

# Evaluation of maize research projects and future research – focusing on projects conducted by the Agricultural Research Council - Grain Crops Research Institute (ARC-GCRI)

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26 April 2007

## *Executive summary:*

*The research projects conducted by the ARC on behalf of the Maize Trust was evaluated using four methods, namely two assessment criteria methods, an assessment rubric and by interviews with several role-players in the maize industry. The main concerns centered on the question if the projects currently conducted by the ARC were making progress on themes identified as a high priority by the different industrial partners. The concern that projects were based on what the ARC could do with current manpower rather than what should be done was also raised. Several projects have also been going for a long time and little or no applicable results obtained.*

*The assessment has shown that the ARC-GCRI research portfolio was relatively well balanced and that approximately the same weight was given to the major disciplines of plant breeding, agronomy, basic research, extension and a combination of plant protection and plant science. It was found that succession planning and capacity building was at an alarming low level. The fact that research employment contracts are only for three year periods, that a moratorium on new appointments are still in place and that most of the capable researchers are over forty five years of age does not bode well for the future of this research institute.*

*The aim of this assessment was not to judge the technical aspects of individual projects, but rather to assess the appropriateness of the projects when compared to industry research priorities. The very brief overview of the technical aspects confirmed that the projects themselves were based on reasonable to good science. As far as the relevance to the industry and performance within the projects approximately 14% of 37 projects did not meet the minimum standards for reasons including poor performance, poor science, overly complex protocols, inadequate manpower, insufficient infrastructure, overrunning of reasonable time limits and low relevance to industry research requirements.*

*Note was taken of the complex political arena in which the ARC and researchers are operating and the apparent concentration on the sustainable rural livelihood program. This objective, as well as the drive*

*towards reaching a self-funding level of 50% of the budget and historical programs that need to be maintained all contribute to the drain on manpower and infrastructure.*

*There was a strong suggestion that the role of the ARC should be revisited and that the best option would be that they concentrate on five main topics:*

- Adaptive research: Testing of new varieties generated by private sector breeding programs for appropriateness for the local industry*
- Systems research: Testing different practices for soil preparation, fertilization and husbandry to find best solutions for local conditions*
- Industrial Watchdog: Testing fertilizer and chemicals for consistency in quality and efficacy*
- Plant protection: Entomology, Plant Pathology and Plant science projects aimed at finding best control practices with the stress on applied and not basic research*
- Extension services: To train and equip the government extension service and provide them with appropriate training materials in order to address the needs of the emerging sector*

*The Maize Trust is in a position to bring pressure to bear to manage the ARC in this direction using funding as leverage.*

*Some new projects were suggested, mainly aimed at adaptive research and small grower development. The ever increasing climatic change to drier conditions needs urgent attention but again stressing adaptive research projects.*

*The system used to ascertain the selection of projects relevant to the industry is inherently flawed. The basis of the initial meeting with growers is a document prepared by the ARC. Because of this very little choice remains with the grower as to what will be researched subsequently. In effect, all the subsequent project evaluation meetings become little more than a “rubber stamping” exercise. A more active and consultative approach from the Trust is recommended. The question is if the Trust can afford to continue with a relatively passive participation and still expect good progress on research and development. Active and continued assessment of new technology and opportunities and searching for possible applications within the industry should be an ongoing process. Using an active participation approach the Trust would be free to be more selective in where projects are placed and can also ensure that rapid progress is made. Such participation could be in the form of a research management project funded through the Trust.*

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## **Introduction**

The Maize Trust is supporting research and development projects conducted by various service providers. These projects cover a wide scope of activities that should follow norms and procedures stipulated by the Trust in guideline documents. The Agricultural Research Council (ARC) Grain Crops Research Institute (GCRI) has been a recipient of substantial amounts of funding in the past. Although much of the work and projects conducted by the ARC-GCRI have been significant and of relevance in the past, there are current concerns that the research topics might not address the needs stipulated by the various role players in the industry. It is also felt that progress on various research topics is not satisfactory. This report will attempt to provide data that will make objective evaluation of these concerns possible.

### *Brief*

The Maize Trust requires the following:

- An evaluation of the practical value of each project to the maize industry
- Motivated reasons for whether such projects are in line with the research requirements of the South African maize industry
- Motivated reasons whether such projects should be expanded. Limited, continued, discontinued or replaced by alternative research projects
- An assessment of the views and requirements of relevant industry associations
- Motivated reasons for research not yet incorporated in the current ARC-GCI program

### *The change in the traditional role of the ARC*

Agricultural research has always been behind the achievement of successful adaptations to the often difficult farming conditions in Southern Africa. The distance to the lucrative European and American markets has required technical innovation that could be seen as unique in the world. The Department of Agriculture (DoA), and later the ARC, has coped quite well with the research requirements of commodity products. Most of the research was aimed at the developed commercial sector, where technological innovation was a requirement for success. The ARC often became involved in long-term and costly projects that the normal agribusiness would not consider as viable investment. To an extent the ARC were

also seen as a watchdog for farmers to ensure that agric-products were of acceptable standard and to take risk on behalf of farmers.

With the change of the research branch of the DoA to a para-statal organization in the early 90's there has been little change in the research style of the ARC. It is debatable if this role is sustainable, or even appropriate, in the new research environment where the private sector is playing an ever increasing important role. To illustrate the situation: Traditionally the ARC (DoA) was involved in plant breeding, and much of the genetic pool resources were maintained by the DoA. Partly due to sanctions and other reasons, access to international genetic material or developed cultivars were not easy, and the DoA had to develop own resources. Developed varieties were often given to growers or sold at a nominal price. In this role the DoA was the first organization to provide the new generation of hybrid cultivars to the fledgling modern maize farmer.

This situation has changed dramatically since several agri-business entities now develop or import their own genetic material and are geared towards the business of supplying seed to growers. The ARC breeding programs supply seed to a competitive market, while at the same time testing competitive products in adaptation trails. There is very little ownership of the genetic material, and developed varieties become integrated in the resources of outside companies that are competing directly with the ARC for a market segment.

With the expectation that the ARC should fund a substantial amount of their budget from sources outside the state, a role change has also ensued. The ARC has become involved with several money generating projects such as the adaptation testing of privately owned commercial varieties, assessment of pesticides and herbicides and similar services. Since this is one of the very few options open to the ARC, most of the man hours and effort were to be directed towards these actions.

The only way that the ARC can do industry driven research is through grant funding. This implies that the funding organization becomes a co-responsible partner to ensure that research goals are set clearly and research remains targeted. The author is not convinced that the process of transition of the ARC to a para-statal organization has happened in depth at all institutes. At the same time the funding organization has to realize that there is a direct project management responsibility that they have to respond to. There is a level of conflict within the ARC to maintain long term programs, do money generating testing of products and also address the concerns of commercial farmers, while all of this has to happen against a background of pressure to be involved in politically popular programs.

The political arena has also changed substantially, and the ARC as “rural developer” are forced into a new role that has very little to do with commercial agriculture and commodity market development.

#### *Extension services*

From own previous experience of working in the DoA, there has always been a lack of direct extension of research findings through the accepted channels of the DoA extension service. The researcher was responsible for his own extension work in the past, while the extension officers of the DoA stuck with old and proven technology in virtually all instances. A large body of modern research did not reach the intended audience in those days and the situation has deteriorated drastically since then. With the virtual collapse of extension, very little of a vast body of valuable and innovative research reaches the intended audience and the researcher has to rely largely on his or her own extension efforts. Scientific publications are often not widely read, and by “translating” research into popular articles, much of the reasoning and impact behind recommendations are often lost.

#### *Political pressure*

In the post 1994 era, several projects have to be conducted in order to enable senior departmental officials to show measurable progress has been made towards assisting and developing previously disadvantaged farmers. In essence there is nothing wrong with this, but several if not all of the perceived research needs have been met previously and the data is available in some form or the other in the current research programs or archives of the ARC. It is of great concern that there is very little if any communication with the small growers regarding their felt needs and programs are conducted largely on the basis of needs perceived by the researcher and political powers to be.

The latest directive for ARC research to which all research programs have to adhere to are based on the National Agricultural Strategic Plan and states the following research objectives :

- Generate applied and new scientific innovation through basic research projects
- Develop and maintain sustainable natural resources
- Food security and safety of nutritional sources
- Management and mitigation of agricultural risk
- Commercialization of agricultural products- largely based on indigenous products

These topics are very generic and non-specific. This in turn leads to a kind of apathy within the ARC. Through creative proposal writing and interpretation any topic can be fitted into the mentioned framework. The result would be that very little would change and the incentivisation towards strategic goals would probably not happen as intended.

The implication of the political agendas are that research man-hours are dedicated to topics that is of little industrial concern, while the same man-hours are taken away from the topics where relevant results would make economic and competitive headway for the industry. The author is of the opinion that a large body of research can be “translated” from commercial scale to development scale with little effort and cost, leaving some minor applicable topics to be addressed that would benefit the development farmer.

The ANC agricultural policy document states that they will aim at channeling at least 40% of the ARC research effort towards the development of smallholder farmers. As part of this drive the Sustainable livelihood program (SRL) was launched in the ARC.

#### *Focus on Sustainable Rural Livelihood (SRL)*

The political pressure is formalized in the research program through the ARC-SRL program. The ARC-SRL was initiated by the Minister of Agriculture in 1999, and during 2002 was elevated to a core Division of the ARC. SRL enables the ARC to focus its research and development and technology transfer activities towards the needs of the resource poor agriculture sector or 2nd economy in Agriculture.

SRL is headed by a Group Executive (GE) and is supported by Five Business Unit Managers specializing in:

- Horticulture
- Grain and Industrial Crops
- Public Support Services
- Livestock
- ARC Technology Transfer Academy (ATTA)

The vision of the SRL is to be an internationally recognized centre of excellence in the commercialization of the Resource Poor Agricultural Sector (RPAS).

The method intended to achieve this mission is to promote agricultural and related sectors through research development and technology transfer.

- Core division to bridge gap between 1st & 2nd agric economy;
- Drive & facilitate R&D & tech transfer to 2nd economy;
- Align ARC's research with 2nd economy needs for Development;
- Support adaptive research, through alliances with Stakeholders;
- Interact with ultimate client regarding development priorities;
- Evaluate, allocate and monitor project funds, communication and information dissemination to enhance competitiveness, access to services and resources, skills, natural resource management, food security and agribusiness for resource poor agriculture
- Advisory services & co-ordination within ARC & with Stakeholders.

This program would therefore impact directly on the manpower and research infrastructure of the ARC and should be kept in mind when expecting timely and applicable results from the ARC as research service provider.

