
**New Partnership for Africa's Development (NEPAD)**

**Comprehensive Africa Agriculture Development Programme (CAADP)**


**Food and Agriculture Organization of the United Nations**

**Investment Centre Division**

# GOVERNMENT OF THE REPUBLIC OF MAURITIUS

## SUPPORT TO NEPAD–CAADP IMPLEMENTATION

## TCP/MAR/2904 (I)

**(NEPAD Ref. 05/16 E)**

## Volume VI of VII

## BANKABLE INVESTMENT PROJECT PROFILE

## Mauritius Agricultural Biotechnology Institute (MABI)

***February 2005***

# MAURITIUS: Support to NEPAD–CAADP Implementation

**Volume I: National Medium–Term Investment Programme (NMTIP)**

***Bankable Investment Project Profiles (BIPPs)***

**Volume II: Agricultural Diversification (Integrated Processing and Marketing)**

**Volume III: Mauritius Agricultural Information System (MAIS)**

**Volume IV: Sustainable Land and Water Management**

**Volume V: Community Development and Poverty Alleviation Project**

**Volume VI: Mauritius Agricultural Biotechnology Institute (MABI)**

**Volume VII: Strengthening the Agro–Processing Capacity of Rodrigues**

# NEPAD–CAADP BANKABLE INVESTMENT PROJECT PROFILE

**Country:** Mauritius

**Sector of Activities:** Agricultural Research

**Proposed Project Name:** **Setting–up of Mauritius Agricultural Biotechnology Institute (MABI)**

**Project Location:** Mauritius

**Duration of Project:** 3 years

**Estimated Cost:** **Rs517,200,000**

**Suggested Financing:**

| *Source* | *US$ million*[1] | *Rs million* | *% of total* |
|---|---|---|---|
| ***Government*** | 12.2 | 360.0 | 69.6 |
| ***Financing institution(s)*** | 5.3 | 157.2 | 30.4 |
| ***Beneficiaries*** | – | – | – |
| ***Private sector*** | – | – | – |
| ***Total*** | ***17.5*** | ***517.2*** | ***100.0*** |

[1] Exchange rate:
Currency: Mauritius Rupee (Rs)
US$1 =Rs29.5
Rs1 = US$0.0339

# MAURITIUS:

## NEPAD–CAADP Bankable Investment Project Profile

## *"Setting up of Mauritius Agricultural Biotechnology Institute (MABI)"*

---

### Table of Contents

## Abbreviations

| | |
|---|---|
| AGOA | African Growth and Opportunity Act |
| AREU | Agricultural Research and Extension Unit |
| BIPP | Bankable Investment Project Profile |
| CAADP | Comprehensive Africa Agriculture Development Programme |
| EU | European Union |
| FAO | Food and Agriculture Organization of the United Nations |
| FARC | Food and Agricultural Research Council |
| GMO | Genetically Modified Organism |
| ICT | Information Communication Technology |
| IMF | International Monetary Fund |
| IPR | Intellectual Property Rights |
| MABI | Mauritius Agricultural Biotechnology Institute |
| MAFTNR | Ministry of Agriculture, Food Technology and Natural Resources |
| MRC | Mauritius Research Council |
| MSIRI | Mauritius Sugar Industry Research Institute |
| NEPAD | New Partnership for Africa's Development |
| NGO | Non–governmental Organization |
| NMTIP | National Medium–Term Investment Programme |
| NSSSP | Non–Sugar Sector Strategic Plan |
| PBR | Plant Breeders' Rights |
| TRIPS | Trade–Related Aspects of Intellectual Property Rights |
| UOM | University of Mauritius |
| UPOV | International Union for the Protection of New Varieties of Plants |

# I. PROJECT BACKGROUND

## A. Programme Origin

I.1. The *Ministry of Agriculture, Food Technology and Natural Resources* (MAFTNR) will be setting up a *Mauritius Agricultural Biotechnology Institute* (MABI) that will develop and deliver a comprehensive set of products and services through the application of modern biotechnology to the non–sugar agricultural sector. As one of the pillars of the *Comprehensive Africa Agriculture Development Programme* (CAADP), agricultural research, technology dissemination and adoption remains a top priority for the Government of Mauritius. The importance of biotechnology has been highlighted in the *Non–Sugar Sector Strategic Plan* (NSSSP) which perceives biotechnology as *"a promising futuristic tool to the Mauritian agriculture in responding to the numerous existing challenges within the sector and in addressing several of its most pressing weaknesses, at a pace that is unachievable, if at all possible, through conventional means"*. In an address to a forum for the AGOA Summit, the Minister of Agriculture has renewed the pledge for a strong governmental commitment to the project. Accordingly, some studies on the feasibility and strategic implementation of biotechnology integration have been conducted and special budgetary provisions have been allocated by Government to promote biotechnology research. The project has reached an advanced stage where government funds of Rs360 million have already been earmarked and disbursement of Rs40 million has been provided for in the financial budget 2004–2005 for the payment of consultancy services and to start construction.

I.2. A feasibility study was conducted in 2001–2002[2] to make an appraisal of the agricultural sector in Mauritius in relation to the use of biotechnology in the Mauritian agricultural and food sectors. The feasibility study was undertaken, combined with visits to public, private and university groups and organisations, including statutory bodies, to assess issues including equipment, core services, R&D priorities, application of biotechnology, training, operational context and market potential, and also constraints to current operations (see Annex 5). The Australian consultancy report came with the main recommendation that a *'Food and Agricultural Biotechnology Institute of Excellence'* was a *'high priority to meet the needs of Mauritius with possible regional expansion'*.

I.3. The MABI would focus initially on practical outcomes for the non–sugar sector of the agricultural industry in Mauritius, but in the longer term should develop regional and international linkages and strategic alliances, so that it becomes a regional hub for agricultural biotechnology. Following the publication of the final report in May 2003, the deliberations of a Ministry–level Committee highlighted the need for technical profiling of the staff of the MABI as proposed in the report of the Consultant. Hence, the *Food and Agricultural Research Council* (FARC) was asked to set up a Technical Committee to work out a well–defined technical and professional profile of the staff of the various divisions as already proposed in the report and to subsequently propose a staff training programme.

## B. General Information

I.4. With the depletion of our natural resources and the increasing need for food, our ability to feed the world and preserve the environment depends on the application of advanced science, innovation and technology in agriculture and food. Biotechnology encompasses all aspects of exploitation of living organisms, including agriculture and food. The global trend for biotechnology

[2] By Professor Michael Jones, Director of the *WA State Agriculture Biotechnology Institute* of Perth, Western Australia and by Mr Dass Apanah, Managing Director of *Advance Consultancy Services* of Perth.

has been for rapid growth and expansion to meet the needs of the expanding world population. In the agricultural sector, there is a continuing demand for increased yield and productivity coupled with better quality.

I.5. ***Future of Agricultural Sector in Mauritius.*** One of the major objectives of the MAFTNR in Mauritius is to modernize its agricultural sector with a view to attaining a certain degree of self–sufficiency, developing the local agro–processing industry, promoting entrepreneurship, optimizing export opportunities and maximizing on the potential benefits of regionalisation. Accordingly, the MAFTR in Mauritius has embarked on a vast reorientation program for the reform of the agricultural sector. One of the components of this strategy is to promote a transition from the traditional practices, towards a more sophisticated, technology–based approach to agriculture. In addition, Mauritius, like many other countries, has been relying heavily on Information Technology, Telecommunication, the Internet and E–Business in the *Information Communication Technology* (ICT) sector as part of its new economy for wealth creation and employment. Although this sector will contribute strongly to the national economy in the medium to long term, Agricultural Biotechnology has emerged as an additional key solution, which would contribute towards the economic growth of Mauritius.

I.6. ***Agricultural Biotechnology.*** In agriculture and food sectors, Agricultural Biotechnology can be used in a wide range of applications beneficial to the farming community. Examples include: (i) use of tissue culture techniques for the regeneration of planting materials, which usually cost the farming community a considerable sum of money through imports; (ii) use of molecular disease diagnostic tools for both plants and animals which would enable early detection of disease symptoms, thus preventing direct damage through spread of infection; (iii) molecular plant and animal breeding for the development of improved crop varieties with enhanced yields or improved animal breeds: (iv) the use of Genetically Modified (GM) technology for the development of transgenic crops with enhanced agronomic traits & production of value added foods, etc.

I.7. ***Biotechnology in Mauritius.*** Despite the benefits that this technology has to offer, Biotechnology as a tool for the advancement of scientific research and as a problem solving aid in the Agro–Industry has yet to be fully exploited in Mauritius. The current status of biotechnology–based applications range from the use of tissue culture techniques for the commercial propagation of banana, sugarcane and anthurium plantlets to the use of GM technology towards the production of herbicide resistant sugarcane lines held under confinement.

