FOOD AND AGRICULTURAL RESEARCH COUNCIL

PROCEEDINGS

FIRST ANNUAL MEETING
OF
AGRICULTURAL SCIENTISTS

REDUIT, MAURITIUS, 12-13 JUNE 1995

Editor : Robert Antoine

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ANNUAL MEETING OF AGRICULTURAL SCIENTISTS

RÉDUIT, MAURITIUS, 12 - 13 JUNE 1995

Organised by

The Food and Agricultural Research Council (FARC)

in collaboration with

The Directorate of Agricultural Research and Extension (DARE)
The Mauritius Sugar Industry Research Institute (MSIRI)
The Faculty of Agriculture, University of Mauritius

Sponsored by

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January 1996
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The Annual meeting of Agricultural Scientists (AMAS) of Mauritius is organised as part of the World Bank-assisted Agricultural Management Services Project. Though the objectives of the AMAS are to present to the research community, on an annual basis, the main research achievements of the different agricultural research institutions, it has been decided however by the Organising Committee, that it would be preferable, for this first meeting, that research institutions highlight the trends in their respective programmes and activities. Relevant papers have therefore been invited for presentation and discussions from the Mauritius Sugar Industry Research Institute, the Directorate of Agricultural Research and Extension, the Food and Agricultural Research Council and the Faculty of Agriculture of the University of Mauritius. These papers as well as discussions that ensued after presentation by each institution are published in this Proceedings.

Robert Antoine
WELCOMING ADDRESS 1995

Prof. Robert Antoine
Chairman of the Organising Committee

Honourable Minister of Agriculture and Natural Resources,
Honourable Members of the National Assembly,
Excellencies of the Diplomatic Corps,
Professor Eric Roberts,
Permanent Secretary, Ministry of Agriculture and Natural Resources,
Distinguished guests,
Fellow Scientists

I have the honour and pleasure, as Chairman of the Organizing Committee, of welcoming you to this first Annual Meeting of Agricultural Scientists.

The meeting is being organized by the Food and Agricultural Research Council in conjunction with the Directorate of Agricultural Research and Extension, the Mauritius Sugar Industry Research Institute and the Faculty of Agriculture of the University of Mauritius as part of the initiative under the World Bank-assisted Agricultural Management Services Project. This Project covers, inter-alia, the reorganisation of agricultural research and extension for non-sugar crops and livestock.

During these two days the highlights of ongoing research are to be presented and discussed, thus providing an excellent opportunity for exchange of information and experience.

I should like to express my heartfelt thanks to the organising Committee for the tremendous effort put to make of this very first Annual Meeting of Agricultural Scientists a success.
AGRICULTURAL RESEARCH IN MAURITIUS:
A HISTORICAL PERSPECTIVE

Prof. Robert Antoine
Executive Chairman, FARC

As an introduction to this first meeting and at a time when a major change is taking place in the management of agricultural research in Mauritius, it is perhaps fitting, based on the experience acquired during the last fifty years, to review in the limited time available, the various factors that have led to the present situation.

My objective is to put the subject in its right perspective, mainly for the benefit of our younger generation of scientists. May I therefore recall, as many of us know, that agricultural research may be considered to have originated round about the middle of the last century. The origin may in fact be traced back even much earlier depending upon whether it is understood in its botanical, economic or agronomic sense.

However, organized agricultural research, as we know it, started with the setting-up of the "Station Agronomique" towards the very end of last century by a man of great vision, Philippe Bonâme. Although, he was concerned mainly with the sugar cane, by far the leading crop, he gave a lot of attention to other crops and the agricultural problems of his time without forgetting agricultural training. The results of his work are embodied in 18 annual reports and various bulletins and papers not to mention his classic short report on "Les Cultures Secondaires".

However, in the first decade of the twentieth century, it was realized that the "Station Agronomique" with its limited resources could no longer cope with the problems of the time and that a new central organization was needed. The Royal Commission of 1909 recommended the setting-up of a "Department of Scientific Agriculture" and, in 1913 the Department of Agriculture came into existence for "the enlargement of the scope of agricultural experiments and researches" and providing instruction in agricultural science.

Here again, we were fortunate in having at the helm in the early beginnings and for twelve years, another man of great vision, Harold Tempany who built-up agricultural research and experimentation on the lines that can still be traced to-day. Sugarcane work, of such vital importance, was then carried out by the Divisions of Botany and Sugar Technology. It should be noted that in spite of the depression in the sugar industry and recurrent financial crises, which occurred between 1920 and 1930, due to Tempany's wise and far-sighted policy, the Agricultural Services developed and expanded.

Another major achievement of Harold Tempany was in the agricultural training field. He is justly considered as the founder of the College of Agriculture. Courses in agriculture were designed to meet local needs and it is therefore not surprising that attention was devoted primarily to the needs of the sugar industry, both in field and factory, although training in agricultural activities concerning non-sugar crops were not neglected. The high level of teaching to Diploma level in sugar matters was such that it was a mere formality for College diplomates to pass the City and Guilds of London Institute examination in Sugar Manufacture often in the first class and obtaining the silver medal of the Institution.

Although there was a major expansion of research after the taking over in 1913 of the "Station Agronomique" by the Department of Agriculture, it was felt, following a conference on the sugar industry held in 1927, that special new research efforts had to be made in an attempt to solve the serious problems facing the sugar industry mainly in so far as production of new cane varieties, manurial needs, disease and pest control were concerned. As a result and following the establishment of a Reserve Fund for the Industry, a Sugarcane Research Station was founded in December 1929 as a specialized section of the Department of Agriculture.
It is to be noted that until 1953 the station was to be funded by the Reserve Fund and by the College of Agriculture. Also, due to lack of suitable accommodation, the station was housed in the College, a provisional arrangement, which was to last twenty years, until 1950, when a special building was provided.

The Sugarcane Research Station devoted itself entirely to problems concerning the sugar industry and, although partly financed by and accommodated in the College of Agriculture, its officers were expected to conduct full-time research without any teaching commitment.

However, the paradox does not stop here for it is fitting to outline that, when the college of Agriculture was created, its teaching staff came from the pool of research scientists of the Department of Agriculture and not from the College itself, a situation which, while weakening the research capacities of the Department did nothing to create a research unit proper to the College itself. Added to that, it should be noted that in 1928, just after the departure of Tempany, the Advisory Board of the College rejected a proposal made by the then Governor to set-up a research section at the College.

As Manrakhan has put it "one is left speculating on what might have been for non-sugar research, and even in terms of collaborative research on sugar with the Sugarcane Research Station, had the Governor's proposal been accepted". One could speculate even further in reflecting on the far-reaching influence it could have had on the research status in the Faculty of Agriculture of the University to-day.

During the twenty years (1930 to 1950) when the College was providing accommodation and finance to sugar research, a new director of Agriculture, G.E. Bodkin was appointed in 1933, and he was to stay in office for 15 years during troubled times with social unrests and the difficult war years. It comes therefore as no surprise that Bodkin, after the outbreak of serious trouble in the sugar industry in 1937, had as major interest the creation of the Planters' and Millers' Arbitration and Control Board, operating as a division of the Department of Agriculture. As a result, if Bodkin cannot be credited with any major development in agricultural research as such, yet, he will be remembered as the man who brought peace to the sugar industry. His other overriding concern at the time was the development of the co-operative movement among small planters. The rest of his time was occupied by the steering of the Department during the difficult war years and immediately after when the compulsory planting of food crops, a most unpopular and financially disastrous operation, had to be undertaken, culminating in the catastrophic cyclones of 1945.

In the post-war years, two main factors are going to influence the future of agricultural research after the golden years of the preceeding period when the reputation of both the Department of Agriculture and of the Sugar Research Station has reached its highest level. One, was the direct effect of the war itself on the conditions prevailing in the agricultural sector and, the other, was brought about as a result of the constitutional changes which were to take Mauritius on the path of independence. In the agricultural sector, with the introduction of Liaison Officers as first step towards a Ministerial system of Government, the centre of gravity of research management was to shift slowly but surely from the Réduit campus to Government House in Port Louis.

If, on the one hand, the equilibrium was to be re-established for the sugar sector, the same cannot be said for research in non-sugar crops and livestock.

Let us take a closer look at the post-war developments in the field of agricultural research.

The Sugarcane Research Station operated until 1952 and the excellent work conducted can be found in 23 Annual Reports and 19 bulletins, which include important contributions to the knowledge of the sugarcane plant. It is an undisputable fact that the work of the station contributed to the high level of efficiency which the sugar industry had attained in the 1940's. Norman Craig, the Officer in Charge of the station goes even further in stating that: "it is probably no exaggeration to say that but for the work of the Sugarcane Research Station in the period between its inception and the start of World War II, the sugar industry of Mauritius would have been in a parlous state during those grim war years". However, lack of staff and the changed conditions in the competitive sugar market after the war, set in motion a trend of events which culminated in the creation of the Mauritius Sugar Industry Research Institute which was to revive the tradition of agricultural research of past years in recreating the proper conducive environment.
The policy of the Research Station had been: "to improve the yield of sugar from every acre of land under cane and to extend the area capable of being planted in cane, in order to increase the total sugar output of the Colony." (If I ignore the word "Colony" all that seems very familiar these days.)

Let us note that the Station had a clear mandate, with a well-detailed policy, a research advisory committee, its research officers had no other commitments as we have seen, it had its own extension service; yet it was administered as a Division of the Department of Agriculture. Let us note that, although it had conducted excellent work, when crisis came it was not in a position to face it.

The major reason for the "skeletal state" to which the station had eventually been reduced is that the lack of flexibility of its administration had led to the loss of highly qualified scientists through the inability of Government to provide adequate remuneration when it was needed. The Mauritius Economic Commission of 1947 in its report recommended, inter-alia, that in order to increase and intensify sugarcane research, senior research workers should be given salary scales sufficiently remunerative to attract the best persons from within, and outside, Mauritius.

The success of the Sugar Research Institute can be attributed from the point of view of administration, inter-alia, to a clear mandate, adequate funds, flexibility in decision-making through a properly constituted Executive Board, guidance from Research Advisory Committees; and a good directorship. However, in the 1947 report it was stated that: "the taking over of sugarcane research by the industry would leave the Department of Agriculture free to concentrate on research on other agricultural activities".

If we now turn to non-sugar research we find that, with the evolution towards a ministerial system of Government, the Department of Agriculture will become the Agricultural Services of the Ministry of Agriculture, a very appropriate appellation, with the administration of research moving gradually away from the directorate of agricultural research. As a result, although the expansion continued with the development of new stations, such research and experimentation was coming more and more re-active instead of pro-active although the load of research on a wide range of agricultural and horticultural crops and livestock continued to increase it was to be gradually outpaced by continued developments in the statutory and regulatory services (plant and animal quarantine, veterinary services, seed production, testing and certification, plant propagation, land use, animal production requiring the management of several experiment stations). As a result, with the very limited financial resources allocated to research, the observations of the agricultural consultant, Don Corbett, in 1989 summarize very well the situation: "Procedures used in developing the research programme seem to be more reactive than pro-active, with no formal process of prioritization. The programme that is eventually adopted is the result of reaction to demand, with some guidance from Government policy. There seems equally no formal monitoring or evaluation of research progress".

It is very fortunate that the present Government authorities, conscious of these shortcomings adversely affecting research in the non-sugar sector are, with the assistance of the World Bank and the Overseas Development Administration, in the process of reorganizing and separating the research and extension component from the services proper. You will hear more about these developments during this meeting.

This reorganization comes at the right time in the wake of the searching exercise recently conducted by the High Powered Committee on Agriculture, which led to the submission of a comprehensive report on Agricultural Diversification.

After all the vicissitudes encountered in the agricultural saga, beginning with the "Station Agronomique" and leading to the recently created Directorate of Agricultural Research and Extension, the stage is now being set for the actors to start performing with courage, competence and conviction.

If I have felt that it was fitting to make this brief discourse, it is perhaps that, when I was asked to organize this meeting of agricultural scientists, came to mind the following words of wisdom from a Spanish-born philosopher who once said: "Those who forget their past are condemned to live it again".

I thank you for your attention
INAUGURAL ADDRESS

Hon. K. C. Ruhee
Minister of Agriculture and Natural Resources

Mr. Antoine
Prof. Roberts
Distinguished guests
Participants
Colleagues and friends

I am very happy to be here with all of you this morning for the Annual Meeting of Agricultural Scientists. As someone who can be blamed for having taught many of the agricultural scientists here today and even more so, as one who can go back to being an agricultural scientist in the future, I am particularly gratified that it is my privilege to inaugurate the first ever meeting of this kind organised under the auspices of the Ministry of Agriculture and Natural Resources. Let me welcome all of you and say how nice it is to see such a large gathering of scientists and the users of technology here this morning.

At the outset, let me compliment Mr. Antoine, for not merely organising this Meeting but providing us with a masterly overview of agricultural research in this country during the last fifty years. It is rarely that we get to hear such an exposition from one who has had a ringside view of things. As we spend the next two days trying to fashion our research agenda for the next five years, it would be good to keep the historical perspective also in mind.

I must hasten to point out, however, that the importance of the presence of agricultural scientists here over the next two days lies not so much in the fact that it happens to be the first such meeting. On the contrary, I believe that the true significance of the meeting is that it does mark a departure from the past and heralds a new era of change. During the rest of my address, I shall attempt to explain how it lies within the power of everyone of us, individually and together, to embrace this change, to build on this difference with our past ways of doing things and progressively create new institutions with dynamic work cultures that can help our agricultural community face tomorrow's competitive world.

As I see it, the challenge before us is to create a culture of professional competence in the agricultural sector. During the course of my first interaction as Minister of Agriculture and Natural Resources with the senior staff at Reduit on 7th March, '94, - how long ago that seems - I had made two observations. I had then characterised myself as a worried optimist and said that my optimism about the sector was based, inter-alia, on the quality of the technical manpower available in the Ministry. However, I was even then worried about the fact that the same manpower, the same type of people seemed to perform better when they worked for, say, the MSIRI than for the Government. Obviously, there was an organisational chemistry which was lacking. Apart from this, I had also emphasised the importance of having a coherent agricultural research policy with clearly spelt out objectives.

Actually, the World Bank-assisted Agricultural Management and Services Project (AMSP) addressed this very problem of under-achievement at the organisational or institutional level and proposed the creation of a new Directorate of Agricultural Research and Extension through a reorganisation of Agricultural Services(AS).

This reorganisation is materialising now and DARE would finally become operational by 1st July, 1995 under FARC. Simultaneously, a committee has already been working on the consequent reorganisation of Agricultural Services. Hopefully, all this work can be completed soon.

The setting up of a new Directorate and a reorganised Agricultural Services may not however, by themselves, bring about a new work culture. This would have to be consciously introduced and built up so that over the next
five to ten years, we achieve in the public research, extension and services system the kind of competence and credibility that MSIRI has come to enjoy. Increasingly, agricultural research all over the world is taking on a multi-disciplinary and systems orientation. In the context of Mauritius too, we have to realise that we just do not have the resources in terms of time and money to do everything. There has therefore to be a strong sense of priorities, dictated not so much by our on-going projects and programmes but by the economics of our comparative advantage and the emerging trends of the national and international market place. In this sense, the new things that DARE might want to take on would in a sense be less important than the things that they can shed. In other words, we should not merely do things right but be doing the right things.

At this stage, I must point out that all this will apply to the Agricultural Services as well. As all of you are perhaps aware, we are committed to reinventing Government by disengaging it from functions which can be more efficiently provided by the private sector, including individual farmers. Our ideas and intentions have been spelt out in the document "Initiatives 2000" which has recently been cleared for implementation. The important point is to remember that agriculture is no longer the production of particular commodities but rather the delivery of various products of quality along a long value chain stretching from the primary producer to the sophisticated consumer. I had referred to this aspect quite extensively in my address at the National Consultation on Agricultural Diversification held last December wherein I had said "...The Mauritian consumer is important not only in terms of his buying power but must be increasingly perceived as an inspiration for innovation and upgradation even in the agricultural sector."

Concurrently with zero-basing our on-going activities, we should try and build in a genuine multi-disciplinary dimension in our research. I believe that this could be facilitated by reducing the formal constitution of several divisions in DARE. Sometime back, one of our own officers made an interesting observation as to how the very word 'division' suggests splitting and fragmentation whereas the word 'unit' might imply unity and a stronger product focus. Semantics apart, I think that there is a substantial issue involved here. Therefore DARE might probably be better off having, say, a strawberry, a pineapple or a banana unit in which officers from various disciplines work with a common mandate and client focus rather than having the traditional format of subject-matter divisions. Depending on the thrust in the research project, the team leaders or coordinators could be chosen from the appropriate discipline. The divisions representing subject-matter specialisations could merely guide their officers who would be in one or more units in charge of specific research and development projects. DARE -and even Agricultural Services on similar logic- could therefore have two organigrams. In the conventional format, the organigram could show the different divisions with the limited role of technical guidance as noted above. This could be used essentially for administrative purposes. The other organigram could be commodity and/or research topic-specific. The greater flexibility and mobility that the second organigram provides could then facilitate DARE responding quickly to new challenges in the future

In terms of work culture, we should consciously build up the practice of having seminars and presentations within and across project or commodity units. This would be part of the process of opening up professional communication within the organisation. Apart from keeping colleagues informed of what is going on in a particular crop or research topic, the officer giving the seminar would also benefit by feedback from them. This would lead to the healthy practice and pressure of peer-level reviews. All this may not happen in the very first meeting where we have obviously certain constraints. I would, however, like - and I am sure it is the intention - to open future meetings of agricultural scientists to wider participation and make the sessions more technically-oriented.

All this should also help build up confidence among our scientists and technicians to perform self-evaluation and defend their proposals for research or services before professional forums. Both these are desirable if DARE or Agricultural Services are to canvass for funding support in the long run from the client industry or even an international commodity organisation. I do appreciate that DARE cannot work purely like an academic body. On the other hand, there is no reason at all why the work ethos in DARE or Agricultural Services cannot reflect the fact that they are organisations of knowledge workers engaged in developing and delivering relevant technology and related services to a demanding clientele.

Apart from communication within, there is need also to emphasise the importance to DARE and AS of communication across organisations such as FARC, MSIRI and UOM, apart from the private sector. One aspect of this is the meeting of agricultural scientists which will become an annual feature from now on. I do not think
however that such communication should be achieved only through formal mechanisms such as the Annual Meeting of Agricultural Scientists. I feel that we should encourage the formation of a professional association in the agriculture sector of not only of officers drawn from all these organisations as well as the private sector, but also individual farmers. The members of the association should meet regularly not only to listen to their own colleagues but also visiting experts. MSIRI or the University of Mauritius may be providing this opportunity once in a while but many of our officers do not seem to take advantage of this. The need is to make this a more participative and general process. I would like to make it clear that Government expects, and would be willing to support, professional development in the agriculture sector as a whole.

Taking this logic further, I feel that Government should, either directly or through a professional body such as the one I referred to, institute an Agricultural Scientist of the Year award. The scheme should be used imaginatively and effectively to motivate the young and active scientists to compete for such an honour and thereby build up a climate of achievement in the system. It is not enough to merely honour past work on ceremonial occasions. After all, the agriculture sector employs the largest number of professionals in this country, comparable with engineers, doctors, accountants and computer programmers. It would be desirable to introduce an element of professional competition among this group. We can perhaps think of a separate award for lifetime achievement. I would welcome specific suggestions on this idea so that at the next annual meeting of agricultural scientists, we are able to present the first award and this then becomes an annual tradition.

Apart from encouraging communication, fostering competition and rewarding merit, we need also to draw up a special programme to upgrade the professional skills of our scientists and technicians and implement it immediately. Skills development has hitherto, mistakenly, been regarded as synonymous with deputation to long-term study courses. While rationalising this activity and making it more transparent and fair - which is what I have been trying to do during the last fifteen months - we should also explore new ways of achieving our real aim which is to promote not bookish knowledge but practical hands-on skills. This could be achieved through local short-term programmes for groups of officers. Senior staff from organisations like the MSIRI or UOM could be utilised for this purpose.

I believe that we could also get outside agencies to design specific packages tailored to our needs and also assist us in implementation. I am happy that the team of senior agricultural scientists from India are here with us during these two days. I would like institutional research and training linkages established between DARE and their institutes. We are planning similar linkages with institutions in the UK with the help of the ODA.

Many of the organisational and procedural reforms suggested above need to be worked out in detail and this would require professional input of a high order. Some of it could perhaps be tackled in-house. We have the two Advisers deputed by the ODA whose expertise we must tap. However, I do feel that the effort of these people might need to be supplemented by and supported through outside consultants. We should quickly put together a panel of resource institutions and resource persons whose practical experience could be tapped in this massive exercise in Organisation and Human Resources Development.

Financial resources might be no problem as we might be able to meet this expenditure under the AMSP. The more important thing is that we should develop a clear vision of the kind of institutions and their research agendas that we want to build in this country to meet the challenges of high-technology and high-value agriculture into the 21st Century. We should not let this vision run ahead of us, but carry everyone with us on the endeavour.

Ideally, the new organisations and the new work ethos should have been in place by yesterday. Today therefore, we are already late in a sense. However, talking about the required changes and acting upon our conviction today would still be better than doing it tomorrow as a force majeure exercise. Since modern agriculture is all about efficiency in resource use in a sustainable manner, we should begin with the realisation that time is the only resource at our command that is completely non-renewable.

Even a journey of a thousand miles must start with the first step, as the Chinese philosopher pointed out. It is this that makes our meeting over the next two days important. It is not an one-off event but hopefully something that is part of the process of change that we are trying to bring in. It is the first step that we are taking to develop a collective vision of what we want to be and where we want to go. As we step out on this long and arduous journey together, let us wish each other luck and success. Success, not at the end of the journey, for we do not
even know if it is a thousand miles or ten thousand miles that we want to or have to travel, but the success of knowing at every stage of the journey that we are progressing in the right direction and along the right lines. Can we ask for more?

Before concluding, let me appeal to all the scientists who would be participating in this two-day meeting to reflect also on how we can improve the format and enhance the content of this Meeting in the coming years so as to make it a prestigious and eagerly-awaited scientific event. New traditions, like new organisations or work cultures, cannot be built in a year or two. They require sustained, enthusiastic and systematic work as Mr. Antoine's address and his own professional life reminds us. All of us must take inspiration from the fact that at his age, when he no longer needs to prove himself or anything, he finds so much work of interest to do and do it well.

That reminds me of the lines of William Wordsworth.

"Bliss it was in that dawn to be alive;
But to be young was very heaven"

Let us all feel young once again and strive towards a new dawn for Mauritian agriculture.
It is indeed a great honour to be invited by Professor Antoine and the committee that organised this event to address you. As you've heard, I have been coming to Mauritius for quite a long time now and was indeed one of the two first examiners for the B.Sc. degree in Agriculture in Mauritius. I've come back in various reincarnations from time to time, mainly as an external examiner but once as a member of the Inter-Universities Council mission that came here to find ways that U.K. could best provide a little help to the University. I can't claim to be an expert on Mauritius even though I think some consultants, if they touch down in an airport, say they have a working knowledge of the country, and if they've walked out of the airport for more than an hour or two, they say they are an expert. But at least I've had the privilege of seeing the country over an extremely important part of its history when the rate of development in Mauritius has been almost phenomenal: it is now very often cited as a major example of successful development. I happened to be at a meeting in Nairobi just three weeks ago and one of the Vice Presidents of the World Bank cited Mauritius as one of the prime examples of successful and sensible development. I feel privileged to have seen some of the changes.

I've also come to love the country and so I see it perhaps sometimes through rose coloured spectacles; nevertheless I think I'm still sufficiently an outsider to be able to look at it sometimes objectively. So I have some qualification as somebody who is deeply concerned about Mauritius, someone who has been mainly concerned with the Faculty of Agriculture at the University, but who has also had the opportunity to get to know the other institutions in Mauritius where agricultural research takes place - particularly MSIRI, the Ministry and also to some extent the private sector, especially some of the sugar estates where development through research has been important. So I can claim at least to know something about Mauritius, its agriculture, and its science; and I suppose the other qualification that I may have for talking here is that, I've been involved in research related to agriculture for a very long time: at various times I've been engaged in trying to develop and manage research and recently in the Consultative Group for International Agricultural Research currently as Chairman of the Board of ICRISAT which is one of the larger research institutions in that system.

First of all I'll try and answer one question very briefly: "We are concerned here with agricultural research in Mauritius, but why research? I think that the question can be answered very simply: there have been quite a large number of independent studies now on the economics of investment in agricultural research, and they've all come to the conclusion that this is one of the best investments in terms of the return on the investment that you can make. It is therefore very clear that any sensible country or organization concerned with agriculture is going to invest in research. Of course, it needs to be good research, it needs to be research of high quality and that is perhaps where we need to take a closer look and that is why the title of my talk is "The conditions under which research flourishes" what I really mean is "conditions under which good research flourishes" because quality is important.
Incidentally if there were to be a sub-title to my talk, it has already been provided this morning by the last words of Robert Antoine when he quoted a Spanish philosopher: "those who forget their past are condemned to living it again". I don't see the problem here yet, but I think there is always the danger.

I've certainly seen it in my own country and I've seen it in various other parts of the world. We do find it rather difficult to learn from the lessons of the past and so I think that's why we've already had a tremendous introduction to this conference. We first had the talk from Professor Antoine which gave us concisely but clearly the context in which we find ourselves in Mauritius with regard to agricultural research; how it developed and how we find ourselves where we are now; and then from Minister Ruhee, we saw a vision for the future, how Mauritius needs to develop and "create new institutions with dynamic work of cultures" to use his words. With one looking to the past and the other looking to the future, where do I fit in? Possibly by seeing what lessons are to be learnt from outside that can be brought into Mauritius. I thought that what I would do first of all is to consider examples of how things went well and how they may be going badly elsewhere and see if we can draw from those lessons and apply them in Mauritius.

I think most people who have any concern with agriculture know something about the CGIAR and its International Centres but I will remind you briefly something about this organisation. In the 1960's, two research institutes were established, the International Rice Research Institute (IRRI) in the Philippines, and a little later CIMMYT, the International Centre for Improvement of Maize and Wheat in Mexico. These have turned out to be great successes and I think very few people would argue otherwise. They certainly played an important role in the "Green Revolution". I think it was as a result of these successes and the kind of culture that had developed in those two organisations and that led to the development of the Consultative Group for International Agricultural Research with a view to seeing whether the approach could be further extended.