### **Methodology**

The main challenge in respect of the assessment required by the Maize Trust is to be as objective as possible. The interviews with the relevant role players would out of necessity be biased by their points of view and would be subjective by nature. The Trust recommended that the ARC-CGRI, the National Chamber of Millers and Grain- South Africa should be interviewed as a minimum requirement. It would also be beneficial if senior management of the ARC could be interviewed. To fit into the available timeframe stipulated by the Trust the following direct interviews were conducted:

- Dr PJA van der Merwe, Research and Technology Manager, ARC-GCRI
- Mr MA Prinsloo, Department Manager, Crop Science, ARC-GCRI
- Prof AH McDonald, Department Manager, Crop Protection, ARC-GCRI
- Dr K Mashingaidze, Department Manager, Plant Breeding & Biotechnology, ARC-GCRI

- Dr AEJ Saayman-du Toit, Department Manager, Crop Sciences and Technology Transfer
- Dr. MJ du Plessis, Department Manager Production Systems
- Dr J Purchase, CEO, Grain South Africa, representing maize growers
- Mr JF de Villiers, Executive Director, National Chamber of Milling, representing grain millers

Senior Management of the ARC could not be reached for an interview during the time available to the author.

### *Assessment methodology*

In order to evaluate of the practical value of each project to the maize industry a grading system that placed projects in the following categories:

- Essential core  
Research that is totally in line with the strengths of the institute and is crucial for the continued functioning of the research and development strategy of the wider industry
- Core  
Research of high importance and falls within the strengths of the institute and is important for the continued functioning of the research and development strategy of the wider industry
- Supporting core  
Research that supports essential core or core research but is aimed at developing appropriate tools or techniques to make the effective conduct of core programs possible
- Non-essential  
Research that does not fit into the other categories and are more of a personal interest and capabilities or of limited industrial impact

A further classification of a relevance ranking was used in order to assess whether projects are in line with the research requirements of the South African maize industry. A simple high-medium-low ranking was used.

Every project was examined individually and will be reported on in this document. A summary of finding will be given for each, and the results will also be incorporated into a summary table. This would serve to answer whether a project needs to be expanded, limited, continued, discontinued or replaced by alternative research projects.

The views and requirements of relevant industry associations were incorporated in final recommendations and throughout the assessment process. Finally some suggestion will be made regarding projects that is important but not yet seen in the current ARC-GCI program

### *Rubric development*

Several methods exist to limit the level of subjectivity due to personal bias in assessments of the kind reported on in this assignment. The easiest and most straightforward method is the use of assessment rubrics. This method translates subjective criteria to a marks system that would yield a relatively objective result. As with any subjective data, the outcomes are still biased, but much less as it would be with no measurement tool of any kind.

The included rubric was developed based on the criteria required by the Trust. By assessing the projects presented in “The Maize Trust Research Proposal” on face value, and subsequent interviews, a broad category most relevant to a combination of opinions were selected. Within the category a mark was allocated based on a high middle or low position within the category. The marks per project added to a total of 50 which were then converted to a percentage. The rubric and classification is shown in the Table 1.

A broad classification of the implications of the allocated percentage were developed taking into account what the factors present or absent in a category determination were. Based on this all the projects were classified according to the criteria stipulated by the Trust.

The individual projects were assessed by applying the rubric and also categorized into one or more of the following:

- Plant breeding research  
All aspects of crossing, evaluation of genotypes, planting and monitoring of breeding related trails
- Agronomy research  
Soil preparation and system analysis relating to effective growing of maize
- Quality research  
The quality of marketable products relating to maize
- Plant protection research  
Entomology, Plant Pathology, Nematology and all other pest or disease related research

Table 1: Rubric developed for the assessment of ARC projects:

| Topic   | 1-2   | 3-5  | 6-8   | 9-10   |
|---|---|--|---|--|
| Scientific viability of project topic             | Topic based on poor science and will not reach desired outcomes   | Topic scientifically acceptable but would probably take long to complete   | Topic on sound scientific basis with good prospects of results within a reasonable time   | Topic on very sound scientific basis with good prospects of valuable timely results                                |
| Practical value of topic to the maize industry    | Topic only of scientific or personal interest and will not contribute to practical outcomes                         | Topic will yield results in time but would need various basic research aspects to become practical   | Topic will yield good results but would not be of immediately practical value   | Topic will yield very practical and relevantly applicable results  |
| Topic in line with industry research requirements | Topic of little practical value and does not address issues of relevance to the industry                            | Topic of value but not within the main stream of requirements set by the industry  | Topic of high value to the maize industry but not fully within topics identified as relevant by the industry                            | Topic of high value to the maize industry in general and totally within relevant topics identified by the industry |
| Project duration and future development           | Project conducted on open-ended basis. Needs complete revision or scrapping   | Project needs revision and some addition or removal of topics to ensure relevant outcomes  | Project managed well in most aspects and should be adapted to ensure timely completion  | Project managed well in all aspects and should be supported to completion  |
| ARC capacity to conduct research on topic         | ARC lacks personnel, expertise and equipment to conduct the research. Outside service providers would be preferred. | ARC has capable personnel but lacks the equipment to conduct the research topic. Manpower and equipment resources outside the ARC will be required | ARC has capable personnel and is well equipped to conduct the research topic. Manpower resources from outside the ARC will be required. | ARC has fully capable personnel and is well equipped to conduct the research topic                                 |

0-33%: Project lacks in one or more of the key performance areas of scientific content, practical value, appropriateness to the needs of the relevant industry sector, overly long or falls outside the ARC capacity and infrastructure to conduct efficiently

34-65% Project generally acceptable but needs revision in one or more aspects including scientific content, practical value, appropriateness for the relevant industry sector, duration or inherent expertise or infrastructure of the ARC to conduct efficiently

66-100% Project acceptable and has appropriate scientific content, is of practical value, is appropriate for the relevant industrial sector, is of appropriate duration the ARC has inherent expertise and facilities to conduct efficiently

- Extension research  
All aspect relating to interaction with target groups and technology transfer
- Industry Watchdog research  
Project relating to the safeguard and monitoring of quality of grower's inputs
- Basic Research  
All projects that yield results appropriate for the scientific conduct of a project and not of high practical value outside direct research concerns

The results are presented in various ways in an attempt to clearly illustrate the trends required by the Trust for this assignment

### *Interviews*

Interviews of the ARC personnel were largely aimed at assessing the understanding of the research leaders of the requirements of the industry. Interviews were conducted at the Head of Department level, since the aim of the assessment was not to assess technical aspects of the projects themselves, or the progress within individual projects. They were asked to comment on their perception of where their projects fitted into the overall ARC strategy.

The projects in the current ARC portfolio could be classified as belonging to one or more of the following four categories:

- Historical programs: Programs that originated in the DoA before the creation of the ARC which then became ARC responsibility. This would include the international germ plasma collection. Although this program is funded through a parliamentary grant, it still requires manpower and facilities which competes with other programs
- ARC fund generating programs. These would be largely service contracts aimed at the private sector and where the main purpose is to render services that could be of an industrial “watchdog” nature.
- SLR-type projects with a largely political drive
- Basic research and industry related research where funding comes from donor organizations

The interviews with Grain SA and the Chamber of Millers were very illuminating and clearly illustrated where the dissatisfaction with the performance of the ARC originated. Unfortunately senior management from the ARC head office was not available for comment due to other commitments.

### **Results**

The results will be reported on a per project basis as required by the Trust. Some comments made during interviews will be included where appropriate. The following page will show the individual project assessments applying the methodology described previously. This will be followed by summary findings that will represent the more general impressions.

*Rubric assessment*

**Crop Science**

Project Number: M101/10 Project Title: Evaluate maize hybrids for different production systems

Score: 70%

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 4   |     |      |
| Practical value of topic to the maize industry    |     |     |     | 9    |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           |     |     | 6   |      |
| ARC capacity to conduct research on topic         |     |     | 7   |      |

This project falls within the scope of what the author sees as a core function of the ARC. The ARC is well geared towards the large scale planting of variety adaptation trails and should continue to do so. The high rate of failure to obtain results from co-operators trails are of concern. It would seem that during the past season a failure to obtain results from trails were approximately 37% for ARC managed trails and 79% for co-workers. This project is a historical and industry related project and should continue. This is an open-ended project that will continue in approximately the same form indefinitely. The project should be adjusted to gather quality data i.e. kernel size, colour and harness as well and this data should be co-reported in the MIG with all the other data gathered from the trails.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant Breeding:  | 60%                             | R 409 000                   |
| Agronomy:        | 7%                              | R 47 716                    |
| Plant Protection | 3%                              | R 20 450                    |
| Extension        | 10%                             | R 68 167                    |

Project Number: M101/11 Project Title: Evaluation of short season maize cultivars under irrigation (**NEW**)

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     |     | 7   |      |
| Practical value of topic to the maize industry    |     |     |     | 9    |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           |     |     |     | 9    |
| ARC capacity to conduct research on topic         |     |     | 6   |      |

Score: 80%

This project falls within the scope of what the author sees as a core function of the ARC. The ARC is well geared towards the large scale planting of variety adaptation trails and should continue to do so. This project is an industry related project and should continue. This is an open-ended project that will continue in approximately the same form indefinitely. The project should be adjusted to gather quality data i.e. kernel size, colour and harness as well and this data should be co-reported in the MIG with all the other data gathered from the trails. The main aim of the project is to develop ultra-short season varieties that would make double harvests per season under irrigated conditions. The ARC should include ultra – short season genotypes that are already available in the private sector.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant Breeding:  | 70%                             | R 131 545                   |
| Agronomy:        | 20%                             | R 37 584                    |
| Plant Protection | 3%                              | R 5 637                     |
| Extension        | 7%                              | R 13 154                    |

Project Number: M101/80 Project Title: Evaluate maize genotypes for economic viability

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 4   |     |      |
| Practical value of topic to the maize industry    |     |     | 6   |      |
| Topic in line with industry research requirements |     | 3   |     |      |
| Project duration and future development           | 2   |     |     |      |
| ARC capacity to conduct research on topic         |     |     | 7   |      |

Score: 44%

This project falls within the scope of what the author sees as a core function of the ARC. The ARC is well geared towards the large scale planting of variety adaptation trails and should continue to do so. This project is an SRL project and is partly of industry concern. This is an open-ended project that will continue in approximately the same form indefinitely. The project should be adjusted to gather quality data i.e. kernel size, colour and harness as well and this data should be co-reported in the MIG with all the other data gathered from the trails. The main aim of the project is to develop gap-bridging cultivars for the 2<sup>nd</sup> economy. The open pollinated varieties included in this trail should be considered as a necessary and affordable interim option for development farmers on their way towards small-scale commercial operations. A marketing/separate milling system should also be developed to ensure that farmers benefit from planting QPM's (This is reflected in the low score for project duration and future development).

