



Republic of Zambia

ZAMBIA AGRICULTURE RESEARCH INSTITUTE

Ministry of Agriculture and Cooperatives

2009 ANNUAL REPORT

Mt. Makulu Central Research Station

P/B 7

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List of Acronyms

CIA	Crop Improvement and Agronomy
DTMA	Drought Tolerant Maize for Africa
FRA	Food Reserve Agency
FSSS	Farming Systems and Social Sciences
GMOs	Genetically Modified Organisms
ITPGRFA	International Treaty on Plant and Genetic Resources for Food and Agriculture
NPGRC	National Plant Genetic Resource Centre
PARO	Principal Agricultural Research Officer
PC	Phytosanitary Certificate
PIP	Plant Import Permit
PPQ	Plant Protection and Quarantine
PQPS	Plant Quarantine and Phytosanitary Service
RMT	Research Management Team
RUR	Round up Ready
SADC	Southern African Development Community
SOFECSA	Soil Fertility Consortium of Southern Africa
SPGRC	SADC Plant Genetic Resource Centre
SWM	Soils and Water Management
ZABS	Zambia Bureau of Standards
ZARI	Zambia Agriculture Research Institute
ZNFU	Zambia National Farmers Union

1.0 Introduction

The Zambia Agriculture Research Institute (ZARI) is one of the nine Departments in the Ministry of Agriculture and Cooperatives. ZARI was created during the 2003 ministerial restructuring exercise as a core Department within the Ministry in order to strengthen the research functions and be in conformity with regional arrangements in the SADC countries.

ZARI has the mandate to provide agricultural services and conduct public good as well as farmer demand-driven research in soils, rain-fed and irrigated crops, plant protection and farming systems. The ZARI programmes and activities conducted during the 2008/09 season are outlined in this annual report.

In general, implementation of core research programmes during the period under review was moderate. Out of a total of 12 months only 5 months were funded at 56% of the budget. Activities conducted included field trials in the area of crop improvement, soil productivity and services provision in the area of plant nutrients, soil analyses, soil survey, plant insect pest and disease diagnostics, quarantine/phytosanitary service and training in post-harvest technologies to facilitate trade and market access. Some funds were also released for infrastructure rehabilitation. This went towards revamping the irrigation facilities, the library and the laboratories. Rainfall was adequate in most parts of the country during the period under review. A number of research stations held field days to demonstrate available and promising technologies developed through ZARI research efforts. Operations continued to be hampered by poor conditions of vehicles and equipment due to low lack of capital funds. There has been a marked improvement in staffing levels in the Department.

2.0 Mission Statement

The mission of the Institute is to 'contribute to the welfare of the Zambian people through the provision of technologies and knowledge that enhance household food security and equitable income-generating opportunities for the farming community and agricultural enterprises while ensuring the maintenance of the natural resource base'.

3.0 Objectives

The overall objective of ZARI is to generate and adapt crop and soil technologies in order to increase agricultural productivity and diversify production. This includes the development of low cost sustainable farming systems for all major agro-ecological zones and farm sizes through participation of both the public and private sectors in research activities. This would ensure the provision of a high quality, appropriate and cost effective service to farmers.

4.0 Structural Organization and Functions

The Institute is headed by a Director and is made up of two core Branches, namely, the Technical Services Branch and Research Services Branch. The Department has a Research Management Team (RMT) which co-ordinates, manages and controls human, physical and financial resources of four technical Divisions, Central Services and Administration. The technical divisions comprise Crop Improvement and Agronomy (CIA), Soils and Water Management (SWM), Plant Protection and Quarantine (PPQ) and Farming Systems and Social Sciences (FSSS). Central Services consists of biometrics, library, documentation and information services, whereas the Administration provides the remaining support services mainly concerning personnel welfare.

Under the Crop Improvement and Agronomy Division there are eight (8) research programmes, three (3) are under the Soils and Water Management Division, four (4) fall under the Plant Protection and Quarantine Division and yet another four (4) are under Farming Systems and Social Sciences Division.

