels
6. To develop and maintain the databases in collaboration with SLCARP conduct workshops, seminars, training programmes, exhibitions *etc*, to disseminate and update the stakeholders on the latest advances in that discipline
7. To conduct regular skills development workshops for practicing agriculturists, particularly the farmers and to identify the ways and means of linking farmers/producers to markets
8. To provide an independent forum to meet stakeholders to discuss issues in relation to the development of the discipline

The members of the NCAB are shown in Annexure 1. In line with the above-mentioned responsibilities, the present assignment has been focused on formulating National Agricultural Biotechnology Research Priorities for the five-year period from 2017 to 2021.

**Identification of  
National Research Priorities: 2017-2021  
Agricultural Biotechnology**

The Agricultural Biotechnology R&D programmes conducted by public R&D institutions and the national universities have made a significant contribution to the development of Agricultural Sector to raise both crop production and productivity in the country. The priorities in Agricultural Biotechnology activities in each sector/crop are primarily identified by the relevant R&D institution based on the national agricultural policies. Accordingly, a coherently developed document on national level biotechnological priorities is a pre-requisite to provide guidelines to develop priorities at the institutional level for optimum allocation of physical and human resources and effective carrying out of national level Agricultural Biotechnology R&D programs. The national priorities thus developed need be periodically updated to cater for the current trends in the national development and for the efficient and effective adoption of novel technology. Accordingly, the focus of the current exercise was to update and develop the national biotechnology priorities in consultation with relevant stakeholders and end users.

**Overall Objective**

Facilitate the application of appropriate biotechnologies in Sri Lanka to improve agricultural production and consequently contribute to the enhancement of food security and socio-economic standards in the country

**Specific Objectives**

- a) Implement a National Research and Development (R&D) Programme based on the assessment of present capacities, and on the needs and priorities of the country in the area of agricultural biotechnology research.
- b) Strengthen the Institutions' capacities including infrastructure and favourable administrative procedures related to agricultural biotechnology R&D.
- c) Capacity building of human resources related to agricultural biotechnology R&D.
- d) Promote the use of biotechnology in the development of agriculture sector through productivity enhancement.

- e) Increase the public awareness and public participation related to agricultural biotechnology.

## **Methodology**

In order to achieve the above objectives the following methodology was followed in identifying and updating the current national Agricultural Biotechnology research priorities in Sri Lanka.

- 1) Recording the current status and the priorities of each sector of Agricultural Biotechnology in Sri Lanka.
- 2) Analysis of current status and the priorities of agricultural Biotechnology in Sri Lanka.
- 3) Documenting the national priorities of agricultural Biotechnology in Sri Lanka for 2017-2021.

### **Step 1: Recording the Current Status and Identifying the Priorities of Each Sector of Agricultural Biotechnology in Sri Lanka**

A comprehensive process was followed on recording the current status and the future potential of Agricultural Biotechnology and identifying the current priorities of each sector. Firstly an expert from each sector was nominated from each sub-sector to record the status and priorities in agricultural biotechnology. Each speaker, in consultation with the researchers and relevant stake holders, from within the relevant R&D institutions, identified and recorded the current status and the priorities of each sector of Agricultural Biotechnology. The presentations were structured to give a brief introduction to the sector, the current status of biotechnological research, future potential and the plans and strengths and limitations with regard to human resources & infrastructure in achieving the proposed targets. The stake holder workshop was held in mid-August, 2016, with the participation of the researchers of NARS, national universities and private sector, representatives from funding bodies of research and other relevant stakeholders in Sri Lanka. The list of topics covered by each of the expert is given in annexure 02. Presentations on each discipline were intended to make the stakeholder groups aware on the current status of the following areas:

- a) Agricultural Biotechnology Policy in Sri Lanka
- b) Food Crop Sector in Sri Lanka
- c) Plantation Crop Sector in Sri Lanka
- d) Export Agriculture Crops Sector in Sri Lanka
- e) Ornamental Crops Sector in Sri Lanka
- f) Fisheries & Aquatic Resources in Sri Lanka
- g) Livestock & Poultry Sector in Sri Lanka
- h) Private Sector in Sri Lanka
- i) National University system in Sri Lanka

## **Step 2: Analysis of the Current Status and the Priorities of Agricultural Biotechnology in Sri Lanka**

An in-depth analysis was carried out by break-out groups at the stakeholder workshop with the information derived from each of the presentations. Based on this analysis, future priorities were identified and recommendations of each sub-sector were made. Also the existing priorities were revised with the newly identified priorities considering the current trends and the needs of the country.