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant Breeding:  | 80%                             | R 80 987                    |
| Agronomy:        | 3%                              | R 3 037                     |
| Plant Protection | 3%                              | R 3 037                     |
| Extension        | 14%                             | R 14 172                    |

Project Number: M102/10 Project Title: Determine the milling quality and colour deviation of white maize cultivars

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     |     |     | 10   |
| Project duration and future development           |     | 4   |     |      |
| ARC capacity to conduct research on topic         |     | 3   |     |      |

Score: 46%

This project is a core project that is of high importance to millers, and indirectly to growers, to ensure appropriate selection of varieties to plant. This project should have made more progress than it did in the time it has been running. It is surprising to see that technique development is still taking place at this late stage of the project lifecycle. Automated systems that would make the whole quality determination more streamlined and user friendly are under constant development and a new search for appropriate technology is recommended. The author is not convinced that the ARC is necessarily the best service provider to do this research.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant Breeding:  | 5%                              | R 19 616                    |
| Quality Research | 70%                             | R 274 634                   |
| Basic Research   | 20%                             | R 78 467                    |
| Extension        | 5%                              | R 19 616                    |

Project Number: M102/12 Project Title: Calibration of NIT for maize protein, starch and ash determinations

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     |     |     | 9    |
| Practical value of topic to the maize industry    |     |     | 7   |      |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           |     |     | 6   |      |
| ARC capacity to conduct research on topic         |     | 4   |     |      |

Score: 70%

This project is a core project that is of high importance to millers, and indirectly to growers, to ensure appropriate selection of varieties to plant. This project should progress according to schedule since it is largely laboratory based. The author is not convinced that the ARC is necessarily the best service provider to do the research aspects of the project. This project is a good opportunity to involve universities with the aim of training manpower for future industry needs. Bio-fuel varieties would also need to be assessed using very similar technology in the near future.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant Breeding:  | 2%                              | R 2 714                     |
| Quality Research | 70%                             | R 95 011                    |
| Basic Research   | 25%                             | R 33 933                    |
| Extension        | 3%                              | R 4 072                     |

Project Number: M102/13 Project Title: Development of methodology to evaluate the suitability of yellow maize cultivars for grit production

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     |     | 7   |      |
| Practical value of topic to the maize industry    |     |     |     | 10   |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           |     |     | 6   |      |
| ARC capacity to conduct research on topic         |     | 4   |     |      |

Score: 72%

This project is a core project that is of high importance to millers, and indirectly to growers, to ensure appropriate selection of varieties to plant. This project should progress according to schedule since it is largely laboratory based. The author is not convinced that the ARC is necessarily the best service provider to do the research aspects of the project.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant Breeding:  | 5%                              | R 7 055                     |
| Quality Research | 70%                             | R 98 777                    |
| Basic Research   | 20%                             | R 28 222                    |
| Extension        | 5%                              | R 7 055                     |

Project Number: M103/13 Project Title: Systems analyses for maize production under different management practices for specific agro-ecoregional zones

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     | 3   |     |      |
| Project duration and future development           |     |     | 6   |      |
| ARC capacity to conduct research on topic         | 2   |     |     |      |

Score: 34 %

This project is of an historical nature and the author is not convinced that any ground-breaking new results will be gained from the project. The core competency previously involved with this project is no longer employed at the ARC and the project is in a maintenance mode. By now this model should be fully validated and in general use, or scrapped depending on the reliability. This tool is in common use elsewhere, and most of the tweaking and appropriate calibration has been done. Several other models also exist which yield very similar results to the package described here.

Scientifically the project can be classified as follows:

| Discipline     | Approximate weight of component | Approximate cost allocation |
|----------------|---------------------------------|-----------------------------|
| Plant Breeding | 5%                              | R 12 328                    |
| Agronomy       | 5%                              | R 12 328                    |
| Extension      | 20%                             | R 49 310                    |
| Basic Research | 70%                             | R 172 585                   |

Project Number: M103/15 Project Title: Estimating methods for grain yield across South Africa using systems/ statistical analysis and crop modeling

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 4   |     |      |
| Practical value of topic to the maize industry    |     |     | 8   |      |
| Topic in line with industry research requirements |     |     |     | 10   |
| Project duration and future development           |     |     | 8   |      |
| ARC capacity to conduct research on topic         |     | 3   |     |      |

Score: 66 %

This project is of great importance to the industry for proper forward planning. Current results do not correlate well with previous methods used and enough data should be generated to validate the model. This project can very easily become open-ended and the author recommends that an initial period of three years should be allowed after which a thorough re-evaluation should take place. During this period the focus should be on validation of results and comparison with existing techniques.

The project seems to be expensive

Scientifically the project can be classified as follows:

| Discipline        | Approximate weight of component | Approximate cost allocation |
|-------------------|---------------------------------|-----------------------------|
| Industry Watchdog | 5%                              | R 18 218                    |
| Extension         | 25%                             | R 91 090                    |
| Basic Research    | 70%                             | R 255 052                   |

Project Number: M104/13 Project Title: Evaluation of biological, organic and inorganic substances associated with improved plant growth, yield and biotic and abiotic stress tolerance traits in maize

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     |     | 6   |      |
| Practical value of topic to the maize industry    |     |     |     | 9    |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           |     |     |     | 9    |
| ARC capacity to conduct research on topic         |     |     | 8   |      |

Score: 82 %

This project is of great importance to the industry and falls in a category seen by the author as a core function of the ARC. It is of practical value and should be maintained. Care should be taken to ensure that agreed protocols are used at all times. This project is classified as an Industry Watchdog project.

Scientifically the project can be classified as follows:

| Discipline        | Approximate weight of component | Approximate cost allocation |
|-------------------|---------------------------------|-----------------------------|
| Industry Watchdog | 75%                             | R 172 863                   |
| Extension         | 20%                             | R 46 097                    |
| Basic Research    | 5%                              | R 11 524                    |

Project Number: M 105/80 Project Title: The impact of crop rotation and fertilizers on sustainability and economic issues on developing farmers in the North West Province

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     |     | 7   |      |
| Project duration and future development           |     |     | 6   |      |
| ARC capacity to conduct research on topic         |     |     | 6   |      |

Score: 50%

Project is classified as SRL and has limited value for the industry since most of the research required here has been done before and only needs to be re-applied. The author cannot find the source of the request to do this research. The Trust is already funding a GSA development project in this area- is there any collaboration between the two parties? The project seems expensive and duplicating other efforts.

Scientifically the project can be classified as follows:

| Discipline | Approximate weight of component | Approximate cost allocation |
|------------|---------------------------------|-----------------------------|
| Agronomy   | 60%                             | R 148 080                   |
| Extension  | 40%                             | R 98 720                    |

Project Number: M121/81 Project Title: Maize cultivar evaluation under different soil fertility conditions for resource poor farmers

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     | 5   |     |      |
| Project duration and future development           |     | 3   |     |      |
| ARC capacity to conduct research on topic         |     |     | 7   |      |

Score: 42%

Project is classified as SRL and has limited value for the industry since most of the research required here has been done before and only needs to be re-applied. Care should be taken with these SRL projects not to re-invent the wheel. This topic seems to be a duplication of aspects of other projects already conducted at the ARC-GCRI- M101/10, M105/80, and M101/80.

Scientifically the project can be classified as follows:

| Discipline     | Approximate weight of component | Approximate cost allocation |
|----------------|---------------------------------|-----------------------------|
| Plant Breeding | 50%                             | R 32 047                    |
| Agronomy       | 20%                             | R 12 819                    |
| Extension      | 30%                             | R 19 228                    |

## **Production Systems**

Project Number: M105/10 Project Title: Comparison of integrated crop rotation, tillage systems and fertilizer application on economic and sustainable crop production on the Highveld

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 5   |     |      |
| Practical value of topic to the maize industry    |     |     |     | 9    |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           |     |     | 8   |      |
| ARC capacity to conduct research on topic         |     |     | 8   |      |

Score: 78%

This project is appropriate and falls within the core function of the ARC. Since there are so many variables been assessed in the same trail, it is recommended that even more representative sites should be included to ensure widely applicable results. This specific topic represents systems research which is of great benefit to all levels of maize growers and should be encouraged. The general lack of agronomists within the industry is of great concern and a specific action should be launched to develop new indigenous manpower. An Agronomist trained and sourced from elsewhere in Africa might not be suitable, since our conditions and systems are widely different to what happens in most African countries.

Scientifically the project can be classified as follows:

| Discipline     | Approximate weight of component | Approximate cost allocation |
|----------------|---------------------------------|-----------------------------|
| Plant Breeding | 5%                              | R 12 340                    |
| Agronomy       | 80%                             | R 197 440                   |
| Extension      | 15%                             | R 37 020                    |

Project Number: M 105/11 Project Title: Evaluation of suitable conservation tillage methods in crop production systems

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           |     |     | 6   |      |
| ARC capacity to conduct research on topic         |     |     |     | 9    |

Score: 60%

This project is appropriate and falls within the core function of the ARC, but not necessarily within the ARC-GCRI alone. The ARC-Agricultural Engineering Institute is doing similar work and has progressed far in this regard. Ensure that there is no inappropriate duplication of effort. This topic is of great importance across all levels of farming and would also benefit 2<sup>nd</sup> economy growers.

Scientifically the project can be classified as follows:

| Discipline | Approximate weight of component | Approximate cost allocation |
|------------|---------------------------------|-----------------------------|
| Agronomy   | 80%                             | R 234 846                   |
| Extension  | 20%                             | R 58 711                    |

Project Number: M 105/12 Project Title: Investigating maize root diseases in a crop rotation trail (**NEW**)

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     |     | 8   |      |
| Project duration and future development           |     |     | 8   |      |
| ARC capacity to conduct research on topic         |     |     | 8   |      |

Score: 60 %

This project is appropriate and falls within the core function of the ARC. This is a topic of great interest since maize on maize cropping system is general practice in South Africa. This specific topic represents systems research which is of great benefit to all levels of maize growers and should be encouraged. Any projects including sub-soil fauna is technically very difficult and over-runs of intended deadlines should be expected. Similar research has been done for several crops and situations and note should be taken of the vast body of available data.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant Protection | 55%                             | R 20 849                    |
| Agronomy         | 30%                             | R 11 372                    |
| Extension        | 15%                             | R 5 686                     |

Project Number: M106/10 Project Title: The role of soil microbiology in maize production

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     |     | 5   |      |
| Project duration and future development           |     |     | 7   |      |
| ARC capacity to conduct research on topic         |     |     | 6   |      |

Score: 48 %

This project is appropriate and falls within the core function of the ARC. This is a very specialized field and the author is not convinced that the ARC has the capacity to do the project full justice. It is important to do the project in order to obtain independent verification of previous results obtained by other researchers. This type of research is expensive.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant Protection | 10%                             | R 24 493                    |
| Agronomy         | 5%                              | R 12 247                    |
| Basic Research   | 80%                             | R 195 946                   |
| Extension        | 5%                              | R 12 247                    |

Project Number: M121/15 Project Title: Fertilizer monitoring for maize production

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     |     |     | 9    |
| Practical value of topic to the maize industry    |     |     |     | 9    |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           |     |     |     | 9    |
| ARC capacity to conduct research on topic         |     |     | 8   |      |

Score: 88 %

This project is appropriate and falls within the core function of the ARC. This project requires specialized apparatus that would probably be readily available at institutes such as CSIR, SABS and some universities. High costs will probably be incurred during the project. This project is classified as an industry watchdog project. It would be very important to adhere stringently to agreed protocols. Ideally this research should be conducted by the SABS. Even if fertilizer manufacturers do not necessarily welcome projects of this nature, they should be encouraged to contribute towards project costs.