The technical divisions and administration form the basis for the formulation of the programme components of the Annual Work Plan and Budget. Activities under these programmes are conducted throughout the country covering ten (10) research stations and on-farm trials and demonstration locations. In addition, other activities such as Infrastructure Rehabilitation, Seed Multiplication, Crop Protection, Soil Surveying, Soil Fertility and Water Management were conducted at the research stations.

5.0 ZARI Activities

5.1 Technical Services Branch

The Technical Services Branch is responsible for the technical operations of the Institute involving timely generation/adaptation of technologies in soils and crops in order to provide high quality research services for the benefit of farmers. Technical Services Branch personnel are stationed at the ten (10) research stations covering the three agro-ecological regions in the country.

The specific functions of the Branch are to coordinate and provide technical backstopping in:

- Farming systems agronomy in the three agro-ecological regions (Regions I, II & III). This is done to ensure responsiveness to farmer needs based on the human, financial, physical and other resources and specialization of each region.
- Plant breeding and agronomy in cereals, oilseeds, tree crops, horticulture, food legumes and roots and tubers. This involves the development of production technology packages and multiplying foundation seed in commodity research

programmes. The collecting and characterizing of plant genetic germplasm in the Plant Genetic Resources Programmes were also carried out. These activities are performed in close liaison with the Agriculture Department post harvest activities.

- Agro-forestry, soil fertility, microbiology, soil survey, soil physics and irrigation research.
- Plant protection (biotechnology, entomology, plant pathology, plant quarantine and phytosanitary services and food storage). Plant Quarantine and Phytosanitary Services are also provided at Border Areas including the Lusaka International Airport, Livingstone, Nakonde, Sesheke, Mufulira and Chirundu.

The Technical Services Branch interfaces closely with the Agriculture Extension Branch under the Department of Agriculture.

The table below summaries the activities conducted in the various research stations

Station	Programme Activities
Mt. Makulu:	Maize, Sorghum, Sunflower, Wheat, Tree and Plantation Crops, Plant Genetic Resources, Soil Survey, Soil Fertility and Agroforestry, Entomology, Pathology, Food Storage and Plant Quarantine and Phytosanitary Services and Biotechnology
Mongu	Pearl Millet, Rice; Cassava, maize and legume rotations
Misamfu	Food Legumes, Finger Millet, Rice, Soil Fertility, Agroforestry and Entomology
Mutanda	Root and Tuber, Food Legumes and Soil Fertility
Mochipapa	Food Legumes, Green manures as sustainable production systems for sorghum-maize and maize-livestock based farming systems in the valley and plateau farming systems, improved fallow trials,
Msekera	Food Legumes, Soil Fertility, Agroforestry, Entomology, Food Storage and Plant Quarantine and Phytosanitary Service
Nanga	Vegetables, Tree and Plantation Crops, Irrigation engineering and Pathology
Kabwe	Food Legumes, Kenaf, Soil Survey and Soil Fertility
Mufulira	Tree and Plantation Crops Research, Soil Survey and Soil Fertility,

On-Station and On-farm verification of promising varieties is conducted by researchers throughout the country.

5.2 The Research Services Branch

The Research Services Branch is responsible for the management and coordination of the research systems through an agro-ecological regions approach to research in the country.

The objectives of the branch are to provide high quality services in areas of Soil Advisory, Plant Insect Pest and Disease Clinics, Library and Biometrics, ensuring that quality fertilisers are available on the market and building capacity in the areas of Bio-technology and to facilitate trade.

The Branch is generally responsible for generating, adapting and disseminating improved agricultural technologies in order to ensure increased and sustainable crop production in collaboration with the Department of Agriculture and other agricultural extension service providers.