In the meanwhile, Ford and Rockefeller had in fact started the International Institute of Tropical Agriculture in Nigeria and CIAT in Colombia, but it is at that point that the CGIAR was established and in 1971 they took over from Ford and Rockefeller. CGIAR did not govern these institutes because each institute within the CGIAR system is entirely independent with its own board of governors. The CGIAR is essentially a club of donors which gets together and discusses priorities and what needs to be done. It is advised by a Technical Advisory Committee, a body of independent scientists who are there to advise the donors what are good projects, what are the priorities into which their funding should go. It is an organisation without any legal entity; it has no formal structure and yet it has worked so far exceedingly well. It is partly due to its informality that many people think it does work well. So early in the 1970's there was an expansion of this system and several institutions were then set up including the one that I am involved with, ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). It was established with its headquarters in India but with outposts in various parts of the world and deals as its name implies, with the whole of the semi-arid tropics.

What can you attribute the success of these institutes to? I think it boils down to a few fairly straightforward things. First decide what you want those institutes to do in broad terms, not in detail, and then hire people to do it, and then let them get on and do it. It involves hiring the best scientists, which means that you reward them tolerably well. You don't necessarily overpay them, but they need adequate facilities so the work is not hampered. Don't interrupt that effort unnecessarily because doing good science is not easy. Most of us involved in science know it is not an easy task, and to some extent you need unreasonable people to do it. By unreasonable people what I mean is you need people who are going to be so enthusiastic to the point of stupidity, sometimes working very long hours. I may be exaggerating very slightly but I don't know of anyone who has made his or her mark in science who hasn't from time to time behaved like that. Now, if they are unreasonable people, they also need careful managing because unreasonable people are not easy to manage. So you have to be very careful to provide the atmosphere in which these unreasonable people can work without too much hindrance. It is only then that you can expect to get research of high quality which is really going to have major impact.

At the same time, it is important to decide clearly on priorities so that scientists work on relevant topics and are accountable. But the lesson that I think that we are learning rather late in the day in the CGIAR system is that is it possible to spend too much time on planning and assessment so that scientists are over-burdened with these matters. What isn't fully understood I think by the people who promote all this is that any time a scientist uses
It's not an example which is completely apposite to Mauritius but I think there is a little parable that is worth telling and it goes like this. Publicly funded Agricultural research in UK has now virtually been destroyed. We don't have it anymore except in Universities. The arguments for its demise went roughly like this. The problem about agriculture in Western Europe and particularly UK is over production not under production. So any agricultural research is likely to exacerbate the problems. So we better not have any. We'll turn agricultural institutions over to fundamental biological research. We don't know what the twenty-first century is going to bring, but now we'll have them doing fundamental research because they might find out something which might be useful in the 21st century since we don't know what we will want then anyway. This is the policy that the Agricultural Food & Research Council was required to follow. We no longer have an Agricultural Food and Research Council, we have a Biology & Biotechnology Science Research Council, and this change was an inevitable consequence or the original argument. What was wrong with the basic assumption was that agricultural research is there only to increase production. What farmers want is to increase output per unit of input. They are more interested in efficiency, survival and profit.

Now I don't think you have the same problems in Mauritius but you could quite easily, in a very short time, be in a position of surplus in all sorts of things. But nobody would suggest, that because sugar might be in surplus in the world it therefore means that you stop research on sugar; that would be very silly. Similar arguments apply to other agricultural commodities. Obviously you've got to have a government taking sensible policy decisions if you can have the kind of culture in which agricultural science research is going to flourish. Well I think that as far as the prospects for Mauritius are concerned I'm like your Minister - worriedly optimistic. He was very concerned with developing the dynamic working culture within which all of this can happen. Now some of that depends on the history that Robert Antoine dealt with. I would simply like to add to what he said. There have been some remarkable people in Mauritius who have left behind them an extraordinary basis for the...
further development of science and research in Mauritius. Furthermore Mauritius is aware of this as illustrated very well by Professor Antoine's talk. It is also illustrated very much by the recent book written by Professor Manrakhan, the Vice Chancellor. So it is not as though Mauritius is starting with a clean slate in which the necessary culture for the flourishing of research is a foreign concept. That exists, and the question is how is it to be developed. We need to learn from the lessons of the past and not have to go on re-learning them every time through mistakes. I think Mauritius is in a position to do that and it seems to me that the informal relations between scientists are particularly important in this. I suspect that I've been privileged to be here at the birth of what is going to be an important institution in Mauritius, which will encourage these informal relations: that is this Annual Meeting of Agricultural Scientists of which this is the first. I feel very honoured to have been here at its birth, and, like any relative, I am optimistic about its future.

Thank you very much Mr. Antoine.
SURVIVAL OF THE MAURITIUS SUGAR INDUSTRY - THE ROLE OF R & D

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ABSTRACT
Sugar cane was introduced by the Dutch in 1639. Mahé de Labourdonnais gave a great impetus to the production of sugar on the island and since then the industry has been undergoing a constant process of expansion, modernization and centralization. Today there are only 17 sugar factories which produce around 630 000 tonnes of sugar annually.

The Sugar Industry is now facing the following major problems:
- Loss of cane lands in recent years.
- Scarcity of labour.
- Increases in the cost of production.
- Lower prices for sugar on world and preferential markets.
- Increased awareness of environmental issues.

However, this crop is very well adapted to the growing conditions of Mauritius and efficient organizations have been developed to support the industry. Sugar cane will, therefore, remain one of the major contributors of the Mauritius economy. It must survive and its problems could be solved by:
- Increasing total sugar production at national level.
- Reducing costs of production.
- Maximizing utilization of sugar cane by-products as well as diversifying within sugar.
- Diversifying in other crops.
- Monitoring environmental issues.
- Improving transfer of technology and development.

The role of research, both strategic and applied, in the development of technology to address the above issues is discussed. Advances in technology must not only be communicated to producers but it should also be ensured that they are efficiently adopted. Hence, the use of modern methods of extension, coupled with assistance of research scientists towards the development of new technologies.

To conclude our vision should be:

The Sugar Cane Industry of year 2000 as opposed to The Sugar Industry of 1990s.

INTRODUCTION
Sugar cane was introduced into Mauritius by the Dutch in 1639. The canes were growing well and by 1641 two sugar processing plants were established. However, by 1652 the manufacture of sugar was abandoned but the cultivation of sugarcane was continued for the production of arak.

In the early days of the French occupation of the island, no attention was paid to sugar cane. It was Mahé de Labourdonnais who gave great impetus to the production of sugar and who created the first sugar factories. At the beginning of the XIXth Century, there were 60 to 80 factories producing over 3000 tonnes of sugar (Koenig, 1988). However, since that time, the sugar industry has been undergoing a process of constant expansion, modernization and centralization of factories. Today there are only 17 sugar factories which produce around 630 000 tonnes of sugar annually.
The Sugar Industry is now facing the following major problems (Julien et al, 1994):

- Loss of cane lands in recent years.
- Scarcity of labour.
- Increases in the cost of production.
- Lower prices for sugar on world and preferential markets.
- Increased awareness of environmental issues.

However, sugar cane has remarkable attributes:

- It tolerates cyclonic winds, losses being far less important than in other crops (Julien, 1995).
- It is a C4 plant with a highly efficient mechanism of photosynthesis (Alexander, 1973).
- Thus, it is capable of producing very high levels of dry matter (Alexander, 1973).
- It possesses a diversity of yield components (Paturau, 1989).
- It can be used as a clean and renewable source of energy (Payne, 1991).
- It has a high potential for improvement because of its wide genetic diversity (Stevenson, 1965).
- It is a perennial plant.

Furthermore, advanced technical knowledge exists in Mauritius, both at research and production levels, as well as well-developed supporting structures and recognized institutions for production, insurance, financing and sales (Julien et al, 1994).

Sugar cane is an important crop in the tropics and sub-tropics, and will remain one of the major contributors of the Mauritian economy. The industry must survive and its problems could be solved by:

- Increasing total sugar production at national level.
- Reducing costs of production.
- Maximizing utilization of sugar cane by-products as well as diversifying within sugar.
- Diversifying in other crops.
- Monitoring environmental issues.
- Improving transfer of technology.
- Support to development.

Research has played, for over a century, a major role in maintaining the competitiveness of the sugar industry of Mauritius (Antoine, 1995). The most important achievements in recent years have been reported and have addressed issues primarily related to productivity per unit area and diversification through the cultivation of associated crops (Ricaud, 1991, 1992, 1993, 1994; Julien, 1995). The future role of R & D in achieving the above goals is discussed in this paper.

**INCREASING TOTAL SUGAR PRODUCTION AT THE NATIONAL LEVEL**

Total sugar production at the national level has to be increased in view of quotas of raw sugar which will have to be supplied to the European refiners.

This may be achieved by:

- Increasing sugar production per unit area.
- Rehabilitation of abandoned cane lands (Julien et al, 1994) and extension of plantation in new areas.
- Reducing the yield gap which exists between fields of planters and millers (Julien et al, 1994).
- Improving the efficiency of labour.
- Identifying constraints to mechanization and transport, and proposing solutions.

**Increasing sugar yield per unit area**

The most important areas of research to attain the above goal are:

- Increasing the efficiency of breeding and selection of new cane varieties.
- Improving sugar cane husbandry with particular emphasis on mechanization, ripening and irrigation.
Other areas of research which will also contribute are:

- The efficient use of fertilizers.
- Improved cultural operations and practices.
- Pest and disease control.

**Creation of new cane varieties**

The compilation of large databases have led to a critical analysis of our breeding and selection programme and resulted in an increase in efficiency which has culminated in the release of highly productive, disease-resistant varieties (Domaingue & Ramdoyal, 1989).

The breeding and selection programme will now lay emphasis on developing new varieties with more specific characteristics as follows:

- High sucrose content and adapted to early harvest.
- Suitable for both manual and mechanical harvesting.
- Specifically adapted to drought and high rainfall areas.

Strategic research work along the following lines will contribute to improve breeding and selection:

- Genetics and inheritance studies on characters of agronomic importance, resistance to major diseases and morphological characteristics such as free trashling.
- Genome mapping using the most recent biotechnological techniques.
- Marker assisted selection.

**Crop husbandry**

Research in sugar cane husbandry has led to the development of sound cultural practices which have contributed to increase productivity. Our main objectives will aim at reducing costs of production and adapt present practices to mechanization. The following priority areas have been identified:

- Reduction in the cost of planting material.
- Optimization of cane crop cycles with respect to ratoon decline and food crop production.
- Minimum tillage practice on flat land.
- Improvement of weed control through the use of better and safer chemicals and improvement of spraying techniques.

**Irrigation and drainage**

Various systems of irrigation are in use in Mauritius and research has helped to define the optimum conditions under which sprinkler and drip should work (Soopramanien et al, 1990; Batchelor & Soopramanien, 1993). Further research is warranted in the following fields:

- Efficient use of water in northern and western sectors of the island with respect to the choice of irrigation systems and their economic analysis.
- Research on the efficiency of the Pivot and dragline systems.
- Evaluation of intensive versus extensive irrigation.
- Irrigation scheduling.

Drainage has been identified as a problem mainly in the superhumid areas and will be addressed.

**Mechanization**

Studies on mechanization are on the priority list in order to minimize adverse effects of labour shortage and reduce costs of production. Some of the problems associated with the introduction of mechanization for cane cultivation as well as crops grown in association have been solved (MSIRI, 1992; McIntyre, 1993; MSIRI, 1994). The main areas that remain to be addressed are:

- Soil preparation and mechanical planting.
- Studies to minimize the deleterious effect of mechanical loading and harvesting on yield in humid and superhumid areas.
- Studies to improve the efficiency of transport systems.
- Farm layout and field planning assisted by Geographic Information System (GIS).
- Mechanization for increasing labour efficiency.
**Disease and Pest Control**

The strategy of disease control has been based on the development of disease-resistant varieties, in very rare occasions have chemicals been used (Antoine, 1967). This strategy will be pursued by improving diagnostic tools and through a better understanding of the mechanism and genetics of disease resistance (Doookun, 1995). Biological control has always been adopted for pests in Mauritius and this strategy will be maintained (Rajabalee, 1990). Work on the biology and control of the following important pests will be pursued:

- Regular monitoring for extent of infestation and degree of parasitism of cane borers (e.g. *Chilo sacchariphagus*, *Sesamia calamistis*), scale insects (e.g. *Aulacaspis tegalensis*, *Pulvinaria iceryi*) and army worms.
- Biological studies on army worms (e.g. *Mythimna* sp, *Simplicia pannalis*).

**Biometrical studies**

Biometrical studies will assist in the analysis of some of the most important projects, namely:

- Yield forecasting.
- Shortening of the selection cycle.
- Improvement of the mechanization database (Mecabase).
- Development of other specific databases.

**Sugar milling and processing**

The role of R & D can be summarized as follows:

1. Trouble shooting.
2. Monitoring the quality and accuracy of analysis performed by various organizations.
3. Pollution control.

The actual development of new machinery is considered as not justifiable as it is always possible to resort to a transfer of technology. However, an update of developments taking place on a world-wide basis in this field is considered vital.

There has been a serious deterioration in the quality of raw material, which now includes large amounts of soil, rocks, trash and unripe cane, being sent to our factories in the last decade, as a result of shortage of labour and the introduction of mechanization. Consequently, the effect of quality of raw material on mill efficiency, processing and mode of payment will be investigated.

The following subjects are also considered to be of importance:

- Elucidation of the problem of reduced overall recovery.
- Variation of crystal size with respect to exhaustion.
- Automation to improve the control of processes.
- Increase in the efficiency of processing to reduce major losses at the level of clarifiers, evaporators and boilers.
- Efficiency of alternators so as to maximize energy from surplus power.

**Rehabilitation of abandoned cane lands**

There has been a rapid decrease of the order of 400 ha/year in the area of land under cane cultivation in recent years (Julien et al., 1994). This issue will be addressed by performing surveys based on rapid appraisal techniques to identify the major reasons and discuss remedial actions with planters.

The Land Index database and GIS techniques will be used for the planning and field layout of Land Area Management Units (LAMU’s) during the process of rehabilitation (Jhoty, 1995).

**Yield gap between planters and millers**

Preliminary studies have shown that the yield of planters is lower than that of millers by about 10 to 30 tonnes of cane per hectare (Julien et al., 1994). Global production would be increased if that yield gap could be reduced. Consequently, it is proposed to conduct a global analysis at level of each factory
area to establish its evolution in time and variation among planter groups. Investigations will also be conducted to identify the various factors responsible for this yield gap.

**Improving labour efficiency**

Mechanization has and will solve to some extent the problems of scarcity of labour in the sugar industry (MSIRI, 1992). However, it cannot be introduced under all conditions. The major constraints being slopes, field layout, rockiness of soils, very wet conditions during cultural operations. Consequently, if the performance of labour could be improved, it would alleviate the problem of scarcity of labour. This would also contribute to a reduction of costs of production through increased efficiency during field operations as well as at factory level, where losses due to supply of cane would be minimized.

Studies along the following lines will be conducted:

- Ergonomics.
- Physical condition and nutrition with respect to labour output.
- Socio-economic factors which would incite greater performance.
- Partial mechanization to increase efficiency of labour.

**Environmental studies**

Multiple means are identified for core research programmes to maximize productivity in the sugar industry. Among these, compilation and exploitation of relevant databases through statistical and spatial analyses are vital for identifying the land, management and socio-economic constraints affecting productivity (Julien et al., 1984). The databases, agronomic and topographical, integrated in a computerized system, i.e. geographical information system for cane lands (GISCANE), are a necessary supporting tool for carrying out these land/crop related research studies (Jhoty, 1995).

The main objectives are:

- To identify land, management and socio-economic constraints affecting productivity through statistical and geographical analyses.
- To produce visual aids or map documents to improve the understanding of the inter-relationship of land, climate and crop when recommendations are made for crops and fertilizers.
- To assist modelling for yield forecasting.

**Reduction of costs of production**

The rate of increase of cost of production has been considerable in recent years and is mainly due to high labour cost and the increase in price of agrochemicals as well as electricity and water (Julien et al., 1994).

The more important issues which have to be studied to reduce costs of production are:

- The optimal use of inputs such as fertilizers, herbicides, seeds, etc.
- Economic analysis to evaluate the best technology in the field of crop husbandry, e.g. irrigation systems.
- Economic analysis of units of production with priority to mechanization.
- Economic studies of length of cane crop cycles.
- Improving management techniques for different planter groups.

**DIVERSIFICATION WITHIN SUGAR**

The major objective of diversifying within sugar is to make maximum economic use of the diversity of yield components of sugar cane (cane tops and trash and by-products of processing). This includes maximum use of by-products and the production of derivatives of high value.
The use of bagasse for generation of electricity

Generation of electricity from bagasse (which is a renewable clean source of energy) will become more and more important in years to come. The following studies will contribute towards higher production and more efficient use of this by-product:

- Steam balance of factories to identify energy saving prospects.
- Storage and handling of bagasse.
- Reduction in the volume of bagasse to reduce transport costs.
- Breeding for high fibre varieties.

Sucrochemistry

The technologies for deriving chemicals from sugar cane or its by-products have been well researched and their potential utilization assessed (Paturau, 1989). Numerous products can be derived from cane juice, molasses and bagasse. However, production of other chemicals are market oriented. No specific research appears to be warranted in Mauritius. In the event that a product is identified, there would be a need for a transfer of technology with some degree of adaptation. Products which could become important are citric, lactic and oxalic acids.

The following other uses of by-products are worth mentioning:

- Utilization of by-products for animal feed is gaining importance and will require some R & D inputs. MSIRI would be willing to undertake this in collaboration with Ministry of Agriculture and University of Mauritius.
- Canning and preservation of cane juice.
- Production of producer and methane gas.
- Improving efficiency of production of alcohol from molasses.
- Use of vinasse and scums as sources of fertilizers.

Organic sugar

There is nowadays a market demand for organic sugar. However, yields are low. Consequently, experimental work for increasing yield of fields earmarked for organic sugar production so as to ensure its economic viability will be initiated.

CROP DIVERSIFICATION

Growing food crops in association with sugar cane has been adopted to maximize production of these crops for self-sufficiency (Wiehe et al., 1984). The crop can be grown on rotational land between two cane cycles or in its interrows. A number of factors will influence the choice of the crop, e.g. length of cycle, climatic adaptation, competition, etc.

Potato, maize, groundnuts, beans and tomatoes have been shown to be suitable crops for growing in interrows or on rotational land. Govinden (1995) has shown that our priorities at present should be potatoes, tomatoes and maize to be used as a vegetable.

Research inputs for maize will be reduced as a result of economic factors; however, the development of varieties for Rodrigues will continue as well as selection of green cobs and sweet corn varieties, and technology of seed production.

The projects for improving the quality and production of tomatoes will be pursued as follows:

- Selection for cultivars for different production systems.
- Improvement in fruit quality.
- Improvement in cultural practices.
- Seed production.
- Disease and pest management.
- Post-harvest technology.
In order to extend the planting season of potatoes and thus reduce the time of storage, there is a need for varieties that are tolerant to heat and bacterial wilt, which is particularly important in summer.

The main research priorities for that crop are:
- Breeding for better adaptation and disease resistance.
- Improvement in seed quality.
- Mechanization of cultural operations.
- Seed production and management.
- Irrigation.
- Disease and pest management.
- Post-harvest technology.

**MONITORING ENVIRONMENTAL ISSUES**

Environmental issues are priorities at world-wide level; consequently, R & D will aim at evaluating the impact of cane cultivation, milling and processing on the environment (Ricaud *et al.*, 1993). Preliminary studies have characterized factory wastes and shown that further studies are warranted on the fate of agrochemicals.

The major fields of study which will be pursued are:
- The persistence and leaching of pesticides commonly used in sugar cane fields.
- The degradation of agro-chemicals in soils and their movement into surface and ground waters.
- The effects of mechanization on soil conservation with the rapid development of that practice.
- Erodibility and erosion of soils in cane fields.
- Monitoring and treatment of waste from sugar factories.

**TRANSFER OF TECHNOLOGY**

Research findings have only value if they lead directly or indirectly to an advancement in technology which then must be adopted by producers. MSIRI is directly responsible for extension to medium (10 - 40 ha), large and miller planters. Extension for smaller planters (about 35 000 who own about 65 000 plots of less than 10 ha and average 0.8 ha) is conducted by the Farmers Service Corporation. In order to ensure that new developments are adopted by this last group, MSIRI work in close collaboration with Farmers Service Centres and Directorate of Agricultural Research and Extension officers as well as with Sugar Estates Planters’ Advisers.

With the use of improved extension methods and modern communication techniques, the linkage between MSIRI researchers and all categories of producers will be strengthened.

The plan of action includes:
- Visits, Meetings, Field days and open-days, etc.
- On-farm trials and field demonstrations.
- Publications (Recommendation sheets, booklets, etc).
- Video films.
- Creation of a data bank for direct access to information.
- Organization of local and international seminars.

The evaluation of the different methods used for transfer of technology to producers is also of importance.
DEVELOPMENT

The mandate of a research organization should also include support to the development of new technologies. This, in association with efficient extension, will contribute to the successful implementation of advanced technologies.

A few examples, already undertaken by MSIRI, are cited below:

− The organization, monitoring and control of application of ripeners by aircrafts.
− The implementation and control of cane nurseries (Anon, 1991).
− The use of GIS technology for locating the best position of a centre pivot and also as an aid to field layout and farm planning (Jhoty et al, 1994).
− The production of maize (Rughoo et al, 1990) and seed potato (Autrey et al, 1991).

New projects will include:

− The preparation of an irrigation suitability map
− An economic analysis of industrial field data to determine optimum cane cycles and the ratio of long to short season.
− An economic evaluation of various development projects.

CONCLUSION

In order to save the industry, our vision should be ‘The Sugar Cane Industry of year 2000 as opposed to The Sugar Industry of 1990s’.

The role of R & D in attaining this vision is crucial.

REFERENCES


RESEARCH AND DEVELOPMENT IN RELATION TO THE LONG-TERM PROSPECTS OF DIVERSIFICATION CROPS IN MSIRI'S MANDATE

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ABSTRACT

It has become necessary to conduct a mid-term review of MSIRI's 1993-1998 Research and Development (R & D) programme in order to take into consideration the rapid changes in the economy and the new agricultural diversification policy decided at the end of 1994 and to align it with the findings and recommendations of the National Long-Term Perspective Study also presented in 1994.

For each of MSIRI's 5 mandate food crops, viz maize, potato, groundnut, bean and tomato, this paper first describes the current situation and competitiveness of local production and the expected evolution of the demand to the year 2020. Then, it analyses the future prospects in the light of the improvement in yield and the reduction in cost of production that can realistically be achieved, of the resultant changes in competitiveness and in financial attractiveness to growers and of the availability of the three most limiting production factors, viz land, labour and water. Then, it proposes appropriate production policies and desirable levels of involvement with R & D. Finally, it defines priorities of R & D in relation to the proposed production policies and the availability of funds and personnel. The special needs of Rodrigues are also considered. In view of the unavoidable competition with sugar cane for R & D resources, MSIRI's policy is to concentrate efforts on a few good options. Thus, involvement with vegetables (potato, tomato, vegetable corn, fresh groundnut and green bean) whose prospects are good will be maintained or increased while involvement with pulse and grain crops (dry maize, dry groundnut and dry bean) whose prospects are poor will be reduced or minimized.

INTRODUCTION

The Mauritius Sugar Industry Research Institute (MSIRI) has been entrusted with the national mandate for research and development (R & D) on maize, potato, groundnut, bean and tomato in addition to sugar cane. Its current 1993-1998 R & D programme was finalized in 1993 following consultations with all stake holders (MSIRI, 1994). Since then, there have been rapid and profound changes in the economy and other spheres of society which have much impact on agriculture. In particular, a new agricultural diversification policy has been defined (Anon, 1995) and a national long-term perspective study (NLTPS) has been completed (Anon, 1994 a). It has therefore become necessary to review the R & D programme and to align it with the new agricultural diversification policy and with the recommendations of the NLTPS.

This paper describes and explains in a stepwise fashion the changes that have been made to the R & D programme. For each of MSIRI's five mandate crops, the paper first describes the current situation regarding local production and the country's competitive position. Use is made of the NLTPS to estimate future demands to the year 2020. Future prospects are next analysed in the light of improvement in yield and reduction in cost of production that can realistically be achieved, of the possibility for local production to compete with imports and of the likelihood that financial returns to growers will be attractive enough for them to use their scarce resources, especially land, labour and water to grow these crops. The prospects in turn dictate the level of production that should be encouraged and consequently, the extent to which the Institute should be involved with R & D on the crops. Since financial and human resources for R & D are limited, the paper also broadly defines priorities, but it does not attempt to propose a complete R & D agenda. This can only come after the proposals have been thoroughly discussed and a consensus has been reached among all the stake holders.
MAIZE

The production of maize grain has decreased dramatically since 1986. The main reason for this decrease is that the crop is no longer attractive to potential growers because the profit margin is too low (Table 1). The guaranteed price has not been raised while the cost of production, especially that of labour has increased. The area under maize is too small for growers to benefit from economies of scale, particularly in the use of machinery. Although yield has improved with the advent of better hybrids, the increase has not been sufficient to compensate for the increase in cost of production.

Although the demand for maize grain is expected to increase by about 40% from about 35,000 t in 1993 to about 47,000 t in 2020 (Anon, 1994 a), the future prospects are considered to be very poor for several reasons:

(i) Since the price of imported maize is much lower than that of the current guaranteed price, local production is of little benefit to the country and an increase in the guaranteed price is not justified.
(ii) There is limited scope for improving yield further. This is because maize has to be grown before or after the summer in order to minimize the risks of losses due to cyclones. At such times, the climate is not conducive to high yields and the crop has to be irrigated. Better use can undoubtedly be found for the available land and water.
(iii) The scope for reducing cost of production is also limited. Some reduction in labour cost through mechanical harvesting is possible in pure stands but not in interrows of sugar cane. Moreover, most of the land that is available for pure stand production is under sugar cane. Although maize can be grown in rotation with sugar cane this entails sacrificing a sugar cane harvest, but the returns from the maize is barely sufficient to offset the loss of revenue from the cane (Anon, 1994 b).

The prospects for vegetable corn, either green cobs of field maize or sweet corn are better. The gross margins are higher because the selling price is much higher and the production cost is slightly lower (Table 1). However, the market is presently quite small and it can easily be saturated at certain times. With the advent of sweet corn, the demand is expected to increase, such that the production of vegetable corn all year round becomes worthwhile even if it is on a small scale.

The situation is different in Rodrigues where maize is currently the most important crop. Production of maize grain is also declining as some producers turn to more profitable crops and others abandon agriculture altogether (Anon, 1992). Nevertheless, maize grain production is expected to continue, albeit at a lower level, for two main reasons. Firstly, most growers in Rodrigues produce maize as a sideline activity to supplement family income; in the absence of irrigation, there is little else that they can substitute for maize as a rainfed crop. Secondly, in contrast to Mauritians, most Rodriguans consume maize grain and some in fact prefer it to rice.