Scientifically the project can be classified as follows:

| Discipline     | Approximate weight of component | Approximate cost allocation |
|----------------|---------------------------------|-----------------------------|
| Basic Research | 95%                             | R 285 078                   |
| Extension      | 5%                              | R 15 004                    |

## **Plant Breeding and Biotechnology**

Project Number: M141/12 Project Title: Breeding for Grey Leaf Spot (*Cercospora zeae-maydis*) resistance in maize

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           |     |     | 6   |      |
| ARC capacity to conduct research on topic         |     |     | 6   |      |

Score: 54 %

This project is appropriate and falls within ARC responsibilities to some extent. It is also of importance to the maize industry. The progress on the project is extremely slow and the reasons for this needs to be verified. This probably the first true biotechnology oriented local project that will be used in maize breeding. The impression is created that the scientists are trying to prove a concept rather than addressing the main research topic. The project needs to be terminated if no real progress can be shown within the next two years. The process has taken virtually as long as conventional breeding, but at a far higher cost.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant protection | 10%                             | R 39 675                    |
| Basic research   | 75%                             | R 297 561                   |
| Plant Breeding   | 15%                             | R 59 512                    |

Project Number: M 141/16 Project Title: Development and application of molecular markers in maize breeding

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     | 3   |     |      |
| Project duration and future development           |     |     | 6   |      |
| ARC capacity to conduct research on topic         |     |     |     | 9    |

Score: 48 %

Should the ARC still be a primary plant breeder? This project assumes that that should be the case, and aims at proving the case with the Grey Leaf Spot breeding program. In combination with M141/12 this program is extremely expensive (R 772 832.00 for this year, after nearly 8 years of high costs). The progress has not been much faster but in several orders of magnitude more expensive than conventional breeding- the question remains- is it economically justifiable? That been said, the main topic i.e. breeding for GLS resistance is important to the industry. The Trust should consider the benefits/limitations of this type of work and make a decision on the status of the ARC-GCRI as primary maize breeder. This will have a direct influence on this type of work and would make a focus shift necessary.

Scientifically the project can be classified as follows:

| Discipline     | Approximate weight of component | Approximate cost allocation |
|----------------|---------------------------------|-----------------------------|
| Basic research | 75%                             | R 282 063                   |
| Plant Breeding | 15%                             | R 56 413                    |

Project Number: M141/80 Project Title: Variation between *Fusarium verticillioides* isolates in their ability to produce fumonisins infect maize kernels and their resultant population dynamics (NEW)

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     |     | 8   |      |
| Practical value of topic to the maize industry    |     |     |     | 9    |
| Topic in line with industry research requirements |     |     | 8   |      |
| Project duration and future development           |     |     |     | 9    |
| ARC capacity to conduct research on topic         |     | 3   |     |      |

Score: 74%

This project is in line with core industrial requirements and the proposed collaboration with FABI is a positive development. This project can become open-ended very rapidly and should be managed well to remain focused.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant protection | 50%                             | R 176 562                   |
| Extension        | 5%                              | R 17 656                    |
| Basic research   | 45%                             | R 158 905                   |

Project Number: M161/10 Project Title: Maize cultivar development

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     |     | 6   |      |
| Topic in line with industry research requirements |     | 3   |     |      |
| Project duration and future development           |     |     | 6   |      |
| ARC capacity to conduct research on topic         |     |     | 6   |      |

Score: 48 %

Should the ARC still be a primary plant breeder? Compared to the budgets available to overseas private companies to develop new maize genetic material, which would be rapidly available in South Africa, we cannot compete. Monsanto is pouring R5.5 billion into plant breeding annually. Most of the genes generated through those programs become available eventually. The author is of the opinion that conventional plant breeding of hybrids should best be left to other private sector role players. It would be far more appropriate to do variety screening and adaptation trials, and also far more cost efficient. The competitive edge is gone- for several years already- and the ARC and industry should adapt to it. The drought resistance and short season genes are out there already and desperately needs to put into acceptable adapted varieties- some of these are in the private sector already- they only need wide-scale testing- and this is probably where the ARC would fit in?

CSIR has several phytotrons that are no longer used- this is ideal to simulate drought conditions to enable a drought resistance breeding program.

Scientifically the project can be classified as follows:

| Discipline     | Approximate weight of component | Approximate cost allocation |
|----------------|---------------------------------|-----------------------------|
| Basic research | 2%                              | R 6 841                     |
| Plant Breeding | 98%                             | R 335 232                   |

Project Number: M 161/11 Project Title: Fingerprinting of maize genotypes

| Topic   | 0-2 | 3-5 | 6-8 | 8-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements | 2   |     |     |      |
| Project duration and future development           |     | 3   |     |      |
| ARC capacity to conduct research on topic         |     |     |     | 9    |

Score: 40 %

This project would be of use if the ARC remains to be a main stream plant breeder. The author does not believe that this should be the case. Fingerprinting would only have two benefits, the one been to keep track of genetic material generated through the breeding program as a policing action to protect plant breeder's rights. The other would be to identify heterosygotic material early in the program. Only the latter is really required, but several universities and other institutes in South Africa can apply the required techniques- Should we keep this going?

Scientifically the project can be classified as follows:

| Discipline     | Approximate weight of component | Approximate cost allocation |
|----------------|---------------------------------|-----------------------------|
| Basic research | 80%                             | R 115 816                   |
| Plant Breeding | 20%                             | R 28 954                    |

Project Number: M161/80 Project Title: Participatory evaluation and identification of maize varieties for smallholder farmers

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     |     | 6   |      |
| Topic in line with industry research requirements |     | 3   |     |      |
| Project duration and future development           |     |     | 6   |      |
| ARC capacity to conduct research on topic         |     |     | 6   |      |

Score: 48 %

This is a SLR project and partly funded by the ARC head-office. It duplicates some of the work conducted by LIMPAST in Limpopo and also makes use of the Limpopo DoA personnel. The author suspects that there is double funding going on in the program, if then only in Limpopo? This needs to be verified. The question that needs to be asked is if this an appropriate and core function project for the ARC- it seems more of an extension project that should be managed by provincial DoA's? This could form an appropriate extension empowerment program.

Scientifically the project can be classified as follows:

| Discipline     | Approximate weight of component | Approximate cost allocation |
|----------------|---------------------------------|-----------------------------|
| Basic research | 5%                              | R 21 986                    |
| Extension      | 80%                             | R 351 772                   |
| Plant Breeding | 15%                             | R 65 957                    |

Project Number: M191/10 Project Title: Maize breeding: Inbred lines and cultivar development

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     | 3   |     |      |
| Project duration and future development           |     | 3   |     |      |
| ARC capacity to conduct research on topic         |     |     |     | 9    |

Score: 42 %

This program presupposes that the role of the DoA/ARC has not changed over the past three decades. The maize germplasm working collection is in the public domain since it is publicly funded by means of a parliamentary grant. In theory this material should then be available to any recognized plant breeder. The author suspects that this is not the case. It seems that the new options are becoming scarce, since the back-crosses are now to OPV's. There are four other OPV/QPM breeding programs in the full proposal, as well as several other projects that involve plant breeding at some level. The question remains- is this still a core ARC function and how much cross-subsidization of programs are occurring?

Scientifically the project can be classified as follows:

| Discipline     | Approximate weight of component | Approximate cost allocation |
|----------------|---------------------------------|-----------------------------|
| Plant Breeding | 100%                            | R 335 825                   |

Project Number: M 191/11 Project Title: Genetic characterization of *Stenocarpella maydis* tolerance in maize

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     |     | 6   |      |
| Topic in line with industry research requirements |     | 3   |     |      |
| Project duration and future development           |     |     | 6   |      |
| ARC capacity to conduct research on topic         |     |     |     | 9    |

Score: 54 %

This program is squeezing the last drops from a program that has run its course. The topic is very relevant since there is some mycotoxin involvement, but generally speaking, most of what could be done easily has been done. It is obvious that this project is used for student training, and therefore should be supported from the point of manpower regeneration. Will it cause any major breakthroughs? The author seriously doubts this. The program is expensive for the content shown in the project description.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Basic Research   | 80%                             | R 284 754                   |
| Plant Protection | 10%                             | R 35 594                    |
| Plant Breeding   | 10%                             | R 35 594                    |

Project Number: M191/12 Project Title: Evaluation of maize genotypes suitable for increased ethanol extraction for bio-fuel purposes (NEW)

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    | 2   |     |     |      |
| Topic in line with industry research requirements |     | 3   |     |      |
| Project duration and future development           | 2   |     |     |      |
| ARC capacity to conduct research on topic         |     |     | 6   |      |

Score: 32 %

This project would possibly be of interest sometime in the future. There are numerous crucial issues that would need to be clarified before bio-fuel from maize becomes a reality. As a stop-gap measure, several of the corn-belt varieties are well adapted for bio-fuel production and liaison with the private sector in this regard is recommended. Suitability for bio-fuel would probably also entail more than just high starch content.

Scientifically the project can be classified as follows:

| Discipline     | Approximate weight of component | Approximate cost allocation |
|----------------|---------------------------------|-----------------------------|
| Extension      | 95%                             | R 330 381                   |
| Basic research | 5%                              | R 17 388                    |

Project Number: M191/80 Project Title: Development and transfer of high quality protein maize (QPM) varieties to small-holder farmers, using marker-assisted breeding.

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements | 2   |     |     |      |
| Project duration and future development           | 2   |     |     |      |
| ARC capacity to conduct research on topic         |     |     |     | 9    |

Score: 38%

This is an SRL program. This program scores poorly for one major reason. There has been very little thinking about how the QPM's will be managed on the milling side. Although the high protein contents make perfect sense, all this benefit will be lost by the 2<sup>nd</sup> economy farmer once he delivers his product to the mill. There is currently no system in place to keep the QPM's separate in the mill, and all the potential benefit will be diluted with tons and tons of non-QPM maize. So far these varieties have shown themselves to be drought prone and does not compare well with other OPV's under less than ideal situations. Most of the intended breeding program would not be to develop new QPM's but rather to toughen existing material. This program needs to be re-planned before more is spent on it. For what is happening in the program, the cost is very high.