The Research Services Branch is structured on Agro-Climatic, or the Agro-Ecological Region basis, and thus the agro-ecological approach to research, ensures conditions that are more responsive to the farmers' needs than the previous traditional 'provincial approach'. Accordingly, three (3) Agro-Ecological Regions are identified, which are mainly based on soil types and climatic conditions thus determining the agricultural potential and productivity of any given region in the country. The research infrastructure comprises ten research stations conveniently located in the Regions II and III, being Central, Eastern and Western Zambia, and the Northern, Luapula, Copperbelt and North-western provinces respectively. Research programme activities conducted in Region I, covering most of the Southern parts of the country especially in the Rift Valleys of the Zambezi and Luangwa trough are carried out by scientists based in region II research stations. This is because Region I has no developed research station infrastructure. Below is a broad outline of the main geographical locations of the Agro-Ecological Regions.

- **Region I** - includes the Zambezi, Gwembe, Luangwa and Lusemfwā Valleys, especially the extreme southern ends of the Western and Southern Provinces.
- **Region II** - covers the central parts of the country and includes the Central, Lusaka, Eastern, and the northern parts of the Southern and Western Provinces;
- **Region III** – comprises mainly the Northern, Luapula, Copperbelt and North-Western Province.

The ten research stations over the three Agro-Ecological Regions are each headed by a Principal Agricultural Research Officer (the Programmes Officer) responsible for station programmes. And still at each station, other Principal Agricultural Research Officers (PAROs) head different research disciplines.

Specific activities conducted included field trials, screen house experiments, soil surveys, provision of advisory services in soil plant nutrient management, soil and fertiliser sampling and laboratory analyses, plant disease and insect laboratory analyses, training in post harvest technologies and phytosanitary services to facilitate trade.

Most research stations held field days and took part in the agricultural shows to showcase the various ZARI technologies.

6.0 Research Indicators and Targets

The indicators for research are the number of technologies developed, varieties released, soils analysed, plant insect pests and diseases diagnosed and recommendations made, border inspections made, phytosanitary certificates and plant import permits issued. Others are the number of laboratories rehabilitated and equipped, and staff trained including in the areas of GMO testing and the use of molecular techniques.

The research programme is targeted at farmers, importers and exporters.

7.0 Research Outputs (Achievements)

The following is a summary of the achieved results during the period under review:

- 8,555 soil and plant samples were analysed by the Soil Fertility Laboratories for various nutrients. Fertilizer and crop recommendations were made from the analytical results obtained.
- Researchers continued receiving infested plant samples and insect specimen from farmers for identification. The pests were identified and appropriate recommendations for their control were made
- 6,500 sachets of soybean inoculant (250g) were sold to stakeholders which mainly comprised the Zambia National Farmers Union (ZNFU)
- Research activities in relation to climate change continued in Sinazongwe, Petauke, Kasama and Monze. The aim is to help farmers build their adaptive capacity to cope with climatic variability.
- 14,091 Plant Import Permits (PIP) and 6,499 Phytosanitary Certificates (PC) were issued while 2,981 Export Inspections, 218 Fumigation Inspections, 171 Nursery Inspections, 16 Premises Inspections, 691 Import Inspections and 51 Farm Inspections were conducted.
- In order to ensure that food commodities coming in to the country are GMO free, more GMO test kits (Bt1 and RUR) were purchased and distributed to plant Health Inspectors at border posts.