In view of the very poor prospects for maize grain in Mauritius it makes sense to stop producing it and to use the land, labour and water resources for other crops. Research and development on maize for grain is therefore not warranted except for some support to Rodrigues. One worthwhile project would be to improve the drought tolerance of the maize variety grown in Rodrigues. Since the prospects for vegetable corn is better, some minimum R & D should be devoted to the crop as a function of its current value and potential. The NLTPS has estimated the future annual demand at 10,000 t, which is equivalent to less than 1 cob per person per week (Anon, 1994 a). This conservative demand represents a potential market value of R 100 million. Thus, R & D expenditure of up to about 0.7 million annually may be justified. The R & D priorities on vegetable corn are to develop the varieties and to refine production techniques to ensure that at least the market of 10,000 t is satisfied. At this level of production, the seed requirement may be too low to warrant the organization of a hybrid seed production scheme, and consequently, emphasis in variety development should be shifted from hybrids to open-pollinated varieties.

POTATO

Since 1982 when the country first became self-sufficient in potato, production has stagnated until 1987, then regressed slightly until 1991 but it has started picking up again since then. This shows that it has not been
possible with the quota system in place since 1980 to match production to demand, undoubtedly because our potato yield is still very variable. Currently, the average grower may expect a gross margin of about R 50,000/ha (Table 1), which makes potato production a very profitable enterprise. The consumer price of R 3/kg is high by world standards and this limits the demand. Without the subsidies, local production would barely be able to compete with imports. This shows that much improvement is necessary if the country is to produce the totality of the 40,500 t per year that would be required by year 2020 (Anon, 1994 a).

Prospects are good since production can be increased, yield can be improved and costs of production can be reduced. Part of the required increase in production may come from an improvement in yield but another part will have to come from an extension in the area under cultivation. Govinden and Ramasamy (1994) have estimated that on miller-planters cane lands alone, there is a potential for producing about 31,000 t. More area can be found on large and small planters cane lands. The current average yield of about 22 t/ha is satisfactory given that only a small part of the crop is irrigated. With irrigation, yield and production can increase appreciably. The varieties that are grown have all been developed for temperate climates and there is no doubt that local varieties adapted to our climate should be better. Yield is variable, not only because of external factors such as drought or excess rainfall but also because many producers, including some of the large ones have not yet mastered production techniques. The gap between actual and achievable yields will have to be narrowed. Cost of production is excessive mainly because of high seed and labour costs and heavy reliance on pesticides for the control of pests and diseases. Even now each of these can be reduced to some extent and there are prospects for further reductions in the future.

Three factors explain why potato production should be developed to the limit. Firstly, the domestic market is good and is expected to increase further. Secondly, the quality of local potato is better than that of imported ones. Thirdly, the crop is financially attractive. However, unless appropriate research and development is undertaken it may not always be so as cost of production keeps on increasing. The prospects dictate that sufficient R & D efforts be maintained in order to improve yield and reduce cost of production.

The potato ware and seed industries currently are worth about R 140 million annually, and a further potential market of about R 80 million exists. Thus, if 1% of the current market value and 0.5% of the potential market value were to be spent on R & D, a total expenditure of R 1.8 million would be justified. Research priorities include the development of a range of varieties with superior yield and better resistance to diseases and pests and more effective control of pests and diseases. Apart from research per se, it is also necessary to expand seed production to meet all of our requirements and to develop irrigation and mechanization. In addition, more attention should be paid to extension in order to encourage new producers, in particular large growers and to narrow the gap between actual and achievable yields. Pending the selection of a variety truly resistant to bacterial wilt, potato can only be planted in Rodrigues in the coolest part of the year in June and July. Irrigation is then essential for a good crop.

GROUNDNUT

The production of groundnut has been decreasing steadily since 1990. Most of the current production is sold as the fresh nut and very little as the dry nut. As for maize, the main reason behind this disinterest is that the revenue from groundnut, especially dry groundnut, is too low (Table 1). Since the fresh nuts cannot be imported and the price of the local produce is relatively high, consumers have responded by reducing their demand. The price of the dry nut is also so high that the agro-industries prefer to import at cheaper prices. In future they may have to import even more in order to meet the expected normal increase in demand.

The prospects for producing dry groundnut locally are poor for several reasons. Firstly, the soil and climate of Mauritius are not ideal for the crop; where there is sufficient rain, as on the Central Plateau, the soils are acidic to very acidic and the weather is somewhat too cool during part of the year; where the weather is warmer, as in the West and North, much of the soil is rocky to very rocky, rainfall is insufficient and whatever irrigation is available goes to more remunerative crops. Secondly, in the summer when rainfall is adequate, the incidence of diseases is very high. New varieties with excellent resistance to diseases have been selected but they all belong to botanical types that are not acceptable to local consumers. The latter demand Spanish-type varieties, and
none with adequate resistance to leaf diseases has been found to date. One Virginia-type variety with resistance
to leaf diseases and having excellent export quality nuts has been released, but it is still not grown.

Thirdly, the need to dry the nuts increases the production cost. In many groundnut-producing countries, the
plants are uprooted and the nuts are allowed to dry in the field. This is not possible in Mauritius because of the
risk of showers and consequently, of the development of rot organisms. Fourthly, it is not possible at present to
envisage the mechanization of harvesting because the soils are not suitable, being too heavy or too rocky or
both. It seems advisable, therefore, to abandon the production of dry groundnut and to concentrate on the
production of the fresh nuts to satisfy the domestic market.

The demand for fresh groundnut is expected to increase to about 4 500 t by year 2020 (Anon, 1994 a) and the
market value of such a crop would amount to about R 66 million at today's prices. Thus, there is some
justification in spending up to about R 0.65 million on research and development. The first priority in R & D is
to select a Spanish-type variety with resistance to leaf diseases and having acceptable nut quality. Once this is
found, some attention could be turned to selecting varieties with drought tolerance or with tolerance to soil
acidity.

**BEAN**

The bean situation is even worse than that of groundnut. Dry bean production has never taken off, essentially
because growers do not make a profit out of it (Table 1). The little that is produced is in fact left over from
green bean production. Even green bean production has regressed since 1988 when the country was exporting
to the point where now, the domestic market is not satisfied for part of the year.

In spite of the growing demand for dry bean, the prospects are very poor for several reasons. There is little hope
of competing with imports and of making dry bean production financially attractive to growers. Although the
average yield is not bad, it is still not good enough. Superior varieties have been selected, but to date, it has not
been possible to produce seeds of acceptable quality in sufficient quantities mainly because of diseases. The
cost of production is much too high mainly because of the high cost of labour and of disease control. It may be
possible to reduce the cost of production by mechanizing certain operations such as planting, pesticide
application and threshing, but these measures may not be sufficient. Thus, it seems preferable to give up dry
bean production and to concentrate on green bean whose prospects are superior. The prospects for green bean
are superior because, on one hand the demand is large and increasing and, on the other, the market price is good
for most of the time. Indeed, the domestic demand is not always satisfied causing the price to be sometimes
exaggerated.

The yield of green bean is satisfactory but the quality is not always so. New varieties of snap beans have been
identified but they have not been released yet because of a major problem with the production of seeds. The
cost of production is also excessive because of the labour required for harvesting and of the high cost of disease
and pest control. Not much reduction can be achieved in the near future in these 2 items of the cost of
production.

Major R & D efforts are therefore required. The priorities of R & D would be to select appropriate snap bean
varieties, to work out seed production and to control diseases and pests more effectively and at a lower cost. A
case can be made for seed producers to support the research on seed production in one way or another.

Both green and dry beans are also interesting crops for Rodrigues. A small amount of dry bean is currently
exported to Mauritius. But the research needs have not been clearly established.

**TOMATO**

Tomato is the second most important vegetable in Mauritius after potato. The 10 000 t that are produced
annually are worth about R 100 million. Although fresh tomato is not imported, the country cannot be said to be
self-sufficient because quite a large amount of processed tomato is imported in the form of paste, purée and
juice. Moreover, seasonal production is very variable since the crop is very susceptible to heavy rains and
strong winds. After each cyclone, tomato disappears from the market for up to 2 months. At other times, there may be gluts leading to very low prices. In spite of these risks, the crop is remunerative to growers (Table 1).

Prospects for fresh tomato are good. The demand is high and increasing. Yields are low, but they can certainly be improved. The cost of production is high, but there are possibilities for reducing it. However, even these improvements are unlikely to bring down the cost to the point where a competitive processing industry based on the local produce can be developed. Consequently, our aim should be to produce all of the fresh tomato we require and to stabilize production and prices. This represents quite a challenge for R & D. In order to improve yield, it is necessary to pursue the selection of varieties of both cooking and salad types. Particular emphasis in the selection programme should be paid to resistance to major diseases and to tolerance to heat and perhaps also to tolerance to heavy rain. Yield could be increased considerably if more of the tomato fields were to be irrigated. More attention should also be paid to extension given that on many growers’ fields pests and diseases are not always controlled effectively inspite of the heavy use of pesticides. The most effective way to reduce cost of production is to mechanize as many cultural practices as possible. It is only now that a few large growers have started producing the crop that mechanization has started to receive attention.

The reduction of risks should also be investigated. The cool storage of green tomato for use after cyclones should be explored. Another possibility worth investigating is the conservation by cool storage or otherwise of seedlings for transplanting immediately after a cyclone. A third possibility would be to design cyclone-proof structures in which appropriate methods would be used to maximize the yield of salad tomato.

CONCLUSION

Financial and human resources for R & D are limited. Consequently, food crops have to compete with sugar cane for them, and in this competition, food crops have always been on the losing end. This is essentially because sugar cane is more attractive, less risky and less demanding to growers. However, the situation is changing in the aftermath of the GATT agreements. The country can afford to import some but not all of its food crops. In particular, the importation of fresh vegetables is not envisageable given their perishable nature. Moreover, the prospects for fresh vegetables are generally good. For these reasons, MSIRI has revised its R & D policy concerning its mandate crops. With regards to grain crops (dry maize, dry bean, dry groundnut) whose prospects are poor to very poor, it proposes to limit or curtail its involvement in order to devote more attention to vegetable crops (potato, tomato, green bean) whose prospects are higher. It also proposes to reinforce its extension efforts directed at medium and large growers who have not to date been enthusiastic about producing food crops on their cane lands.

REFERENCES


Table 1. Estimated cost of production and gross margin of selected crops per season

<table>
<thead>
<tr>
<th>Crop</th>
<th>Cost of production (MUR / ha x 10³)</th>
<th>Gross Revenue</th>
<th>Gross Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maize</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry</td>
<td>21</td>
<td>26</td>
<td>5</td>
</tr>
<tr>
<td>Green</td>
<td>20</td>
<td>54</td>
<td>34</td>
</tr>
<tr>
<td><strong>Potato</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh</td>
<td>53</td>
<td>103</td>
<td>50</td>
</tr>
<tr>
<td><strong>Groundnut</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry</td>
<td>14</td>
<td>26</td>
<td>12</td>
</tr>
<tr>
<td>Fresh</td>
<td>13</td>
<td>30</td>
<td>17</td>
</tr>
<tr>
<td><strong>Bean</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry</td>
<td>30</td>
<td>23</td>
<td>(-7)</td>
</tr>
<tr>
<td>Green</td>
<td>25</td>
<td>56</td>
<td>31</td>
</tr>
<tr>
<td><strong>Tomato</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooking</td>
<td>59</td>
<td>120</td>
<td>61</td>
</tr>
<tr>
<td>Salad</td>
<td>70</td>
<td>330</td>
<td>260</td>
</tr>
<tr>
<td><strong>Sugar cane</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One year</td>
<td>26</td>
<td>55</td>
<td>29</td>
</tr>
</tbody>
</table>

Source: J.A. Tonta (1995) : Personal communication
ABSTRACT

Biotechnology projects have been initiated at the Mauritius Sugar Industry Research Institute in 1986. Tissue culture was adopted for the rapid micropropagation of potato and extended to sugar cane in 1991. Presently, the technique is being applied for the bulking of newly released varieties free from diseases for the planting community. Tissue culture also forms the basis for more advanced techniques such as genetic transformation. The introduction of the bar gene which imparts resistance to the herbicide Basta using the Biolistic particle delivery system in embryogenic calli of sugar cane has recently been initiated as a model system. The search for molecular markers associated with two major fungal diseases of sugar cane namely, rust (Puccinia melanocephala) and yellow spot (Mycovelloisiella koepkei) using random amplified polymorphic DNA (RAPD) is in progress along with collaborative projects on the genome mapping of sugar cane. Monoclonal antibodies and nucleic acid technologies have been applied to the gumming disease pathogen Xanthomonas campestris pv vasculorum to study variation. Race 1 of the bacterium has been shown to be distinct from races 2 and 3 by both methods. The same techniques are being extended to leaf scald (Xanthomonas albilineans) to distinguish between the African and Mascarene serotypes that occur in Mauritius. Furthermore, the polymerase chain reaction (PCR) is being used for the detection of latent infection by Pseudomonas solanacearum in potato tubers. Using restriction fragment length polymorphism (RFLP) analysis, variation has been found to exist in this pathogen isolated from various hosts.

INTRODUCTION

Biotechnology is a multidisciplinary technology that has led to advances in crop improvement. It has provided techniques for the micropropagation of plants, genetic transformation, diagnostic tools for identification and strain differentiation as well as for studying the plant genome. At the Mauritius Sugar Industry Research Institute (MSIRI), several of these techniques are being applied to sugar cane and potato. Since 1986, various projects have been initiated and they can be subdivided into three main themes: tissue culture, disease diagnosis and sugar cane improvement. The main objectives are rapid micropropagation of new varieties, germplasm conservation through tissue culture and cryopreservation, genetic transformation, development of new diagnostic tools for disease identification, clean seed production and quarantine and identification of molecular markers for disease resistance in sugar cane.

TISSUE CULTURE

Tissue culture for rapid micropropagation has been adopted for sugar cane and potato. For the latter, varieties are first cleaned from viruses (potato virus X (PVX), potato virus Y (PVY) and potato leaf roll virus (PLRV)) and bacterial wilt (Pseudomonas solanacearum). Plantlets are established from either bud or meristem culture and multiplied by single node cuttings. Rooted plantlets are transferred singly into pots in an air-conditioned glasshouse for 3-4 months for the production of mini tubers. These tubers, each weighing about 1-2 g are treated to breakdown dormancy and are further bulked in a screen house to produce normal size tubers. All plantlets are indexed by the ELISA technique (Clark and Adams, 1977) for PVX, PVY, PLRV potato virus A, potato virus M and potato virus S, and all infected batches are destroyed.
Emphasis is also being put on the in vitro micropropagation of sugar cane. Axillary buds were used at the beginning to initiate plantlets, but owing to a high level of contamination, meristem tip and apical buds are now preferred for culture initiation. Established plantlets are transferred to either liquid (both shake and static cultures) or solid medium at 25 °C under a photoperiod of 12 h light and 12 h darkness to allow shoot proliferation (Anon, 1992). Within 3-4 weeks, depending on the variety, a cluster of 10-15 plantlets is obtained. The cluster is split and allowed to further proliferate. For sugar cane, plantlets are sub-cultured 6-7 times before rooting and transferred to the glasshouse. After four weeks, plants are placed in the open under reduced light and finally transferred to a well prepared field at the rate of 16,000 plantlets per hectare. Adequate water supply during the early stage of transplantation both in the glasshouse and in the field has been found to be essential for plantlet establishment (Anon, 1993). To-date, three commercial varieties, M 695/69, M 1658/78 and M 52/78 have been multiplied in vitro and evaluated in the field. Plantlets of these varieties have been found to perform equally well as 3-eye cuttings and no difference in morphology, agronomic characteristic (except for higher tillering in plant cane of tissue culture derived plants that disappear in ratoon) or disease resistance has been observed. The main benefits of in vitro multiplication are in the rapid bulking of newly released clones and production of clean material for nurseries. Other advantages include the elimination of diseases from infected material, no requirement for hot water treatment of cuttings, conservation of varieties in vitro, and cryopreservation of varieties.

**DISEASE DIAGNOSIS**

An immediate application of Biotechnology has been in the development of diagnostic tools for a more sensitive detection of pathogens as well as in providing techniques to study variation. New techniques have become available for the specific identification, characterization and detection of pathogens. These include serological techniques such as monoclonal antibodies, DNA probe, enzymatic amplification of DNA by polymerase chain reaction (PCR). Monoclonal antibodies and DNA probes have been produced for the diagnosis and race differentiation of Xanthomonas campestris pv vasculorum, causal agent of gumming disease of sugar cane. Race 1 of the bacterium has been shown to be distinct from races 2 and 3 by both methods (Saumtally and Autrey, 1990; Dookun, 1993). DNA probes were obtained by the technique of genomic subtraction (Cook and Sequeira, 1991) and was applied in restriction fragment length polymorphism (RFLP) analysis (Saumtally and Autrey, 1990). For leaf scald disease of sugar cane, Xanthomonas albilineans, the same technology is being applied for obtaining probes specific to the two serotypes, Mascarene and African, that exist in Mauritius.

For potato bacterial wilt pathogen, Pseudomonas solanacearum, the PCR technique using specific primers (Seal et al, 1993) is being applied for the detection of latent infection in tubers. As this pathogen is both seed and soil borne, it is important to detect the pathogen in both environments. Detection in the soil by PCR is difficult because of the presence of inhibitors that interfere with the reaction. An immuno-capture PCR method consisting of serological test followed by PCR is being investigated. Studies by RFLP analysis from various hosts have indicated variability in the pathogens from potato, anthurium and tomato (Anon, 1993).

These diagnostic tools will have important implications for the safe movement of germplasm from country to country as well as in epidemiological studies for the characterization of variants and hence would provide an improved strategy for controlling pathogens.

**SUGAR CANE IMPROVEMENT**

Mid and long term projects on sugar cane improvements were started in 1994. One of the objectives is to identify molecular markers associated with disease resistance. Two important fungal diseases, rust (Puccinia melanocephala) and yellow spot (Mycovellosiella koepkei) are being used as models. After screening the progenies issuing from bi-parental crosses to these two diseases, the genetic profile of progenies showing high susceptibility and high resistance to the diseases are being compared by random amplified polymorphic DNA (RAPD) against parental genome. The identification of molecular markers would help in the selection of clones with desirable traits and speed up the selection programme. Along the same line, a collaborative project with the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD),
Montpellier, France is in progress to identify molecular markers linked to various agronomic traits in released varieties. MSIRI also forms part of an International Consortium of Sugar cane Biotechnology and has links with various institutions such as the Californian Institute of Biological Research, Texas A & M University, University of Cornell and the Brigham Young University in the USA to characterize the genome of sugar cane.

The application of genetic transformation for the introduction of genes of interest is also being investigated using the biolistic particle delivery system (Kikkert, 1993). This approach has been shown to be successful for the transformation of gramineae. The parameters for the introduction of the gus and bar genes in sugar cane calli of varieties M 3035/66 are being worked out.

CONCLUSION

Biotechnology at MSIRI was initiated for the in-vitro propagation of potato and sugar cane varieties and for the development of more sensitive and precise diagnostic tools. These objectives were attained and it was felt necessary to apply the molecular techniques to sugar cane. It is envisaged that the use of marker assisted selection will allow screening of genotypes and improve the speed and efficiency of selection in the sugar cane breeding programme. Biotechnology requires high inputs in the way of equipment, training and financial resources but it is essential to pursue research in this field owing to the potential benefit that can eventually be obtained through this technology. In order to build a strong research base, it is essential to collaborate with foreign and local institutions with similar interests.

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GEOGRAPHICAL INFORMATION SYSTEM AND RELATED INFORMATION TECHNOLOGY FOR THE MANAGEMENT OF SUGAR CANE LANDS

I Jhoty

Scientific Officer, MSIRI

ABSTRACT

Based on the use of Geographical Information System (GIS), an information system for the management of sugar cane lands called GISCANE is described. Results obtained have established the positive contribution of GIS, and allied techniques of information technology have been identified to provide input data as well as support to land planning exercises.

INTRODUCTION

The management of sugar cane lands requires for compilation and analysis a vast amount of relevant data on edaphic, climatic and crop characteristics.

The aim is to increase productivity. Thus, in 1977 at the Mauritius Sugar Industry Research Institute (MSIRI), a computerized database known as Land Index Database (LID) was compiled to contain an array of attribute data on land, climate and agronomic characteristics pertaining to each cane field. Initiated for cane lands of sugar estates, the LID has been extended to cover also lands of large and small planters.

The LID has been utilized and has produced valuable information especially on cane yield disparities from region to region and according to lands belonging to different categories of planters.

To enhance capabilities of analysis and to display cane fields with related attribute data, a Geographical Information System (GIS) software was acquired. With the combined use of this GIS tool of information technology and the LID, has stemmed a computer-based system named GISCANE for the management of sugar cane lands.

GIS CAPABILITIES

The GIS by definition is a computer-based system that makes use of hardware, software and peripherals (digitizers, plotters/printers, etc) to capture, store, retrieve, manipulate, analyze and display all forms of geographical (referenced) data.

The power of GIS lies in its capability to overlay, query and display different data layers, provide help to discern the spatial interrelationships of land features to one another and relate these to their sets of attribute data. As such, GIS simulation and visual products are effective and powerful means of communicating information to users and decision-makers.
GISCANE

The different data sets in GISCANE are shown in Figure 1.

![Figure 1. Data Flow in GISCANE](image)

The components of hardware, software and peripherals are as follows:

(i) hardware - 1 PC 586, 2 PCs 486 & 1 PC 386
(ii) software - 3 PC-ARC/INFO, 2 ArcView, 1 PC TIN, 1 UNIGIS & 1 DEMIURGE
(iii) peripherals - 1 ink jet printer, 1 Epson printer, 2 digitizers & 1 HP plotter A1 size

The immediate task confronting GISCANE is compiling the digital cartographic database (DCD) of cane fields to match with the Land Index Database (LID). This is a formidable task and will take some time before it is completed.

However, progress has been made and from what has been compiled in the DCD and its linking with the LID, some GIS analyses have been done. Examples of derived products of GISCANE are:

(i) simple coloured field map with soil distribution
(ii) simple coloured field map with slope distribution
(iii) simple coloured field map with variety distribution
(iv) complex coloured field map with rainfall isohyets, variety and yield distribution, etc.
(v) coloured field maps showing food crop suitability for potato/maize/groundnut according to growing seasons.

Information on these themes are obviously important for many purposes. Questions may be asked on:

Has there been the right choice of variety in the area according to soil type, altitude and rainfall?
Is yield affected by slope or any other factor?
What is the extent of land that is mechanizable?
Where should food crops be grown for greater success?
What measures should be taken to increase or sustain yield?
Visualizing the spatial distribution of these themes accentuates the awareness and understanding of the interrelationships of the different factors of the environment and the crop. This in turn helps in decision-taking for adopting actions that will enhance productivity.

With the appropriate software, digital terrain modelling (DTM) was done to locate the best site for the installation of a Centre Pivot Irrigation System. This has allowed determining the precise overall system span length, an assessment of physical constraints, and indicating the areas for land cut and fill so that the wheel passes are optimized and the overhead structures have the required crop clearance.

Data in GISCANE can also be accessed in a PC-based application named SIRITELL which provides valuable information on sugar cane practices.

It should be noted that GIS has also been applied in the sugar industry in such countries as South Africa and Australia. A full review of GIS applications in the industry in these countries and Mauritius has been carried out (Jhoty et al., 1995).

Presently, a severe limitation hindering the progress of GISCANE is that up-to-date and large scale maps at 1:2500 or 1:5000 with 2m contours are not available for more than 50% of sugar cane lands. These maps are essential to compile the digital cartographic database of GISCANE.

RELATED INFORMATION TECHNOLOGY

Many other disciplines are experiencing the impact of information technology such that diverse types of data can now be made available in digital form. Thus, supportive new techniques of information technology in other fields capable of being integrated in GISCANE are now identified:

(i) *Digital Orthophotography*: to provide accurate and up-to-date field layouts, contours and elevation values for digital terrain modelling (DTM).
(ii) *Remote Sensing*: to provide multidate data on land use, loss of agricultural land, derocking status on cane lands, etc.
(iii) *Global Positioning System (GPS)*: to provide survey means of producing farm maps necessary for land planning related to mechanization of cultural operations, to establish ground control points, to enable research on precision farming concerned with spatially variable soil and crop parameters.

CONCLUSION

GIS analyses carried out and products derived so far have proved that GIS is a decision support tool in the management of sugar cane lands aiming at increasing productivity. The identified technologies of digital orthophotography, remote sensing and GPS will further contribute in the acquisition of data and in land planning.

At a juncture when the sugar industry is called upon to harness its resources and increase productivity to benefit from the advantages of extra sugar quotas and preferential prices, the use of GIS and allied technologies can be envisaged to reinforce the actions required to make the industry a success.

ACKNOWLEDGEMENT

Thanks are due to Dr R Julien, Director, MSIRI to allow the presentation and publication of this paper.
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RESEARCH IN MECHANIZATION TO SUSTAIN AGRICULTURE

E. Jacquin
Head, Mechanization Division, MSIRI

ABSTRACT

Labour intensive operations for sugar cane and food crop cultivation have been identified by the Mechanization Division of the MSIRI in view to carry out research aimed at minimizing the impact of labour shortage and cost. Ways and means of reducing production costs and sustaining productivity are suggested and problems arising from increased mechanization are considered. The strategy adopted to carry out the research programme is developed.

INTRODUCTION

It is believed that agricultural labour will become more and more scarce and costly and that other costs of production will increase. Thus, research in mechanization is geared towards the reduction of the dependence on labour and production costs as well as to sustain productivity.

SOLVING THE LABOUR SHORTAGE PROBLEM

The following field operations have been identified as being the most labour intensive

Elimination of old cane stubbles prior to planting

Manual removal of old cane stubbles after sub-soiling as previously done is labour intensive and causes soil and organic matter losses. Finding mechanical ways to destroy these stubbles in situ while preparing the seed bed simultaneously will result in considerable labour saving. Up to now, this has been achieved satisfactorily by a combination of 5 passes of light and heavy disc harrows, the latter requiring the use of a 180 HP tractor. The same result can be obtained in one pass only with tractor power take-off driven crushing equipment which are very susceptible to damage by stones (Jacquin et al., 1995). Prior destoning of fields is thus a must and this will also be beneficial to mechanical harvesting. Research per sé has not been carried out by the Division but techniques applied in Reunion, Belle Vue (Nicolin & Siegmund, 1992), and other sugar estates are known and this technology can be transferred.