Scientifically the project can be classified as follows:

| Discipline     | Approximate weight of component | Approximate cost allocation |
|----------------|---------------------------------|-----------------------------|
| Basic Research | 10%                             | R 48 784                    |
| Extension      | 35%                             | R 170 745                   |
| Plant Breeding | 55%                             | R 268 313                   |

## **Crop Protection**

Project Number: M131/10 Project Title: Integrated management strategies for the stalk borer complex in maize

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     |     |     | 9    |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           | 2   |     |     |      |
| ARC capacity to conduct research on topic         |     |     |     | 9    |

Score: 64 %

This program is a core ARC program and should continue. The way it is written up makes it virtually impossible to judge relevance and appropriateness of all the sub-topics. The author suggests that these subtopics should be identified and managed separately before joining everything together as an integrated project. The project is very relevant, especially since it seems that some sources of the Bt gene are losing its protective abilities. The project needs to continue, but needs technical revision.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Basic Research   | 40%                             | R 287 443                   |
| Extension        | 5%                              | R 35 930                    |
| Plant Protection | 35%                             | R 251 512                   |
| Plant Breeding   | 20%                             | R 143 722                   |

Project Number: M 131/11 Project Title: Stand reducing insect pests of maize

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     |     | 6   |      |
| Practical value of topic to the maize industry    |     |     |     | 9    |
| Topic in line with industry research requirements |     | 3   |     |      |
| Project duration and future development           |     |     | 6   |      |
| ARC capacity to conduct research on topic         |     |     |     | 9    |

Score: 66 %

Writing a book is one way of preserving knowledge and capacity. There are similar books available- the one authored by Annecke and Moran during the 80's probably the most similar to the one intended here (Annecke, D.P. & Moran, V.C. 1982. Insects and mites of cultivated plants in South Africa. Butterworths, Durban/Pretoria). The author would like to suggest another, or maybe even additional vehicle, which would be the credit card key ring used by the Brazilian citrus industry. The system consists of a key-ring with several credit-card sized laminated photos of the pest and a brief and basic description of control measures. This would be very beneficial to small-scale farmers, and even the commercial farmers would find it useful. The trap monitoring is of an ongoing nature and should remain in place as early warning system for pest control by growers

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Basic Research   | 10%                             | R 51 129                    |
| Extension        | 80%                             | R 409 035                   |
| Plant Protection | 10%                             | R 51 129                    |

Project Number: M 131/12 Project Title: Integrated management strategies for streak disease in maize

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     |     | 8   |      |
| Practical value of topic to the maize industry    |     |     |     | 9    |
| Topic in line with industry research requirements |     |     | 8   |      |
| Project duration and future development           |     |     |     | 9    |
| ARC capacity to conduct research on topic         |     |     | 8   |      |

Score: 84%

Theoretically this project would not be necessary if responsible introduction of corn-belt material took place. Maize streak disease is incipient in Africa, and any susceptible material brought into Africa will succumb to the disease sooner or later. Resistance genes have been identified and are widely used in east and west Africa. These genes confer resistance to most strains of MSV, and it should be a relatively straight forward processes to retro-engineer the genes into currently susceptible varieties. This is and should remain a core function of the ARC. This project should be transferred to plant breeding shortly to complete the engineering process. The project is both expensive and of unusually long duration. If the ARC could pay more attention to adaptive research this type of susceptibility would be picked up earlier before the wide-spread release of susceptible material.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant Breeding   | 25%                             | R 56 896                    |
| Basic Research   | 10%                             | R 22 758                    |
| Extension        | 5%                              | R 11 379                    |
| Plant Protection | 60%                             | R 136 551                   |

Project Number: M141/10 Project Title: Integrated control of maize ear rots

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           |     | 4   |     |      |
| ARC capacity to conduct research on topic         |     |     | 6   |      |

Score: 50%

This project is of crucial importance and in line with high industrial priorities. Unfortunately it suffers from technical shortcomings, mainly in the way it is presented. As with M131/10 the way this project is written up makes it very difficult to assess or judge progress. The author suggests that this project should also be split into identifiable and measurable subprojects to enable the Trust to make a better assessment of relevance and progress. The size of the project contributes to a high cost, and the integrated work plan and probably lack of skilled personnel make progress slow. The cost as with M131/12 seems high for a project of this nature.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant Breeding   | 25%                             | R 202 490                   |
| Basic Research   | 10%                             | R 80 996                    |
| Extension        | 5%                              | R 40 498                    |
| Plant Protection | 60%                             | R 485 978                   |

Project Number: M141/11 Project Title: Integrated control of maize common rust, northern corn-leaf blight and eyespot

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     |     | 6   |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     | 5   |     |      |
| Project duration and future development           |     |     | 6   |      |
| ARC capacity to conduct research on topic         |     |     | 2   |      |

Score: 44%

This topic seems to be in line with core industry requirements but has been plagued by difficult experimental conditions, mainly inconsistency in the presence of the pathogen. The apparent inability to manipulate infections creates some doubt as far as researcher competency is concerned. After repeated failures in field work the decision is only made now to move to green-house conditions? Maybe a more in depth investigation of this project is required. The susceptibility risk to this group of pathogens has increased with the introduction of corn-belt material, as is the case with M131/12

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant Breeding   | 15%                             | R 44 080                    |
| Basic Research   | 25%                             | R 73 467                    |
| Extension        | 5%                              | R 14 693                    |
| Plant Protection | 55%                             | R 161 627                   |

Project Number: M151/10 Project Title: Integrated nematode control in maize

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     | 3   |     |      |
| Project duration and future development           |     | 3   |     |      |
| ARC capacity to conduct research on topic         |     |     | 8   |      |

Score: 40 %

This project is of somewhat historic nature and probably answers unasked questions from the grower community. Again, it is complex in presentation which makes specific topics difficult to assess and determine progress. This has been a very long running project and should be brought to a conclusion. In most crops, Nematodes, the way they occur and how to control them is relatively straightforward. This is probably also true of maize and solutions should be possible after 8 years of research?

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant breeding   | 15%                             | R 68 214                    |
| Basic research   | 35%                             | R 159 166                   |
| Plant protection | 45%                             | R 204 642                   |
| Extension        | 5%                              | R 22 738                    |

## **Plant Science & Technology Transfer**

Project Number: M111/13 Project Title: Increased use of integrated weed control

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           |     | 3   |     |      |
| ARC capacity to conduct research on topic         |     | 3   |     |      |

Score: 42 %

This topic is a core ARC function and could be very beneficial to the industry. The way it is written up and the maybe unnecessary level of detail gives the impression of what is termed "padding" to flesh out a minor project to a major level. The project is aimed at assessing the efficacy of several herbicides, but a number of sub-actions seem to be unrelated to this main theme. The project would probably benefit from a re-presentation of motivated sub-projects Could relatively straightforward solutions such as switching to a roundup ready variety for two years and using a glyphosate or generic on the grasses not be economically viable in the long run if compared to intricate herbicide combinations and spraying schedules? This type of exercise could be simulated on paper and might yield practical and rapid solutions to the problem.

Scientifically the project can be classified as follows:

| Discipline       | Approximate weight of component | Approximate cost allocation |
|------------------|---------------------------------|-----------------------------|
| Plant protection | 45%                             | R 147 157                   |
| Extension        | 20%                             | R 65 403                    |
| Basic research   | 35%                             | R 114 456                   |

Project Number: M 111/15 Project Title: Herbicide-related crop damage to maize

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    |     | 3   |     |      |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           |     |     |     | 9    |
| ARC capacity to conduct research on topic         |     |     |     | 8    |

Score: 64%

This is a typical watchdog project and should be a core ARC function. The project is not prohibitively expensive, but it is a function that should theoretically belong with the SABS. Should some attention not be given to supporting the SABS to fulfill their obligation? Currently a two year back-log exists at the SABS, and any of the commodity industries that are dependent on new chemicals becoming available in a timely fashion should be interested to ensure that the manpower exists at the SABS to fulfill their function? Care should be taken to ensure that testing protocols should be well formulated, agreed to and adhered to.

Scientifically the project can be classified as follows:

| Discipline        | Approximate weight of component | Approximate cost allocation |
|-------------------|---------------------------------|-----------------------------|
| Plant protection  | 5%                              | R 10 062                    |
| Extension         | 20%                             | R 40 249                    |
| Basic research    | 20%                             | R 40 249                    |
| Industry Watchdog | 55%                             | R 110 685                   |

Project Number: M 112/10 Project Title: Vigor and germination of maize seed

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 3   |     |      |
| Practical value of topic to the maize industry    | 2   |     |     |      |
| Topic in line with industry research requirements | 2   |     |     |      |
| Project duration and future development           | 2   |     |     |      |
| ARC capacity to conduct research on topic         |     |     |     | 9    |

Score: 36%

This is a typical watchdog project and should be a core ARC function. There is little evidence that this was a project requested by growers. There seems to be no standardized and generally accepted protocol. The type of problems created by poor germination and seed vigor and germination is relatively easy to note and rectify by a grower early in the growing season. This should not be a high priority project. Due to the lack of a agreed to protocol and the laboratory not been registered for this kind of work, the continuation of this project needs to be re-assessed.

Scientifically the project can be classified as follows:

| Discipline        | Approximate weight of component | Approximate cost allocation |
|-------------------|---------------------------------|-----------------------------|
| Extension         | 25%                             | R 54 079                    |
| Basic research    | 10%                             | R 21 631                    |
| Industry Watchdog | 65%                             | R 140 605                   |

Project Number: M181/10 Project Title: Maize Information Guide

| Topic   | 1-2 | 3-5 | 6-8 | 9-10 |
|---|-----|-----|-----|------|
| Scientific viability of project topic             |     | 5   |     |      |
| Practical value of topic to the maize industry    |     |     |     | 9    |
| Topic in line with industry research requirements |     |     |     | 9    |
| Project duration and future development           |     |     |     | 9    |
| ARC capacity to conduct research on topic         |     |     |     | 10   |

Score: 84 %

This project is a core function of the ARC and should continue. The MIG is a valuable and practical publication. New data on quality aspects such as hardness colour and kernel size should be added when it becomes available to enhance the publication. Pertinent data for use by 2<sup>nd</sup> economy farmers should be included.