- A total of 19.5 ton of maize foundation seed was produced for the year 2008/09 growing season. The open pollinated varieties grown were ZM 421, ZM 521, ZM 621 and Obatampa.
- Certified sorghum seed of Sima (1.0 ton), Kuyuma (1.0 ton) and [Framida x SDS 3845]16-2-2 (1.5tons) were produced at Nanga. The team in collaboration with the Food Diversification Project (FoDis) is engaged in technology transfer activities in Shangombo (165 farmers), Sinazongwe (150 farmers), Siavonga (100 farmers), Rufunsa (400 farmers) and Luangwa (400 farmers) districts
- The Variety Release Committee met on 23rd September 2009 at SCCI and ZARI participated in the meeting that saw seven varieties of rice, beans and finger millet being released. The names of the new released varieties are: Beans – A small seeded white variety that is ideal for canning called Lwangenji; Finger Millet – Two finger millet varieties from the mutation (radiation) breeding programme were presented for release called Sumina and Chilapalakata; Rice – Two upland varieties (Nerica 1 and 4) and two dambo varieties (Kilombelo and ITA – 230) were presented for release.
- Researchers participated in the pre-shipment inspection (testing the maize for GMO at the source before loading) and at the borders on maize imported into the country from South Africa by Food Reserve Agency (FRA), Millers Association of Zambia (MAZ) and other Organizations. Only GMO free maize was allowed into the country. Over 40 Mt were analysed out of which about 1.5 Mt were GMO positive and returned to their country of origin.
- Researchers in collaboration with the Auditors General's office conducted a performance audit of the Food Reserve Agency (FRA). The overall objective of the audit was to assess the performance of FRA on the Operation and Quality systems in grain storage management in comparison with the set standards. The audit reviewed all technical, operational, administrative considerations and other issues that may affect the institution's performance. The audit covered Eastern Central and Northern Provinces.
- Researchers participated in the development of a recipe book of traditional foods for people living with HIV/AIDS organised by the Department of Agriculture, Food and Nutrition Section. Forty five (45) recipes were developed. Examples are katapa, kanunka, cassava snacks, bambara nut milk, fried okra, Chikanda etc.
- The ZARI documentary was produced and shown on ZNBC TV on the 19th of January 2009 during Lima Time programme.

8.0 Meetings and Workshops/Seminars/Studies

- The maize team conducted a Technician Training Workshop in collaboration with CIMMYT and also participated in Insect Resistant Maize (IRMA) project seminar. Further the maize team organized a National Coordination Unit (NCU) meeting and participated in the Annual Collaborators Meeting that was held in Zambia at Protea Hotel organized by CIMMYT.
- The maize team received visitors from Harvest Plus, CIMMYT and Generation Challenge Program (GCP) from 20th -25th September 2009. The purpose of the

visit was to sensitize and initiate collaborative work with key institutions on Harvest Plus work. The visitors included Drs. Kelvin Pixley (Mexico), Peter de Haan and Harrie Hendrickx (Netherlands), Gregory Edmeads (New Zealand) and Amsal Tarekegne (Zimbabwe).

- SPGRC/NPGRCs Review and Planning Meetings: The Team participated in the meetings held 15-19 September 2009 at which the status of implementation of the 2008/09 activities and the planned activities for 2009/10 season were presented.
- The wheat team in conjunction with the pathology team and the department of plant science at the University of the Free State, RSA, undertook a survey on wheat stem rust. The purpose of the survey was to determine if the Ug99 wheat stem rust race, which is very virulent, had reached Zambia. The survey was completed on 17th September, 2009. The districts visited were Mpongwe, Mkushi, Mazabuka, Kafue (Zambeef Estates, formerly Mastock Farm), Lusaka, and Chibombo. Stem rust infection was found only at Zamseed Farm on two breeding lines. The infection level was however very low.
- Researchers participated in a training course on the taxonomy and identification of fruit flies of economic importance, at the ICIPE headquarters in Nairobi, Kenya. The training was aimed at capacity building in fruit fly taxonomy and exploring the possibility of setting up a fruit fly networking group in the SADC region.
- A Researcher attended a Quality Management System (QMS) training in ISO 9001: 2000 in Kenya. Skill on ISO 9001 and ISO 19011 was acquired.
- Researchers participated at a workshop in South Africa on Early warning and Monitoring of Migratory Pests in Southern Africa. The objective of the workshop was to review the performance of the established SADC migratory pests' network. Coordination of network has been handed to the International Red Locust Control Organization for Central and Southern Africa (ILRCO-CSA).
- Researchers attended a regional training on Pest Risk Analysis (PRA) at KEPHIS, Nairobi, Kenya. The workshop was organized with the view of creating a Regional Pest Risk Analysis Network, create and maintain a data base of potential quarantine pests, capacity building of expertise's by sharing experiences in PRA processes. Participating countries included Burundi, Kenya, Namibia, Rwanda, Seychelles, Tanzania, Uganda and Zambia.
- PQPS attended a one day sensitization workshop for stakeholders on Non-Tariff Barriers (NTBs) on web based reporting and monitoring mechanism organized by SADC/COMESA/EAC in collaboration with the Ministry of Commerce, Trade and Industry (MCTI). The aim of the sensitization workshop was to facilitate the process of identifying, reporting, monitoring and the elimination of current and future NTBs that impedes or restricts international trade. Website: <http://ntb.africonnect.com>.