## **Step 3: Finalizing the National Priorities of Agricultural Biotechnology in Sri Lanka for 2017-2021**

The recommendations resulted at the stake holder meeting were critically evaluated by the National Committee on Agricultural Biotechnology at several rounds of discussions held at SLCARP to determine and update the national research priorities of agricultural Biotechnology for 2017-2021, based on the current status and the economic needs of the country.



## National Research Priorities: 2017-2021

### Agricultural Biotechnology

The agricultural biotechnology research priorities identified for each sector are listed below.

#### 1. Plantation Crop Sector

- a. Genetic characterization of crop germplasm
- b. Marker aided selection for crop improvement (yield, biotic and abiotic stresses with special reference to heat and drought)
- c. *In-vitro* conservation (cryopreservation and tissue culture) of crop germplasm
- d. Mass production of planting material via *in vitro* techniques
- e. Detection and identification of pathogens of economically important diseases and pests
- f. Production of disease free high quality planting material

#### 2. Food Crop Sector

- a. Molecular characterization of genetic resources of important food crops
- b. Gene/QTL mapping and Marker Assisted Selection for important traits on yield, biotic and abiotic stresses and nutritional qualities
- c. Use of novel molecular techniques for crop improvement
- d. Development and application of disease diagnostic tools for major food crops using molecular tools
- e. Production of high quality and disease free planting materials of major food crops
- f. *In-vitro* conservation (cryopreservation and tissue culture) of crop germplasm

### 3. Livestock, Poultry & Fisheries Sector

#### A. Fisheries Sector

- a. Development of biotechnological protocols for marine micro algae propagation
- b. Extraction of bioactive compounds from marine micro algae and other marine organisms
- c. Development of resistant brood stocks of shrimp for white spot disease using molecular markers
- d. Marker Assisted Selection for selected aquatic plants of ornamental value: *Cryptocoryne* (leaf colour and leaf shape) and *Anubias* (leaf shape)
- e. Stock identification for economically important marine food fish using molecular tools
- f. Development of barcoding database for endangered, endemic and threatened fish species
- g. Molecular identification of antimicrobial resistant pathogens along fish product supply chain (especially targeting export industry)
- h. Molecular identification of parasites in food fish (targeting export industry)
- i. Molecular characterization of lactic acid bacteria and other commercially important micro-organisms applicable in processing industry

#### B. Livestock and Poultry Sector

- a. Development and application of Biotechnologies related to animal feed and nutrition
  - i. Molecular identification and quantification of Mycotoxin producing micro-organism in poultry feed
  - ii. Intestinal microbe population identification in poultry

- iii. Improvement of nutrient availability of animal feed through manipulation of rumen microbes
  - iv. Micro-propagation of hybrid grass varieties
- b. Improvement of molecular technologies for disease diagnosis for viral, bacterial, fungal and parasitic diseases
  - c. Vaccine production for viral, bacterial and parasitic diseases for emerging needs

#### 4. Export Agricultural Crops/Ornamental Crops

##### A. Export Agricultural Crops

- a. Molecular characterization of important export agricultural crops
- b. Pest and disease diagnosis of Cinnamon using molecular techniques
- c. Molecular evaluation of germplasm and Geographical Indicator fixing in Black pepper and Coffee
- d. Development of biotic and abiotic tolerant varieties of Pepper and Arabica coffee using reverse genetics approaches

##### B. Floricultural Crops

- a. Production of commercially viable new varieties through genetic engineering in Orchids, Anthuriums and other indigenous species
- b. Indexing for quality of planting material during import and export
- c. Mass production of planting material via *in-vitro* techniques - Orchids, Anthuriums, Ornamental flowering plants and foliage
- d. Pest and disease diagnosis of ornamental crops through molecular techniques