Mechanical planting and sowing

Successful mechanization of planting and sowing is of utmost importance as yield depends on the proper establishment of the crop. For sugar cane, the amount of soil cover and fungicide treatment have been identified as the limiting factors, (Jacquin et al., 1995). If these are mastered, whole-stalk planters can be used successfully. As for billet planters, the drawback remains irregular sett distribution. For potato, variability in tuber size limits the use of simple and reliable planters available on the market.

Presently no major problems have been encountered regarding mechanical sowing of beans, maize and groundnuts. Research is necessary for small seed like onion and carrots.
Herbicide and fertiliser application

The efficiency of mechanization of these cultural operations for sugar cane is unquestionable. Actually in ideal conditions on sugar estates (flat land, block of 4 fields of row length 100 m each), the daily output of tractor mounted equipment is 10 hectares for herbicide spraying and 8 hectares for fertiliser spreading (Préfumo, 1995). The mechanization of these operations should be vulgarised for sugar cane and extended successfully to food crops. Fertilisation should pose no problem; we will probably resort to broadcast application with existing simple equipment (Jacquin, 1995). For fungicide and insecticide spraying, research on type of nozzles, operating pressure and volume of product per hectare is necessary.

Mechanical harvesting

This will definitely alleviate the labour shortage problem in the crop season. The productivity of the best performing cane harvester in 1993 is equivalent to 15 000 man-days, i.e., 120 men for a 130 day crop. Guidelines for the maximisation of harvester performance have been given (Chunen & Jacquin et al., 1994, Jacquin et al., 1992).

Mechanical loading

If mechanical in-field loading is a success in other climatic zones, a solution for superhumid areas, where the limitations are the conservation of water shoots and poor trafficability in the wet months (June to August), has yet to be found, as this can increase labour productivity for cane cutting two to three fold.

REDUCING PRODUCTION COSTS

Alleviating labour shortage in the above operations may not necessarily reduce costs. However in the preparation of seed bed, a reduction in the number of implement passes and depths of work will minimise energy input. Minimum tillage for sugar cane improves soil structure (Mc Intyre & Barbe, 1990) and with potato, there has been no significant difference in yield between treatments with two and four implement passes (Jacquin et al., 1995). Trials have been initiated with the view of reducing depth of work for that crop in interrows of long season cane. Savings can also be obtained by proper choices of equipment for harvesting and loading operations and by keeping associated losses to a minimum. In transport, much also can be gained by a proper choice of prime mover-trailer systems and a reduction of down time (Pyneeande, 1995).

SUSTAINING PRODUCTIVITY

Mechanization can sustain productivity by allowing timeliness of operations. Land preparation and planting can be performed in a short span of time which is a great advantage especially in marginal (super humid) zones. There are equipment like the ‘Rotobêche’ (Jacquin, 1995) and PTO driven disc plough than can be utilised in soils too humid for conventional land preparation equipment. Mechanical spraying of herbicide in cane and pesticides for food crops can be done more rapidly, preventing yield losses caused by weeds, pests and diseases. Mechanical harvesting will allow the milling of varieties at their optimum maturity and the shortening of harvest season, thus reducing losses due to drop in sugar % cane.

PROBLEMS ARISING FROM INCREASED MECHANIZATION

Using machines to perform operations that have been traditionally done by labour is not an easy process and will certainly give rise to some problems.
Varieties actually cultivated may not necessarily be suitable to mechanized operations. For example, variability of tuber size is an obstacle to successful mechanical potato planting. Stalks of M1557/70 are not suitable for mechanical planting and losses through extractor fans of chopper harvester average 8.2% for M 695/69 harvested green (Chunen & Jacquin et al., 1994). Chopper harvesters are now equipped with variable speed extractor fans and it is possible to find the optimum speed with respect to cane losses and removal of extraneous matter. The effect of extraneous matter on losses during processing at the mills should also be quantified. Mechanical in-field loading cannot actually be practised with cane varieties which do not tolerate stubble shaving. Increased use of machines may result in erosion and compaction problems while the burning of cane prior to mechanical harvest causes pollution.

RESEARCH STRATEGY

Setting Trials

Setting trials and measuring the beneficial effects on crop growth, development and yield is a common research procedure. In the Mechanization Division, the negative effects, namely soil compaction, erosion and yield loss are also closely monitored in view of identifying the causes so as to apply corrective measures.

Follow up of operations in commercial conditions

This is done to identify conditions for optimum productivity. The creation of MECABASE, a software to follow mechanical harvesting and the study of cane transport systems are good examples.

Assessment of new equipment

In some cases, importers of agricultural equipment ask for advice on the suitability of equipment to Mauritian conditions before ordering while in others they introduce new equipment directly. The Division is often requested to perform preliminary tests on those equipment and advice is given on minor adjustments and settings for more efficient performance.

Information

This can work both ways: members of the staff receiving information (conferences, missions, contact with importers of equipment, training) or dispensing information (report, meetings, talks, training sessions)

Economic analysis

For each operation previously mentioned, an economic analysis is being or will be carried out in order to identify operations that should be mechanized even if labour is still available and others that are to be mechanized only in the event of acute labour shortage.

RESOURCES AVAILABLE FOR RESEARCH AND DEVELOPMENT

What are the resources (equipment and human) available to carry out this research in order to sustain agriculture?

Equipment

Modern land preparation implements and a sophisticated tractor have been purchased. A data acquisition system and a dynamometer have also been acquired to assess the performance and efficiency of prime movers in actual
working conditions. A gamma neutron probe and other soil physics measuring equipment are available to characterise soils as well as to assess compaction effects and erosion.

**Personnel**

The personnel of the Division is limited to four, including the Head. To overcome this limitation, we collaborate with University of Mauritius and other Divisions of the MSIRI.

**University of Mauritius**

B Sc students of the Faculty of Engineering carry out final year projects on subjects in the research programme of the Division. Two have already been completed: one on mechanical planting of sugar cane and another on cane transport.

**Other Divisions of the MSIRI**

In order to ensure successful mechanization, solution to the problems listed above should be found. Collaboration of the Mechanization Division with the following Divisions is of utmost importance: Economics, Food Crop Agronomy, Irrigation, Land Resource Survey, Plant Breeding and Sugar Technology.

**REFERENCES**


PREFUMO, S. (1995) Personal communication


DISCUSSIONS

Q. Isn't it desirable for institutions that are involved in the commodity chain of any crop (filiere de production) to get together and have some sort of consensus on an integrated approach as well as to develop a series of commitment around the production of a certain number of commodities? The success of the potato and the onion crops were cited as examples.

N.G. I fully agree with the approach; however there need to be consensus among all stakeholders. I think that one of the purposes of the National Consultation on Diversification is to come up with something along this line.

R.J. I concur with this approach which is commendable and we now need to implement it.

Q. Could you elaborate on (i) the figure of 6,288 ha of abandoned land, and (ii) on the reasons why these lands were being abandoned?

R.J. (i) The computations were carried out on data obtained from the sugar estates, as sent to the factories by planters each year and cover the period 1980 - 1994. Given that this is very vital statistics, we are in the process of arriving at the potential area that can produce sugar cane and how much it is going to produce. We need double checking of the data with the Sugar Industry Fund Board and I hope this is going to take place in the very near future.

(ii) There is a study which has earmarked the various reasons of land being abandoned. A preliminary survey in the North has shown that some of the land had gone to urbanisation, some of them has been divided into subplots through inheritance and are no more cultivated, but possibly some of them have been converted to food crops.

Q. You mentioned that you want to increase sugar production in the northern area. Given that irrigation water is the major binding constraint, how do you intend to go about it?

R.J. This is our major concern in fact. The primary constraint is of course water and coupled with that I think in recent years the very poor climatic conditions have had a very strong impact particularly fields which were established and have failed because of drought conditions.

To tackle that, there are the small dams project to start with and the long-term project of the Midland Dam. Policy decisions would need to be taken quickly for the rapid laying down of small dam projects which could at least cover irrigation for some 800 ha. Another avenue of irrigation is to change some of the systems which are now obsolete like surface irrigation, certain high-energy cost sprinkler systems into more efficient ones like the centre-pivot or drip irrigation wherever it becomes economic.

Q. Is it possible to use biotech methods/techniques as an investigating tool to accelerate the process of disease identification in a particular disease situation in Mauritius?

A.D. For the potato disease, the ELISA test is so far the quickest method to get traces because you can do a lot of screening in a day. PCR could as well be used but is more elaborate.

Q. In relation to diversification within sugar, are there any projects implemented at the MSIRI apart from the production of electricity from bagasse?

R.J. The project which is on now is one trying to improve the yield of organic sugar. Basic research in the transformation of sugar into other by-products is very costly and are dependent on the economic feasibility and well as marketing avenues for such products. One of the options that may be considered is to adapt locally the technology developed elsewhere.

Q. Would the use of biotechnological methods and techniques reduce the time of release of new cane varieties?
A.D. The work being undertaken are only recent and it will take a few years to have the preliminary results. Only then, we could say by how long the selection programme would be shortened.

R.J. As it is now the selection takes 12 to 15 years. We are in the process, after analysis and simulation at computer level, to make promising varieties jump selection stages in order to produce cane specifically adapted to particular conditions for e.g. drought. Both the classical plant breeding and the high tech approach will have to be merged together into a synergy.
DARE’S STRUCTURE, ITS OBJECTIVES AND ITS ROLE IN DIVERSIFICATION

S N Naidu
Ag. Director, DARE

ABSTRACT

The mission and general objectives of the Directorate of Agricultural Research and Extension (DARE) are defined. Its organisational structure is described, and major research themes identified. The strategy and methodologies to be adopted to improve work performance are outlined.

INTRODUCTION

Aims and Objectives

DARE’s mission is:

To serve its clients through excellence in cost-effective high quality research and extension, and to meet the policy requirements of government

DARE’s general objectives

- to raise farm incomes by developing productivity-enhancing, relevant and sustainable technologies
- to implement a problem solving multi-disciplinary approach to ensure that its clients needs are identified and catered for, with increasing emphasis given to on-farm research
- to ensure that technologies and information generated by research and development is quickly transferred to clients
- to support and complement work being carried out by other scientific institutions in Mauritius, and to extend and strengthen links with appropriate organisations overseas
- to ensure that its effectiveness, efficiency, quality of work and standards of service and management are progressively improved
- to optimise the use of resources and to maintain, renew and update facilities by appropriate investment
- to recruit and retain staff of the highest quality and to improve them with working conditions and opportunities for training and skill development which will enable them to follow productive and fulfilling careers
- to foster among staff throughout the organisation a clear understanding of the context and relevance of DARE’s work, a commitment to excellence and an enduring concern for efficiency and standards of service
DARE will aim to achieve and monitor progress towards the following specific targets during the period of this Plan:

To merge with the FARC by July 1995. Constitute the DARE as an operational autonomous unit within FARC, responsible to a non-executive Management Board.

To achieve independent parastatal status by July 1997.

To produce a medium-term strategy and implementation plan for DARE’s research, extension, and human resource development by September 1996.

To implement the work programme plans of each of the technical Departments, Divisions, and Units, and DARE as a whole during 1995.

To extend and strengthen collaborative linkages with other research and development institutions in Mauritius and overseas. Formalise these linkages with Memoranda of Understandings (MOU’s) where appropriate.

To improve internal review mechanisms for DARE’s services and output and to implement an external peer review of DARE’s research during 2000 in the form of a Visiting Group.

To establish the Extension and Training Department’s headquarters within the Farmers Services Corporation building at the St. Pierre.

To complete its building development and investment programme at its research and development sites.

To fill all key vacant posts in the administration, and technical sections.

To undertake a major human resources review in order to assess DARE’s capabilities and needs, and to develop a long term plan.

RESEARCH PROGRAMME

The Strategy

The purpose of DARE’s research is to overcome its clients problems, provide opportunities for wealth creation, and enhance their quality of life. DARE’s policy will be to conduct adaptive research. The approach will be to apply relevant knowledge and techniques gained from basic research elsewhere to local circumstances after necessary adaptation.

DARE also seeks to ensure that there is a rapid transfer of new knowledge gained from strategic studies into production systems which can be applied to the benefit of growers, consumers and the environment.

It is DARE’s objective to maintain this situation by:

Pursuing new initiatives to provide clients with a continuum of technologies to respond to their changing needs.

Responding to the short and long term priorities of government, farmers and consumers to ensure that the results of DARE’s research remain directly relevant to their requirements.

Pursuing a vigorous technology transfer policy to ensure that results of research are rapidly translated into products and information of commercial benefit.
Identifying, targeting and exploiting research and development opportunities leading to improved quality of life and wealth creation within the agricultural sector.

Through DARE’s extension services, and participatory methodologies, continue a close dialogue with clients to determine what their future research needs will be.

The organisation of DARE’s research programme will be structured to address the major problem and opportunity areas. The major policy groups for DARE’s research are:

<table>
<thead>
<tr>
<th>Groups</th>
<th>Areas</th>
<th>DARE Structure</th>
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</thead>
<tbody>
<tr>
<td>Crops</td>
<td>Agronomy</td>
<td>Agronomy Division</td>
</tr>
<tr>
<td></td>
<td>Horticulture</td>
<td>Fruit Division</td>
</tr>
<tr>
<td></td>
<td>Crop Protection</td>
<td>Vegetables &amp; Ornamentals Division</td>
</tr>
<tr>
<td></td>
<td>Resource Management</td>
<td>Resource Management Division</td>
</tr>
<tr>
<td>Livestock</td>
<td>Production</td>
<td>Livestock Production Division</td>
</tr>
<tr>
<td></td>
<td>Animal Health</td>
<td>Animal Health Division</td>
</tr>
</tbody>
</table>

Scientific work in these areas will be supported by four specialist Units; Socio-economics, Biometrics, Information and Agricultural Engineering. The Socio-economic and Biometrics Units will work with the scientific sections to ensure that DARE’s research is problem-oriented and quality controlled. The Agricultural Engineering Unit will work in collaboration with all sections to develop appropriate technologies in mechanisation, irrigation and processing. The Information Unit will provide a library and documentation service for DARE staff, and facilitate the transfer of information on DARE’s activities to the public.

**Crops Research**

*Agronomy and Horticultural Crops Production*

DARE’s research will contribute to the establishment of sustainable production systems and development of new crop technologies through improvements in crop quality, extending the range of crops and varieties and their seasonal availability.

*Plant Protection*

Major research areas of work receiving strong policy support will aim to minimise the use of pesticides, develop an expertise that can provide rapid diagnosis of pests and diseases, and deploy alternative technologies to conventional pesticides.

*Resource Management*

Concerns for the protection of the environment are global. DARE will address national issues of sustainable land utilisation, plant genetic resource conservation, and pollution. A priority will be to work with other institutions in Mauritius to assess and monitor the presence of agro-chemicals in underground water and rivers.
Livestock Research

Research thrusts will aim to respond to farmers needs in raising the productivity of livestock enterprises by; developing improved management practices, the introduction of improved breeds and breeding techniques, and, improving the range and yields of locally produced feeds. An integral part of these thrusts will be to investigate diseases of importance and develop cost-effective measures for their control.

Social Development and Economics

The creation of a socio-economics capability in DARE will add an important dimension to the development of its research and extension programmes. Giving the scientific sections access to social and economics expertise will help them better understand farmers’ situation and thereby be more responsive. An economics capability will also enable research and extension managers evaluate the validity and viability of their work.

Research Methodology

DARE will adopt a methodology comprising various stages and combinations of on-station and on-farm research. Multi-disciplinary team field visits will bring together staff from both research and extension to interact with farmers and assess their problems. The various stages of on-station research will include the initial screening and evaluation of new crop varieties and livestock breeds as well as various nutrition, husbandry and management techniques. Promising results will be further tested in farmers field trials, the latter whenever possible under farmer’s management. Interactions within the farming system will be studied.

National Collaboration

DARE will work closely with and support other research and development institutions in Mauritius for the common good of optimising effort and resources. Important links would be forged with the following organisations:

- Agricultural Services (AS) of the MANR
- Food and Agricultural Research Council (FARC)
- Mauritius Sugar Industry Research Institute (MSIRI)
- University of Mauritius (UM)
- Mauritius Research Council (MRC)

Where appropriate, these linkages will be formalised with Memoranda of Understanding which would set out respective roles, responsibilities and coordinating mechanisms.

International Collaboration

The collaborative programmes already established with the International Agricultural Centres of the ICGAR’s will continue, and in specific areas will be expanded. DARE will also seek bilateral technical assistance and funding. For example, through the British Overseas Development Administration’s (ODA) aid programme, sources of expertise would be identified with a view to arranging long-term collaborative inputs. DARE’s policy will be to forge sustained relationships with organisations overseas that can provide continuity in information sourcing and human resources development.
Commercial Contract Research

A long term objective is to undertake research and development in support of the agricultural industry. It is anticipated that scope for near market development research will grow. DARE should prepare to serve this market by developing a capacity and reputation for high quality research that is responsive to customers’ policy, strategic objectives and commercial requirements.

Technology Transfer

The effective transfer of information ‘know how’ and developed technology for the commercial benefit to the agricultural sector is the ultimate justification for DARE’s research programmes. DARE’s extensive programme of activities in support of technology transfer will reflect the considerable importance that it attributes to this function. The creation of an Information Unit in DARE also reflects the importance attached to its information transfer and dissemination role.

Publication of research results in scientific papers, technical reports and articles will be a major vehicle for information transfer. In collaboration with the extension services, DARE’s ‘know how’ will be put across to its customers through workshops, seminars, demonstrations and open days.

EXTENSION PROGRAMME

Approach

The extension service assists people, through educational procedures, in improving farming methods and techniques, increasing production efficiency and income, bettering their levels of living, and lifting their social and educational standards.

One of the essential features of the proposed service will hinge around the technology triangle whereby researchers, extension officers and farmers communicate and exchange information for the mutual benefit of all parties concerned.

The extension services will play a key role in the feedback of farmers’ problems to researchers who will be provided with a forum to be in direct contact with farmer problems and priorities. Research can then be in phase with the problems facing the farming community. Farmers will also be given the means to contribute in the formulation of the research agenda and in priority setting.

Farmer training

The training needs of the farming community in respective zones/districts will be determined by field staff as part of their routine advisory activities. The study of the extension zone profiles will also bring the above needs in clear focus.

RESOURCES

Organisation

For the period of the Corporate Plan, the DARE will undertake research and extension on several sites previously managed by the AS. The sites already selected are:

- Crops Research
- Central Experimental Station, Reduit
- Wooton Experimental Station, Curepipe
Livestock Research          Ruminant Research Laboratory, Richelieu
Extension                  Demonstration centres at Mapou, Plaisance, Flacq and Rivière des
                            Anguilles

Further sites may be acquired as and when it is considered essential for the research programme.

Staff resources are managed within a framework of research, extension and support service division, units and
departments. The research divisions have been formed to reflect major thrust areas. DARE’s organisational
structure is presented at Annex.

**Finance**

The major source of DARE’s funds come from the Government of Mauritius, through the MANR. The
Agricultural Management and Services Project (AMSP) includes an allocation for DARE, though these are
estimates only and remain subject to approval and change. The funding to be provided by the ODA is a
committed allocation for technical assistance and staff development.

**Human Resources**

The staff of DARE are its most valuable asset and their high quality and effectiveness are vital to the
achievement of DARE’s objectives.

**Staff Posts and Staff Numbers**

The projected number of posts over the period 1995/1996 is shown in below.

<table>
<thead>
<tr>
<th>Posts</th>
<th>Allocation</th>
<th>Filled</th>
<th>Vacant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock Research</td>
<td>21</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td>Crop Research</td>
<td>89</td>
<td>64</td>
<td>25</td>
</tr>
<tr>
<td>Central Services</td>
<td>13</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Extension Services</td>
<td>47</td>
<td>41</td>
<td>6</td>
</tr>
</tbody>
</table>

**Appointments**

On the creation of DARE, it was policy to fill vacant posts transfer of staff from the AS. However, as it has not
been possible to fill all posts from this source, external recruitment will be necessary. A policy on external
recruitment procedures will be drafted and enacted when the DARE merges with the FARC in July 1995.

It is DARE’s objective to introduce more young scientists into the service and the induction of graduates from
the University of Mauritius will be a feature of the new recruitment policy.

**Conditions of Employment**

Presently, all DARE staff are engaged on Civil Service conditions of employment. It is government’s intention
to review the schemes of service of posts in the DARE and to reflect any increased duties and responsibilities in
revised conditions of service. By becoming a parastatal body, initially by merging with the FARC, more
flexibility will be possible in enacting any changes.
The first step in this exercise will be to commission an independent review. It is anticipated that the study will be initiated by July 1995, and it is MANR’s intention to implement the approved recommendations soon after. The exact timing of this will depend upon how quickly the consultation process can be completed and whether new legislation is required.

The new terms and conditions of service will be assessed to ensure that:

- A human resource policy is developed that is appropriate to DARE’s mission, aims and objectives
- Staff receive ample opportunity for career development
- DARE performs research, development and advisory functions efficiently and to the satisfaction of its clients
- DARE is recognised as a good employer by existing staff and potential recruits
- Terms and conditions of employment which overall are no less beneficial than those enjoyed by staff at present
- Be acceptable to the Management Board and MANR

Sites and Facilities

DARE needs to acquire, maintain and develop excellent research and extension facilities at locations relevant to its major client groups. Under a Memorandum of Understanding agreement with the AS, the DARE will take on specific sites and facilities as required for its research, development and extension programmes.

Presently, the DARE has taken on the following facilities:

- Headquarters and Departmental and Divisional Offices at Reduit
- Research sites at Reduit (CES) and Curepipe (WES) and Richelieu (RRL)
- All District Extension Offices
- All Demonstration Centres

Building Programme

In order to implement the projected work programmes it will be necessary to upgrade some of the existing facilities and in certain areas, construct new ones. The pace of this development will depend upon both the practicalities of planning and building, and the availability of finance. Finance for the building programme may come from two sources - Government of Mauritius and World Bank. In the AMASP, World Bank funds could be made available for capital works and equipment, though decisions on how best utilise these funds and for what purpose would rest with the MANR.

The major works to be undertaken are yet to be planned. Building projects approved to date are:

i) Renovation and refurbishment of an office building at Reduit for DARE’s headquarter’s (Completed)

ii) Interior construction work at the FSC building at St Pierre to establish a headquarters for DARE’s Extension Services (July 1995)
POLICIES AND PLANS TO 2000

Background

Agriculture has great potential to contribute to national wealth. The current trade gap in agricultural products especially fruit and animal products, suggests that there are many opportunities for the industry to contribute to bridging this gap, and to increase the export market for commodities where the Mauritius climate offers advantage and the industry infrastructure is well placed. Further growth opportunities exist in gaining advantage from the recognised benefits to health of increased consumption of fresh fruit and vegetables as currently, Mauritius’ consumption per capita is low in comparison to many of its neighbours.

In order to keep pace with home consumption and maintain a comparative advantage in exports, many areas of production will become complex and highly technical, requiring specialised production systems. Research and development has a major part to play in underpinning the future capacity of the agricultural industry to meet these challenges by increasing the availability and quality of crops and livestock products and by improving their efficiency of production.

A strong research and extension strategy is vital to enhance the industry’s efficiency and competitiveness and to meet the objectives of its users. As the principal body for research, development, and provider of advice on non-sugar crops and livestock in Mauritius, the DARE has a key role to play in providing the underpinning science and in meeting the particular needs of its customers, both in industry and government.

New Challenges

National research and extension policy in agricultural diversification has reached a watershed in 1995 that will have a major impact on a wide range of government providers of services, not least the DARE. As a consequence, DARE’s future policies and plans need to take into account a range of new challenges.

Realising our potential in ‘Initiatives 2000’

The draft paper ‘Initiatives 2000’ produced by the High Powered Committee for Agricultural Diversification in April 1995 sets out policy and strategic directions for radical reform of government sector services. This clear statement from government offers the DARE an exciting opportunity to contribute to improving national wealth creation and quality of life. DARE, with its clear mandate to be the key player in agricultural diversification efforts must equip itself to ensure that it undertakes research and development that is relevant to industrial needs and is rapidly transferred to the end users; clear objectives that are highlighted in the draft of recent policy document “Initiatives 2000”.

Scientific and commercial objectives

DARE’s research programmes will be ready to adapt to the changing priorities of its clients. DARE’s immediate task in research is to confirm its priorities for the immediate and medium-term future.

This will be done through a range of processes to include:

- a nation-wide survey of farmers problems and needs to be undertaken by the DARE May/June 1995
- outcome of a national research strategy paper to be produced by the FARC September 1995
- guidance and direction of DARE’s Technical Advisory Committee (TAC) July 1995
Research

The direction and objectives of DARE’s research will reflect the developing and evolving policy and research needs of government in general and MANR in particular. The challenge will be to maintain a continuum of technologies that meet client needs. In many sectors with wealth creating potential, the focus will be upon improving productivity; competitiveness; market responsiveness; exploitation of opportunities for increased sourcing from within Mauritius and expansion into new markets. Responsiveness, hence profitability, will depend critically upon success in meeting the demands of the market in terms of quality, seasonality, range of varieties, crop uniformity and flavour, improved storage and shelf life, and other value-adding factors.

DARE will gear and equip its strategic resources in order to underpin these and other elements which aim to maximise effective use of crop and livestock production resources by minimising the use of agrochemicals, energy and other environmentally sensitive inputs, and overcoming crop and livestock stress.

At this stage, we anticipate that DARE’s strategic programme will develop particularly in the following areas:

- Screening and testing of horticultural crops and varieties with potential to arrest imports and fill niche markets
- Systems approach to crop production - developing multi-disciplinary systems with potential for improving crop quality and availability, extending the cropping season and reducing production costs
- Reducing use of pesticides - maximising biological control and developing alternatives to conventional pesticide applications
- Improving crop quality through an improved understanding of the physiological processes involved in fruit ripening and flavour development; prevention of deterioration of fresh produce between harvest and sale
- Improving shelf-life and storage quality of horticultural produce while minimising post-harvest chemical treatments
- Developing techniques for both organic and intensive crop production systems
- Developing environmentally sound practices to improve efficiency in resource use and management and to reduce agro-chemical leaching
- Conserving genetic resources
- Developing techniques for enhancing the productivity of livestock enterprises by improving reproductive performance, feed utilisation, and management techniques
- Introducing appropriate bio-technology techniques to improve livestock production and health

Commercial and industry-funded science

DARE will make every effort to retain government confidence and funding by ensuring that it continues to receive a good quality research and advisory service. At the same time the DARE will bid for contract research and development work for customers in the private sector. Some areas where DARE plans to develop specialist expertise include: Crop Protection, Ornamentals and Fruit Production. The potential for contract work will be studied during 1995/96.
International funded research and development

DARE will operate a planned approach to secure increased international funding for collaborative ventures with the FAO, IAEA, EU, UNDP and others. DARE will align itself with organisations seeking partners in development to undertake research and development projects. The DARE will aim to provide the best appropriate technology to ensure both the commercial success of those projects and their suitability to the climate and culture within which they will operate.