I.8. Research and Development programmes for sugarcane biotechnology are mainly undertaken at the *Mauritius Sugar Industry Research Institute* (MSIRI) whilst research pertaining to crops of the non–sugar sector such as banana and flowers such as anthurium, are undertaken at the tissue culture laboratories of the *Barkly Experimental Station* and that of the FARC under the aegis of the MAFTR in Mauritius. Biotechnology Research and Development for sugar is well supported at the MSIRI, where the researchers have sound scientific skills and have developed excellent collaborative linkages with overseas organisations. Although infrastructure for biotechnological and molecular research has been developed, upgrading of facilities in radioactive work and bio safety is needed. Also there is increasing competition from countries such as Brazil in the field of sequencing and genomics initiatives and it will be increasingly difficult for MSIRI molecular researchers to keep pace with new developments in the absence of these new technologies in Mauritius.

I.9. In the non–sugar sector, biotechnology has also been successfully used for the commercial propagation of anthurium plantlets by the private sector such as the tissue culture laboratory of *Microlab*, a branch of the *Anthurium Export Company* Ltd.

I.10. ***Biotechnology in Africa.*** In order to increase food security and efficient food production, African countries have taken on Agricultural Biotechnology at various levels. Some use micro propagation as the main approach, whilst others such as South Africa have a policy to encourage development and application of biotechnology more widely, with targeted investment in this area such as animal vaccines and molecular diagnostics. With respect to Agricultural Biotechnology, overall Mauritius is now located between the low and medium levels. As a result of geographical, historical and political factors in Africa, there is a lack of resources/funding in the field of biotechnology in most countries. Several African countries lack the basic infrastructure and facilities coupled with inexistent legislative framework that discourage the development of new technologies because of the lack of protection for profitable inventions/technologies. The selection of crops for research and development is mainly for national consumption for e.g. cassava, sweet potato and yam and there is no orientation towards export markets.

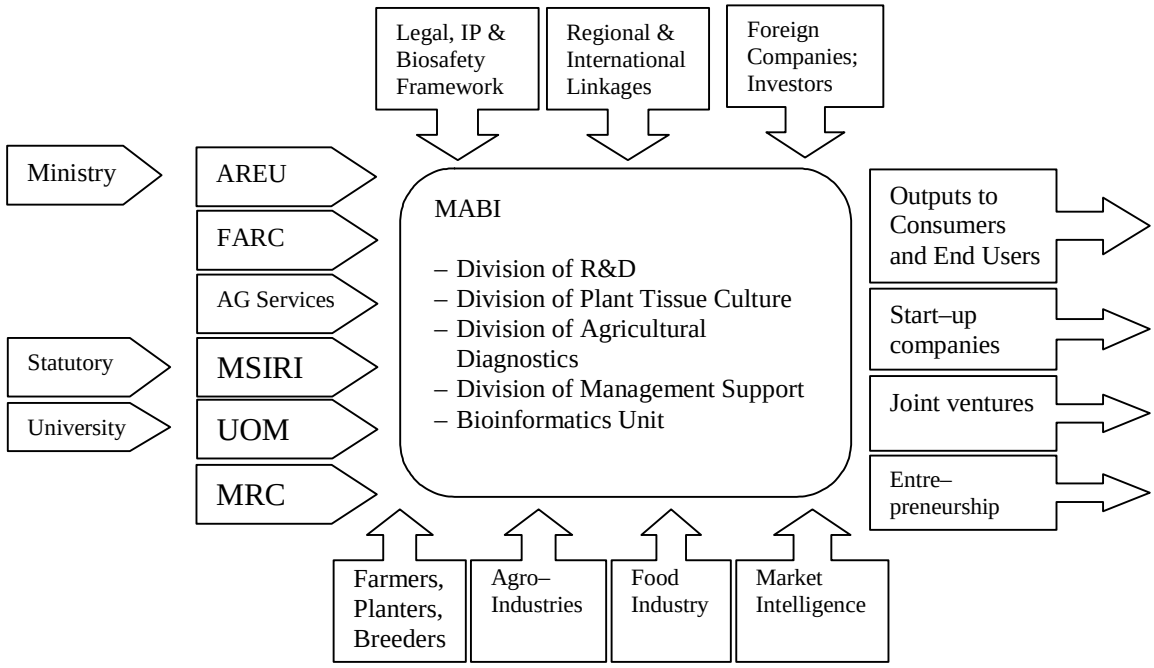
## II. PROGRAMME AREA

II.1. The chosen location for the MABI is in the District of Moka and is situated close to the roundabout at Réduit, opposite the *University of Mauritius* (UOM). The project area is currently under sugar cane cultivation and the MABI is anticipated to cover 4.9 acres with car parking of 2.5 acres.

II.2. There are several justifications for the choice of the project location namely:

- Its ***proximity to the UOM***:
  - The UOM has an important role to play in the successful establishment of the MABI. Postgraduate students of the UOM undertaking research in crops of national interests as advocated by the NSSSP, constitute a potential pool of researchers for the institution. A very close relationship between MABI and UOM is required with the joint supervision of projects, with location of many postgraduate students at the MABI. Its proximity to the research institutions and agricultural services of the MAFTRN.
  - Most of the agricultural services divisions and research institutions are in Réduit and they will play a key role in the successful implementation and operation of the MABI, as displayed by the diagram below. These institutions include the FARC, *Mauritius Research Council* (MRC), *Agricultural Research and Extension Unit* (AREU), MSIRI, Plant Pathology Division, Horticulture Division and Agricultural Information Division amongst others.

- ***Well–developed road network***, which has been further strengthened with the construction of a highway/bypass linking Ebene, Réduit and Rose–Hill. Road access to the MABI and to the agricultural services of the Ministry in Réduit has been improved with the construction of the highway, relieving traffic in the area, especially in the mornings and afternoons




## III. PROGRAMME RATIONALE

III.1. The Republic of Mauritius is increasingly and constantly challenged with mounting competition of their agricultural export products. Attempts to improve agricultural productivity are coupled with inherent constraints such as high vulnerability to climatic offsets and depleting cultivable land resources in favour of more remunerative economic activities. Moreover, it is reported that import of foodstuffs represents 14 percent of the total import bill for Mauritius. Thus, it has become increasingly important for Mauritius to enhance quality, productivity and profitability of their agricultural products in order to meet consumer needs as well as maintaining international competitiveness.

III.2. With the inherent limitations of the conventional agricultural practices, biotechnology has emerged as a key technology for the improvement of crop varieties in Mauritius. Whilst the sugar sector has been benefiting from the application of biotechnology, there have been little achievements in the non–sugar sector where biotechnology has been restrictively applied due to problems of coordination of research and lack of adequate infrastructural and technical amenities. The setting up of the MABI addresses all the mistakes of the past and proposes the centralisation of all activities pertaining to agricultural biotechnology research and application under one apex organisation endowed with the appropriate resources and amenities.

III.3. Biotechnology is a heavy investment technology having cross cutting areas of application often necessitating common items of equipment. Instead of investing massively in reinforcing the existing institutions with individual biotechnology facilities and run the risk of duplicating resources, the MABI will provide *"adequate and readily accessible research facilities and support services for all institutions involved in non–sugar research in a most cost–effective manner through the efficient pooling of existing resources, equipment and human, and within a framework that would ensure their judicious utilisation"* (Source: NSSSP). As mentioned in the latter document, application of biotechnology in the non–sugar sector has also failed due to lack of available skilled human resource

capacity. As part of the implementation arrangements for the project, provision is made for capacity building of the technical staff that would be employed by the MABI.

III.4. For the agriculture sector to benefit from the advantages of a wider range of modern biotechnology techniques, a *Mauritius Agricultural Biotechnology Institute* will be set up in order to cater for all research and application of biotechnology in the non–sugar agricultural sector. The latter is set to play a more prominent role in the economy with the proposed reduction in the guaranteed price of sugar exports to the EU market. With the significant economic losses to be anticipated from the reduction in the sugar preference margin, as estimated by the IMF, Mauritian agriculture has to turn to sector of activities other than sugar for its future development. Besides its commercial application to the agricultural sector, biotechnology plays an important role in the conservation of biodiversity. With more than 57,000 ha of land under forests, Mauritius will benefit from the application of biotechnology through plant breeding, tissue culture and tree pathology amongst others. The institute will ultimately provide enormous possibilities to address the most pressing constraints to the sector and sharpen our competitive edge. Once Mauritius has built up its technical expertise and developed the research facilities, there will be considerable potential to expand into regional markets.