## 5. Other Crops and Organisms

- a. Commercial propagation of, Oil palm and Bamboo using *in-vitro* techniques
- b. Screening and improving microorganisms and their products either for direct consumption as food, or in agro-industries for sustainable agriculture

## 5. Other

- a. Policy Research to enhance the application of biotechnology in agriculture
- b. Application of genetic engineering tools to achieve resistance for biotic and abiotic stresses
- c. Bio-prospecting for agricultural use
- d. DNA fingerprinting/bar-coding of important plants and varieties

### **Summary of National Research Priorities in Agricultural Biotechnology**

The national priorities in agricultural biotechnology for the period of 2017-2021 are summarized in table 01.



**Table 01: National Priorities in Agricultural Biotechnology for 2017-2021**

Major Thrust / Priority Areas	Thrust /Priority areas	Sector
<b>A. Germplasm Conservation and characterization</b>	1) Genetic characterization of germplasm of important crops 2) <i>In-vitro</i> conservation (cryopreservation) 3) DNA fingerprinting/bar-coding of important plants and varieties 4) Stock identification for economically important marine food fish using molecular tools	1) Plantation, Export agriculture & Food crops 2) Plantation crops, Food crops 3) Food crops, Fisheries sector 4) Fisheries sector
<b>B. Genetic Improvement</b>	1) Marker aided selection for crop improvement (yield, biotic and abiotic stresses (heat & drought)) 2) Production of commercially viable new varieties through genetic engineering 3) Marker Assisted Selection for selected aquatic plants of ornamental Value	1) Plantation, Export agriculture & Food crops 2) Floricultural crops 3) Fisheries sector
<b>C. Tissue Culture &amp; Mass Propagation</b>	1) Mass production of planting material via <i>in vitro</i> techniques 2) Production of disease free high quality planting material 3) Development of biotechnological protocols for marine micro algae propagation 4) Embryo rescue techniques	1) Plantation, Food & Floricultural crops, Bamboo, oil palm 2) Plantation crops, Food crops 3) Fisheries sector 4) All crops
<b>D. Detection and Identification of Pathogens and Pests</b>	1) Indexing for quality of planting material during import and export 2) Detection and identification of pathogens of diseases and pests 3) Development of resistant brood stocks of shrimp for white spot disease by molecular tools 4) Molecular detection of antimicrobial resistant pathogens along fish product supply chain	1) Floricultural crops 2) Plantation, Export agriculture, Floricultural crops & Food crops. 3) Fisheries sector 4) Fisheries sector

	5) Molecular identification of parasites in food fish (targeting export industry) 6) Molecular tools for disease diagnosis for viral, bacterial, fungal and parasitic diseases	5) Fisheries sector 6) Livestock and poultry sector
<b>E. Biotechnological Industrial Application</b>	<ol style="list-style-type: none"> <li>1. Extraction of bioactive compounds from marine micro algae and other marine organisms</li> <li>2. Development and application of Biotechnologies for animal feed and nutrition</li> <li>3. Vaccine production for viral, bacterial and parasitic diseases</li> <li>4. Screening microorganisms &amp; their products either for direct consumption as food, or use in agro-industries for sustainable agriculture</li> <li>5. Bio-Prospecting for agricultural crops</li> </ol>	<ol style="list-style-type: none"> <li>1) Fisheries sector</li> <li>2) Livestock and poultry sector</li> <li>3) Livestock and poultry sector</li> <li>4) Micro organisms</li> <li>5) Plantation, Export agriculture, Floricultural crops &amp; Food crops</li> </ol>
<b>F. Genetic Engineering</b>	1) Production of commercially viable new varieties through genetic engineering	1)All Crops.