Scientifically the project can be classified as follows:

| Discipline     | Approximate weight of component | Approximate cost allocation |
|----------------|---------------------------------|-----------------------------|
| Extension      | 95%                             | R 330 381                   |
| Basic research | 5%                              | R 17 388                    |

## Summary

Table 2: Summary of assessment findings based on rubrics, interviewer comments as well as personal experience

| Project Nr.                                    | Project Title  | Duration  | Classification  | Relevance | Rubric score | CurrentCost          |
|--|--|-----------|-----------------|-----------|--------------|----------------------|
| <b>Crop Science</b>                            |  |           |                 |           |              |                      |
| M101/10  | Evaluate maize hybrids for different production systems  | 8yr + 3yr | essential core  | High      | 70%          | R 681,667            |
| M101/11  | Evaluate of short-season maize cultivars under irrigation  | 3yr       | essential core  | High      | 80%          | R 187,922            |
| M101/80  | Evaluate maize genotypes for economic viability  | 6yr+3yr   | core            | Medium    | 44%          | R 101,234            |
| M102/10  | Determine the milling quality and colour deviation of white maize cultivars  | 9yr       | essential core  | High      | 46%          | R 392,335            |
| M102/12  | Calibration of NIT for maize protein, starch and ash determinations  | 3yr       | supporting core | High      | 70%          | R 135,831            |
| M102/13  | Development of methodology to eval. Suitability of yellow maize for grits  | 3 yr      | supporting core | High      | 72%          | R 141,111            |
| M103/13  | Sys anal for maize prod under diff management pract for specific zones   | 6yr+1yr   | non-essential   | Low       | 34%          | R 246,551            |
| M103/15  | Estimating methods for grain yield across SA using stats and modeling  | 3yr       | supporting core | High      | 66%          | R 364,360            |
| M104/13  | Eval of biological,organic and inorganic on growth etc of maize  | 6yr       | core            | High      | 82%          | R 230,484            |
| M105/80  | The impact of crop rotation and fertilizers for development farmers-NW   | 3yr       | non-essential   | Medium    | 50%          | R 176,238            |
| M121/81  | Maize cultivar evaluation under diff soil fertility conditions for dev. Farmers  | 8yr       | non-essential   | Medium    | 42%          | R 64,094             |
| <b>Production systems</b>                      |  |           |                 |           |              |                      |
| M105/10  | Compare crop rotation, tillage and fert appl on sustainability in highveld   | 6yr +1 yr | core            | High      | 78%          | R 246,801            |
| M105/11  | Evaluation of suitable cons tillage methods  | 3yr       | core            | Medium    | 60%          | R 293,557            |
| M105/12  | Investigating maize root diseases in crop rotation trail   | 1 yr      | core            | Medium    | 60%          | R 37,908             |
| M106/10  | The role of soil microbiology in maize production  | 3 yr      | non-essential   | High      | 48%          | R 244,933            |
| M121/15  | Fertiliser monitoring for maize production   | 9yr       | core            | High      | 88%          | R 197,552            |
| M121/34  | Additional fertilizer monitoring for maize production  | 9 yr      | core            | High      |              | R 102,531            |
| <b>Plant Breeding and Biotechnology</b>        |  |           |                 |           |              |                      |
| M141/12  | Breeding for grey leaf spot resistance   | 10yr      | supporting core | Medium    | 54%          | R 396,748            |
| M141/16  | Development and application of molecular markers in maize breeding   | 6yr+3yr   | supporting core | Medium    | 48%          | R 376,084            |
| M141/80  | Variation and characteristics of F.verticilloides isolates   | 3yr       | core            | Medium    | 74%          | R 353,123            |
| M161/10  | Maize cultivar development- drought resistance   | 3 yr      | supporting core | Medium    | 48%          | R 342,073            |
| M161/11  | Fingerprinting of maize genotypes  | 8yr       | supporting core | Medium    | 40%          | R 144,770            |
| M161/80  | Participatory eval and ident of maize vars for dev farmers   | 9yr       | supporting core | Medium    | 48%          | R 439,715            |
| M191/10  | Maize breeding-inbred lines and cultivar development   | 3 yr      | non-essential   | Low       | 42%          | R 335,825            |
| M191/11  | Genetic char of Stenocarpella tollerance in maize  | 3 yr      | core            | High      | 54%          | R 355,942            |
| M191/12  | Evaluation of maize genotypes suitable for bio-fuel ethanol extraction   | 3yr       | core            | Low       | 32%          | R 88,142             |
| M191/80  | Dev of high quality prot QPM to small-holder farmers   | 10 yr     | core            | Medium    | 38%          | R 487,843            |
| <b>Crop Protection</b>                         |  |           |                 |           |              |                      |
| M131/10  | Integrated management strategies for stalk borer   | 8yr + 3yr | core            | High      | 64%          | R 718,608            |
| M131/11  | Stand-reducing insect pests of maize   | 10yr      | core            | Medium    | 66%          | R 511,294            |
| M131/12  | Integrated manag strat for streak dis in maize   | 9yr       | non-essential   | Medium    | 84%          | R 227,585            |
| M141/10  | Integrated control of maize ear rots   | 8yr +3 yr | core            | High      | 50%          | R 809,963            |
| M141/11  | Integrated control of maize common rust leaf blight and eye spot   | 10 yr     | supporting core | Medium    | 44%          | R 293,867            |
| M151/10  | Integrated nematode control in maize   | 8yr + 3yr | supporting core | Medium    | 40%          | R 454,760            |
| <b>Plant Science &amp; Technology Transfer</b> |  |           |                 |           |              |                      |
| M111/13  | Increased use of integrated weed control   | 8yr       | core            | Medium    | 42%          | R 327,016            |
| M111/15  | Herbicide related crop damage to maize   | 8yr       | core            | Medium    | 64%          | R 201,247            |
| M112/10  | Vigor and germination of maize seed  | 9yr       | non-essential   | Low       | 36%          | R 216,316            |
| M181/10  | MIG  | 9yr       | core            | High      | 84%          | R 347,770            |
|  |  |           |                 |           |              | <b>11,273,800.00</b> |
| 0-33%  | Project lacks in one ore more of the key performance areas of scientific content, practical value, appropriateness to the needs of the relevant industry sector, overly long or falls outside the ARC capacity and infrastructure to conduct efficiently   |           |                 |           |              |                      |
| 33-65%   | Project generally acceptable but needs revision in one or more aspects including scientific content, practical value, appropriateness for the relevant industry sector, duration or inherent expertise or infrastructure of the ARC to conduct efficiently |           |                 |           |              |                      |
| 66-100%  | Project acceptable and has appropriate scientific content, is of practical value, is appropriate for the relevant industrial sector, is of appropriate duration the ARC has inherent expertise and facilities to conduct efficiently                       |           |                 |           |              |                      |

From Table 2 it can be seen that according to the classification of research explained on page 9-11 of this document that 8% of all projects are deemed to be essential to the industry, while a further 46% are directly in line with the objectives set out by the various role-players in the industry. Supporting this main effort is a further 27 % of projects that are aimed at developing tools and techniques to make the core and

essential research projects possible (total of 81% of projects in the acceptable bracket). A total of 19% of projects are of lesser value and should be revised or substantially adapted to find a closer fit with industrial requirements or should be terminated soon due to a lack of satisfactory performance.

Turning to relevance to the industry, Table 2 shows that 41% of the projects are totally in line with industrial objectives, while a further 49% are of less essential relevance (total of 90% positive relevance to the industry). A further 10% of the projects are deemed to be of low relevance. If a project has high relevance it is not implied that the way the project is managed currently is reaching these industrial goals.

The summary of the detailed rubric results are shown in table 3.

Table 3 shows the distribution of projects assessed by the rubric method and the projects that require intervention.

| % bracket | No of projects in bracket | Comment                       |
|-----------|---------------------------|-------------------------------|
| 0-9       | 0                         |                               |
| 10-19     | 0                         |                               |
| 20-29     | 0                         |                               |
| 30-39     | 4                         | Projects needs major revision |
| 40-49     | 12                        | Projects should be improved   |
| 50-59     | 4                         | Projects could be improved    |
| 60-69     | 6                         | Satisfactory                  |
| 70-79     | 5                         | Good projects                 |
| 80-89     | 5                         | Excellent projects            |
| 90-100    | 0                         |                               |

(86% relatively positive- 14% negative)

### *Interviews*

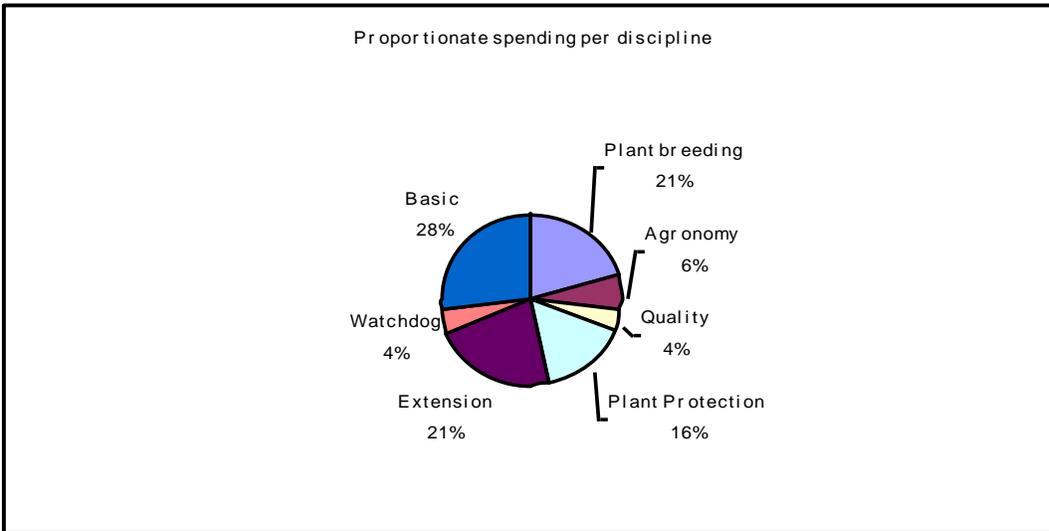
Some of the issues mentioned during interviews where as follows:

*“The ARC is doing mainly what it has personnel for and not necessarily what the industry requires- plant breeding is predominant and should no longer be a core function of the ARC.”*

In order to answer this question, each project was evaluated and a percentage allocated to the time and effort such a project would need from specific scientific disciplines. A brief description of the disciplines

is given on pages 10 & 11 of this document. Each of the individual project assessments documented here shows a “scientific classification” based on this theoretical analysis. To arrive at a value the project costs were then divided into these categories. Graphic presentations were generated for this data. Figure 1 shows the overall spending of Trust funding for the ARC-GCRI based on this classification system. This method has the benefit that it highlights spending per scientific discipline and not per ARC department.

Figure 1: Proportionate allocation of funding per scientific discipline.



It can be seen that a relative even distribution of funding are allocated to the major disciplines. Referring back to the objective setting by the ARC and then extrapolating from Figure 1 it seems that the following fit to ARC objectives can be shown:

- Generate applied and new scientific innovation through basic research projects (28%-Basic research)
- Develop and maintain sustainable natural resources (21%-Plant breeding)
- Food security and safety of nutritional sources (22%- Agronomy-Plant Protection)
- Management and mitigation of agricultural risk (25%- Extension, Watchdog)
- Commercialization of agricultural products- largely based on indigenous products (4% -Not really applicable + Quality)

It would therefore seem that internally in the ARC the manpower and funding effort on these programs is in a relative balance.