III.5. Initially, MABI would focus on practical outcomes for the non–sugar sector of the agricultural industry. In the longer term, MABI should develop regional and international linkages and strategic alliances so that it becomes a regional hub for agricultural biotechnology. In brief, MABI will support both the needs of Mauritius and enable it to capture regional benefits with a view to develop Mauritius into a knowledge–based economy.

## IV. PROGRAMME OBJECTIVES

IV.1. The setting up of the Mauritius Agricultural Biotechnology Institute follows from the proposed reforms for the modernisation of the agricultural sector to enhance its technological competency and commercial viability. The proposed project hence looks to establish the capacity in Mauritius to lead the agricultural sector from traditional to modern sophisticated technology with a view to strengthening competitiveness in domestic and export markets. In the words of the Minister of Agriculture, "the Institute will provide a solid scientific infrastructural foundation for high calibre applied research in biotechnology and will have the responsibility of providing the targeted technological boost to the Mauritian non–sugar sector". He also made reference to the possibility for Mauritius to contribute to the adoption of biotechnology within the African region and to assist neighbouring countries in their respective biotechnology programmes.

IV.2. The main objectives of the MABI are to:

- ***Address priority weaknesses of the sector using modern technologies*** with a service orientation to the planting and farming community at large in the following respects:
  - *Production of elite planting materials* of priority crops/varieties for mass propagation.
  - *Production of disease and pest resistant and novel trait crops/varieties*. The focus will be on new crop varieties with increased yields, more resistant to diseases and pests and which are adapted to the climate of Mauritius. With strict sanitary and phytosanitary norms, it is essential to reduce the use of pesticides to reduce the residues in the produce. This may be achieved by better inherent resistance and by improving crop protection through developing effective systems of integrated pest management. The consultants recommend the establishment of a Plant Breeding

Section within the Division of Research and Development, and the appointment of an additional and properly supported Plant Breeder, with knowledge of established breeding techniques and molecular biological training.

- *Provision of high quality diagnostic services* for the development of safer products, for use in marker–assisted selection in plant breeding and animal breeding for animal quality traits, and for the maintenance of bio security (development of bio safety protocols).
- *Conservation and utilisation of biodiversity and natural resources* via tissue culture, micro–propagation, germplasm management, use of molecular markers and other approaches and bio prospecting for potential herbal and medicinal value. There are several hundred endangered indigenous species in Mauritius and it is essential that they are protected and maintained.
- Commercialisation of some R&D activities, including processes in exchange for royalty payments.
- *Facilitating development of 'bioentrepreneur'*. The establishment of the Institute will provide the impetus to develop 'bioentrepreneurs' in Mauritius. Once the concepts and potential applications of agricultural biotechnology have been recognised, opportunities presented can be explored with private organisations, international companies and venture capitalists.
- *Incubation of companies: providing full facilities for commercial start up.* The MABI must retain the flexibility to provide full facilities to enable new companies to start up. This strategy is now being employed in the USA, Europe and Australia to encourage commercialisation of research because it provides access to a critical mass of researchers with a high skills base and leading technology with minimum risk. The provision of such facilities is mutually beneficial for both parties since it provides access to a pool of trained staff, focuses research and development on real activities and also generates good publicity whilst building strategic viable partnerships.

- ***Acting as a Centre of Excellence*** for high calibre research work as well as a training centre for:
  - *Conducting high level research work* to provide strong technical support to agricultural activities of economic importance.
  - *Ongoing training* of local staff as well as technicians of the region through local and foreign expertise.

- ***Targeting subsequently of regional market, following market research.*** In the medium term as the MABI builds up its expertise and accumulate successes in research and development, it can target the regional market and explore the opportunities of developing commercial applications for niche markets. The possibility for the MABI to become a regional hub in the delivery of services and know–how in agricultural biotechnology could then be contemplated.

## V. PROGRAMME DESCRIPTION

V.1. There are two stages involved for this programme (see Annex 6 for diagrammatic representation):

V.2. ***Planning/Pre–operational Stage.*** The information provided in this document originates from this stage. However these would have to be refined from the findings of the second stage which is ongoing and for which information is currently unavailable.

V.3. ***Operational Stage of MABI.*** This stage would involve an updating of research priorities and detailed formulation of research programmes and projects (including costing, etc.) and determination of any specific needs for laboratory equipment and consumables (if need be) there from, and very precise determination of staff and training needs, that would be in the form of a Staff Development Programme.

V.4. The construction phase is anticipated to spread over the financial years 2004/05, 2005/06 and 2006/07. For the financial year 2004/05, the sum of Rs40m allocated to this project will be used for the payment of consultancy services and to start construction. The appointment of Mechanical, Electrical, Waste treatment, Quantity surveying, Civil/Structural Engineering Consultants are imminent. All the works related to drawings are expected to follow prior to the appointment of civil work contractors.

V.5. ***Infrastructure and Organisation Structure.*** The gross size of the building is estimated to be around 7,000 $m^2$ with about 700 $m^2$ of outbuildings to include containment glasshouses, general stores and livestock house.

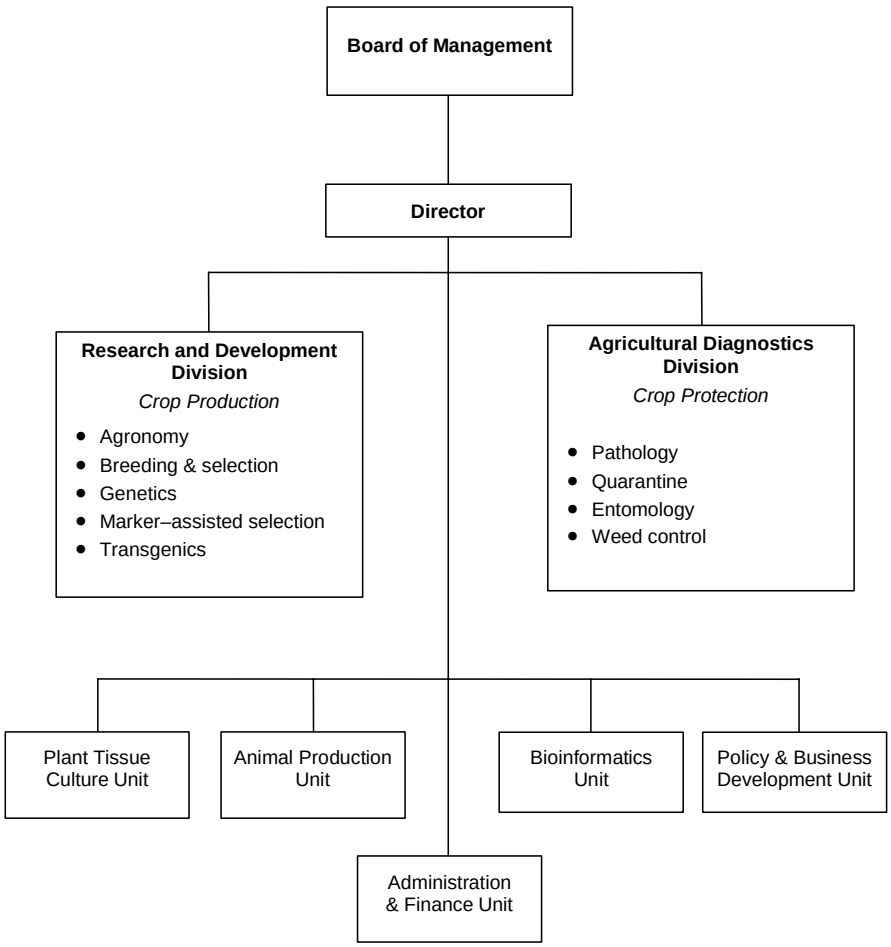
V.6. Since it is intended that the MABI will become a regional hub in the medium term, the type of building, construction design and fit out are structured according to International Standard Specifications. Some of the major considerations include Australian Standards relating to laboratories, Guidelines from the Office of Gene Technology, Australian Building Code, local building codes in Mauritius, fire regulations, bio safety/containment, security requirements, air conditioning etc. The building should allow for future expansion, incubation of companies and delivery of specialist training courses for the region, with appropriate support for plant growth and an animal house.

V.7. The Technical Committee has recommended an adjustment to the organisational structure proposed by the consultancy firm to reflect the relativity of the different functions. Hence, the committee has proposed that the MABI constitute of the following:

- Research and Development Division (Crop Production);
- Agricultural Diagnostics Division (Crop Production);
- Plant Tissue Culture Unit;
- Bio–informatics Unit;
- Animal Production Unit;
- Policy and Business Development Unit;
- Management Unit.