Technology Transfer

High priority will be given to the technology transfer process to ensure that the results DARE’s research are made available to as many potential users as possible and in a form which enables them to maximise benefit from the implementation of improved technology as simply as possible. DARE recognises that effective technology transfer needs to be driven by market requirements and initiatives will be undertaken to define market needs in all spheres of DARE’s activities.

DARE will plan a schedule of subject days, demonstrations, seminars and farmers visits on DARE’s sites where producers and other customers can see and hear for themselves the results of research and development work.

The results of DARE work will also be disseminated to clients through: technical reports and leaflets, technical articles in papers, journals and books, exhibitions and shows.

Resource Policy

Finance

The projections of finance required for 1995/96 and the increasingly competitive market for research and development funding provide clear incentives for DARE to reduce expenditure while seeking to protect the key research and advisory services needed to carry out its business effectively. An early task will be to improve cost efficiency using MARMIS and following the installation of a new integrated accounting system. The specific objective will be to reduce operational and overhead costs.

Human Resources

DARE will seek to improve the quality of internal communications, to increase staff and customer awareness of facilities and expertise available on all DARE sites and to optimise operational efficiency by continuing improvements in strategic planning.

It is our objective to manage the transfer of staff from the AS to DARE in a professional manner that causes minimum disruption and anxiety.

DARE recognises the importance of staff training in providing opportunities for flexibility and developing in the skills, knowledge and experience necessary to meet DARE’s objectives. A phased increase in investment in staff training to 5% of salary costs is expected to be reached by the end of the Plan period.

Sites and services

The building programme referred to in section 3.8 incorporates the future plans and policies for site resources and the replacement and refurbishment of DARE facilities over the period of the Plan.
CONCLUSION

DARE management is firmly committed to the pursuit of efficiency, value for money and professionalism throughout the entire service through implementation of extensive improvements in efficiency. DARE will continue to conserve, improve and manage the quality of its work for clients in accordance with a clearly defined strategy.

DARE’s immediate objectives are to:

- clearly define and document responsibilities and accountabilities of all DARE staff and Departments
- prepare clearly defined and documented procedures
- monitor performance and effectiveness of procedures
- strive to achieve greater efficiency, streamlining and cost savings throughout DARE

In pursuit of these objectives, particular emphasis will be placed upon:

- developing strong client/supplier principles throughout DARE
- a ‘get it right first time’ approach
- exemplary client care
- delivery of quality service
- look for adding value at every step.

REFERENCES


CROP RESEARCH ACTIVITIES AT DARE

D Dumur

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ABSTRACT

The range of crops for which DARE is called upon to research is indicated. With more than 92 crops that are currently grown on large scale or potentially exploitable, there is need for a priority setting methodology in developing work programmes reflecting national priorities that were identified by the recent reviews on Agricultural Diversification. A commodity problem analysis and a Rapid Rural Appraisal were undertaken on several themes.

These research themes, spread over five research divisions are then briefly described. The activities within each research theme will be reviewed in the light of ongoing RRA exercise. While the overall aim is to increase farmer's income through increased productivity and/or reduced crop losses, attention will also be given to the sustainability of the cropping systems and the development of environment friendly practices.

INTRODUCTION

The DARE has the mandate for conducting research and extension activities on crops other than sugar cane and crops that are grown in the interlines of sugar cane. With such a mandate, the range of crops that the DARE has to cover is indeed substantial; a list is given in Table 1. The field and foodcrops, and vegetable crops that are grown in commercial scale number around twenty five. Over the recent years, with the growing interest in fruit production, some ten species are grown by commercial growers. While commercial flower growing was focused on anthurium till late, there is now growing interest for diversification with other species.

Consequently, the DARE is or will be called upon to address the problems faced by the commercial growers of a wide range of crops, and this makes heavy demand on resources, both human and financial. These crops vary considerably in economic importance and many crops may not at present justify any research effort. On the other hand, there is an urgent need to concentrate research efforts on other crops that are not presently exploited on the large scale in view of their export potential. Since one organisation may not have all the necessary facilities and resources to conduct research and development activities on such a wide range of crops, it is therefore necessary to prioritise and to concentrate our efforts on the selected crops.

In this context, a commodity problem analysis was conducted following discussions held among the research staff, extension officers and farmers to identify the main problems encountered within the ‘filière’ from seed to consumption, and to develop our research programme. The work programme was then reviewed by the Technical Advisory Committee and necessary modifications have been made. Also with a view to identifying the immediate and perceived problems of farmers, an exercise, namely the Rapid Rural Appraisal, has been started and it is hoped that this will help us in addressing the immediate problems.

SALIENT ISSUES IN THE CROP SECTOR

A major review of the main issues, problems, constraints and opportunities within the context of the Agricultural Diversification programme was recently undertaken by the Task Forces set up by the Ministry of Agriculture. The main findings are reproduced here as they amply illustrate the background under which our main producers are operating and also provide an insight of their expectations.

Although various measures to increase crop production and to enhance the potential for crop diversification have been provided to farmers, the crop sector, is facing some teething problems and these include:
Scarcity of arable land for diversification activities

Most of our highly productive arable lands are already under cultivation and over the recent years, land is being lost to urban and infrastructural development. Hence for increasing agricultural production, intensive systems of production for maximising productivity are adopted, often through the use of external inputs such as fertilizers, irrigation, and through inter-cropping with sugarcane.

However, with the recent retrenchment programme in the tea sector, more area would be available for agricultural purposes. Though sugar cane is the preferred crop, a significant acreage is devoted to fruit, vegetable and foodcrop production.

Acute shortage of labour and its high cost

This situation arises as a result of competition for labour from other sectors of the economy that are capable of offering better salaries and working conditions. This has limited the range of crops that could be envisaged within the earlier strategy of import-substitution; thus crops like fine bean which have a high labour requirement for harvesting and handling thereafter are at a disadvantage. The scarce labour supply goes along with a high cost and this has strong adverse effects on the cost of production of the local produce and consequently hampers the competitiveness of local produce on export markets and also possibly against imported produce.

The farming community, including the traditional small vegetable producers, is expecting to receive proven labour saving techniques and technologies for adoption and many are now in favour of using light machinery for many field operations.

Dearth of technical know-how in non-traditional crop production activities, as in the case of export of fresh agricultural produce

Although most tropical fruits can been produced locally, they have only been produced on a limited commercial scale and for the local market.

The selection of varieties, quality control, crop management, scheduling of production, packaging and transport conditions are some of the critical factors which must be perfected to ensure our produce captures a share of the world market and has a reputation for quality.

Moreover there is a growing interest among farmers for intensive systems of crop production like hydroponics, soil less cultivation, and crop production under controlled environment. Organic agriculture is also of particular interest in view of the prices the crop produce fetches in some markets.

Lack of improved varieties and high quality planting materials

There is an urgent and pressing need to make available to our farming community a wide range of varieties that have previously been screened for high yield, pest and disease resistance or tolerance and also for other specific traits. Measures need to be intensified so that high quality planting materials, both from conventional or other sources, are provided to meet the growing expectations of the farmers.

Growing concern for environment

Pesticides are costly and farmers apply insurance doses, often in cocktails. This practice leads to higher productions costs and farmers have also become increasingly aware of the development of resistance against certain pesticides by some pests, in particular the Diamond Back Moth (DBM) in the cruciferous species. Farmers are now pressing for more effective control measures and in this context control strategies like IPM are of particular interest.
Seasonality of production and Fluctuating Prices

Unlike sugar cane and except for a few controlled produce (at agricultural Marketing Board) like onion, garlic, most of the commodities produced from crops under the mandate of DARE do not have a guaranteed price and market structure. Hence prices fluctuate considerably. This problem is particularly acute for most vegetable crops which are highly seasonal.

MAIN RESEARCH ACTIVITIES AND THRUSTS

Organisation of Research

Crop research activities at the DARE will be under the responsibility of five divisions, namely:

1. Agronomy
2. Fruit
3. Vegetable and Ornamental
4. Crop Protection
5. Resource Management

For those who are familiar with the research activities under the Agricultural Services, they will no doubt observe that the activities formerly conducted under the Division of Horticulture are now split in two divisions, thereby reflecting the greater emphasis that is being placed on fruit research, vegetable and ornamentals. On the other hand, there is a single division for crop protection matters. This division will cater for both entomological and pathological problems in addition to weed control; the rationale being to investigate the problems related to crop protection in a more integrated manner as exemplified with the greening disease and its vectors in citrus.

The Resource Management Division is new and will be responsible for developing practices that enhance resource use efficiency, sustainability of production systems and ensure minimal adverse effects associated with the use of the resource to the environment.

Current Research Activities or Future Research Themes

As stated earlier, the DARE started its crop research activities only last year (more specifically in April 1994) with one research programme, namely the fruit development one which benefits the assistance of the French Government. Three main projects are included in this programme, namely the introduction and screening of varieties of different species with emphasis on citrus and strawberry, the control of vectors of the greening disease of citrus and the control of the fruit flies (which is now transferred to the Agricultural Services).

As from March this year, seven research projects were taken over by the DARE following the transfer of the scientific staff. The proposed research projects were reviewed and several modifications were made to take account of the recommendations of the Task Forces on the Agricultural Diversification and the results of the commodity problem analysis. Although work is continuing on the seven projects, more modification will be made after the results of the Rapid Rural Appraisal are known.

The Rapid Rural Appraisal is presently under progress and is focussed around the main eight research thrusts (as shown in Table 2) that have been identified mainly on the basis of the economic value of the commodity and the perceived specific urgent needs of the farmers. A pilot RRA exercise was first conducted in the first week of May 1995 on the pineapple based cropping system in the three main production sites. After analysis of the results on the methodology, the exercise is now extended to cover the other main cropping systems and commodities throughout the island. It is expected that the results would help us fine tune our research programmes to address the immediate and perceived needs of the farmers.
Table 2: Main thrust themes for the Rapid Rural Appraisal

<table>
<thead>
<tr>
<th>Crop</th>
<th>Number of farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pineapple</td>
<td>25</td>
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<tr>
<td>2. Vegetable</td>
<td>400</td>
</tr>
<tr>
<td>3. Fruit</td>
<td>50</td>
</tr>
<tr>
<td>4. Pulse</td>
<td>144</td>
</tr>
<tr>
<td>5. Onion and garlic</td>
<td>158</td>
</tr>
<tr>
<td>6. Ornamental</td>
<td>59</td>
</tr>
<tr>
<td>7. Diversification in tea areas</td>
<td>60</td>
</tr>
<tr>
<td>8. Fodder and pasture</td>
<td>60</td>
</tr>
<tr>
<td>9. Tobacco</td>
<td>28</td>
</tr>
<tr>
<td>10. Mushroom</td>
<td>15</td>
</tr>
<tr>
<td>11. Ginger and root crops</td>
<td>40</td>
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</tbody>
</table>

Agronomy Division

This division will address problems of important field crops that are currently being grown such as tobacco, tea and onions. Attention will also be given to other crops such as pulses, wheat, fresh tropical mushroom and to general issues like fertility management for sustainable production.

On going Projects

Project 1: Tobacco Research.

Tobacco is the third major crop, with 632 hectares in 1990 for the production of 799 tonnes of cured tobacco leaf. All flue-cured and air-cured tobacco produced is bought by the only local cigarette manufacturer.

Major constraints are scarcity of labour and shortage of land that meet the rotation requirements of tobacco. Measures to improve the performance of the industry include upgrading of leaf quality, mechanisation of field operations, adoption of chemical sucker control, and the introduction of varieties that are high-yielding and disease-resistant. It will also be useful to search for low-nicotine varieties.

Recent research on tobacco has concentrated on introduction of new varieties of flue-cured tobacco and new types such as cigar and burley tobacco for testing; development of labour-saving methods such as mechanisation of field transplanting of seedlings, chemical control of suckers; introduction of a machine for stitching leaves, mechanical aids to facilitate harvesting and transport, and an electric elevator to assist in the process of barn-filling. Investigations are under way to develop alternative systems of seedling production using seed-trays and pelleted seeds. Chemical weed control is being looked into. Disease and pest problems have been investigated and control measures have been recommended. Mutation breeding techniques are now being used in the tobacco plant improvement programme.

Objectives

(i) To identify new opportunities for tobacco production.

(ii) To investigate problems and constraints to production.

(iii) To generate cost-effective technologies for increasing and improving production.
(iv) To identify opportunities for labour saving, and develop relevant technologies.

Project 2: Pulse Research.

Mauritius imports annually some 1500 tonnes of pulses crops, mainly beans, peas, lentils and limabean. Beans have been grown with success for a long time in Mauritius and in Rodrigues, except for the occurrence of plant diseases like haloblight and rust. Following the White Paper of 1983, guaranteed prices were offered by the Agricultural Marketing Board to encourage producers. Production rose to nearly 100 tonnes in 1989 but dwindled again thereafter.

Our imports also include soyabean oil which can be generated from the dual-purpose pulse soyabean. This crop can also help produce protein-rich soyabean cake as a by-product which could be utilised by the livestock sector. There are other potential uses such as soya milk and meat substitutes.

Recent research on pulses has concentrated on bean, cowpea, pea and soyabean. Others include the winged bean and the lima bean. Breeding work undertaken since 1990 has led to the development of two improved varieties to replace the traditional variety Long Tom. Cowpea varieties were introduced from IITA, Nigeria and three varieties were found suitable for local conditions. As for peas, material introduced from Australia proved to be late varieties and were highly susceptible to powdery mildew. Work on soyabean has identified varieties Williams and Davis as the best under local conditions, but there has been no interest to start production for lack of a market for the produce. The local oil refinery has assured itself of a regular supply of raw material at lower prices on the world market.

Objectives

(i) To identify new pulse crops for the local market.

(ii) To investigate problems and constraints to production.

(iii) To generate cost-effective technologies for increasing and improving production of pulse crops in Mauritius and Rodrigues.

(iv) To identify opportunities for labour saving, and develop relevant technologies.

Project 3: Fodder and Pasture Research

Cattle and most goats and sheep are reared in confinement by small breeders mainly, being fed on mixed grasses collected from roadsides, forests, sugarcane fields and wastelands within a cut-and-carry system and no fodder is grown by small breeders despite the fact that research has already identified grass and legume species that are high-yielding and adapted to various agro-climatic zones. During the sugarcane harvest season, in winter when availability of fresh grass is severely reduced, these animals are fed mostly with cane tops. In drought years shortages are especially severe in the North and West of the country.

Breeders with large herds of cattle or deer have established improved pastures or else have access to unimproved pastures on lands leased from the State. Shortage of fodder in winter is made up with ensiled cane tops, or with bagasse/molasses mix.

Major constraints are the low productivity of these pastures, particularly in winter, and the poor nutritional quality of the species making up such pastures. The setting-up of fodder plots to feed animals in the cut-and-carry system of the small livestock breeder is limited on account of the lack of land as well as the existence of more lucrative alternative uses for any available land.

Livestock production is also an important sector in Rodrigues with an animal population comprising in 1991 of 5842 heads of cattle, 5790 sheep and 2758 goats. Until recently, all grazed on common pasture lands which
suffered from overgrazing and lack of any form of management. Now fodder is being cultivated in fenced paddocks and made available to livestock owners; it is managed to help animals tide over the dry winter season when natural pastures would normally be unproductive. The potential area for pasture and fodder production is estimated at 10,000 hectares in Mauritius and 4,800 in Rodrigues.

During the period from 1968 to 1972, work on fodder and pastures was intensified within FAO's Milk and Beef Project and various grass and leguminous species were introduced and tested in pastures at La Brasserie, Curepipe. Bracharia spp performed well under grazing. In coastal areas, elephant grass and Setaria were found best with annual yields of 175 tonnes of fresh fodder per hectare. Later trials have shown Setaria to perform best in the superhumid regions whilst elephant grass is best for the drier areas.

Natural pastures on the coast were also studied and it has been shown that carrying capacities of 18 sheep per hectare were possible with proper fertilizer and grazing management of Stenotaphrum dimidiatum under Casuarina trees. Leguminous species such as Stylo and Siratro were successfully introduced in pastures to improve the protein intake of animals. The tree legume Leucaena leucocephala provides high-protein feed for livestock animals, and was commonly found on the western coast. Improved varieties such as Cunningham have been introduced and multiplied. However it is now severely affected by Heteropsylla cubana, an insect causing severe defoliation.

Objectives
(i) To investigate problems and constraints to fodder production and pasture development.
(ii) To generate cost-effective technologies for the improvement of pastures.
(iii) To generate cost-effective technologies for a better utilisation of fodder and pastures.
(iv) To generate cost-effective methods of fodder conservation.

Project 4: Onion Research.

Mauritius consumed 6022 tonnes of fresh onions in 1990, out of which only 2635 tonnes were produced locally. Some 300 tonnes are produced in Rodrigues and exported to Mauritius. Production has recently extended into new areas and under very different agro-climatic conditions. The traditional variety Local Red is preferred by consumers on account of its pungency and good storage characteristics. It accounts for 25% of local consumption of onions with yields ranging between 12 and 20 tonnes per hectare. Recently growers have started producing high-yielding varieties, usually F1 hybrids, from imported seed. Red Creole, Texas Grano, Tropicana Hybrid and Yellow Dessex are amongst these, and give 30 to 37 tonnes per hectare; they do not cure as well as the Local Red on account of their thick neck.

Onion growing is labour intensive, and is presently faced with problems of shortage and high cost of labour. It is necessary therefore to introduce mechanical methods for field operations. Direct sowing as an alternative to transplanting should be investigated. Long term storage of both imported and local onions is provided by the Agricultural Marketing Board, which can thus ensure a regular supply to consumers throughout the year. Losses in storage are due mainly to diseases, sprouting, rooting and shrinkage. Moreover certain problems like bolting and split-bulbs are still causing loss in quality and during storage, but are yet to be controlled. Research has also provided control measures for pests such as mites, thrips and nematodes.

Objectives
(i) To investigate problems and constraints to production.
(ii) To generate cost-effective technologies for increasing and improving productivity and post harvest quality.
(iii) To identify opportunities for labour saving, and develop relevant technologies.
(iv) To investigate management practices, pre harvest and post harvest, for improving storage life and quality.

Project 5: Mushroom Research.
Mushroom growing is a recent activity in Mauritius. Paddy straw mushroom was introduced by the Chinese Agricultural Team and results were erratic. Oyster mushroom was then introduced with better success. Research was then taken over by the Agronomy Division who developed a package of practices for the production of this specy on a substrate based on sugar-cane bagasse with supplementation. There is now scope for developing similar packages for higher-priced mushroom species such as Shitake and Agaricus to meet the requirements of local hotel industry for the fresh product.

The production of quality spawn has been mastered, and growers are now being supplied spawn on a regular basis. A simple technology has also been worked out using ready-to-grow fruiting bags. Different strains of Oyster mushroom have been introduced and tested for adaptation to our range of environments.

Other mushroom species have been introduced, and have produced fruits under laboratory conditions but the production systems have yet to be perfected before they can be proposed for commercial production. First trials are now under way to test methods of composting bagasse for use in the production of Agaricus mushroom. A collection of mushroom species and strains has been set-up.

Objectives

(i) Undertake surveys to ascertain local demand for fresh mushroom.
(ii) To develop low-cost technologies for production of Agaricus mushroom.
(iii) To improve systems of production for Oyster mushroom.
(iv) To develop methods of spawn production for different species of mushroom.
(v) To study mechanisation of operations in mushroom growing.
(vi) To maintain and enrich a mushroom collection.

Future Research Activities


It has been claimed that growers are making heavy use of chemical fertilizers. There are also reports of the presence of fertilizer nutrients in surface waters, and of nitrates in aquifers reaching levels beyond the permissible values on a few occasions. Phosphates are reported to cause pollution in lagoon waters. It is therefore important that alternative systems of plant nutrition be developed involving more rational levels of inorganic fertilizers, and that other sources of plant nutrients be tapped. There are possibilities for recycling agricultural wastes, composting, green manures, rhizobial nitrogen and mychorriza. These have to be integrated so that they provide the nutrient requirements of specific crops in a timely manner. The merits of these systems will have to be verified.

There is also need to adjust fertilizer recommendations for specific crops as a function of residual soil fertility and expected crop demands. At present fixed rates of fertilizer application are recommended irrespective of these factors. Economic considerations are often left out. It will be useful therefore to design methods that would assist the extension agents work out recommendations for specific situations on the basis of soil analysis data and expected crop demand. Such methods may assist in fine-tuning fertilizer application rates.

Recently there has been an increasing demand in special markets in Europe and United States for organic produce. Organic foods consist of all foods (fruits and vegetables and livestock products) that have been produced without recourse to synthetic chemicals. They must be totally natural in their production and post-harvest handling. Such produce fetches 25-35% higher prices. However the costs of production are generally higher than for conventional farming. Practically no study has been done in a systematic manner on organic farming methods.

Objectives

(i) To develop integrated plant nutrition systems (IPNS) for major vegetable crops.
(ii) To develop methods for fine-tuning fertilizer recommendations.
(iii) To assess the merits of IPNS in limiting environmental pollution.
(iv) To identify crops that could be produced organically.
(v) To generate production technologies compatible with the principles of organic agriculture.

**Project 7: Diversification in tea-growing areas.**

With the retrenchment programme in the public tea sector, some 2000 hectares would be released for diversification activities. In fact, interest has been shown by tea small-holders for cultivating vegetable and fruit crops in the tea-growing areas where soils are acidic and superhumid conditions prevail. The integration of new crops into a tea-based cropping system must be considered with care; it must be managed so as to minimise degradation of land as a resource, avoid misuse of agro-chemicals, and ensure that results of such diversification efforts be sustainable.

First trials in the tea areas focussed on investigation of soil amendments necessary to correct for the high acidity and the low content of organic matter of such soils with a view to ensure more productive vegetable crops. Further work is required to ascertain whether the promising results would be sustainable.

Experiments are in progress on diversification crops such as Banana, Cardamom, Turmeric, Citrus and Table Grapes. 71 banana plants of varieties introduced by FARC are being raised for experimentation: Williams, Grand Naine, Cavendish 901 and Petit Naine. Citrus under trial include Mandarines Dancy and Beauty, Tangor Ortanique, Clementine Corsica, and Satsuma varieties.

**Objectives**

(i) To identify crops suitable for production in tea areas.
(ii) To develop cropping patterns for sustainable production.
(iii) To investigate appropriate soil amendment programmes.
(iv) To investigate problems and constraints to production.

**Project 8: Wheat Research.**

Annual imports of wheat flour stand at around 70,000 tonnes. It would be interesting therefore to investigate the possibility of producing it locally and to assess the likely cost of production. A wheat mill is now operating in the country processing imported raw materials. Moreover the production of this commodity locally would help ensure some measure of food security with regard to staple foods.

Rice is the other popular staple. Previous research has resolved all technical issues relating to its production under flooded conditions. Yields were high, and two crops could be grown in the year. However, costs of production were very high compared to imports. Results from tests in sugarcane interlines or in full-stand under rainfed conditions were not promising.

**Objectives**

(i) To investigate problems and constraints to production.
(ii) To develop cost-effective technologies for local production.
(iii) To identify opportunities for integration into existing or new cropping systems.

**Fruit Research Division**

In the context of agricultural diversification and food self-sufficiency, there is considerable scope for improving the production of fruits such as banana, citrus, grape, strawberry and pineapple for local consumption, and for extending the range of export commodities as is the case for pineapple, litchi, mango, passion fruit and papaya, and providing raw material for agro-processing. This division will intensify efforts on the introduction,
multiplication and screening of fruit species within the “Fruit Development Programme” and within the Indo Mauritian Programme. Special attention will also be given to the setting up of a post harvest research unit to develop appropriate standards and grading systems, in particular for fruits with export potential. Techniques to improve the quality of planting materials will also be investigated upon.

Ongoing Project

Project 9: Fruit cultivation.

Local production of fruit on the commercial scale is restricted mainly to banana, pineapple and citrus. Other species are grown mainly in the backyards. Imports of fresh fruits averaging 3500 tonnes annually are necessary to satisfy local demands.

With the assistance of the French Government, a fruit development programme was started in 1992. Planting materials of citrus, strawberry and other fruit species have been introduced and are being evaluated. Moreover one project on litchi, mango and pineapple was also taken over as from March this year. Other fruit crops with potential on the local market include strawberry, table grapes, passion fruit, papaya and tropical apple. Table grapes and tropical apple are relatively new as commercial crops, and appropriate crop husbandry packages will have to be developed.

Reasons for the limited production include a lack of improved varieties, poor orchard management practices, pest and disease problems, poor quality and lack of post-harvest technologies. Little work has been undertaken on post-harvest management of fresh produce, except for diagnosis of diseases.

Objectives

(i) To identify new fruit crops/elite varieties for export as well as for the local market.
(ii) To develop improved technologies for the propagation of disease-free planting material.
(iii) To investigate problems and constraints to production.
(iv) To generate technology in order to increase and improve production of fruit crops for export.
(v) To generate and test post-harvest management practices for export produce.

Vegetable & Ornamental Division

Screening of introduced and locally selected varieties of the major vegetable crops will constitute the principal activity of this division. Efforts will also be focussed on the development of soilless cultivation techniques and related technologies, including cultivation under protected or semi protected conditions. Research to improve the quality of locally produced seeds will also be conducted. Research attention will also be directed to technology packages designed for export-oriented production of these commodities and covering such issues as varieties suitable for export.

Since 1988, the strategy for agricultural diversification has emphasized export-oriented production. Export of anthurium had by that time increased ten-fold from 1980 volumes exported. The area under Anthurium is about 75 hectares, and 85% of the blooms produced are exported. Exports have risen consistently from one million blooms in 1980 to 10 millions in 1990. There is a need to diversify the range of ornamentals and decorative foliage for the export market. Other tropical flowers such as heliconia, strelitzia and orchids would be tried.

Project 10: Vegetable Research.

There is a pressing need for extending the range of vegetable crops grown in Mauritius to meet the requirements of the tourist industry as well as the changing tastes of local consumers. New crops of potential interest include asparagus, gherkin, brussels sprout, artichoke, tomato and broccoli.
To overcome the problem related to seasonality in production, it is necessary to introduce new varieties likely to help even out production levels throughout the year. Production of vegetables in protected environments in plastic tunnels or in glasshouses can also assist towards off-season production, and will need research attention.

In view of the problem of labour shortage, mechanisation of operations is becoming increasingly important. Varietal screening will have to consider materials that lend themselves to mechanised cultivation, harvest and post-harvest handling. Labour-saving techniques such as module-raised seedlings will need to be introduced.