9.0 Administrative Issues

9.1 Financial Position

In general, implementation of core research programmes during the period under review was moderate. Out of a total of 12 months only 5 months were funded at 56% of the budget.

9.2 Staff Recruitment

Many new members of staff have joined ZARI during the period under review and a lot of vacancies have been filled especially at Agricultural Research Officer and Technical Research Assistant levels. The ZARI staff strength by close of the year 2009 was 80%. Due to lack of accommodation at border points, PQPS is failing to position Plant Health Inspectors to monitor movement of plants, plant parts, plant products and other regulated articles entering the country.

9.3 Vehicles

Just like in 2008, the work in the department is currently being hampered by the poor status of vehicles in the various research programmes. The vehicles are necessary for field activities.

9.4 Equipment

The work in the department is also being hampered by the poor status or lack of equipment in the various research programmes. The equipment is necessary for field activities, laboratory analysis and processing of data.

9.5 Buildings

Most buildings at all stations are dilapidated and require attention.

10.0 Conclusion

The Zambia Agriculture Research Institute (ZARI) has the mandate to conduct public good as well as farmer demand-driven research in soils, rain-fed and irrigated crops, plant protection and farming systems. During the period under review, progress was reported in the areas of Soils research, Plant Quarantine and Phytosanitary Services (PQPS), Variety Releases and Research.

The implementation of core research programmes under ZARI was moderate. However, the 7 months that were not funded did affect the implementation of some programmes. Activities conducted included field trials in the area of crop improvement

and soil productivity and improvement services provision in the area of plant nutrients, soil analyses, plant insect pest and disease diagnostics, quarantine/phytosanitary services and training in post harvest technologies to facilitate trade. Rainfall was adequate in most parts of the country. A number of research stations held field days to demonstrate available and promising technologies developed through ZARI research efforts.

11.0 Recommendations

For the Department to attain its set objectives there is need to improve on the release of funds to the Department to upgrade the facilities and procure new vehicles and equipment.

Appendix 1. Financial Report

Annual Budget Summary

The GRZ budget estimates for the 2009 totalled **K17,321,104,363**. This was broken down as follows:

Personal Emoluments	6,734,841,230
Recurrent Departmental Charges	
ZARI H/Qs	1,832,126,897
Research Stations	4,004,136,236
Grants	590,000,000
Agriculture Research Infrastructure Development	4,160,000,000
Total	K17,321,104,363

1 USD = K5,000

Appendix 2. Staffing Position

By the close of the year, ZARI staff strength stood at 80%

	Establishment	In Place	%
Professional (PhD, MSc, BSc)	175	132	75
Technical (Diplomas, Certificates)	144	109	76
Administration (Human Resource Management, Registry, Stores, etc)	54	54	100
Support (General)	379	306	81
Totals	752	601	80

Appendix 3. Vehicles

MINISTRY OF AGRICULTURE AND CO-OPERATIVES MANAGEMENT INFORMATION SYSTEM

VEHICLES, TRACTORS AND MOTOR CYCLES

Sub-Programme: ZARI Station/District: Mt Makulu 2008.