V.8. The Bio–informatics Unit would collaborate with and function as a node of a Bioinformatics Network or Grid that could be proposed by the *Joint Indo–Mauritian Committee on Bioinformatics.*

V.9. The laboratory facilities and other infrastructure falling under the responsibility of the above–mentioned divisions and units are listed in Annex 3.




V.10. As regards the structure and staffing, the committee recommends that a maintenance section be set up to cater for the management, maintenance and repair of labs, computer hardware and software, etc, particularly given the high–technology intensive status of the MABI.

V.11. ***Equipment.*** In agricultural biotechnology, the availability of new equipment provides a competitive advantage. For the MABI to be a regional institute of excellence, it must provide the core equipment, platform technologies and facilities needed for quality research and development, its application and commercialisation. The purchase of expensive equipments can only be justified if they are properly maintained, fully utilised, and available to all researchers. A list of the equipment required for the operation of the MABI is provided in Annex 1. The specifications for the items of equipment need to be defined closer to the date of tender.

V.12. ***Staffing.*** The building will house an estimated 116 scientific and technical staff, supported by the Ministry, by 2008. These staff will consist of staff transferred into the Institute (currently at the Ministry) and new appointments. There will also be increasing numbers of postgraduate and seconded staff from UOM, staff from MSIRI using specific facilities, and in time, commercial researchers and overseas researchers from international linkages. The Director and the Senior Executive Group of the MABI will be responsible for the appointment of the staff and the determination of their conditions of

service. Thus, the MABI will pay for its staff salaries, determined on a scale different from that used by current parastatal bodies to reflect its status as a special category.

V.13. The consultancy firm has had consultations with the staff of the different para–statal organisations namely Agricultural Services of MAFTRN, FARC, AREU and MSIRI. The scientists were keen to update their skills to carry out their tasks more effectively. However, there is a gap between their knowledge of agricultural biotechnology and the application of biotechnology in Mauritius. The scientists have a comparatively good level of basic skills in biotechnology across the various para–statal bodies. Nevertheless, there is a requirement for additional training relevant to the specific fields of activities of MABI. The proposed profiles and competencies for each Division and Unit involved in the Scientific and Technical aspects of the MABI are provided in Annex 2.

## VI. INDICATIVE COSTS

| Main Items | Costs (Rs'000) |
|---|---|
| 1. Building works & Fitouts and Consultancy Fees (*) | 414,000 |
| 2. Equipment, including generator | 60,000 |
| 3. Consumables | 28,000 |
| 4. Furniture | 10,200 |
| 5. Computerisation | 90 |
| 6. Staffing and training (including technical assistance) (***) | |
| Contingency | 4,000 |
| Total Cost (**) | 517,200 |

(*) Figures are based on preliminary estimates and are subject to changes on appointment of various consultants and approval of preliminary drawings & programme of works

(**) To be noted that items 1. to 6. were estimated at rates prevailing in as at March 2002 when the feasibility study for the setting up of the MABI was carried out

(***) To be determined during operational stage

## VII. PROPOSED SOURCES OF FUNDING

VII.1. The Government of Mauritius will be financing Rs360m out of the total project cost of Rs517m. Financial assistance will be required for the remaining Rs157m. For the financial budget 2004/05, the Government of Mauritius has made provision for a disbursement of Rs40m for the project. Budgetary provisions of Rs550,000 have also made available for training of 4–5 officers, which is only a preliminary stage of the training required. The financial implications for the training and staff development of the MABI will be known once the operational stage has been completed.

VII.2. All the operational costs of the MABI would be covered for under the budget for the MAFTRN. Thus, any funding requirements for training, paying of staff or technical assistance would in theory be borne upon by the ministry. However given the significant financial implications for this project, it is hoped that international organisations/agencies would contribute both in kind and in money terms for the successful implementation of the project.

## VIII. PROGRAMME BENEFITS

VIII.1. The ***main benefits*** anticipated from the project are:

- Increased productivity and superior quality products
- More rapid production of new varieties
- Higher yields of crops
- Reduced application of chemical sprays (insecticides, fungicides and herbicides) with less exposure to farm workers
- More efficient use of agricultural and veterinary chemicals
- Reduced water consumption
- Sustainable production and improved natural resource management
- Conservation of biodiversity

VIII.2. The ***main beneficiaries*** of the project would be:

- ***Farmers:***
  - Through biotechnology, the *production of crops with decreased dependence on pesticides*. The built in protection against diseases and insects reduces the need to apply conventional insecticides, thereby reducing handling, exposure and potential spillage;
  - *More food at reduced costs.* Varieties of crops can be enhanced to enable farmers to produce more food at lower costs. Enhanced food crops through biotechnology make it possible to obtain higher crop yields by effectively controlling disease, insects and weeds that cause extensive crop loss and damage;
  - *More efficient use of farmland.* By easing crop damage and disease, improved pests control allow for the more efficient use of farmland.
- ***Consumers:***
  - Given that crops can be grown with better yields and at reduced costs with the application of biotechnology, the consumers will benefit from *lower prices for food consumed*;
  - *Products of higher quality and enhanced nutritional value* will be made available to the consumers. The additional qualities of food produced using biotechnology include longer shelf life, improved protein functionality and increased energy availability. In the emerging use of biotechnology (third generation), plants are used to create proteins that can then be used to produce edible vaccines and antibiotics.
- ***Preservation of the environment through reduced soil erosion.*** The use of crops produced through biotechnology can contribute to a decrease in erosion because harmful weeds are controlled while the crop thrives. These tillage systems are effective for helping to save the soil, conserve soil moisture and nutrients, etc.

- ***Agricultural stakeholders,*** government agencies, planters including co–operatives and Individuals, Para–statal Institutions, Tertiary Institutions, Industry sectors and Regional countries who will benefit from the services of the MABI which are as follows:
  - To provide a national resource for R&D in food and agricultural biotechnology (*"One–Stop Shop"*);
  - To establish a critical mass of researchers and facilities in agricultural biotechnology;
  - To develop strategies for agricultural biotechnology to enable Mauritius to achieve a knowledge based nation status within 10 years;
  - To develop strategies for non sugar crops to meet national priorities;
  - To undertake basic and applied R&D in food and agricultural biotechnology;
  - To provide staff training and development in agricultural biotechnology;
  - To provide services to the community and product development;
  - To commercialise R&D;
  - To develop national, regional and international strategic partnerships.

## IX. IMPLEMENTATION ARRANGEMENTS

IX.1. The project would establish a three–tier management structure for implementation. At the headquarters of MAFTRN, the Biotechnology department would be in charge of the project, responsible for central planning, procurement and coordination. Three sub–committees have been set up to oversee the project in terms of (i) Construction and logistics; (ii) Identification of research priorities and programmes under MABI with inputs from all stakeholders; and (iii) Human capacity building and training.

IX.2. ***Construction and Logistics.*** As regards the construction phases of the project, this is provided in Chapter V above. The planning/construction and related procedures are being taken at the level of *Ministry of Public Infrastructure* and tenders are being launched by the *Central Tender Board*.

IX.3. ***Research Priorities.*** Crops of national priorities for MABI research and development programmes have already been identified in the Consultant's report and were further reviewed at the level of the sub–committee on research priorities. As identified by the Australian consultancy firm, the research priorities would include plant breeding, quality improvement and post harvest technology. The top priority crops would include potato, ginger, onion, garlic, tomato, banana and anthurium. These priorities are in line with the policies identified in the Non–sugar sector strategic plan (see Annex 7). The Technical Committee set up by FARC emphasises the concept of Research Programmes or thematic areas of research, as opposed to single, isolated research projects worked out on a piecemeal basis. Such programmes carry the notion of a continuum of research undertakings, from the low level/tech, classical conventional projects graded up to high–tech, biotech or IT or other technology–intensive projects cross–cutting several disciplines.

IX.4. ***Training and Recruitment.*** There is also a need to make sure that national capacity can assess the available information on new developments regarding biotechnology. Much emphasis is being laid at the Ministry of Agriculture, Food technology and Natural Resources on human capacity

building through the establishment of linkages with Research, Training and Development institutions in countries such as India, Australia, etc. In addition, it is also proposed that foreign expertise be sought to train local staff in priority areas that demand training of a large number of technicians. Experts from Australia and India could be resorted to for this purpose. In the first instance, the ministry should contact the overseas institutions with a view to identifying experts who could participate in these offshore training programmes and to negotiate mutually attractive arrangements for the provision of these services.