If the industry perspective is applied to the same data set the picture changes substantially. The industry expects the ARC-GCRI to address the following topics:

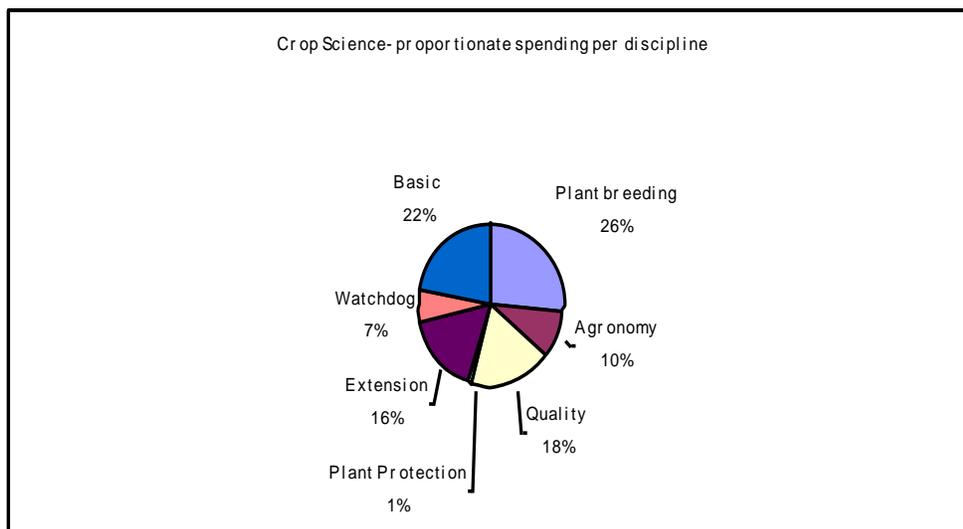
- Adaptive research- New genetic material tested for geographical adaptability, agronomic qualities, milling suitability etc. but new material not predominantly generated through the public sector. The private sector is in a far better position to do market driven research and development, and are mostly involved with international companies that are backed by multi-million budgets. (9.8%)
- Systems research- determines the best practice for soil preparation, fertilization, pest and disease control and cropping. (22%)
- Industry watchdog-
  - Unbiased adaptation trails and comparisons of privately owned maize varieties
  - Quality control for fertilizer and other chemicals
  - Fertilizer recommendations (4%)
- Extension services- especially essential for 2<sup>nd</sup> economy farmers (21%)

It can be seen that the ARC is only addressing slightly more than half of what the industry is expecting. It is therefore not surprising that certain negative perceptions can evolve.

If the role of the specific divisions is analyzed in the same manner the following graphs can be generated:

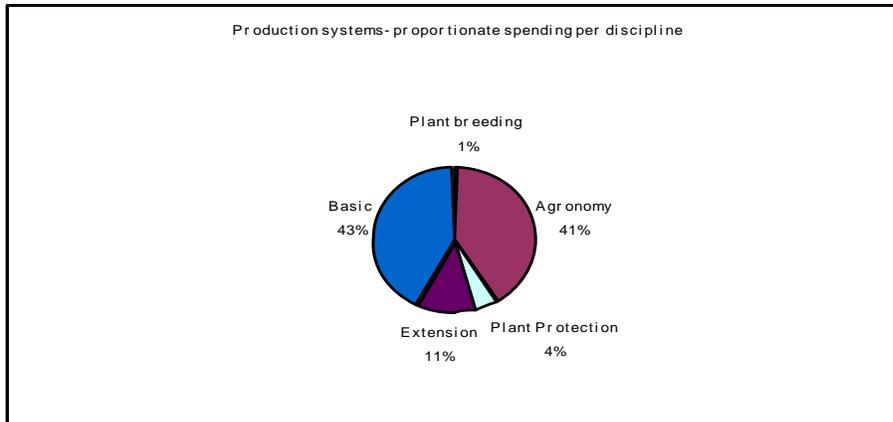
Figures 2-6: Percentage allocation of scientific disciplines within divisions at ARC

Figure 2: Crop science



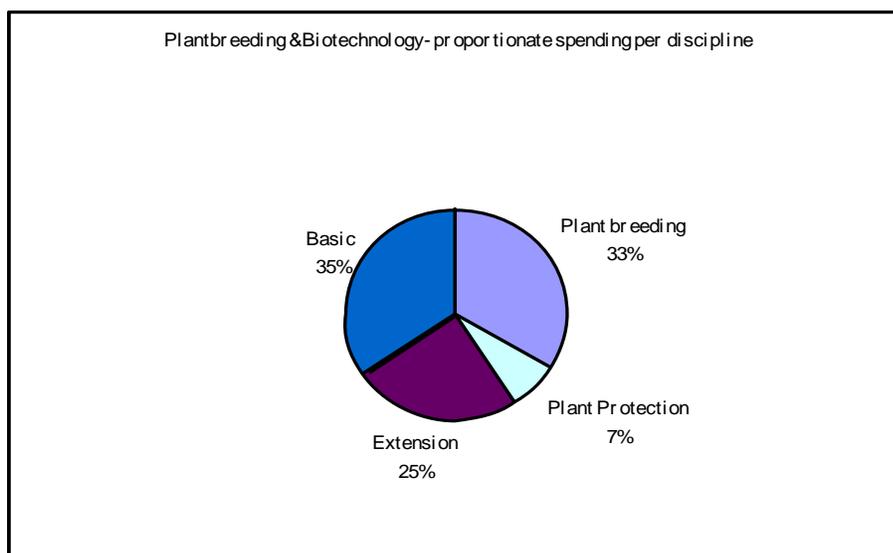
The crop science department has 11 projects sponsored by the Trust. Of these, three are seen as essential core activities, while a further two are core programs that would need some adjusting. Supporting these projects are three projects, while a further three are of somewhat dubious nature. The Department receives R 2 721 827.00 for this work of which R 2 234 944.00 is spent on high value projects, while R 486 883.00 goes to projects that needs revision.

Figure 3: Production systems



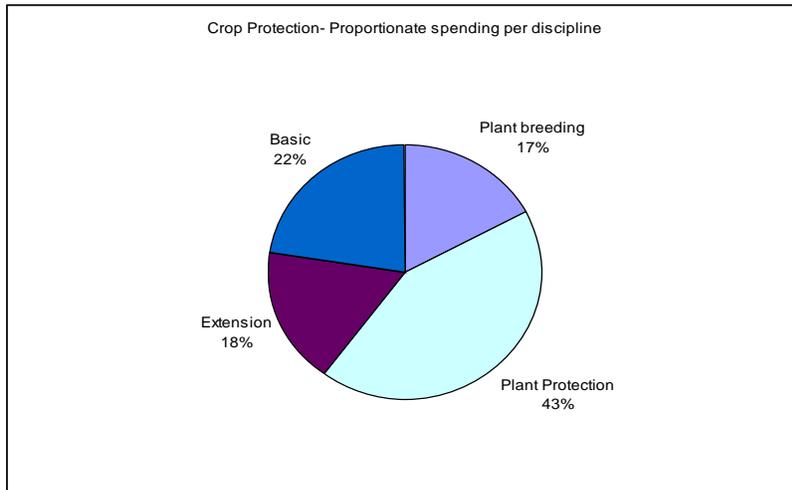
The Production systems department conducts six projects on behalf of the trust of which five is deemed as core programs, while the exception is penalized by a lack of properly qualified personnel and skill. A total amount of R 1 123 282 is allocated of which R 878 349 is spent on reasonable projects while R 244 933 goes to the problematic project.

Figure 4: Plant Breeding & Biotechnology



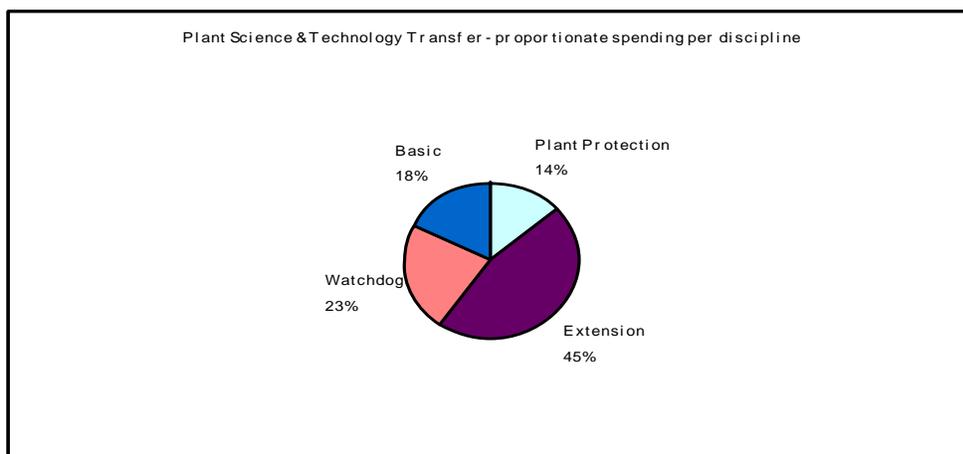
The Plant Breeding and Biotechnology Department conducts ten projects on behalf of the Trust. Of these four are core projects, a further 5 supports these main activities, and one project is seen as of lesser value. The total amount spent is R3 320 265 of which R 2 984 440 goes to acceptable projects and R 335 825 to the problematic project. A revision of the biotechnology projects is required.

Figure 5: Crop Protection



The Crop protection department conducts six projects on behalf of the Trust of which three is seen a core projects, with two supporting projects and one non essential project. The financial breakdown is a follows- Total spent: R 3 016 077, Total on essentials: R 2 788 492, Total on non-essentials: R 227 585

Figure 6: Plant Science & Technology Transfer



The Plant Science & Technology Transfer department conducts four projects on behalf of the Trust. Of those three are core projects while the fourth is seen as non-essential. The total amount spent is R 1 092 349, with R 876 033 on core, and R 216 316 on non-essentials.

### *Current situation*

The combination of the three evaluation techniques used in this assessment yield roughly similar results as shown in Table 3. The rubric method is probably the most accurate and unbiased of the methods used. It should be pointed out that the relevance assessment could classify a project as highly relevant to the industry. This does not imply that the project in its current form is answering the research need. This could be due to one or several shortcomings. These projects need to be assessed more thoroughly to determine where interventions should happen to bring them into line with requirements. The comments on the individual projects highlighted some of the issues.

Table 3: Comparison of results obtain with the three different evaluation methods

| Method                        | Acceptable research projects | Unacceptable research projects |
|-------------------------------|------------------------------|--------------------------------|
| Research classification       | 81%                          | 19%                            |
| Research relevance assessment | 90%                          | 10%                            |
| Research Rubric               | 86%                          | 14%                            |

The ARC is working in a challenging environment. There are several factors which make unbiased and unfettered research difficult. On the one hand they are stuck in a traditional role, while the research environment and requirements are changing rapidly, while there is also pressure to be involved in non-mainstream research. Outwardly and in their own opinion they are working within the program that has been approved by several industrial bodies. The problems associated with this view will be discussed in this document.