	Type Of Vehicle	Total No	No. Operational	No. Non-Operational	No. Repairable	No. Scrap/Bos
	(1)	(2)	(3)	(4)	(5)	(6)
1	Mitsubishi Pajero Petrol	1	1	3	1	2
2	Mitsubishi L200 Diesel	1	0	7	1	6
3	Mitsubishi Rosa Bus	1	0	1	1	0
4	Nissan D/Cab Diesel	2	1	2	0	2
5	Nissan Patrol Diesel	1	1	2	1	1
6	Nissan D/C Petrol	1	1	2	1	1
7	Toyota Hilux Diesel	5	4	2	1	1
8	Toyota Hilux Petrol	3	2	1	1	0
9	Toyota L/Cruiser Diesel	3	3	1	1	0
10	Landrover 110	0	0	0	0	0
11	Motor Cycle CT200	2	2	2	2	0
12	Motor Cycle AG200	2	2	0	0	0
13	Motor Cycle XL125	0	0	2	0	2
14	Motor Cycle Suzuki	0	0	1	0	1
15	Tractor MF 365	1	0	1	0	1
16	Tractor Valmet 665	0	0	0	0	0
17	Holland Tractor	1	1	1	1	0
18	Marsey Ferguson Tractor	1	1	1	1	0
19	Nissan Pick up	1	1	1	1	0

Comments: As per attached memo!

Notes: Columns (3) + (4) = (2)
Columns (5) + (6) = (4)

Completed by (Name and Position): Robbie Kazhila – Workshop Supervisor Date: 31 December 2009

Appendix 4. Key Performance Indicators

Narrative Summary	Objectively Verifiable Indicators	Means of Verification
<p>Output 1: Agricultural research infrastructure rehabilitated</p>	<p>Indicators</p> <ol style="list-style-type: none"> 1) infrastructure assessments at 10 research institutions assessed 2) infrastructure at 10 research institutions rehabilitated 3) laboratory and field equipment for 15 research laboratories procured 4) 30 vehicles, 3 Trucks, 3 minibuses and 20 motorcycles procured 5) 10 Tractors procured 	<ul style="list-style-type: none"> • Assessment reports. • Number of research stations rehabilitated. • Number of laboratories rehabilitated. • Number of Vehicles, Trucks, minibuses, Tractors and Motor cycles procured.
<p>Output 2: Appropriate irrigation technologies developed</p>	<p>Indicators</p> <ol style="list-style-type: none"> 1) Irrigation equipment at Nanga, Mt. Makulu, Mufulira, Kabwe and Misamfu bought and or rehabilitated 2) Eight irrigation trials and demonstrations conducted 	<ul style="list-style-type: none"> • Research reports • Number of equipment bought
<p>Output 3: Phyto-sanitary and quarantine services provided</p>	<p>Indicators</p> <ol style="list-style-type: none"> 1) 8 houses and 8 offices at boarder posts/exit points built 2) Various Staff posted to border posts not currently manned 3) Various clients receive phyto-sanitary and quarantine services 4) Various improved exotic pest and disease surveillance services provided. 5) Two Pest Risk Analysis for market access conducted 	<ul style="list-style-type: none"> • Research reports • Number of work stations rehabilitated at unmanned boarder posts
<p>Output 4: Long Term training provided</p>	<p>Indicators</p> <ol style="list-style-type: none"> 1) Five ZARI staff pursuing PhD training 2) Ten ZARI staff pursuing MSc training 3) 20 ZARI staff would have attended short courses 	<ul style="list-style-type: none"> • Training progress reports • Research Reports
<p>Output 5: Introduction and use of agro-biotechnology especially Genetically Modified Organisms (GMOs) regulated</p>	<p>Indicators</p> <ol style="list-style-type: none"> 1) One Biotechnology laboratory at MT. Makulu equipped (Equipment purchased and installed) 2) Three members of staff trained in biotechnology 3) About One-hundred identification services provided on GMOs detection in crops 	<ul style="list-style-type: none"> • Research reports. • Number of GMOs identified • Number institutions and persons capacity developed.
<p>Output 6: Appropriate agronomic packages and technologies developed</p>	<p>Indicators</p> <ol style="list-style-type: none"> 1) Various quantities of basic seed produced 2) About 100 on-station and on-farm trials conducted 3) Ten economic analysis conducted on agronomic packages and technologies 	<ul style="list-style-type: none"> • Research reports. • Economic analysis reports