IX.5. In order to create a pool of scientists that will implement these programmes and deliver the expected outcomes of the institute, the ministry (at the level of the training subcommittee) is in the process of setting up a training programme that is based on the following criteria:

- To achieving organisational objectives;
- Evaluating the requirement of the job to attain the standard to perform the tasks;
- Fulfilling the individual needs to gain maximum output from staff.

IX.6. Required competencies and indicative areas of training for the operation of MABI have already been identified (Annex 4). A survey has already been carried out to identify existing staff of the ministry with minimal tertiary qualification in agricultural biotechnology. The same exercise is being extended towards identifying suitable qualified candidates in the field of agricultural biotechnology, presently not in service at the ministry.

IX.7. ***Funding.*** It is important to set up a funding scheme that would support investment in agricultural biotechnology and promote new ideas/technologies. The consultants recommend the creation of an *"Agricultural Biotechnology Scheme"* that would finance the following areas: Training and development, support for novel ideas, collaboration and interdisciplinary research and development, national policy and international policy development. They propose that a new system of allocation of funds be developed, with clear guidelines so that resources are allocated to priority areas and to high quality ideas.

IX.8. The information provided in this document will undoubtedly be fine–tuned in the light of the local issues and the ongoing planning process will involve further discussion within the Ministry, planning division or other staff appointed by the Ministry, including senior scientists, as the design progresses.

IX.9. ***Monitoring and Evaluation.*** In order to ensure that the MABI is fulfilling its role and meeting its objectives, there should be periodical reviews as suggested by the consultancy firm. No monitoring framework has been proposed but it has been recommended that initially, progress be monitored over a 3 year periods taking into account the following: achievement of targets, staff and organisational issues, success of training programs, any problems in establishing the Institute.

## X. TECHNICAL ASSISTANCE REQUIREMENTS

X.1. The expected requirements in terms of technical assistance are as follows:

X.2. ***Training.*** Short–term training courses could be sponsored in different areas of biotechnology and laboratory management as per Annex 4. It is proposed that foreign experts be sought to train local staff in priority areas that demand training of a large number of technicians. Assistance from experts from Australia and India could be approached for this purpose. In the first instance, the ministry should contact the overseas institutions such as FAO to identify experts who could participate in these offshore training programmes and to negotiate mutually attractive arrangements for the provision of these services. Until the existing human capacity in biotechnology has been inventoried, the technical committee will not be able to refine the training areas and attach a cost estimate to the training/capacity building requirements.

X.3. During the official visit of the Minister of Agriculture and the Permanent Secretary to Singapore and Australia in Sep/Oct 2001 in the context of discussion on biotechnology, negotiations have been initiated with various institutions of interest to develop collaborative linkages with these countries. The MAFTRN will have to follow up with government departments and academic institutions in Australia. The ministry has finalised a Memorandum of Understanding with the *Department of Biotechnology* of Government of India. Initial negotiations have already started and an Indian delegation of biotechnology experts has offered assistance in the form of training and transfer of technology in various areas of interest.

X.4. ***Financial/sponsorship of Projects.*** Mauritius should take advantage of the regional initiatives in biotechnology. Workshops and training programmes are regularly organised by international organisations with a view to foster the use of biotechnology at the regional level in a collaborative manner. Funding is also usually provided to assist developing nations to support Biotechnology projects in agriculture. The MAFTRN should tap these opportunities in consultation with the *Ministry of Foreign Affairs and Regional Cooperation.*

X.5. The possibility of having joint execution of research projects and exchange of scientists and experts or the sponsorship of projects such as the development of new crop varieties for the region should be considered.

## XI. ISSUES AND PROPOSED ACTIONS

XI.1. ***Identification of Research Priorities (Local and Regional).*** To evaluate whether modern biotechnology will be of benefit to Mauritius, policy makers at the national level should be able to define clearly the desired outcomes from public investments in R&D: identify the priorities to be addressed and ensure that these priorities are consistent with the government's efforts to improve the livelihood of its people. This is currently being investigated at the level of the sub–committee on research priorities. While the priorities of the African region may be different from those of Mauritius, there are however some common regional priorities which have been identified as potential areas that the MABI could exploit for e.g. propagation, plant breeding and disease resistance. Before embarking into the region, it will be necessary to undertake market research and to develop a strategic plan and determine the market needs and potential for each regional country.

XI.2. ***Rules and Regulations.*** For the sound uptake of this technology, it is also significant to ensure that regulations are in place for assessing the risks of new products to the health of humans and

animals as well as to the preservation of the Mauritian ecology. In this context, the *Genetically Modified Organisms* (GMO) *Act* was enacted in April 2004. This legislation takes care of:

- Firstly, of a legal void for the protection of our consumers against genetically modified foods that are already in our markets; and
- Secondly, addresses the uses of GMO that need to be approached with great caution for the safety of human and animal health as well as the conservation of our environment and its natural biodiversity.

XI.3. The objects of this Act are:

- To provide for measures to regulate the responsible planning, development, production, use, marketing and application of genetically modified organisms in the food and agricultural sector;
- To ensure that all activities, including importation, exportation, production, release and distribution, of genetically modified organisms and their derivatives be carried out in such a way as to limit possible harmful consequences to the environment and risk to human and animal health; and
- To create a *National Biosafety Committee* whose objects and functions shall, inter alias, be to advise the Minister on all aspects concerning genetically modified organisms, publish guidelines and a code of practice and encourage public participation in decision–making processes.

## XII. POSSIBLE RISKS

XII.1. The adoption of biotechnology in developing countries holds both promises and problems. It presents profound ethical and safety issues, complicated by the issues of proprietary science. The strong position of the private sector in developed countries, where the bulk of developments in agricultural biotechnology have so far taken place, raises fears of increased dependency on the private sector than the public sector. There have been concerns about the creation of uncontrollable 'super weeds' or 'super viruses'. At the centre of controversy are also patenting and property rights. This means that the adoption of technology will inevitably raise numerous issues and public concerns, including the risks to the environment, the risks and impact on social and economic order, the ethical challenges and the role of private and public sectors in biotechnology research for developing country agriculture.

XII.2. The development of a legislative framework that would include Intellectual Property Rights (Plant Variety Protection, Intellectual Property and Trade Secrets) and Bio safety (in terms of laboratory, novel (GM foods) and quarantine and phytosanitary clearance) would address many of the issues mentioned above.

XII.3. ***Intellectual Property Rights.*** The expansion and strengthening of Intellectual Property Rights would stimulate the development, commercialisation and diffusion of newly discovered technologies/processes to farmers. A strong national IPR system will provide greater access to proprietary technologies and consistent IPR policies and management will encourage mutually beneficial partnerships between the public and private sectors. The mechanism by which Mauritius will join the international IPR community is by becoming a signatory to the UPOV Convention for

PBR, and the WTO–TRIPS Agreement for patents. The Australian consultancy report recommends that Mauritius signs up to the 'first to file' patenting system used in Europe and the rest of the world, excluding USA.

XII.4. ***Biosafety.*** Regulations for safe conduct of researchers in laboratories normally fall under standard health and safety legislation. Additional legislation is required for recombinant DNA work and should include:

- A statutory national committee, the National Bio safety Advisory Committee (NBAC), based at the Ministry should be responsible for overseeing and implementing policy on recombinant organisms, with appropriate representation from different disciplines to cover the issues involved, including at least one layperson and one legal representative.
- An Institutional Bio safety Committee at each institution at which recombinant DNA work is undertaken. These committees should be the first contact point for institutional researchers and will be responsible for ensuring local compliance with bio safety regulations, for making decisions on activities of low risk, and for reporting projects to the national committee.
- A mechanism for applications to carry out recombinant DNA work, including contained laboratory, glasshouse, small–scale field releases and commercial releases of GM material.

XII.5. In setting up discussions forum to address key aspects of biotechnological applications, especially in a small developing country like Mauritius, it is important to bring together all potential stakeholders including senior policy makers, scientists, business representatives, non–governmental organisations and leaders of agricultural research systems. In this respect, the setting up of the MABI, advocated by the NSSSP is an excellent first step towards the implementation of biotechnology in the development agenda of the country. One pre–requisite for the successful operation of MABI would be the development of strong collaborative and effective functional linkages with institutions and other stakeholders operating in the agricultural sector. As far as legislations are concerned, the *GMO Act* has been enacted in April 2004 and the MAFTNR is currently working on the operational aspect of this legislation for its promulgation soon. Other pieces of legislations are currently being worked on to cater for a new *Plants Bill* (i.e. the previous *Plants Act* which date back to 20 years will be updated with due emphasis being placed on phytosanitary conditions and PBR) and a *Seeds Bill* which will cater for the production, certification, distribution and use of good quality seeds.