New production systems such as hydroponics and plastic houses will also be investigated under our conditions.

**Objectives**

(i) To identify new vegetable crops/ elite varieties for the local market, and develop techniques for their production.
(ii) To review and improve as required seed production methods.
(iii) To introduce and screen varieties suitable for local conditions, keeping in view the requirements of mechanised operations, agro-processing needs and post-harvest characteristics.
(iv) To investigate problems and constraints to production of vegetables in general.
(v) To investigate new technologies capable of improving productivity.
(vi) To generate and test post-harvest management practices.

**Future Research Activities**

**Project 11: Ornamental plants for export**

The area under Anthurium is about 75 hectares, and 85% of the blooms produced are exported. Export has risen consistently from one million blooms in 1980 to 10 millions in 1990. There is at present a need to diversify the range of ornamentals and decorative foliage for the export market. Other tropical flowers such as heliconia, strelitzia and orchids could be tried. Carnation, rose, gladiolus and chrysanthemum are also worthy of consideration.

Work by private producers has generated a range of spathe colours in Anthurium which now helps exporters provide variety in their consignments. Colours range from white through pink, orange, and red to dark-red. However the range of ornamental plants remains restricted, and no research has been undertaken to broaden the range. Some heliconia and strelitzia is being exported. One sugar estate has been experimenting on the production of orchids for the local market.

**Objectives**

(i) To assess the potential of ornamentals for export.
(ii) To identify new ornamental crops that could be produced locally for export.
(iii) To investigate problems and constraints to production of specific ornamental crops.
(iv) To generate propagation and production technologies for ornamental crops.
(v) To generate and test post-harvest management practices for ornamental crops.

**Crop Protection Division**

Considerable crop losses result from damage due to insect pests, diseases and weed infestation. In some crops the risks and/or cost of control measures may be so high as to discourage their production. Control measures add to the cost of production, and increases the pesticide load on the environment.

The use of pesticides has contributed significantly to raising and stabilising agricultural production. However, in recent years there have been signs of abuse of chemicals by way of induced resistance, environmental pollution and accidents. Effort is now being directed towards integrated pest management methods, which combine the
use of chemicals with other means such as manipulation of predators and parasites of the pest, plant resistance, pest avoidance and the use of behaviour modifying chemicals.

Project 13: Chemical Control of insect pests in vegetable and ornamental crops.

Vegetables are attacked by a wide variety of insect pests and mites, and their profitable production cannot be envisaged without resorting to application of insecticides and acaricides. The ornamental Anthurium is similarly affected. It will be necessary therefore to screen new chemicals and work out appropriate dosage rates for the effective control of problem pests. Consideration will nonetheless be given to more durable and more environmentally friendly alternatives whenever possible. Main pests include the leaf miners on bean crops; leaf miners, thrips and mites on garlic and eggplant; diamond back moth in cabbage and cauliflower; the fruit-fly *Bactrocera cucurbitae* which causes serious losses in cucurbits, and thrips and mites on Anthurium.

Field surveys will be required to study the population dynamics of these pests in time and space. Wherever possible economic threshold levels will be determined. Attention will be directed to regular surveys of pests of vegetables and to the development of control measures in the event of pest outbreaks or new occurrences.

Main pests that have received attention recently include the leaf miners *Liriomyza trifolii* and *L. huidobrensis*, *Thrips palmi*, *Thrips tabaci*, and the mites *Tetranychus* spp and *Aceria tulipae*. Trials have also been conducted for controlling the fruit-fly *Bactrocera cucurbitae* on cucurbits using attractants in traps, insecticide application or a combination of the two methods.

Objectives

(i) To study the population dynamics of serious insect pests in time and space.
(ii) To determine economic threshold for common insect pests.
(iii) To screen and assess the effectiveness of new pesticides.
(iv) To develop control measures in the event of pest outbreaks or new occurrences.
(v) To test alternative control strategies eg IPM for pests of economic significance.
(vi) To test performance of alternative equipment for pesticide application.

Project 14: Control of the Stable Fly.

Livestock in Mauritius is afflicted with two species of the stable fly (*Stomoxys nigra* and *Stomoxys calcitrans*) which severely limit the development of milk, cattle and deer production. They are particularly abundant on grazing lands in the superhumid areas in the central part of the country.

Exceptionally, and given the importance of the problem, this project will receive the attention of the crop protection unit despite the fact that it addresses a livestock problem.

Control can be achieved by application of chemical insecticides, release of parasitoids, and using funnel traps. Further studies are required to understand the dynamics of these pests so that control methods may be made more effective and/or more convenient to apply.

Objectives

(i) To study the population dynamics of stable flies in time and space.
(ii) To screen and assess the effectiveness of new pesticides against stable flies.
(iii) To test alternative control strategies eg IPM.
(iv) To test performance of alternative delivery systems for pesticide against stable flies.
Project 15:  Control of psyllid vectors of greening disease and citrus white fly.

Citrus is seriously affected by certain diseases such as greening, which reflects in a reduced productivity and a reduced life for infected trees, thus presenting a severe constraint to the expansion of citrus growing. This disease is transmitted by two insect vectors, Diaphorina citri and Trioza erytreae. D.citri is the more prevalent of the two, being present across the country and having an alternate host, the common shrub Murraya paniculata.

Two parasites, Tamarixia radiata and Tamarixia dryi, have been introduced and released in the past; they have not performed as expected on account of the existence of the alternate host as well as the presence of untreated citrus plants in backyard gardens.

Another pest of citrus is the white fly, Aleurothrixus floccosus, for which the parasite Cales noacki was introduced and released. Further studies are required to ascertain the degree of parasitism and the extent of control achieved.

Objectives

(i) To study the population dynamics of the vectors of greening and the citrus white fly in time and space.
(ii) To undertake an inventory of host plants of the vectors of greening.
(iii) To screen and assess the effectiveness of new pesticides against these flies.
(iv) To test alternative control strategies eg IPM.
(v) To evaluate the impact of control programmes.

Project 16:  Control of the Leucaena psyllid.

The Leucaena psyllid, Heteropsylla cubana, has been noted since two years ago in Mauritius and in Rodrigues; it causes severe damage to leucaena foliage which usually provides a cheap source of protein for animal feeding. Control measures have to be devised to check this pest.

A search for predators and parasites of this pest has already been started.

Objectives

(i) To study the population dynamics of this insect pest in time and space.
(ii) To survey and determine the existence of predators and parasites in Mauritius and Rodrigues.
(iii) To develop control measures against the Leucaena psyllid.
(iv) To test alternative control strategies eg IPM.

Project 17:  Control of major plant diseases.

Vegetables are also prey to a wide variety of disease organisms. It will be necessary therefore to screen new chemicals and work out appropriate dosage rates for the effective control of fungal and bacterial diseases as well as nematode infestations. Main problems include the purple blotch and blast diseases in onions; bacterial diseases of cucurbits, scab of tomato. Attention will be directed to regular surveys of diseases of vegetables and tobacco, and to the development of control measures in the event of outbreaks or incidence of unrecorded diseases.
Recent work has investigated the performance of fungicides for the control of foliar diseases of onions mainly to identify a substitute for Mancozeb, a product which is very effective but which is likely to be banned in a near future; survey and characterisation of bacterial diseases of cucurbits, including a first record of bacterial leaf blight disease of cucumber caused by Xanthomonas campestris pv. cucurbitae; control of tomato scab disease. Foliage diseases of ginger have also been looked into.

Objectives

(i) To develop and test methods for the control plant diseases of economic importance.
(ii) To study the incidence of major diseases in time and space.
(iii) To determine economic threshold for major diseases.
(iv) To test the effectiveness of new pesticides.
(v) To develop control measures in the event of pest outbreaks or new occurrences.
(vi) To test alternative control strategies eg IPM for pests of economic significance.

Project 18: IPM for the control of plant parasitic nematodes.

In line with the elaboration of Integrated Pest Management programmes for insect pests, programmes for disease control will be worked out whenever feasible. Economic thresholds will be determined for major diseases. Alternative control methods such as the use of resistant/tolerant varieties and crop rotation will have to be investigated.

Various chemical treatments and solarisation have been tested for the control of rootknot nematode in onion, eggplant, tomato and carrots.

Objectives

(i) To develop and test methods for the control of plant parasitic nematodes.
(ii) To study the incidence of parasitic nematodes in time and space.
(iii) To determine economic threshold for major parasitic nematodes.
(iv) To screen and test the effectiveness of new nematicides.
(v) To develop control measures in the event of outbreaks or new occurrences.
(vi) To test alternative control strategies eg IPM in crops of economic importance.

Project 19: Control of seed borne pathogens.

Seed quality is an important factor in increasing crop yields. In addition to such factors as genetic purity, presence of weed seeds and physical condition, the quality of seeds and the resulting field performance is determined by the presence of seedborne diseases. There is need therefore to investigate their occurrence as well as methods for their control in locally-produced as well as imported seeds.

Seed consignments are regularly sampled and tested for diseases in the case of locally-produced seeds as well as imported seeds.

Objectives

(i) To develop and test methods for the control of seedborne diseases.
(ii) To screen and test the effectiveness of new chemicals for their control.
(iii) To develop control measures in the event of outbreaks or new occurrences.

Project 20: Control of post-harvest diseases.

Fresh agricultural produce is subject to attack by parasites, both before and after harvest, more particularly after injury during handling or the occurrence of stress conditions such as high or low temperatures. This results in
loss of produce, deterioration of product quality, low market value and poor consumer acceptance. It is critical therefore to study the prevalence and consequences of the diseases, and to study management practices for their control. Banana, pineapple, mango, papaya are fruits that need early attention on account of their scale of production or their potential for export. Attention will also be given to diseases of stored produce such as potatoes and onions.

Virtually no work has been done on post-harvest management except for investigations into diseases and characterisation of their causal agents.

**Objectives**

(i) To survey the incidence of post-harvest diseases on crops with export potential.

(ii) To develop and test methods for the control of post-harvest diseases.

(iii) To develop quality control procedures for export produce.

**Project 21: Weed control.**

Weeds are serious pests of all crops, especially during the crop establishment. Unless they are controlled, weeds compete with the crop for resources leading to direct losses through a reduction in plant stand, growth and yield. Indirectly they affect cultivated crops by providing food and shelter to many pests or by serving as alternate host to others. Traditionally weed control has been effected by physical removal or by application of chemical herbicides. But with the scarcity of labour in the agricultural sector, research has already been undertaken to develop chemical control methods for sugarcane, tea, maize and potatoes. It is necessary therefore to develop and test similar methods for tobacco, vegetables and orchard crops. For successful application in vegetable gardens, such chemical herbicides must be effective, selective to the crop and with short residual action so as not to affect succeeding crops adversely. Moreover, out of concern for preservation of the environment from harmful chemicals, it is important that alternative strategies be investigated based on crop husbandry favouring the early establishment and vigour of crop seedlings to help them shade off the weeds; mulching to smother weeds, or based on biological control by parasitic organisms. In addition it will be necessary to identify more efficient product formulations and methods of application so as to minimise rates of application, and hence costs and the chemical load on the environment.

Work has been started on chemical weed control in tobacco with mixed results. Similarly, work has been initiated on vegetables as well as in pineapple.

**Objectives**

(i) To screen and test chemical herbicides for use in vegetable crops.

(ii) To screen and test chemical herbicides for use in tobacco crops and in orchards.

(iii) To determine the critical periods of weed competition.

(iv) To investigate improved formulations and delivery systems for herbicides.

(v) To investigate integrated weed management based on cultural practices, chemicals and/or biological agents.

**Resource Management Division**

Agricultural resources are limited, and must therefore be managed so as to ensure optimisation of their use to meet our needs now and in the future. The development of such sustainable systems of agricultural production requires an integrated approach in aspects of natural resources conservation, management and utilisation. It calls
for a thorough understanding of environmental variables and a better land use planning so as to ensure that the production of agricultural commodities is undertaken at locations where they are best adapted and have economic as well as ecological advantages.

Concern for the environment also requires that environmental consequences of agricultural practices be monitored on a short-term as well as on a long-term basis. The presence of agro-chemicals in underground water and rivers would suggest a review of current agricultural practices in this light. Management of agricultural wastes, recycling of crop residues and minimum-tillage systems are possible areas for investigation.

**Future Research Activities**

**Project 22 : Conservation of Plant Genetic Resources.**

Plant genetic resources need to be conserved to avoid their loss, and to ensure their availability for crop improvement activities in the future. Characterisation of accessions will have to be undertaken for species of economic value. It is especially critical to complete this exercise at the earliest being given the increasing utilisation of imported varieties by the farming community and which may hasten the disappearance of local varieties/landraces.

A germplasm collection has been started at Barkly E.S. No characterisation or evaluation has been effected as yet.

**Objectives**

(i) To undertake the collection of local germplasm of economic value.

(ii) To undertake the characterisation, documentation and evaluation of such plant genetic resources (PGR).

(iii) To undertake the conservation of PGR through seed storage and/or field genebanks.

(iv) To develop a national database on plant genetic resources.

**Project 23 : Cropping systems.**

The agricultural sector is competing with industry, urban development and other sectors for land and labour. It is therefore important that a land-use plan be established for agriculture, and management plans be developed based on ecological considerations with respect to climate factors, soil data, crop physiology, crop preferences as well as on socioeconomic factors. Such data will be useful for revising land-use plans in the light of changing circumstances, to develop cropping systems better adapted to specific environments, and to assess the possible impact of climate-change scenarios. An example could be the development of more intensive cropping patterns for areas brought under irrigation schemes.

Cropping systems are limited to sequences of purestand crops for most vegetables, and to sugarcane intercropped with foodcrops such as potatoes and maize. A Land Index system has been set-up at the MSIRI for land under sugarcane, and allows the potential of these lands to be determined for crops normally grown in sugarcane interlines. Similar data need to be collected for other areas and land-uses.

**Objectives**

(i) To investigate cropping systems for the optimisation of resource use.

(ii) To develop land-use plans

**Project 24 : Land Resource appraisal and Soil conservation**
With the increasing use of mechanised land preparation, it will be necessary to investigate the susceptibility of our soils to erosion as well as appropriate equipment and methods to limit the degradation of the soil, its susceptibility to erosion, and the harmful effects of soil compaction. Soil erosion implies loss of fertile soil and fertility to farming, the soil being carried away into rivers, reservoirs and eventually into the sea. The consequences are silting up of rivers and reservoirs, and pollution of lagoons. Previous work has been limited to computation of an Erodibility Index for a few sites.

**Objectives**

(i) To determine the erodibility index of main soil groups.

(ii) To determine the erosivity of rainfall at selected sites.

(iii) To study the influence of slope and cropping patterns on soil erosion.

(iv) To evaluate watershed management schemes.

**CONCLUSION**

DARE is expected to support research and extension activities of over 92 commodities in the crop sector and it is obvious that to cover all these commodities, substantial amount of resources and expertise is required. A number of these commodities however may not warrant immediate attention; nonetheless expectations on new crops and new technologies are also increasing.

It is therefore important that a system or framework for prioritisation of research activities be established. For this purpose, the national reviews related to national needs have been useful indicators. Moreover an analysis of problems along the production and consumption chain has also been attempted following discussions with farmers, extension officers and the research staff. With a view to developing a work programme and to focussing our attention on the immediate and perceived problems of farmers, a Rapid Rural Appraisal exercise is currently underway to identify problems in situ.

An assessment of the infrastructural facilities and human resources that are required to address the likely volume of problems of farmers is timely and essential. Inter institutional collaboration, both with local and foreign institutes, should be a high national priority to do justice to the farming community. A mechanism to enable or strengthen such collaboration will have to be established so that facilities and expertise can be used effectively for the benefit of the farming community.

**REFERENCES**


**Table 1**: Crops under the mandate of DARE

<table>
<thead>
<tr>
<th>AGRONOMY DIVISION</th>
<th>FRUIT DIVISION</th>
<th>VEGETABLE</th>
<th>ORNAMENTAL</th>
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<tbody>
<tr>
<td>Actual</td>
<td>Future</td>
<td>Actual</td>
<td>Future</td>
</tr>
<tr>
<td>1</td>
<td>Bean</td>
<td>Rice</td>
<td>Banana</td>
</tr>
<tr>
<td>2</td>
<td>Eddoes</td>
<td>Soyabean</td>
<td>Coconut</td>
</tr>
<tr>
<td>3</td>
<td>Fodder spp</td>
<td>Sweetcorn</td>
<td>Grape</td>
</tr>
<tr>
<td>4</td>
<td>Ginger</td>
<td>Wheat</td>
<td>Grapefruit</td>
</tr>
<tr>
<td>5</td>
<td>Groundnut</td>
<td>Guava</td>
<td>Custard apple</td>
</tr>
<tr>
<td>6</td>
<td>Lima Bean</td>
<td>Lemon</td>
<td>Hog Plum</td>
</tr>
<tr>
<td>7</td>
<td>Manioc</td>
<td>Lime</td>
<td>Jackfruit</td>
</tr>
<tr>
<td>8</td>
<td>Mushroom</td>
<td>Litchi</td>
<td>Longan</td>
</tr>
<tr>
<td>9</td>
<td>Soyabean</td>
<td>Mandarin</td>
<td>Nectarine</td>
</tr>
<tr>
<td>10</td>
<td>Sweet potato</td>
<td>Mango</td>
<td>Peach</td>
</tr>
<tr>
<td>11</td>
<td>Tea</td>
<td>Melon</td>
<td>Prune</td>
</tr>
<tr>
<td>12</td>
<td>Tobacco</td>
<td>Orange</td>
<td>Soursop</td>
</tr>
<tr>
<td>13</td>
<td>Turmeric</td>
<td>Papaya</td>
<td>Tamarind</td>
</tr>
<tr>
<td>14</td>
<td>Passionfruit</td>
<td>Green peas</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Pineapple</td>
<td>Ladies Finger</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Shaddock</td>
<td>Leek</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Strawberry</td>
<td>Lettuce</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Watermelon</td>
<td>Onion</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Watercress</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Patole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Pumpkin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Ridge Gourd</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Sweet Pepper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Tomato</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Watercress</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| | | | | | | | |
| | | | | | | | |

Total Crops 92
LIVESTOCK RESEARCH - CURRENT AND FUTURE ACTIVITIES

B Hulman
Assistant Director (Livestock), DARE

ABSTRACT

Past research work in livestock laid emphasis on the use of local products and by-products in the diet of dairy and beef cattle. This led to the use of high levels of molasses, containing urea, in livestock feeding. The present paper outlines the researchable problems in livestock and proposes the areas in which programmes of applied research will be worked out. The programmes can, however, be modified following the results of the rapid rural appraisal which is presently being conducted.

INTRODUCTION

Livestock research in Mauritius dates as far back as the early 60's with the implementation of the FAO/UNDP financed Milk and Meat Project. The research programmes were centred on the utilisation of local products and by-products in animal feed, with particular reference to cattle. The other species of livestock received much less attention than cattle.

It was thus demonstrated that diets of beef and dairy cattle can contain between 30 to 60% molasses and that urea, as a source of non-protein nitrogen, can significantly reduce dietary requirement of protein of the growing and lactating animal. Results of research have also shown that sugarcane tops, as used by the smallholder dairy farmer, can provide the energy for maintenance of the growing and lactating animal. Sugarcane tops have been successfully ensiled and fed to cattle. Bagasse can be utilised as a source of fibre for the ruminant, but steam treatment has had little effect on animal performance, in terms of liveweight gains, although the digestibility was improved by about 50%.

Over the past twenty years there has been a significant decline in the national cattle herd from around 40,000 head to 19,000 in 1993. Likewise the goat population has decreased to around 22,000 head (Table 1). There has been an increase in the pig population. Similarly deer production has gathered momentum and the population is now estimated to be about 60,000 compared to around 30,000 about 20 years ago.

Table 1: Livestock Population

<table>
<thead>
<tr>
<th></th>
<th>July 83</th>
<th>May 93</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>24 175</td>
<td>17 460</td>
</tr>
<tr>
<td>Goats</td>
<td>72 278</td>
<td>22 906</td>
</tr>
<tr>
<td>Sheep</td>
<td>2 037</td>
<td>400</td>
</tr>
<tr>
<td>Pigs</td>
<td>7 055</td>
<td>15 264</td>
</tr>
<tr>
<td>Deer*</td>
<td>40 000</td>
<td>60 000</td>
</tr>
</tbody>
</table>

There has, therefore, been a corresponding decrease in milk, beef and goat meat production (Table 2) while poultry meat, eggs, venison and pork production have increased. Although there has been a net increase in total meat production, because of poultry meat, the country relies heavily on importation to satisfy the increasing demand for milk, beef and goat meat and mutton.
Table 2: Local Production & Importation of Milk & Meat

<table>
<thead>
<tr>
<th>Production Sector</th>
<th>Units</th>
<th>1983</th>
<th>1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk (dry equivalent)</td>
<td></td>
<td>970</td>
<td>12 401</td>
</tr>
<tr>
<td></td>
<td></td>
<td>650</td>
<td>15 122</td>
</tr>
<tr>
<td>Beef</td>
<td>tonnes</td>
<td>407</td>
<td>5 238</td>
</tr>
<tr>
<td></td>
<td></td>
<td>427</td>
<td>9 436</td>
</tr>
<tr>
<td>Goat Meat &amp; Mutton</td>
<td>tonnes</td>
<td>116</td>
<td>2 867</td>
</tr>
<tr>
<td></td>
<td></td>
<td>94</td>
<td>4 534</td>
</tr>
<tr>
<td>Pork</td>
<td></td>
<td>602</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 054</td>
<td>43</td>
</tr>
<tr>
<td>Poultry Meat</td>
<td></td>
<td>5 800</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17 000</td>
<td>330</td>
</tr>
<tr>
<td>Venison</td>
<td></td>
<td>250</td>
<td>475</td>
</tr>
<tr>
<td>Eggs x 10^6</td>
<td>Units</td>
<td>40</td>
<td>92</td>
</tr>
</tbody>
</table>

CURRENT LIVESTOCK ACTIVITIES

The projects which are being implemented in the Livestock Research Department are deemed to be need based, end-user driven and implementation is, as far as possible, on-farm backed by strong on-station experimentation. The research programme includes the following thrusts:

Smallholder Dairy Production Thrust

Reproduction problems and factors associated with reproduction of the cow seem to be affecting calving interval, heat detection and reproductive efficiency. A project to diagnose reproductive biology of the post-partum reproductive female is being implemented in order to determine the reasons for:

a) Long calving interval
b) Low reproductive efficiency
c) Nutritional factors associated with reproduction
d) Any heat detection problem.

Dairy and Beef Thrust

Although the number of ruminant animal has decreased, the availability of fodder has also decreased with urbanisation, more land area devoted to housing development and improved methods of cultural practices in sugarcane fields (herbicide use). During the intercrop season (November to June) which includes a period of moisture deficit, availability of fodder is very much reduced. The formulation and feeding of a complete ruminant feed appears to reduce fodder requirement by the growing and lactating animal. Efforts to improve production of the complete feed is now underway.

Poultry Meat and Eggs Thrust

This sub-sector of the livestock sector has witnessed sustained increase in consumption and production has always responded to demand. The industry is gearing itself to set up the necessary infrastructure in order to satisfy future increases in demand. The small scale poultry meat and egg production units are facing serious problems regarding provision of litter, especially for broiler production, as wood shavings are becoming quite rare. Alternative sources of litter have to be investigated in order to determine their suitability. Bagasse would be an alternative.
Deer Production Thrust

Over the last 10-15 years, deer production in private and leased land has intensified and attempts have been made to increase stocking rate in order to step up production. It has been noticed that in certain cases fawn birth weight has decreased and this could be attributed, amongst others, to a low nutrition level of the hind. Since a significant length of the gestation period falls within the time when pasture production is believed to be low, supplementation needs to be envisaged.

A study to determine pasture profile in selected areas throughout the year is underway. This will help to work out a supplementation strategy during periods of pasture deficits.

FUTURE RESEARCH ACTIVITIES

As a result of population increase and improvement in the income of the population it is expected that demand for milk, meat and livestock products will increase. Table 3 shows the estimated per capita consumption for milk and meat by the year 2020 (National Long Term Perspective Study). It is expected that research will contribute to increase local production of milk and meat so that the gap between local production and importation can be reduced.

Table 3: Estimated Per Capita Consumption of Milk & Meat

<table>
<thead>
<tr>
<th>Sector</th>
<th>Units</th>
<th>1993</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk (dry equivalent)</td>
<td>Kg</td>
<td>11.3</td>
<td>13.0</td>
</tr>
<tr>
<td>Beef</td>
<td></td>
<td>9.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Goat Meat and Mutton</td>
<td>Kg</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Pork</td>
<td>Kg</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Poultry Meat</td>
<td>Kg</td>
<td>16.0</td>
<td>32.0</td>
</tr>
<tr>
<td>Venison</td>
<td>Units</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Eggs</td>
<td>Units</td>
<td>80.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The problems facing the livestock sector have been reviewed by the Livestock Committee of the High Powered Committee and the National Long Term Perspective Study. The Director of Agricultural Research and Extensino (DARE) undertook a survey of the smallholder dairy sector in order to evaluate the problems and prospects of small scale dairy production. DARE is presently involved in carrying out a rapid rural appraisal (RRA) in the livestock farming community in order to help to formulate future research programmes.

While awaiting the results of the RRA, the researchable problems on which future research programmes are going to be based are:

Milk Production

- Long calving interval
- Poor reproductive performance
- Low milk yield (3-5 litres/day)
- Low milk fat content
- High percentage (35%) of unbred cows.
Livestock Research - Current and future activities B. Hulman

Beef Production
- Poor growth rate (500 - 700)g/day
- Low efficiency of feed utilisation

Goat and Sheep Production
- Poor growth rate
- Low efficiency of feed utilisation
- Long kidding/lambing intervals
- Breeds and breeding

Pig Production
- Poor carcass quality
- Low efficiency of feed utilisation
- Low piglet survival rate
- Waste disposal problem

Small Scale Poultry Production
- Alternative sources of litter
- Waste disposal problem

Deer Production
- Feed supplementation strategy
- Fawn mortality
- Reproductive efficiency of hinds

Animal Health
- Animal health status in the country
- Increase in incidence of mastitis
- Increase incidence of disease in large scale goat farming
- Parasitism in small ruminants and drug resistance
- Infectious Bursal Disease in poultry
- Metabolic disorders.

Animal Biotechnology
Under the aegis of the National Agricultural Biotechnology Advisory Committee, possibilities of using modern techniques of biotechnology will be investigated in order to improve animal production and health. Avenues of investigation could be in the following:

(a) Breed improvement programme which includes:
1. Diagnosis of reproduction biology, oestrus cycle, ovulation time and response to manipulation.
2. Performance assessment such as the use of restriction fragment length polymorphism marker to assist in identification and selection, genome diagnosis and identification of marker sites to assist selection for performance traits.