	<ol style="list-style-type: none"> 4) Two alternative pest and disease control technologies develop 5) Five storable, acceptable, resistant/tolerant crop varieties bred against adverse environmental conditions released 6) Fifty participatory plant breeding and conservation agriculture trials and demonstrations conducted 	
Output 7: Monitoring and Evaluation conducted	Indicators Ten Monitoring and evaluation visits made to research stations	<ul style="list-style-type: none"> • Monitoring and evaluation reports
Narrative Summary	Objectively Verifiable Indicators	Means of Verification
Output 1: Agricultural research infrastructure rehabilitated	Indicators <ol style="list-style-type: none"> 6) infrastructure assessments at 9 research institutions assessed 7) infrastructure at 9 research institutions rehabilitated 8) laboratory and field equipment for 15 research laboratories procured 9) 30 vehicles, 3 Trucks, 3 minibuses and 20 motorcycles procured 10) 9 Tractors procured 	<ul style="list-style-type: none"> • Assessment reports. • Number of research stations rehabilitated. • Number of laboratories rehabilitated. • Number of Vehicles, Trucks, minibuses, Tractors and Motor cycles procured.
Output 2: Appropriate irrigation technologies developed	Indicators <ol style="list-style-type: none"> 3) Irrigation equipment at Nanga, Mt. Makulu, Mufulira, Kabwe and Misamfu bought and or rehabilitated 4) Eight irrigation trials and demonstrations conducted 	<ul style="list-style-type: none"> • Research reports • Number of equipment bought
Output 3: Phyto-sanitary and quarantine services provided	Indicators <ol style="list-style-type: none"> 6) Two to three border post workstations built or rehabilitated 7) Two to three Staff posted to border posts not currently manned 8) Five-hundred clients receive phyto-sanitary and quarantine services 9) Fifty improved exotic pest and disease surveillance services provided. 10) Two Pest Risk Analysis for market access conducted 	<ul style="list-style-type: none"> • Research reports • Number of work stations rehabilitated at unmanned boarder posts
Output 4: Long Term training	Indicators <ol style="list-style-type: none"> 1) ZARI staff pursuing PhD training 2) Ten ZARI staff pursuing MSc training 3) Ten ZARI staff would have attended short courses 	<ul style="list-style-type: none"> • Training progress reports • Research Reports
Output 5: Regulated introduction and use of agro-biotechnology especially Genetically Modified Organisms (GMOs)	Indicators <ol style="list-style-type: none"> 4) One Biotechnology laboratory at MT. Makulu equipped (Equipment purchased and installed) 5) Three members of staff trained in biotechnology 6) About One-hundred identification services provided on GMOs detection in crops 	<ul style="list-style-type: none"> • Research reports. • Number of GMOs identified • Number institutions and persons capacity developed.

<p>Output 6: Appropriate agronomic packages and technologies developed</p>	<p>Indicators</p> <ol style="list-style-type: none"> 7) About 100 on-station and on-farm trials conducted 8) Ten economic analysis conducted on agronomic packages and technologies 9) Two alternative pest and disease control technologies develop 10) Five storable, acceptable, resistant/tolerant crop varieties bred against adverse environmental conditions 11) Fifty participatory plant breeding and conservation agriculture trials and demonstrations conducted 	<ul style="list-style-type: none"> • Research reports. • Economic analysis reports
<p>Output 7: Monitoring and Evaluation</p>	<p>Indicators</p> <p>Ten Monitoring and evaluation visits made to research stations</p>	<ul style="list-style-type: none"> • Monitoring and evaluation reports