XII.6. ***Returns to Investment.*** The Government of Mauritius, as well as the main stakeholders, are aware of the huge financial implications of this project. Moreover, the potential for the MABI to go offshore and provide services and facilities to regional countries will only be assessed after the MABI has well established itself in the local context. There is however strong justification for the setting up of such an Institute given the urgency of modernising the agricultural sector, in the face of international pressures on the Sugar Regime, on which the Mauritian economy has hinged upon for a long time.

XII.7. ***Ability to Attract Capacity.*** A survey has already been conducted on the existing human capacity possessing an academic background in biotechnology. Propositions will be made for the capacity building needs of the MABI Staff based on the findings of the survey. Whether problems will arise in attracting and building sufficient capacity for the MABI would only be revealed in the later stages of the project.

## ANNEXES:

**Annex 1: List of Equipment Proposed for the Different Sections of the Institute**

**Annex 2: Staff Profiles and Competencies**

**Annex 3: Proposed Laboratories as Allocated to Each Division and Unit of MABI**

**Annex 4: Required Competencies and Indicative Areas of Training**

**Annex 5: SWOT Analysis of Statutory Bodies**

**Annex 6: Stages of Project**

**Annex 7: Research Priorities**

## Annex 1: List of Equipment Proposed for the Different Sections of the Institute

1. Eppendorf micropipettes (2, 10, 20, 100, 1, 999ul)
2. Ice maker
3. Electronic balance
4. Analytical balance
5. Refrigerated centrifuge
6. Vortex mixers
7. Magnetic stirrers
8. Water bath/accessories
9. Transilluminator
10. Blender/mixer
11. DNA sequencer, AB 1210, 16 capillary
12. Perkin Elmer thermal cycler 2400
13. Perkin Elmer thermal cycler 9700
14. Eppendorf microcentrifuge
15. Spectrophotometer
16. Fluorimeter (DNA Quant)
17. Vacuum centrifuge/concentrator
18. Autoclave
19. Low speed centrifuge and rolers (Beckman)
20. Bench top centrifuge and rolers
21. Gel documentation system
22. Compound microscope (e.g. Olympus)
23. Inverted microscope (e.g. Olympus)
24. Dissecting microscopes
25. Incubator
26. Shaker
27. Drying Oven (glassware)
28. Hybridisation oven
29. DNA Gel Electrophoresis equipment (sets)
30. Microwave Oven
31. Deionised water supply
32. Laminator flow cabinet
33. -80°C freezer
34. DNA sequencing system (manual)
35. Autoradiography cassettes/screens
36. Radioisotope lab (Geiger counter, screens disposal)
37. Taqman Real Time FI PCR 7900 HT
38. Genogrinder
39. Computers
40. Heating Blocks
41. Water bath
42. pH meter
43. Balances
44. Hot plates/stirrers
45. Fridges
46. Freezers
47. Digital camera
48. Digital Projector
49. Particle gun (He inflow)
50. Bioinformatics service
51. Robotic workstation
52. Capillary electrophoresis
53. D Scanner
54. Mass spectrometer (MALDI–TOF)
55. Confocal scanning laser microscope
56. Proteomics facilities
57. Microarray facilities

## Annex 2: Staff Profiles and Competencies

| RESEARCH AND DEVELOPMENT DIVISION (Crop Production) | | |
|---|---|---|
| STAFF PROFILE | | |
| **Position** | **Qualifications** | **Remarks** |
| Principal Scientist | At least PhD in Molecular Biology or Biotechnology or a related field plus 5 years experience in research | Leadership, scientific and strategic role |
| Senior scientist | At least MSc in Molecular Biology, Biotechnology, Biochemistry or related field plus 3 years experience | Research programme leader |
| Scientist | At least BSc in Biology or Agriculture or a related field. Experience will be an advantage | Research project leader and investigator |
| Assistant Scientist | BSc in Agriculture, Biotechnology or related field | Investigator on scientific and technical aspects of research project. Operation and routine maintenance of equipment |
| Technical Assistant | HSC with at least one science subject | Assisting AS in laboratory and field work |
| Laboratory Attendant | Sc with 3 credits | General maintenance of Laboratory |

| REQUIRED COMPETENCIES AND INDICATIVE AREAS OF TRAINING | |
|---|---|
| • Molecular plant breeding<br>• Molecular markers, marker–assisted selection<br>• Genetics and gene mapping<br>• DNA extraction techniques<br>• Fragment analysis: PCR, RAPD, RFLP, AFLP, microsatellites, DNA fingerprinting<br>• Recombinant DNA technology | • Genomics<br>• Proteomics<br>• Microarray Technology<br>• Genetic transformation<br>• Choice of target genes and approach<br>• Generation of transgenic plant<br>• Molecular approaches to variety characterisation and testing |

| PLANT TISSUE CULTURE UNIT | | |
|---|---|---|
| STAFF PROFILE | | |
| **Position** | **Qualifications** | **Remarks** |
| Senior scientist | At least MSc in Biotechnology or Tissue culture or diagnostics or a related field plus 3 years experience | Research programme leader |
| Scientist | At least BSc in Biology or Agriculture or Biochemistry or related field; Experience will be an advantage | Research project leader and investigator |
| Assistant Scientist | BSc in Agriculture, Biotechnology or related field | Investigator on scientific and technical aspects of research project. Operation and routine maintenance of equipment |
| Technical Assistant | HSC with at least one science subject | Assisting AS in laboratory and field work |
| Laboratory Attendant | Sc with 3 credits | General maintenance of Laboratory |

| REQUIRED COMPETENCIES AND INDICATIVE AREAS OF TRAINING | |
|---|---|
| • Plant tissue culture/micropropagation<br>• Transgenic technology | • Microbiology |

| ANIMAL PRODUCTION UNIT | | |
|---|---|---|
| STAFF PROFILE | | |
| **Position** | **Qualifications** | **Remarks** |
| Senior scientist | At least MSc in Animal Biotechnology or diagnostics or a related field plus 3 years experience | Research programme leader |
| Scientist | BSc or MSc in Animal Production or Agriculture or a related field. Experience will be an advantage | Research project leader and investigator |
| Assistant Scientist | BSc in Animal Production or Agriculture or Veterinary Science or related field | Investigator on scientific and technical aspects of research project. Operation and routine maintenance of equipment |
| Technical Assistant | HSC with at least one science subject | Assisting AS in laboratory and field work |
| Laboratory Attendant | Sc with 3 credits | General maintenance of Laboratory |
| REQUIRED COMPETENCIES AND INDICATIVE AREAS OF TRAINING | | |
| • Vaccines, animal diagnostics<br>– New approaches to vaccine development<br>– Molecular diagnostics for animal diseases | • Assays for animal hormones to improve AI success<br>• Animal nutrition in relation to productivity | |

| BIOINFORMATICS UNIT | | |
|---|---|---|
| STAFF PROFILE | | |
| **Position** | **Qualifications** | **Remarks** |
| Senior scientist | At least MSc in Bioinformatics or a related field plus 3 years experience | Research programme leader |
| Scientist | BSc Bioinformatics or Molecular Biology with IT | Research project leader and investigator |
| Assistant Scientist | BSc in Agriculture, Biotechnology or related field | Investigator on scientific and technical aspects of research project. Operation and routine maintenance of equipment |
| REQUIRED COMPETENCIES AND INDICATIVE AREAS OF TRAINING | | |
| • Bioinformatics<br>• Biological Statistics/Data handling/biometry | • Information Technology<br>• Molecular Biology | |

| POLICY & BUSINESS DEVELOPMENT UNIT | |
|---|---|
| STAFF PROFILE | |
| Positions – Qualifications | |
| To be determined by Board of Management or HR Dept of MABI<br>Proposed roles: | |
| • Policy issues & analysis<br>• Establish linkages between industry and institute<br>• Marketing<br>• Market Research | • Incubation of commercial projects<br>• Business Plan Development<br>• Biotechnology Information System |
| REQUIRED COMPETENCIES AND INDICATIVE AREAS OF TRAINING | |
| • Biotechnology policy and development<br>– GM issues: biosafety, risk assessment, labelling, analysis, environment, public acceptance.<br>– Plant variety protection: Plant breeders' rights, Intellectual property issues<br>– Agribusiness and patenting; management and marketing | |

| ADMINISTRATIVE AND FINANCE UNIT | |
|---|---|
| • Administrative staff as per the Consultants Report | • Additional to be determined by the Human Resources Management of MABI |