3. Improvement schemes such as multiple ovulation and embryo transfer, in-vitro fertilisation and embryo sexing.

(b) Health improvement programme which includes:

1. Diagnosis of diseases by the use of monoclonal antibody diagnostic technology.

2. Treatment, prevention of recurrence and eradication by genetic engineering of antigen production and rDNA vaccine production.

(c) Feed resource utilisation programme which can include:

1. Feed quality by way of fermentation technology to improve cell wall degradation.

2. Improvement of rumen efficiency by genetic engineering of rumen microorganisms to enhance cellulolytic capacity.

3. Improvement of conversion efficiency by the use of recombinant growth hormones.

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DARE AND THE EXTENSION AND ADVISORY ACTIVITIES

B. Rajkomar
Assistant Director (Extension & Training), DARE

ABSTRACT

In the context of increasing international competition and changes within the country, DARE’s extension and advisory services will have to respond effectively to the need of its clients by providing appropriate technology and training with client/farmer welfare as the guiding philosophy. Linkages will have to be developed with research, and all other partners in the agricultural development process.

A Resource Profile Study will be carried out and a capacity building programme implemented to enhance technical support for an efficient and effective service to the community.

THE INTERNATIONAL CONTEXT

With the advent of trade liberalisation and the removal of many protective trade barriers, Mauritius will operate and carry out its economic and export-based activities in a very competitive and aggressive environment.

We have a number of handicaps including the following:

1. the island is small, and agricultural land is almost fully used.
2. the population is small, therefore the internal market is small.
3. our main export markets are far away.

However, we do have a number of strategic advantages also, some of which are:

1. the state has a vast expanse of sea territory (as yet untapped?).
2. internal stability (political and social).
3. the will to face the challenge.
4. experience in agricultural production and export.

Though there is a lot of uncertainty ahead, there is also a lot of optimism and opportunities.

THE LOCAL CONTEXT

Agriculture is still dominated by the sugar industry but there has been an important agricultural diversification effort. There is now an urgent need to reinforce diversification not only as a response to the international context but also as an adaptation strategy, as other sectors of the economy (industry, tourism and services) are putting a lot of pressure on the availability and price of resources to agriculture.

In the above environment, DARE is responsible for non-sugar agricultural research and extension. The research component has been covered earlier by the other representatives of DARE. This paper presents the view on extension and advisory activities.
THE PHILOSOPHY

The programme has the basic philosophy of increasing client (farmer/gentleman farmer) welfare, by responding to felt needs of the various groups of clients.

It has the following objectives:

1. To improve client/farmer welfare by provision of the necessary technical support and training.
2. To improve farmer, extension and research linkages.
3. To improve linkages between extension services and other institutions.
4. To strengthen agricultural extension and advice delivery.
5. To improve planning and execution of the extension programme.
6. To improve and strengthen monitoring and evaluation of extension/advisory activities.

APPROACH

The proposed service hinges around the technology triangle whereby researchers, extension officers and farmers communicate and exchange information for the mutual benefit of all parties concerned.

Should we not be talking about the technology square, by bringing in other partners in the agricultural development business, for example input suppliers (seed, fertiliser and pesticides), or rather still the technology circle to include all partners.

THE CLIENTS

DARE’s mandate is for non-sugar agricultural extension. It will have to meet the extension advisory service requirements of various categories of producers engaged in various sectors of agriculture. (Table 1).

<table>
<thead>
<tr>
<th>Table 1 : DARE’s Client</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sector / enterprise</td>
</tr>
<tr>
<td>Vegetable and foodcrops</td>
</tr>
<tr>
<td>Fruits</td>
</tr>
<tr>
<td>Flowers</td>
</tr>
<tr>
<td>Livestock</td>
</tr>
<tr>
<td>Tea and out-of-tea</td>
</tr>
</tbody>
</table>

(1): excluding foodcrops in MSIRI’s mandate
To a certain degree, the extension and advisory services are already being provided through the normal extension activities and the fruit development project. The target population has been estimated at about 4000 full time planters and a total area of 6000 ha (Table 2) for foodcrops and vegetable producers.

Table 2: Agricultural Area (ha) and Full Time Farmers (no.)

<table>
<thead>
<tr>
<th>Agricultural zones</th>
<th>Permanent Gardens (1)</th>
<th>Sugar rotational / interline land (1)</th>
<th>Total area</th>
<th>Full time planters (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pamplemousses</td>
<td>241</td>
<td>552</td>
<td>793</td>
<td>699</td>
</tr>
<tr>
<td>Riviere du Rempart</td>
<td>37</td>
<td>614</td>
<td>651</td>
<td>299</td>
</tr>
<tr>
<td>Moka</td>
<td>449</td>
<td>639</td>
<td>1088</td>
<td>592</td>
</tr>
<tr>
<td>Flacq</td>
<td>160</td>
<td>542</td>
<td>702</td>
<td>866</td>
</tr>
<tr>
<td>Black River</td>
<td>69</td>
<td>170</td>
<td>239</td>
<td>183</td>
</tr>
<tr>
<td>Plaine Wilhems</td>
<td>321</td>
<td>111</td>
<td>432</td>
<td>674</td>
</tr>
<tr>
<td>Savanne</td>
<td>132</td>
<td>853</td>
<td>985</td>
<td>204</td>
</tr>
<tr>
<td>Grand Port</td>
<td>111</td>
<td>994</td>
<td>1105</td>
<td>262</td>
</tr>
<tr>
<td>Total</td>
<td>1520</td>
<td>4475 (3)</td>
<td>5995</td>
<td>3779</td>
</tr>
</tbody>
</table>

(1) Source: MANR Extension Programme of Work 1993 and 1994  
(2) Source: DARE Agricultural Zone Survey, June 1994  
(3) Compares with 4869 ha quoted in the 1992-93 Annual Report of the Mauritius Chamber of Agriculture - Table 40

There is no information on the number of fruit growers but guesstimates put the population at 1000 - 1500. It is estimated that there are about 7000 livestock producers.

METHODS

Apart from conventional extension methods, DARE has also adopted an advisory/consultancy approach to meet the specific needs of identified groups of producers/clients e.g. large producers. For extension activities, reliance is on mass media, group and individual contacts; the advisory services will have specialist multidisciplinary teams, operating as consultancy teams. On-farm trials will also be implemented so that farmers can participate in the evaluation of recommendations. This will ensure that technologies are screened for appropriateness under farming conditions directly relevant to producers. Dissemination of appropriate technologies is also expected to be faster. Such an approach needs close interaction between extension and research staff and clear definition of responsibilities.

RESOURCE PROFILE STUDY

Though extension services have been provided to the farming community since decades, no objective Resource Profile Study (baseline study) has been carried out on a national level. Such a study is imperative for resolving farmer problems and improving the agricultural development process.
Among other topics, the study will deal with:

1. an assessment of resources, both physical and human
2. an assessment of farmer circumstances - natural and socio-economic
3. main crop/livestock enterprises, with cropping patterns / cropping systems / cropping calendars
4. problems, constraints and farmer strategies to these
5. farmers needs for training
6. potential for agricultural development

**CAPACITY BUILDING**

**Information, Information Technology and Communication Technology**

Information will play a crucial role in the modernisation and agricultural diversification process. It is therefore important for farmers to have access to the appropriate information at the right time.

Increased effort is being placed in the development of appropriate extension packages for dissemination to the farming community. Publications will be updated and new ones published as needed. The sources of information will be local and international.

It is imperative to develop and set up a database on agricultural inputs, services and suppliers together with the mechanism for regular updates. Thus, farmers can have the relevant information at a finger touch.

Investment will have to be made in information technology so that information can be rapidly made available to clients. Appropriate packages and expert systems will have to be developed, tested and disseminated.

The home video is a common appliance in the Mauritian household. Use should be made of such a communication tool by preparing appropriate video programmes, which farmers can view at their own leisure and when required.

**Linkages with Research and other partners**

The extension services will play a key role in the feedback of farmer problems to researchers who will be provided with the forum to be in direct contact with farmer problems and priorities. Research can then be in phase with the problems facing the farming community. Farmers will also be given the means to contribute in the formulation of the research agenda and priority setting. In this context, a number of Rapid Rural Appraisals (RRAs) are being undertaken.

An important attitudinal change will have to be induced because service will be client-oriented and instead of working for the farmer, extension and research staff will be working with the farmers. Researchers will be encouraged to visit planters and planters groups, regularly with extension officers so that there is a rapid and regular appraisal of problems.
Feedback and policy reforms

For the shortwhile that DARE has been functioning a number of situations have already made it clear that problems should be addressed by the appropriate authorities, if the farming community is to trust the organisations/institutions involved e.g. seed supply.

As extension, research and socio-economics staff will be regularly in contact with farmers. DARE will be in a privileged position to document and report on problems. However, the reporting in itself will not be enough. Current policies will need review and reforms brought in, in a timely manner. Otherwise, the whole system of partnership will be jeopardised.

Training

Training will be a vital component of the integration of Research and Extension, as the attainment of the objectives will depend on human resource capacity enhancement at all levels.

Training will be continuous and will be for all levels of the organisation so that it leads to:

(i) competence, efficiency and professionalism
(ii) adaptability to meet changing circumstances
(iii) quality in the delivery of the output

The training needs of staff are being evaluated through a training needs assessment for staff at all levels of the organisation (research and extension).

Training needs are being assessed, amongst others, to determine:

(i) short term requirements
(ii) medium and long term requirements

The training needs of the farming community in respective zones/district are being determined by field extension staff as part of their routine advisory activities. The resource profile study will bring in clear focus the above needs. At present, training is being offered through evening meetings and conducted tours.

The training provided to farmers will not only be technical but broad-based, the aim being to empower them to operate for their own welfare and that of their group.

Extension and service-oriented activities

Historically, the extension services have been carrying out a number of service-oriented activities - for example, collection of agricultural statistics on foodcrop, vegetable and fruit production, certification for duty free concessions, etc. Should government policy be in favour of the continuation of these activities by the Extension and Training Department of DARE, then additional resources will have to be provided.

Agricultural Statistics

The operationalisation of the Agricultural Management Information System (AMIS) will facilitate agricultural data collection; processing and retrieval. Only with the effective use of IT can the setting up of an information service regarding plantations, areas, etc. be envisaged.

In the meantime, the whole procedure of data collection, area and yield estimations will be reviewed and improved with the assistance of the Central Statistical Office of the Ministry of Economic Planning and Development.
Women and Youth in Agriculture

DARE has taken on board the Agricultural Youth Clubs Unit responsible for the training of youths in agriculture. The unit will be strengthened and its scope of action broadened to include women in agriculture. The unit will provide training for these groups and provide advisory support so that they can be encouraged to participate in and improve agricultural production. Duplication of activities, covered by other organisations, will be avoided.

PROJECTS - CURRENT AND FUTURE

Environmental Investment Programme (EIP) - Improving Pesticide Use and Regulations

Surveys will be carried out to assess pesticide usage and recommendations made to improve it. Education and training needs will be identified and implemented.

Vocational Training of Farmers

Government has set up a Technical Advisory Committee (TAC) on vocational training in agriculture for farmers and farmers-to-be. Pilot training courses are planned for the near future.

REFERENCES


DISCUSSIONS

Q. The target population for your extension programme has been estimated at about 4,000 full-time planters, how many part-time are there?

B.R. This is only an indicative figure, there are many part-time producers involved for example in the fruit and livestock sectors.

Q. Would vegetable seed production, whether foundation seed or basic seed be under DARE's responsibility?

S.N. Seed production is regarded more as a service to the farming community so that it would be the responsibility of the Agricultural Services. Nonetheless, the component related to varietal selection and new varieties will have to be generated by research i.e. by the DARE. The Agricultural Services would then be responsible for multiplication.

R.A. The production of seed is being considered more and more as a private sector initiative.

Q. Would it be realistic, given the resources available at DARE, to consider conducting research on agronomy, even basic, of ninety-two crops?

D.D. The list of ninety-two crops gives an idea on how much the growers, who have been growing commercially these crops, expect from the researchers of DARE. Of course, it will be necessary to introduce some sort of prioritization so that attention is focussed on priority crops and priority problems or priority systems around the commodity. We identified some of the research themes in the light of discussions we had at the National Consultation, and the Task Force recommendations. We did the commodity profile analysis from seed till consumption and this has been done from discussions with the Extension Officers, farmers and some operators to identify main thrusts.

We are developing a database of certain technology that can be transferred or adapted almost immediately, especially in the post-harvest operations where there is an urgent and pressing need of such type of information and technology for certain crops. We are therefore going for quick adaptive transfer of technology from this database.

Another issue is that certain of the crops are not that economically important and may not justify full-time research programmes. Nonetheless we need to keep note of these crops so as to be able to provide solutions to our farmers, should problems arise.

Q. Your survey as is presented includes the number of farmers only, does it actually include the area, the number of times the crop is planted in a year and a total volume or mass of crop produced and its economic importance, as I feel that these will have to be weighted in the prioritization?

D.D. The exercise as has been done is monotemporal. However this will be an on-going multi-temporal activity in collaboration with the extension to take account of their seasonality. We have taken account of the area that has been covered and considered also the main production sites.

Q. There are two things in the crop research sector, one is the duplication on certain crops which makes the list appear even longer, and the second is the issue raised about Food Security, where I wonder why wheat and rice appear as a potential researchable crops?

D.D. It is true that there is a certain degree of duplication in certain crops, the list will have to be reviewed. Concerning the work to be done on wheat, interest was shown in the High Powered Committee that we should still continue some work on wheat, but it will be a minor one; hence in terms of ranking or priority setting, I don't think it will have a weight.
Q. I remark that there is a competition between large and small planters.

R.J. This is a policy issue and I think it is not the appropriate forum to comment on that one.

K.M. I think we cannot have a complete research agenda without recognising that a series of socio-economic issues that need to be addressed like this one. If we haven't provided for it, then we need to take note that we haven't provided for it and try and work out where, in what type of forum, we could raise and consider such issues.

A.O Talking of food security, I fail to understand why so much emphasis is being laid on and priority being given to tobacco research competing still further on limited resources?

R.A. I think this is a very good example of an important social issue be it from the point of view of the farmers, who are devoting so many acres to this crop, from the point of view of the person who is doing something wrong to his health and to the health of other people, and also from the point of view of Government which is getting revenue from all this.

K.M. My comment goes about how we go about generating a research agenda. We have had two different approaches. Dr. Govinden's approach about generating a research agenda is more from a macro-economic point of view supply and demand situation although this was done as part of the National Long Term Perspective Study, then trying to work out the economics and eventually R & D. Generally the approach which I see for DARE has been more on the basis of field studies then generating a research agenda. Both approaches may be complementary. I think there is need for us to put our thinking together in terms of working out how we might generate that kind of synthesis which is required in terms of the way we proceed in generating research agenda. I think this will have a lot to do in terms of the way in which we organise ourselves in responding to the research agenda, not merely in terms of the distribution of responsibility among institutions we have but also in terms of the structures that we set up to generate the appropriate linkages and interfaces which are required and bringing in possibly other dimensions which are currently left out in the way we approach the research agenda. The AMB is an interesting institution in that it deals with both technical as well as socio-economic issues.

There are a certain number of socio-economic marketing supply and demand issues which need to be brought into the equation in terms of generating the research agenda to some extent. I think really that the issue of how we set a research agenda needs to be addressed, be it in another appropriate forum.

R.J. In the large number of crops that we have to tackle, in terms of research, we can visualise simply observational plots, simple experiments, variety introduction and testing, going to more complex scheme of studies, fertilizers, spacing, pest control to end up with what people denote really as research that is inputs into solving very complex problems. It is clear to me that each of these crops will demand a specific level of research.

Q. What is the calendar of DARE, what sort of deadlines DARE is putting on the crops within its mandate?

S.N. At this point in time, we have identified the main thrusts for research. Since the extension staff joined in, we have formed multi-disciplinary teams and these are going out now in the field meeting planters and undertaking a Rapid Rural Appraisal exercise. At the end of this exercise which we ought to have completed by the end of this month, we are going to sit down and analyse all these problems and that would lead us to make our research agenda.

Of course, we foresee there would be many more problems that we may be able to handle and that is where we need to prioritize and in the prioritization process we shall take in consideration not only the problems as perceived by the producers but also the economic importance of the commodity. We would consider therefore things like the likelihood of a successful research programme, the likelihood of a solution being found in very short term, medium term research programme and also the socio-
economic issues like gross margins will be brought in and standardised; it will be a multi-pronged programme.

Q. Where will you be next year?

S.N. We expect in July to have the research agenda worked out, prioritized and implemented by September, and at the end of the cycle review the situation. We plan to have built the system not only through the Technical Advisory Committee but through an annual Review of Work Programme to ultimately give new directions to research as needed. I suppose at this point in time next year, we would have completed one full year of research.

Q. I see large figure increases targeted for other animals and though I see a 50% increase from 0.4 to 0.6 in the year 2020 for venison, don't you think it is too conservative for long time target?

B.H. We have many constraints, one of them being land. Considering the problems that intensification in production would cause, I think a word of caution would be better here.

M. Considering the long list of crops under DARE's mandate, I presume we may take advantage of the electronic databases. Research Institutions may compile a database for such a long list of crops without too much difficulty even though we may not need to carry out research on all aspects of these crops.

Q. There has been a lot of criticism to the extension services in the past. What could we expect about quality of service from DARE?

B.R. This is one area where we want to make it professional dependent, on training and the technology available from research to disseminate; there will be target set, rigorous monitoring and evaluation.

R.A. The best way to assess the work of the extension service would be, I think, to ask the extension officer to report on what the producer has adopted from his advice.

Q. Do you consider monitoring pesticidal residues on vegetables?

B.R. Agricultural services do monitor regularly the level of pesticides in vegetables.

Q. In Europe, there is the tendency for a shift from inorganic to organic agriculture, what is DARE proposing to do in this context? Which body is there to certify such produce?

D.D We have a component in our research programme to raise some crops on organic substrate.

R.A. That question of setting up a body for certifying organic produce is not difficult. The demand for organic produce in Europe is fairly large, but whether that is going to last is another question.
ABSTRACT

Steps in the strategical and organizational approach leading to the creation of FARC and its early difficult days are described.

The main thrust, identified from the beginning, has been in the field of biotechnology leading to the formulation of a national strategy for the use of biotechnology in agriculture and the environment. Concurrently, a modern biotechnology laboratory was set up with, as major activity, the large scale production of in-vitro plantlets for the planting community.

The other major activity concerns the field of information and documentation with the setting up of an Agricultural Management Information System (MARMIS), a Centralized Technical Database and a National Focal Point for Information thus benefitting from the CD-ROM and DORA projects of CTA.

CREATION OF THE FOOD AND AGRICULTURAL RESEARCH COUNCIL

The heterogeneous character of the agricultural sector requires a certain specific approach whereby research activities could be harmoniously coordinated to meet national objectives. It is to that end that a Food and Agricultural Research Council (FARC) was set up at the dawn of the second phase of our agricultural diversification program. Enacted in July 1985, the FARC is called upon, as defined in the Food and Agricultural Research Council Act (No. 49 of 1985) to:

(a) promote and harmonize research activities in agriculture, fisheries and food production;

(b) maximize benefits of such research;

(c) deal in such other activities relating to research in agriculture, fisheries and food production in line with Government policy.

Allow me now to present an overview of the activities of the Council.

STRATEGICAL APPROACH OF THE FARC

Review of Research Work

One of the primary tasks of the FARC has been to make a complete inventory of the research and experimentation work related to the whole agricultural field in Mauritius already conducted, in progress and planned for the future. Following that study various research projects involving all the research institutions were approved and financed by the FARC.
Developments in Biotechnology

Since its creation, the Food and Agricultural Research Council has always invoked the necessity to explore the possibilities that biotechnology could offer in the development of agriculture in Mauritius.

Advances in biotechnology (with, as a first step, plant tissue culture) have created new possibilities for Mauritian agriculture.

The FARC after setting-up the appropriate structures to receive, condition and harden in-vitro plantlets proceeded, in a first stage, to the introduction of a number of tissue-cultured plantlets of various crop, fruit and flower varieties so as to ensure an enlargement of our agricultural production base.

The FARC through that approach has provided with success, as an emergency procedure, planting material in view of accelerating the process of diversification. The strategy adopted is geared to promote:

(a) the development of the agro-industry through the availability of new varieties such as coffee, pineapple, etc.;
(b) the service to the tourist industry through the availability and provision of local fruits; pineapple, bananas, strawberry, grapes to the hotels;
(c) possibilities for export - for example flowers and fruits such as anthuriums, pineapples.

The implications of such a strategy is that the agricultural diversification programme of the Government is being consolidated. The FARC initiatives should be the driving force of the second phase of our agricultural diversification program oriented towards increased vertical integration and exploiting export potential in crops.

However, the preliminary initiatives of FARC should be considered as emergency measures.

ORGANIZATIONAL STRUCTURE OF FARC

While this preliminary basic work was being conducted, the Chairman of Council went on a visit to U.K., with the main purpose of obtaining first hand information on the organization, structure and functions of the British Agricultural and Food Research Council (AFRC), which had been in existence for over half a century, and of the relevant institutes.

As a result of these visits preliminary recommendations were made concerning the organization of the Mauritius Food and Agricultural Research Council and an organigram proposed. The importance of laying emphasis on work in biotechnology was also stressed.

Following the report, Mr. D.C.M. Corbett, formerly Deputy Chief Scientific Officer in the Policy Division of the British AFRC, was appointed with the following formal terms of reference: "to advise FARC in relation to its objects as defined in Act No. 49 of 1985 on:

(a) the organizational structure and management personnel to enable it to fulfill the objectives; and
(b) appropriate research management procedures to enable it to promote and coordinate agricultural research in Mauritius in accordance with its functions as defined in the Act."

Mr. Corbett after paying two visits to Mauritius during which he had ample opportunity to discuss with representatives of organizations interested in agricultural research as well as with a wide variety of people the role of FARC and how it could best meet its objectives submitted his recommendations.
These were embodied in a report entitled "FARC and the Organization of Agricultural Research in Mauritius" submitted in October 1989 and approved by Council.

These recommendations cover the organizational structure and management of FARC with terms of reference for the senior officials. The organizational structure proposed in an organigram differs slightly from the one already planned in the Chairman's report but aims at producing a more flexible organization.

The major recommendations made were:

(a) In order to become operational as soon as practicable key scientific and administrative staff should be appointed to support the Executive Chairman.

(b) In some activities FARC should perform a role complementary to the other research organizations.

(c) FARC should provide a library service accessible to researchers and complementing that already available at Reduit as well as on-line access to the large agricultural databases.

(d) FARC should develop a current research management system in which research is described and costed uniformly and revised annually thus making it unnecessary to appoint committees to prepare or update the inventory of research.

(e) The library should be computerized so that on-line databases can be accessed as well as the current research information system.

(f) FARC should operate a well-defined research grant scheme under which qualified individuals can apply for support for research projects. The scheme should provide short term assistance for research on defined projects in sciences relevant to food, agriculture, fisheries and forestry falling within the Government Diversification programme.

**MAIN PRESENT THRUSTS**

It is fitting, in presenting the activities conducted so far by FARC, to define the conditions under which the Council has been operating so far.

Created in 1985, the FARC started work immediately with, as already mentioned, the setting up of various committees to conduct the inventory of research and experimentation in agriculture. No less than 84 selected members contributed to the study which led to the identification of various research projects.

Concurrently, developments in the field of biotechnology were taking place with a start in the setting up of the needed infrastructure.

In 1986, following his visit to Europe, the Chairman submitted a report on the organization of FARC.

In 1989, following the visits of the Consultant Corbett, his report was submitted and accepted by the Board of FARC.

During the four years following the creation of FARC, the Chairman was to work almost single-handed, with a minimum shifting assistance provided by the Agricultural Services.

In spite of the recommendation of the Consultant concerning staffing arrangements that situation was to continue until 1994, when the Executive Chairman was to receive his contract and the green light obtained for the recruitment of staff as originally recommended, an operation still under way.
It should be noted that, in spite of the extremely difficult conditions under which the Council was operating all the recommendations of the Consultant have been implemented. That is, in a large measure due to the devotion and hard work of the skeletal staff with special praise for the unstinted assistance given by Mr. N. B. Yerrigadoo.

The results, some of which are going to be presented in more detail during this meeting, involve:

1. **Plant Tissue Culture**

   You will hear more on plant tissue culture with specific reference to the banana plant during a separate presentation. Suffice it to say that the facilities for conditioning tissue-cultured plantlets are functioning very satisfactorily and a modern tissue-culture laboratory, now completed, will be operating shortly.

2. **National Strategy for the Use of Biotechnology in Agriculture and the Environment**

   I shall dwell in some length on this important subject which involves the cooperation of all our Agricultural Research Organizations, coordinated by FARC.

   (a) **Biotechnology Planning Workshop**

   A Biotechnology Planning Workshop organized by FARC with the assistance of ISNAR and the World Bank took place from 22 to 24 April, 1992 with the participation of research managers and senior scientists, from all research organizations, who have worked or have an interest in the area of biotechnology as well as private producers in horticulture, livestock and the agro-industries with the same interest. The group therefore included University, MSIRI, Agricultural Services, FARC, Fisheries, Forests, Environment and the private sector.

   The workshop, in an attempt to define a National Biotechnology Program in agriculture, has, in the first place, identified the key elements of a national strategy on biotechnology. It has then tried to obtain a picture of what the agriculture/environment sector of Mauritius will look like in 20 years time. That was followed by an identification of constraints in agriculture and the environment in Mauritius.

   The development of a national strategy for the use of biotechnology in agriculture and the environment took into account factors such as national priorities and the establishment of consortia to address these priorities. Four such consortia were identified to deal with:

   (i) the production of improved sugarcane varieties (under MSIRI chairmanship);

   (ii) the increased production of value-added products from sugarcane biomass and the minimization of environmental impact (under chairmanship of University);

   (iii) the improvement of quality and the control of diseases in livestock and aquaculture (under chairmanship of the Agricultural Services);

   (iv) the increase availability of elite, disease-free planting material of high value crops (under chairmanship of FARC).

   The four consortia would work under a National Agricultural Biotechnology Advisory Committee (NABAC) responsible through FARC to the Minister of Agriculture. The terms of reference of NABAC have been defined taking into account: priority areas, information/technology access,
regulatory matters, intellectual property management, human resources development, financial investments and the commissioning of the four consortia to address four national priority themes to accelerate the use of biotechnology in agriculture and the environment.