Keeping in mind the obvious pressures and constraints as well as the incorporation of opinions expressed during interviews. Table 4 represents a summary of the projects and provisional recommendations on the way forward. This table should be read in conjunction with the detailed comments on projects included in this document.

These recommendations are made on a provisional basis only. The time allowed for this project did not allow for going into individual projects to any level of serious detail. The recommendations are therefore based on superficial evaluation only. A more thorough and on-going evaluation would be required to express a firm opinion of the science and appropriateness of these projects.

Table 4: Provisional program management recommendation

| Project Nr. | Project Title   | Relevance | Provisional recommendation                          |
|-------------|---|-----------|---|
|             | <b>Crop Science</b>   |           |   |
| M104/13     | Eval of biological,organic and inorganic on growth etc of maize                 | High      | Proceed- ongoing                                    |
| M101/11     | Evaluate of short-season maize cultivars under irrigation                       | High      | Proceed- ongoing                                    |
| M102/13     | Development of methodology to eval. Suitability of yellow maize for grits       | High      | Proceed- ongoing                                    |
| M101/10     | Evaluate maize hybrids for different production systems                         | High      | Proceed- ongoing                                    |
| M102/12     | Calibration of NIT for maize protein, starch and ash determinations             | High      | Proceed- ongoing                                    |
| M103/15     | Estimating methods for grain yield across SA using stats and modeling           | High      | Proceed- evaluate thoroughly within 3 years         |
| M105/80     | The impact of crop rotation and fertilizers for development farmers-NW          | Medium    | Proceed-monitor results- terminate if not efficient |
| M102/10     | Determine the milling quality and colour deviation of white maize cultivars     | High      | Revise, needs management and pressure to conclude   |
| M101/80     | Evaluate maize genotypes for economic viability                                 | Medium    | Redundant   |
| M121/81     | Maize cultivar evaluation under diff soil fertility conditions for dev. Farmers | Medium    | Redundant   |
| M103/13     | Sys anal for maize prod under diff management pract for specific zones          | Low       | Redundant   |
|             | <b>Production systems</b>   |           |   |
| M121/15     | Fertilizer monitoring for maize production                                      | High      | Proceed-ongoing                                     |
| M105/10     | Compare crop rotation, tillage and fert appl on sustainability in highveld      | High      | Proceed-ongoing                                     |
| M105/11     | Evaluation of suitable cons tillage methods                                     | Medium    | Proceed- liaise with ARC-IAE                        |
| M105/12     | Investigating maize root diseases in crop rotation trail                        | Medium    | Proceed, evaluate manpower                          |
| M106/10     | The role of soil microbiology in maize production                               | High      | Proceed, evaluate manpower                          |
| M121/34     | Additional fertilizer monitoring for maize production                           | High      | Part of M121/15- very expensive?                    |
|             | <b>Plant Breeding and Biotechnology</b>   |           |   |
| M141/12     | Variation and characteristics of F.verticilloides isolates                      | Medium    | Proceed and monitor                                 |
| M141/16     | Genetic char of Stenocarpella tolerance in maize                                | High      | Proceed and monitor                                 |
| M161/80     | Breeding for grey leaf spot resistance  | Medium    | Terminate if no definite results are forthcoming    |
| M191/10     | Development and application of molecular markers in maize breeding              | Medium    | Not enough results- evaluate in depth               |
| M191/11     | Maize cultivar development- drought resistance                                  | Medium    | Good topic- poor performance- liaise with CSIR      |
| M191/80     | Participatory eval and ident of maize vars for dev farmers                      | Medium    | Duplication?  |
| M161/11     | Maize breeding-inbred lines and cultivar development                            | Low       | Redundant   |
| M191/12     | Fingerprinting of maize genotypes   | Medium    | Redundant   |
| M161/10     | Dev of high quality prot QPM to small-holder farmers                            | Medium    | Replan  |
| M141/80     | Evaluation of maize genotypes suitable for bio-fuel ethanol extraction          | Low       | Too early   |
|             | <b>Crop Protection</b>  |           |   |
| M131/12     | Integrated manag strat for streak dis in maize                                  | Medium    | Results or terminate                                |
| M131/11     | Stand-reducing insect pests of maize  | Medium    | Investigate other methods of extension              |
| M131/10     | Integrated management strategies for stalk borer                                | High      | Rewrite into topics                                 |
| M141/10     | Integrated control of maize ear rots  | High      | Rewrite into topics                                 |
| M141/11     | Integrated control of maize common rust leaf blight and eye spot                | Medium    | Dubious- student's project?                         |
| M151/10     | Integrated nematode control in maize  | Medium    | Relevance?  |
|             | <b>Plant Science &amp; Technology Transfer</b>                                  |           |   |
| M181/10     | MIG   | High      | Proceed- include quality data                       |
| M111/15     | Herbicide related crop damage to maize  | Medium    | Proceed-ongoing                                     |
| M111/13     | Increased use of integrated weed control  | Medium    | Project too academic?- simplify, focus and proceed  |
| M112/10     | Vigor and germination of maize seed   | Low       | Terminate- relevance?                               |

### *Differentiation between the research needs of the commercial and emerging sectors*

As stated elsewhere in this document, the main research needs of the development farmer are very similar to those of the commercial farmer. Virtually all of the existing research results can be easily adapted and made applicable to the development farmer. Open pollinators and QPM varieties have an important role at the subsistence farmer level and would require some research effort.

The dire need for the emergent farmer is training and extension at a highly practical and basic level, including demonstration and direct participation. The classical “farmer’s day” approach is not effective. Written material does not have a high value and new extension methods should be developed, tested and implemented.

Most of the subsistence farming happens on low fertility soils and with very little mechanization- these are given factors- more research on these topics will not yield major insight or results.

To make progress much more attention should be given to market development and market access for the emergent farmer. Financing of farming operations are a recurrent need and problem since these farmers are seen as high-risk clients.

Researchers in general should not make the mistake of “guessing” needs of the rural development farming communities - the consultative/democratic process is highly regarded and necessary if any form of co-operation is required.

### *Strengths and weaknesses*

All the topics and projects are managed well at the technical level- in other words - the science is adequate. The problems occur at the level of matching these projects to the industrial expectations. The ARC is well-equipped to do on-farm practical research and there are some highly experienced researchers. The ARC-GCRI could be seen as the ultimate “neutral” body that can do objective analysis of several inputs required by maize growers. This role should never be underestimated, but at the same time the ARC should not compromise on this neutrality by allowing funding of certain actions by these outside parties to sway their objectivity.

The ARC-GCRI has been a player on the plant breeding scene for a long time. That time has now passed, since the private sector will be in a much better position to compete in this market. In addition to selling

seeds, most of these companies render a post-sales service that the ARC cannot emulate. However, there is a very definite and important role for the ARC as independent cultivar evaluator. It is also true that the unbiased character of the ARC will be contaminated if they are evaluating their own varieties against the “outside”.

The lack of succession planning, the moratorium on appointments and the lack of obvious manpower generation are highly concerning. The duration of contract for a three year period is totally inadequate. The Author’s experience of the IACR-Rothamsted in the UK, where a similar 3year contract system was in place is that a scientist would learn the ropes the first year, work productively for a year and then start looking for a new job in the last year. We simply do not have a pool of job-hungry scientists than can fill these positions. The ARC will never be able to attract top-line scientists if this type of arrangement continues.

There are no new Agronomists on the horizon, while this is one of the core programs that are of great potential value to the maize grower. The Biotech program seems to make very little progress, despite adequate funding. This should be investigated.

## **Recommendations**

### *Research topics*

Most of the obvious topics are covered by the ARC to some extent, some definitely better and more professionally than others. There are some aspects that requires attention and should feature in the research program sooner rather than later. These are:

- The effect of global climatic change- drought tolerance or avoidance. The genes have been identified- they need to be incorporated in local agronomical acceptable varieties
- Market development for emergent farmers
- Training of extension officers to improve service delivery to emergent maize growers
- More university-based programs to improve capacity building opportunities
- Virtually all programs are aimed at improving yields- but very little attention is given to market development to cater for these higher yields. What secondary products etc. apart from bio-fuel can be developed? How are we positioned to market into Africa?
- Drastic action is needed on the maize quality programs- there are new technologies on the market that can automate most of the required processes.

- Risk mitigation on newly imported varieties- especially imported corn-belt varieties that are susceptible to several local pests and diseases.

### *Research requests from industrial role players*

Probably the most significant flaw observed during this assignment is the way in which industry needs are determined. Although several meetings are held to evaluate the ARC proposals and these proposals are then accepted with minor changes, the basis of the system is a document prepared by the ARC. The easiest way to explain this flaw is by using the analogy of an “a la carte” and buffet meal at a restaurant. In the case of a buffet you are fed, but have very little choice in what you consume, while with the “a la carte” you have a wide choice of options. If the basis of the initial meeting is a document prepared by the ARC, you are sitting down to a buffet, with very little choice of what will happen subsequently. In effect, all the subsequent meetings become little more than a “rubber stamping” exercise. All the role-players are consulted, and everybody is happy- or are they?

The author would like to point out that this is a basic flaw in several of the grower-consultative research programs. The real needs of growers are not listened to and they do not pose the research “need” questions. These questions are formulated beforehand, and the projects are then steered towards what the research institute intended to do anyway.

It is also very true that growers can very seldom formulate the correct research hypothesis. It is also true that some questions can be answered straight away but does not happen due to a lack of proper extension. The grower and milling fraternities need to be listened to and research needs determined, formulated and then circulated back to them to ensure that the questions were interpreted correctly. The base document is then something generated outside the direct influence of the service providers. Ideally this document would then go through the relevant industrial checking procedures and then research projects allocated either through tender or to a list of service providers selected on the basis of abilities and appropriate infrastructure.

### *Research Management from the Trust/Industry*

The need for a proper consultative process is obvious, as well as a broader selection of institutes and experts to choose from when allocating research tasks. The implication is a far more pro-active and research management role from the Trust. This is contrary to current Trust protocol. The question is if the Trust can afford to continue with a relatively passive participation and still expect good progress on

research and development. Active and continued assessment of new technology and opportunities and searching for possible applications within the industry should be an ongoing process. Several of the smaller commodities have research directors to ensure that they remain competitive and on the sharp edge of technology options. Is it not time that the Trust, as a major funding organization, considers taking part in the direct management of the research portfolio? This is probably the only way to ensure timely delivery of results and keeping the research focused on industry related issues. This could be achieved through a research management project funded in the normal way by the Trust.

### *References*

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