## Annex 3: Proposed Laboratories as Allocated to Each Division and Unit of MABI

| Research and Development Division (crop production) | |
|---|---|
| • Plant Biotechnology Laboratory | • DNA sequencing |
| • Horticulture/Floriculture Laboratory | • Radio Isotope Laboratory |
| • Entomology Lab | • Wash up/Autoclave |
| • Biodiversity, Soil Management Lab | • Store |
| • Special Food Laboratory | • Cold Rooms |
| • Proteomics Laboratory | • Growth Cabinets |
| • Microscopes | • Computer Laboratory |
| • Centrifuge Room | • Meeting Room |
| • Equipment Rooms | • Offices |
| • Laminar Flow cupboards | • Reception, Secretarial Support & Archives |
| • PCR Room | • Tea prep |

| Agricultural Diagnostics Division (crop protection) | |
|---|---|
| • Sample Receivable and Preparation | • Wash up/Autoclave |
| • Microbiology Laboratory | • Box Store |
| • Quarantine Laboratory | • Store |
| • Plant Diagnostic Laboratory | • Cold Rooms |
| • Plant Pathology Laboratory | • Growth Cabinets |
| • Histology Laboratory | • Computer Laboratory |
| • Slide Prep Laboratory | • Meeting Room |
| • Laminar flow cupboards | • Offices |
| • Microscopes | • Reception, Secretarial Support & Archives |
| • PCR Room | • Carrel Accommodation |
| • Entomology Laboratory | • Tea Prep |

| Plant Tissue Culture Unit | |
|---|---|
| • Tissue Culture Laboratory | • Growth cabinets |
| • Wash up/Autoclave/Store | • Equipment Room |

| Animal Production Unit | |
|---|---|
| • Livestock Biotechnology Laboratory | • Animal Diagnostic Laboratory |

| Bioinformatics Unit | |
|---|---|
| • Principal Scientist | • Meeting Room |
| • Computer Room/Laboratory | • Gene Bank/Store |
| • Secretarial Support/Reception | • Server |

| Management Unit | |
|---|---|
| • Reception | • Director |
| • Meeting | • Archives |
| • Tea Room | • Stores |
| • Manager/HRM | • Toilets |
| • Financial Manager | |

| Policy & Business Development Unit | |
|---|---|
| • Business Manager | • Other facilities shared with the Management Unit |

| External Shared | |
|---|---|
| • Glass Houses | • General Stores |
| • PC2 Glasshouse | • Insectary |
| • Animal House | • Incinerator |
| • Quarantine | |

| Services | |
|---|---|
| • Switch/transformer | • Lift |
| • Air handling plant | • Toxic Waste Disposal |
| • Sundry plant | |

## Annex 4: Required Competencies and Indicative Areas of Training

***Research and Development Division (Crop Production)***

- Molecular Plant Breeding;
- Molecular markers, marker–assisted selection;
- Genetics and Gene Mapping;
- DNA Extraction Techniques;
- Fragment Analysis: PCR, RAPD, RFLP, AFLP, Microsatellites, DNA fingerprinting;
- Recombinant DNA Technology;
- Genomics;
- Proteomics;
- Microarray Technology;
- Genetic Transformation;
- Choice of target genes and approach;
- Generation of transgenic plants;
- Molecular approaches to variety characterisation and testing.

***Agricultural Diagnostics Division (Crop protection)***

- Crop protection;
- Integrated pest management and biological control;
- Weed Science;
- Post harvest technology;
- Virus elimination, indexing;
- Diagnostic tests for pests and diseases;
- Real time fluorescence PCR Automation of testing/high throughput/cost effective;
- Molecular approaches to variety characterisation and testing.

***Plant Tissue Culture Unit***

- Plant Tissue Culture and Micropropagation techniques;
- Transgenic Technology;
- Microbiology.

***Animal Production Unit***

- Vaccines, animal diagnostics:
  - New approaches to vaccine development,
  - Molecular diagnostics for animal diseases;
- Assays for animal hormones to improve AI success;
- Animal nutrition in relation to productivity.

***Bioinformatics Unit***

- Bioinformatics;
- Biological Statistics/Data handling/biometry;
- Information Technology;
- Molecular Biology.

***Policy and Business Development Unit***

- Biotechnology policy and development:
  - GM issues: biosafety, risk assessment, labelling, analysis, environment, public acceptance,
  - Plant variety protection: Plant Breeder's Rights, Intellectual Property Issues,
  - Agribusiness and patenting: management and marketing.

## Annex 5: SWOT Analysis of Statutory Bodies
***(Undertaken during Feasibility Study)***

| Agricultural Services of MAFTNR | |
|---|---|
| STRENGTHS | WEAKNESSESS |
| • Plant and seed production<br>• Vaccine production<br>• Animal production for self sufficiency<br>• Increased capacity for analytical work<br>• Export of tissue culture plants<br>• Molecular diagnostics for quarantine<br>• Seed certification for quarantine<br>• Evaluation of crop varieties resulting from biotechnological methods<br>• Contribution to biosafety issues | • Biosafety issues regarding quarantine, hence the need for appropriate biotechnological regulation<br>• Introduction of GM materials and germplasm<br>• New infective agents/micro–organism unknown to Mauritius<br>• Lack of synergism, collaboration and apathy between the main parties involved in biotechnology<br>• Need for more trained staff |
| OPPORTUNITIES | THREATS |
| • Development of new crop varieties<br>• Indexed plant and seed production<br>• Vaccines and animal production<br>• New techniques<br>• Diversification in non sugar crops<br>• Disease diagnostics<br>• Bioprospecting<br>• Seed certification for quarantine<br>• Tissue culture to develop elite plants<br>• Increased capacity for analytical work<br>• Regional provision of products and services<br>• Introduction of new DNA technology | • Biosafety issues for quarantine<br>• Need for appropriate biotechnology regulations<br>• Introduction of GMOs<br>• New pests/diseases unknown to Mauritius<br>• Lack of incentive to conduct R&D<br>• Lack of quality control<br>• Requirement for high investment<br>• No Intellectual Property policy in place<br>• No provision for Plant Breeders Rights<br>• Lack of up to date scientific skills which are required in biotechnology |

| Agricultural Research Extension Unit (AREU) | |
|---|---|
| STRENGTHS | WEAKNESSESS |
| • Research scientists at graduate and post graduate levels and one plant breeder<br>• Good ability for technology uptake<br>• Qualified staff who have some knowledge in biotech, but need specific training to develop the needed skills<br>• Availability of an increase number of disease free planting materials<br>• Building infrastructure<br>• Micro propagation of promising varieties to satisfy the pressing demands of farmers<br>• Cryopreservation of clones<br>• Demand exist from farmers for availability of planting materials<br>• Technical know–how for characterization of microbial plant pathogens<br>• Biotechnology Lab just set up | • Collaboration with other institutes non–existent<br>• Lack of trained personnel<br>• Lack of laboratory facilities, equipment and funding<br>• Lack of professionalism to design projects in this field<br>• Absence of fully equipped laboratory and other infrastructure<br>• Lack of on–going training in agricultural biotechnology<br>• Lack of proper laboratory practices<br>• Lack of awareness among farmers for advantages of agribiotech<br>• High cost of antisera<br>• Lack of up–to date equipment and limited staff<br>• Linkages with other biotech division and private labs missing<br>• Lack of training facilities |