## **Annexure**

### **Annexure 1: Members of the National Committee on Agricultural Biotechnology**

Dr. W L G Samarasinghe (Chairman)  
Additional Director  
Plant Genetic Resources Centre  
Department of Agriculture  
Gannoruwa  
Peradeniya

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Principal Scientist  
Genetics & Plant Breeding Division  
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Dr. C M Nanayakkara  
Senior Lecturer  
Department of Plant Sciences  
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University of Colombo

Prof. Pradeepa Silva  
Professor in Animal Science  
Department of Animal Science  
Faculty of Agriculture  
University of Peradeniya

Dr. Priyani Seneviratne  
Deputy Director Research (Biology)  
Rubber Research Institute of Sri Lanka  
Dartonfield  
Agalawatta

Dr Pradeepa C. G. Bandaranayake  
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Dr Padmini C. Girihagama (Secretary)  
Senior Scientist  
Sri Lanka Council for Agricultural Research Policy  
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## **Annexure 2: List of the Speakers at the Stake Holder Workshop**

1. Dr. W. L. G. Samarasinghe, Chairman, NCAB & Additional Director, Plant Genetic Resource Centre, Department of Agriculture -Introduction/Opening Remarks; Current Status & Future Directions in Agricultural Biotechnology Research in Sri Lanka
2. Dr. K. K. S. Fernando, Former Director, Agricultural Biotechnology Centre, University of Peradeniya & Former Director, Seed Certification & Plant Protection Centre, Department of Agriculture -Key note address on Current Status & Future Directions in Agricultural Biotechnology Research in Sri Lanka
3. Dr. C. M. Nanayakkara, Member, NCAB &Senior Lecturer, University of Colombo- Agricultural Biotechnology Policy in Sri Lanka
4. Dr. Jayantha Senanayake, Member, NCAB& Additional Director / National Plant Quarantine Service, Department of Agriculture- Current Status & Future Directions in Agricultural Biotechnology Research in Food Crop Sector
6. Dr. S.A. C. N. Chandrika N. Perera, Member, NCAB & Principal Research Officer, Coconut Research Institute of Sri Lanka-Current Status & Future Directions in Agricultural Biotechnology Research in Plantation Sector
7. Dr. J.M. Seneviratne, Assistant Director/Department of Export Agriculture - Current Status & Future Directions in Agricultural Biotechnology Research in Export Agriculture Crops Sector
8. Dr. Shelomi Krishnarajah, Member, NCAB & Director (Research)/ National Botanic Gardens- Current Status & Future Directions in Agricultural Biotechnology Research in Floricultural Crop Sector
9. Ms. Deishini Herath, Member, NCAB & Senior Scientist/National Aquatic Resources R& D Agency- Current Status & Future Directions in Agricultural Biotechnology Research in Fisheries & Aquatic Resources Sector

10. Dr. S.S. Iddamaldeniya, Member, NCAB & Senior Veterinary Research Officer, Veterinary Research Institute- Current Status & Future Directions in Agricultural Biotechnology Research in in Livestock & Poultry Sector
11. Mr Dilip de Silva, Member, NCAB & Chief Executive Officer, Serendib Horticulture Technologies Pvt. Ltd - Current Status & Future Directions in Agricultural Biotechnology Research in Private sector
12. Dr. Pradeepa C. G Bandaranayake, Member, NCAB & Director, Agricultural Biotechnology Centre, University of Peradeniya- Current Status & Future Directions in Agricultural Biotechnology Research in National University System

### **Annexure 3: Key Cross Cutting Areas**

The key cross cutting areas which are essential for the successful implementation of Agricultural Biotechnology research were also identified at the stake holder workshop as critical for the success of biotechnology R&D programmes. Important cross cutting areas are listed below under capacity building in human resources, infrastructure, technology transfer and constraints in each sector.

#### **A. Capacity Building: Human Resource Development**

##### 1. Plantation Sector

- a. Bioinformatics (NGS), genomics and functional analysis
- b. Molecular pathology
- c. Studies on cry-bank
- d. Molecular pathogen detection and vector studies
- e. Proteomics
- f. Training for research supporting staff on molecular techniques

##### 2. Food Crop Sector

- a. Molecular breeding (Long Term/Short term)
- b. Gene editing (Short Term)
- c. Bio-informatics (Post Graduate level)
- d. Tissue culture techniques for crop improvement and propagation
- e. Training on functional genomics
- f. Proper use and maintenance of molecular lab equipment and lab safety
- g. Regulatory issues