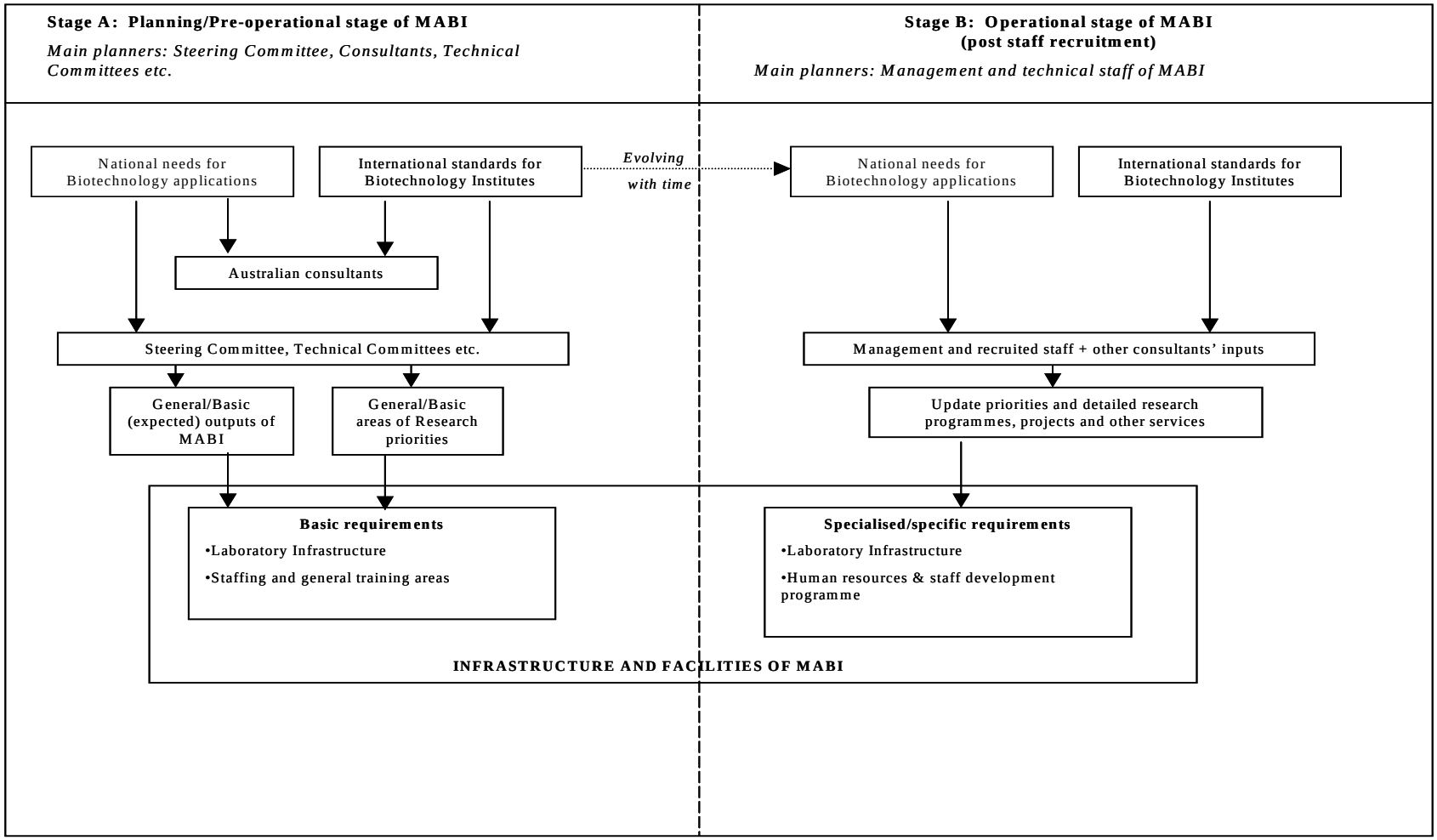
| Agricultural Research Extension Unit (AREU) | |
|---|---|
| OPPORTUNITIES | THREATS |
| • Development of biofertilisers<br>• More research in biotechnology<br>• Acquisition of new knowledge<br>• Better outputs e.g. more varieties with improved characteristics through genetic technologies<br>• Germplasm collection and conservation using biotech<br>• Molecular diagnostics in livestock<br>• Disease free planting materials<br>• Increase crop production<br>• Export improved varieties<br>• DNA Fingerprinting<br>• Development of elite varieties<br>• Rapid multiplication of planting materials<br>• Detection of early bearers in litchi<br>• Screening of germplasm<br>• Disease of quarantine importance<br>• Production of antisera and primers for diagnostics works | • Projects might be transferred to a biotechnology institute<br>• High capital cost of laboratory<br>• Lack of good management<br>• Livestock not a priority for the Government<br>• Capital investment for lab, staff not trained<br>• Absence of official policy and appropriate strategies<br>• Antisera and primers purchased at high cost<br>• Not enough collaboration<br>• No facilities for production of transgenic crops<br>• Resistance to adopt GM varieties by growers and public<br>• Government policy on resources and funding may be inadequate<br>• Lack of policy on Plant Breeders' Rights<br>• May cause loss of royalties |

| Food and Agricultural Research Council (FARC) | |
|---|---|
| STRENGTHS | WEAKNESSESS |
| • Modern, large tissue culture laboratory<br>• Some collaboration with UOM, Faculty of Agriculture<br>• Environment controlled glasshouse and nursery for hardening of plants<br>• Working on tissue culture projects of some crops with AREU | • Lack of equipment and limited staff<br>• Linkages with other biotech division and private labs missing<br>• Lack of training facilities<br>• Proper orientation of work required<br>• Some people are involved in both R&D (establishing protocols) and in micro propagation for commercial production |
| OPPORTUNITIES | THREATS |
| • In Vitro germplasm storage and seed production<br>• Space available to accommodate new sophisticated equipment<br>• Establishing protocols for various crops of local varieties and cultivars<br>• Involvement in some molecular work to avoid duplication | • Some clonal varieties<br>• Price fluctuation at the local markets<br>• Government Policy on resource and funding may be inadequate<br>• Private sector may not co–operate |

| University of Mauritius (UOM) | |
|---|---|
| STRENGTHS | WEAKNESSESS |
| • Some modern equipment available<br>• Motivated students<br>• Flexibility<br>• Specialization in particular fields<br>• Tissue Culture: Natural Plant Research<br>• Cell biology, chemo taxonomy and pharmacology | • Lack of funds and very slow system of purchasing<br>• No legal framework<br>• Lack of trained staff<br>• No proper well researched policy<br>• No proper sustainable collaborative partnership with private companies and international organisations |
| OPPORTUNITIES | THREATS |
| • Bioprospecting and several other fields<br>• Endemic plants<br>• Marine Biotech<br>• Biomass<br>• Biosensors<br>• Production of useful substance by plant tissue culture and by microorganisms | • Isolation and lack of momentum<br>• Lack of incentive to conduct research from university<br>• Critical mass not present yet<br>• Lack of proper incentive to conduct good quality control<br>• No thematic or group orientation |

| Mauritius Sugar Industry Research Institute (MSIRI) | |
|---|---|
| STRENGTHS | WEAKNESSESS |
| • A number of projects in the R&D program ranging from low biotech to high biotech<br>• Well equipped lab for research in biotech<br>• Qualified and trained personnel<br>• Contact and collaborative links units research institutions overseas | • Bioinformatics<br>• Molecular mapping<br>• Molecular Physiology |
| OPPORTUNITIES | THREATS |
| • Improvement of the sugar cane plant, shortening of sugar cane selection program<br>• Transfer of existing technologies to other crops<br>• Provision of training biotech<br>• National Centre for Biotechnology to serve the region | • Lower funding due to reduction in sugar production<br>• Reduced opportunities to employ new staff and their training |

## Annex 6: Stages of Project



## Annex 7: Research Priorities
***(to be refined during operational stage)***

| On–going and proposed research priority areas/projects in biotechnology at agricultural institutions (2003–2007) (submitted by the FARC 12.4.04) | | | | | |
|---|---|---|---|---|---|
| SECTOR/COMMODITY | Policy source | Policy Formulation | Research priority area/Project Title | Proposed Activities | Status |
| CROP PROTECTION (PATHOLOGY) | NSSSP–18.1 | Application of molecular tools for disease diagnosis (NSSSP–18.1) | Status of major viruses affecting chill plantations across the island | Islandwide survey and ELISA | On–going |
| ONION | NSSSP–7 | Investigate into research possibilities to create novel varieties (NSSSP–7) | Onion Breeding | Crossing of parental lines<br>Screening & selection of promising lines | On–going |
| POTATO | NSSSP | Increasing of seed production | Feasibility of using mini– and micro–tubers as planting material | Production of mini–and micro–tubers by tissue culture and an aeroponic system and field evaluation of tubers | On–going |
| VEGETABLE CROPS | NSSSP–18.1 | Investigate into research possibilities in biotechnology to create novel varieties (NSSSP–18.1) | Improvement and promotion of *Colocasia* species | Improvement of *Colocasia* species through induced mutation | On–going |
| CROP PROTECTION (PATHOLOGY) | NSSSP–18.1 | Application of molecular tools for disease diagnosis (NSSSP–18.1) | Use of PCR technique to determine status of phytoplasma disease in major tomato plantations across the island | Island–wide survey and PCR | New |
| FRUIT SECTOR (LITCHI) | NSSSP–18.1 | To look into the possibility of commercializing R & D in Agricultural Biotechnology (NSSSP–18.1) | Early litchi bearers in Mauritius: Characterisation of morphological, physiological and chemotaxonomic markers | Use of DNS markers to characterize clones from Réduit, Paillotte and Labourdonnais | New |