### 3. Livestock, Poultry & Fisheries Sector

- a. Trainings in Biotechnology, Bio-informatics and genomics
- b. Micro-propagation techniques for marine micro algae
- c. Techniques in extraction of Bioactive compounds
- d. PhD level and short term training for scientists and supporting staff  
(Parasitology, Bacteriology, Animal Breeding, Marine biotechnology, Aquatic disease diagnosis)

### 4. Other crops: Export Agriculture/Ornamental/Sugarcane & Bambo

- a. Visiting Ongoing projects of oil palm and bamboo in India & Malaysia.
- b. Molecular techniques in characterization and others relevant to floriculture sector.
- c. PhD level training for scientists and short term training for supporting staff relevant to novel biotechnological approaches in export agricultural crop sector. Bio-tech. Training for floriculture sector.
- d. Training on recent advancements in floriculture techniques in domestication wild flora for floriculture sector.
- e. Training on quality testing and certification to Export Agricultural crop sector.
- f. Training supporting staff on quality testing GI fixing and germplasm.

**Table 02: Capacity Building: A. Human Resource Development**

<b>Discipline</b>	<b>Training type</b>	<b>Sectors</b>
Bioinformatics (NGS), genomics and functional genomics and analysis	RPG	Plantations Food crops Livestock, poultry & Fisheries
Molecular breeding	RPG & STT	Food crops
Gene editing	STT	Food crops
Molecular pathology	STT	Plantations
Studies on cry-bank	STT	Plantations
Molecular pathogen detection and vector studies	STT	Plantations
Proteomics	STT	Plantations
Tissue culture/micro propagation techniques for crop improvement and propagation	STT	Food crops Livestock, Poultry & Fisheries Sector (marine micro algae)
Techniques in extraction of Bioactive compounds	STT	Livestock, Poultry & Fisheries Sector
Parasitology, Bacteriology, Animal Breeding, Marine biotechnology, Aquatic disease diagnosis	RPG & STT	Livestock, Poultry & Fisheries Sector
Molecular techniques in characterization	STT	Ornamentals
Biotechnology in floriculture - recent advancements in floriculture techniques in domestication wild flora for floriculture sector	STT	Ornamentals
Proper use and maintenance of molecular lab equipment and lab safety	STT	Food crops
Quality testing and certification of produce	STT	Export agriculture crops
Regulatory issues	STT	Food crops
Training for research supporting staff on molecular techniques,	STT	Plantations
Familiarization of Oil palm and Bamboo cultivations in India & Malaysia	FV	Other crops (Bamboo)
Training supporting staff on quality testing GI fixing and germplasm	STT	Export agriculture crops

**Training Types Abbreviations:**

**RPG = Post Graduate by Research, Mac = Mac (course work), STT = Short term training, FV = Familiarization visits**

## **B. Capacity Building: Infrastructure Development**

- a. Center of excellence at National level (NGS, high throughput genotyping and sequencing, RT-PCR).
- b. Provision of basic molecular biological equipment for institutional laboratories
- c. Bio-tech lab facilities for production of quality planting material in floriculture sector
- d. Controlled environment facilities for research purposes
- e. Certification lab for GI fixing of black pepper and coffee

## **C. Technology Transfer:**

Initiate Private Public Partnerships (PPT) on Technology transfer(especially Oil palm/ Sugarcane)

## **D. Constraints:**

- a. Lack of awareness of policy makers on importance of Biotechnology in economic development
- b. Non availability of laboratory supplies on time due to procurement delays
- c. Poor Inter-institutional collaborations
- d. Lack of incentive to develop floriculture sector through molecular techniques due to indiscriminate importation of new varieties of Anthuriums and orchids
- e. Delays in fund disbursement

## **E. Any other comments**

- a. CARP to organize forum for discussion among researchers, private sector and Policy makers.
- b. Awareness programmes on multi-disciplinary research
- c. CARP to collaborate among relevant authorities (NRC, NSF, NASTEC, COSTI, Other relevant ministries) dealing with different aspects in research on biotechnology
- d. Interaction among other national committees functioning under CARP on cross cutting issues
- e. Formation of a National Plant breeding and Bio-tech Society



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