### Organigram

The following organigram was adopted:

```
Minister of Agriculture
|
Food and Agricultural Research Council
|
National Agricultural Biotechnology Advisory Committee (NABAC)
```

(Four consortia to address four national priority themes to accelerate the use of biotechnology in Agriculture and Environment)

![Organigram Diagram]

(The Consortia comprises representatives from MOA, MSIRI, University, FARC, Environment, Sugar Industry, Private Sector and addresses the four priority national themes identified).

(c) **Activities of the four Consortia**

(i) **Consortium I - Increasing the availability of elite, disease-free planting material of high value crops**

This Consortium entrusted to FARC has, after the successful establishment of a conditioning unit, established introduced from abroad a wide range of tissue-culture plantlets of fruit and field crops and ornamentals. The modern laboratory recently completed provides facilities for teaching purposes as well. Intellectual property management and regulatory matters concerning biosafety are presently under study. Human resources development are being conducted by the University.

(ii) **Consortium II - Improving the quality and control of diseases in livestock and aquaculture (MOA)**

This Consortium, entrusted to the Directorate of Agricultural Research and Extension, in addition to the conventional techniques of biotechnology now being utilized such as:

- Artificial insemination in cattle using frozen semen.
- Use of ELISA in animal disease diagnosis, especially poultry diseases.
- Use of Rapid Immuno Assay techniques to study ovarian activity in post-partum cattle,
is considering the desirability of using modern techniques of biotechnology in order to improve animal production and health.

(iii) **Consortium III - Increased production of value-added products from sugar cane biomass and minimization of environmental impacts**

This consortium entrusted to the University of Mauritius is conducting three projects.

- Integrated management of sugar-cane mill wastewater for environmental protection, bioenergy production and irrigation.
- Composting of solid wastes in subtropical regions.
- Application of water hyacinth in the treatment of industrial wastewaters in Mauritius.

(iv) **Consortium IV - Continuing production of improved sugarcane varieties with desirable qualities**

This consortium entrusted to the Sugar Industry Research Institute is conducting a whole range of projects in tissue culture (rapid micropropagation, in-vitro conservation, genetic transformation); in disease diagnosis using RFLP and RAPD techniques, in the development of DNA probes for sugar cane pathogens and in sugar cane improvement using molecular markers.

These have already been the subject of a presentation yesterday. With all these developments, Mauritius is well embarked in the field of agricultural biotechnology and it is felt that the National Agricultural Biotechnology Advisory Committee is in a position to organize an international seminar on agricultural biotechnology for small island countries in the near future.

**OTHER ACTIVITIES**

The other activities recommended by the Consultant have been implemented or are in the process of implementation; they concern the setting-up of:

(i) An Agricultural Management Information System (MARMIS)

(ii) A Centralized Technical Database.

These two activities are going to be the subject of a detailed presentation in a moment. Suffice it to say that the final report of the Consultant on MARMIS has just been received and a fair amount of groundwork has already been conducted.

It should also be mentioned that with the assistance and cooperation of CTA (Technical Centre for Agricultural and Rural Cooperation) of the Netherlands, and the approval of Government, the FARC is now functioning as the National Focal Point for Information in Mauritius, thus benefiting from the CD-ROM and DORA projects, and it has also been agreed that it should become the Regional Focal Point for the Western Indian Ocean Area.
In conclusion, it may be said that FARC through its holistic approach should now be in a position to promote a more dynamic and coordinated research environment for the betterment of the Mauritian Agricultural sector.

REFERENCES


THE ROLE OF TISSUE CULTURE IN AGRICULTURAL DIVERSIFICATION

D. Y. Bachraz
Research Coordinator, FARC

ABSTRACT

Agricultural diversification to meet our future needs call for the adoption of new technologies in agriculture. Utilization of the best cultural practices, fertilization, pest control measures will not give the necessary results without the use of best planting material. Tissue culture is now a significant horticultural propagation method which has revolutionized the horticultural industry. Use of this technique should be considered for mass propagation and the establishment of disease free stock material. This type of material is not seasonal as it can be produced throughout the year in the laboratory. The FARC through the setting up of a hardening and conditioning structure in 1990 has provided disease free plantlets of several crops species for successful diversification.

The most recent crops which FARC is working upon are the banana & plantain where several cultivars have been introduced for evaluation. Results have been promising and the possibility of using tissue culture plantlets to improve banana cultivation in Mauritius is desirable. Most banana producing countries have now adopted this technology. Another crop which can benefit from tissue culture is the potato. Potato production in several Asian countries is based on tissue culture plantlets. Several crops grown in Mauritius can benefit from the use of tissue culture, cardamom, papaya, rose, strawberry, garlic, orchids etc.

Policy should be defined on the use of tissue culture for the propagation of several horticultural crops through NABAC. Mauritius needs also to join UPOV Convention to obtain improved crop varieties from abroad. A priority list of crops to be propagated through the new FARC tissue culture Laboratory needs to be established.

INTRODUCTION

Success of the diversification process in the agricultural sector resides in the production of quality products which is demanded by the local market, hotel (Tourists) or the export market. This production should be both economically and ecologically sustainable through the use of new technologies available in agriculture. Utilization of the best cultural practices, fertilisation, pest control measures will not give the necessary results without the use of the best planting material.

Integrated pest management methods with emphasis on biological, genetic and cultural methods of control rather than chemicals and the use of tissue cultured material, can help in the modernisation and sustainability of production. Tissue culture, micropropagation and growing in vitro is now a significant horticultural propagation method which is experiencing rapid acceptance and has revolutionised the horticultural industry. Tissue culture is an important new method of plant propagation available to growers. Farmers should consider tissue culture for two reasons:

1. mass production
2. to establish or maintain "virus-free" stock.

Other uses include somatic hybridization, the induction and selection of mutants and biosynthesis of secondary products.
Every year, excessive amount of grower time, labour and room are spent on unproductive seeds, cuttings and grafts, significant numbers of young plants are lost to viruses, bacteria, fungi, insects, animals or other environmental factors. Disease free plants derived from tissue culture can retrieve much of the time now lost by growers because of the higher percentage of clean, viable, mature plants produced.

Tissue culture plantlets are not immune to attack and disaster but by the time they are hardened off, are well started plants with a good root system and a supply of nutrients. Healthy plants are the first line of defence against diseases.

Healthy plants can be grown in the laboratory at any time of the year. Tissue culture is not limited by the time of the year or weather. Working conditions in the laboratory are ideal and therefore conducive to year round production scheduling. It also saves an enormous amount of daily care required by conventional cuttings and seedlings.

Conscious of the advantages that tissue culture plantlets can procure and the need for important amount of disease free material for diversification, the FARC constructed a transfer laboratory in 1990 for the hardening of imported plantlets. This technology is now well mastered and has been used in the successful introduction of several plant species.

**Crop Varieties introduced by FARC as tissue culture Plantlets**

<table>
<thead>
<tr>
<th>Flowers</th>
<th>Varieties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthurium</td>
<td>12</td>
</tr>
<tr>
<td>Heliconia</td>
<td>4</td>
</tr>
<tr>
<td>Miniature Rose</td>
<td>1</td>
</tr>
<tr>
<td>Hydrangea</td>
<td>1</td>
</tr>
<tr>
<td>Begonia</td>
<td>1</td>
</tr>
<tr>
<td>Gerbera</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fruits</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pineapple</td>
<td>1</td>
</tr>
<tr>
<td>Banana</td>
<td>8</td>
</tr>
<tr>
<td>Grape</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beverage Crop</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffee</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vegetable</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plantain</td>
<td>4</td>
</tr>
</tbody>
</table>

**ANTHURIUM**

Anthurium occupied an important place in the first introductions as planters were eager to test new varieties to meet the demand of new importers. Light and pastel coloured cultivars were needed for the Asian Market which was opening up. Both small and large growers were catered for as a scheme was launched by DBM to finance the import of anthurium, tissue culture plantlets for small growers. Another flower, the heliconia was introduced to diversify the flower market, both for local and export.
GINGER

Ginger was the next crop which was given importance because of the lack of good and disease free material. Four varieties were introduced but only two were retained:

(1) the Mauritian Ginger Variety and
(2) Rio de Janeiro from Brazil

14 tons of seeds were bulked in 1993 and put at the disposal of planters through Agricultural Marketing Board. This caused a lot of improvement in ginger production in 1994.

We cannot say that these were only success stories in the first introductions of FARC. One grape variety received from Plantek Laboratories, Singapore, proved to be a complete failure. We have to be cautious in selecting our suppliers.

The hardening facilities of FARC is at the disposal of any individual or organisation for the introduction of tissue culture material which meet our phyto sanitary regulations. A fee is charged depending on the number of plants introduced and hardened off.

BANANAS

One of the most important projects in which FARC is engaged is the Banana & Plantain Project. 8 varieties of banana and 4 varieties of plantain have been introduced for evaluation.

<table>
<thead>
<tr>
<th>LIST OF BANANAS &amp; PLANTAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BANANAS</strong></td>
</tr>
<tr>
<td>Williams</td>
</tr>
<tr>
<td>Grande Naine</td>
</tr>
<tr>
<td>Petite Naine</td>
</tr>
<tr>
<td>Cavendish 901</td>
</tr>
<tr>
<td>Figue Pomme Geante</td>
</tr>
<tr>
<td>Pisang Mas</td>
</tr>
<tr>
<td>Robusta</td>
</tr>
<tr>
<td>Yankambi Km 5</td>
</tr>
</tbody>
</table>

The first tests plots of Cavendish varieties have given promising results in both observation plots and in planters' fields. If a proper policy could be devised to encourage the use of tissue culture plantlets by banana growers, it would be sure that a tremendous improvement would be noted in the production of this fruit which still remains an important one in the Mauritian diet. Our consumption per head is 8 kg as compared to 11 kg in European countries importing this fruit.

Establishment of new banana plantations can be done through 3 types of materials:

(1) large suckers
(2) small suckers
(3) in-vitro plantlets
The inconvenience of the first two lies in their carrying of pathogens and pests especially nematodes such as *Radopholus similis*, the banana borer *Cosmopolites sordidus*, 4 races of *Fusarium Oxysporum fsp cubense* and viruses such as cucumber mosaic and bunchy top.

In Vitro plantlets provide an excellent alternative material free of these pests and diseases for use in areas of cultivation. This advantage has been intensively exploited over the last 5 years by Latin American Countries such as Columbia & Costa Rica. The technology has been transferred in part from countries with a longer tradition in the use of banana tissue culture plantlets such as Israel, Australia and Taiwan.

The main advantages of in vitro plantlets is given below and has been noted in our tests plots.

1. Plants can be rapidly multiplied from a mother plant of known desirable characters.
2. Selected and screened plants can be maintained free from serious diseases and pests.
3. The use of in vitro plantlets in areas not infected with nematodes avoids the use of nematicides.
4. The use of single-cycle high density banana plantations could be adopted more widely, especially for the window market. The expected advantages of this practice are the following: very high yield in a short time, efficient controlled flowering and harvesting time. Saving of hand labour, the possible use of poor land marginal for permanent cultivation, saving expenditure on infrastructure.
5. 98% survival under field conditions.
6. Plants for invitro plantlets grow faster in the early growing stages than those from sucker.
7. Uniformity of flowering.
8. Short harvesting period.
9. In comparison with the suckers, plants are cheaper and easier to propagate and transport.
10. There are important advantages regarding germplasm conservation and the possibilities of international transfer.
11. The material produced are true to type and conform to the characters of the mother plants.
12. Increased yield of up to 20% as compared to conventional material.

With the increased use of in vitro multiplication, the widespread presence of somaclonal variations has been detected from negligible levels up to 40% of a field. This has been found in all countries that have used in vitro planting material e.g. Australia, Israel, South Africa & Taiwan.

The advantages which have been shown in favour of tissue culture calls for the adoption in the growing of other crops.

The case study which is quoted below illustrates our reluctance or slowness to adopt tissue culture techniques to improve agricultural production.

The article is titled "Vietnamese Farmers set up backyard biotechnology factories". This is from a CIP (International Potato Centre) news release on the use of biotechnology by Vietnamese Farmers to improve potato cultivation.

Following the Vietnam war, during the Paris peace talks in 1973, a Member of the Vietnamese Government visited a French tissue culture laboratory where he learnt about techniques of propagating vegetables in test tubes. Upon his return, he sent a young scientist to France to learn about these propagation techniques.
This Scientist upon his return to Vietnam created a backyard technology for the long term preservation and rapid multiplication of new potato varieties in the Dalat area. A scientist from CIP described it as a perfect example of trickle down technology. Potato production in the Dalat area had always been carried out with European seeds. However due to high costs and the war, the supply of European seed was cut off. In 1978, farmers were discouraged with their crops because of disease, small tubers and low yields.

In 1980, a Vietnamese agency, the Center for Experimental Biology, asked CIP for a newly developed genetic material in an attempt to revitalise potato in the area. CIP forwarded 100 in vitro plantlets. In vitro plantlets are an attractive medium for potato propagation as the seedlings arrives in sterile condition disease free. Plantlets can be maintained indefinitely producing new planting material each year. Thus farmers do not need to save part of one year’s crop for next year’s planting. All the crop can be used as food.

The varieties from CIP were multiplied using in vitro cuttings to provide plantlets for field evaluation and seed tuber production. Three clones - two of Mexican origin and one from Argentina proved outstanding for late blight resistance and yield. Based on these preliminary results and farmer demand, a rapid multiplication scheme was developed. Learning about tissue culture technology from CIP Scientists, the farmers and their families immediately went about setting up small scale potato seedling factories.

They created makeshift laboratories in their bedrooms and backyards where they used tissue culture techniques to propagate potato plants in test tubes brought from a local hospital and research centre. Biodegradable seedlings pots were made from banana leaves. The key to the entire scheme was simplicity and low cost.

Three test-tube plants produced enough planting material for one hectare of potatoes. In vitro technology of potatoes is also proving an efficient way to rapidly distribute new potato varieties. A new variety can now be introduced and distributed in just two years instead of six years as before.

This DALAT (Vietnamese) experience shows that not only sophisticated laboratories but farmers also can enjoy new achievements in biotechnology.

Several other important species of crops can be micro propagated commercially - Cassava, potato, sugar cane, sweet potato, taro, almond, apple, banana, citrus, oil-palm, date-palm, coffee, papaya, yam, grape, cardamom, peach, pear, pineapple, bamboo, eucalyptus, orchids, rose, rubber, strawberry, garlic.

Through NABAC (National Agricultural Biotechnology Advisory Committee), policy has to be defined on the propagation of economically important species by tissue culture. This technology should not be considered as a panacea to all problems existing in different crops selected.

Mauritius needs also to join the UPOV Convention to obtain improved crop varieties from abroad.

Tissue culture and other technologies will play an important role to make the Agricultural diversification programme a success especially for crops where there is a lack of good and enough planting material for development.

The FARC through its new laboratory will start the propagation of selected plants through tissue culture. A priority list of crops to be multiplied will have to be drawn.

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The role of tissue culture in agricultural diversification  

D. Y. Bachraz


THE FOOD AND AGRICULTURAL RESEARCH COUNCIL
AS A NATIONAL FOCAL POINT FOR CTA

Naren Sukurdeep
Information, Documentation & Liaison Officer, FARC

ABSTRACT

The Technical Centre for Agricultural and Rural Cooperation (CTA) is an institution established in 1983 under the ACP-EU Lomé Convention. It has a mandate to help ACP Countries achieve greater food security by providing them with better access to STI. The main activities of CTA may be grouped under Regional Programmes, Publishing Activities, Radio & Audiovisual activities and Information. There is a fair amount of devolution of CTA's activities through either Regional Branch Offices or National Focal Points. The FARC was appointed by the Government of Mauritius to set up and coordinate a project for the setting up of a CTA National Focal Point in Mauritius in January 1991. A number of CTA's programmes or projects have been implemented at FARC. The present paper reviews those activities implemented by FARC namely the DORA, CD-ROM, Workshops/Studies on national/regional information needs. A brief introduction is also made on the Mauritius Agricultural Research Management Information System (MARMIS).

INTRODUCTION

The Government of Mauritius appointed the Food and Agricultural Research Council (FARC) to initiate and coordinate a project for the setting up of a CTA's National Focal Point (NFP) in Mauritius in January 1991. This proposition was made by the Technical Centre for Agricultural and Rural Cooperation (CTA) during the International Meeting on the Agricultural Sector (IMAS) held in Mauritius in December 1990. So far each agricultural research institution has disseminated information on the activities of the CTA and FARC NFP in Mauritius.

The first Annual Meeting of Agricultural Scientists (AMAS) provides an opportunity to present briefly the CTA and the activities of the FARC NFP, after nearly four years of operation, to a wider target audience.

THE TECHNICAL CENTRE FOR AGRICULTURAL AND RURAL COOPERATION (CTA) : A BRIEF

The CTA was established in 1983 under the ACP/EU Lomé Convention with a mandate to help ACP Countries achieve greater food security by providing them with better access to Scientific and Technical Information on all issues related to agricultural and rural development.

Activities

The CTA's activities are broadly categorized under regional programmes, publishing, radio & audiovisual and information & documentation activities.

The Regional Programmes are identified after an assessment of agricultural information needs that starts up with a study on national information needs, followed by a regional evaluation of information needs to be discussed during a regional workshop.
The formation of Regional Committees (CREPS) that groups the main partners for the region is then constituted as another step to evaluate, implement and monitor regional information programmes.

The CREPS (Comité Regional d'Evaluation, de Programmation et de Suivi.) would be marking the trend of CTA's activities in coming years. This approach is in line with the terms of the Fourth Lome Convention which places greater emphasis on developing the capabilities of ACP Countries to harness and manage scientific and technical information (STI) for development.

The seminars are considered as very important means of circulating information on agricultural and rural development but also as important to favour and facilitate contacts between specialists. The CTA either organises or sponsors or sponsors' participation to a number of workshops of topical interests to its collaborating partners.

The CTA has its own publishing and co-publishing programme and is involved in the production of newsletters, magazines and proceedings of the seminars it organises or supports.

The CTA has organised a number of workshops that aim at upgrading the writing skills of agricultural scientists or upgrading the skills for publishing activities within the ACP group of Countries. The CTA publications as well as some other books of relevance to tropical agriculture and rural development are distributed mostly to nationals from the ACP Countries free of charge.

The CTA's rural radio programme is another major activity aiming to help radio programme producers improve broadcasts of technical information on farming. The programme consists of three elements: the supply of technical information packages on important rural development issues; additional documentary support and the organisation of regional retraining workshops. In addition, the CTA supports the production and distribution of video films on tropical agriculture and agricultural extension.

The main thrusts of CTA's information and documentation activities are on-going projects on the supply of reference books to documentation centres (the DORA Project), the CD-ROM Project, the Selective Dissemination of Information (SDI) and the Question and Answer-Service (QAS), in addition to regular training activities for ACP librarians and documentalists.

Operation

The CTA operates either through Regional Branch Offices (RBOs) or National Focal Points (NFPS). Whereas the RBOs identify closely with CTA and works from within regional organisations, their activities are conducted such that they help CTA to acquire a more accurate and more precisely defined picture of a region's information requirements, hence improving the effectiveness of CTA's programme of information dissemination. The existing RBOs are the IRETA (Institute for Research, Extension and Training in Agriculture, University of South Pacific) for the Pacific Region and the CARDI (Caribbean Agricultural Research & Development Institute, West Indies) for the Caribbean region. In Africa, CTA's activities are organised in collaboration with National and Regional agencies on a one-to-one basis, and for that purpose the countries have been grouped into four geographical centres namely Central, Western, Eastern and Southern Africa.

National Focal Points on the other hand are single official point of contact within each ACP country. They maintain a national character ensuring that each country is sufficiently organised to obtain the maximum benefit from the facilities and services offered by CTA and also assisting CTA in understanding national information requirements. Thus for Mauritius, the FARC being chosen as the CTA NFP was called upon to play a focal role in providing additional support to the agricultural research community in terms of access to STI besides having to support the information needs of its staff.

So far a number of CTA's projects and activities have been implemented in Mauritius by the FARC. These are namely the DORA, CD-ROM projects, studies and workshops on agricultural information.
DORA PROJECT

The FARC became recipient of the DORA Project since June 1991. DORA refers to “Distribution d'Ouvrages de Reference en Agriculture”. The main objective of the project is to enable ACP agricultural information centres to purchase the most significant core agricultural reference books to provide for quick referential support to researchers, extension workers, training officers and decision makers.

The collection proposed in general refer to agricultural dictionaries, directories of researchers and research institutions training manuals, technical manuals covering all aspects of agricultural and rural development. However, the significant feature of the DORA is that it is demand oriented.

Selection of publications within the DORA project context was extended to other research institutions namely the MSIRI, Ministry of Agriculture (DARE), Faculty of Agriculture of the University of Mauritius and the FARC itself. A bibliography is compiled for these publications and distributed to participating institutions. The publications are available for loan to the Officers from the different agricultural research institutions. The table below shows the demand for loan of publications from the DORA Project as well as from the core collection of FARC which covers mainly literature on tissue-culture, agronomy of tropical horticultural crops, research, extension and information.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Request for Loan</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSIRI</td>
<td>245</td>
</tr>
<tr>
<td>MOA/DARE</td>
<td>100</td>
</tr>
<tr>
<td>UOM*</td>
<td>65</td>
</tr>
<tr>
<td>FARC</td>
<td>55</td>
</tr>
<tr>
<td>Others (Private Sector, MSA)</td>
<td>25</td>
</tr>
</tbody>
</table>


* Only lecturers; students have no loan facilities but instead are offered photocopying facilities.

CD-ROM PROJECT

The CD-ROM Project was implemented at FARC in November 1992 by the Royal Tropical Institute (KIT), Netherlands on behalf of CTA. The project includes project materials such as micro computer, CD-ROM reader, CD-ROM databases, Printer, Thesaurus, a help desk at KIT, an annual operational budget, prime document access (UNESCO coupons) and a training component on information retrieval from the CD-ROM databases.

The CD-ROM databases available and their respective subject coverage are given in the table below:
Cd-Rom Databases at FARC

<table>
<thead>
<tr>
<th>DATABASE</th>
<th>RECORDS</th>
<th>SUBJECT COVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CABCD</td>
<td>1,300,000+</td>
<td>Agriculture in general</td>
</tr>
<tr>
<td>AGRIS</td>
<td>2,000,000+</td>
<td>Agriculture in general</td>
</tr>
<tr>
<td>TROPAG &amp; RURAL</td>
<td>200,000+</td>
<td>Tropical Agriculture &amp; Rural Development</td>
</tr>
<tr>
<td>SESAME</td>
<td>-</td>
<td>Tropical Agriculture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Francophone)</td>
</tr>
<tr>
<td>DAI</td>
<td>-</td>
<td>Development Activity Information</td>
</tr>
<tr>
<td>CIARL</td>
<td>-</td>
<td>IARC's research</td>
</tr>
<tr>
<td>MAIZE GERMPLASM</td>
<td>-</td>
<td>Maize Germplasm Bank</td>
</tr>
<tr>
<td>(Bank Inquiry System)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Training in information retrieval has been ensured to one person from each of the following institutions namely MSIRI, Ministry of Agriculture (DARE), Faculty of Agriculture and FARC. The CD-ROM workstation and databases are accessible to all research institutions and searches are conducted by Officers having been trained in CD-ROM information retrieval on behalf of researchers from all research institutions. The table below gives the usage level of these CD-ROM databases:

### Usage Level

<table>
<thead>
<tr>
<th>Institution</th>
<th>No. of Searches Made</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministry of Agriculture (DARE)</td>
<td>128</td>
</tr>
<tr>
<td>Faculty of Agriculture</td>
<td>109</td>
</tr>
<tr>
<td>(University of Mauritius)</td>
<td></td>
</tr>
<tr>
<td>MSIRI</td>
<td>95</td>
</tr>
<tr>
<td>FARC</td>
<td>45</td>
</tr>
<tr>
<td>MSA</td>
<td>16</td>
</tr>
</tbody>
</table>

**Statistics: December 1993 - May 1995**

The total amount of 1,780 US $ (UNESCO Coupons) was distributed equally among MSIRI, DARE, UOM, FARC for the acquisition of full-text documents following searches made from CD-ROM databases.
CTA WORKSHOPS/STUDIES

Selective Dissemination Of Information (SDI) Evaluation Forum, 5 - 9 December 1994, Mauritius

The SDI Evaluation Forum was organised by CTA in collaboration with FARC and the Ministry of Agriculture from 5th December to 9th December 1994 at Pointe Aux Canonniers, Mauritius. Thirty-three participants representing the ACP countries, regional and international organisations attended the Forum. Participants from Mauritius attending the Forum came from all the agricultural research institutions.

The SDI is a free literature service offered by CTA to senior research Scientists to keep abreast of latest scientific and technical information relevant to their fields of research. This service has also been offered to a number of our local researchers. The meeting discussed on a number of related important issues such as target groups, products and services, cost and pricing, copyright, impact and sustainability, decentralisation and regionalisation, role and responsibilities of partners. The meeting recommended that the SDI services should be geared to respond to the specific needs generated from research programmes, and that therefore both research managers and information specialists should work in closer collaboration in identifying the needs and providing the relevant information services respectively. A closer collaboration with the operating services from CTA was also called for.

It was also felt that the need to a gradual decentralisation of the service would be necessary in the future. It was suggested that a strategic plan be elaborated to that effect.

STUDIES ON AGRICULTURAL INFORMATION NEEDS

National Level

The CTA commissioned a series of studies on agricultural information needs at national levels. National monographs for the East African Countries which include Mauritius were prepared by national Consultants. Other countries covered within the East African Region are Comores, Djibouti, Ethiopia, Kenya, Madagascar, Seychelles, Somalia, Sudan, Tanzania and Uganda.

The studies had as objectives to:

- review the current socio-economic situation in each country with special reference to the role of agriculture in the national economy;
- status & organisation of agricultural research & extension;
- make an assessment of national information needs;
- identify potential national focal points for all countries of the region to provide for effective linkages with CTA programmes.

Regional Level

The National monographs formed the basis of a Regional Report on Agricultural Information Needs for the East African Region. The Report presents an overview of regional priority needs in agricultural information, discusses on the existing capacities to meet those needs and on the deficiencies in agricultural information systems and infrastructures and make propositions for further inputs from CTA.
Regional Workshop On Agricultural Information Needs Of East Africa - 6-10 December 1993, Seychelles

A regional workshop was organised by CTA in Seychelles in December 1993 to discuss the major propositions of the Regional Report on Agricultural Information Needs for East Africa. This report was prepared by two Consultants, one from Kenya and one from Mauritius. One of the major recommendations of the Seychelles Workshop was that there should be two CTA sub-regional focal points for the East African Region:

- One based at the Institute For Agricultural Research (IAR), Ethiopia for the mainland countries: Djibouti, Ethiopia, Kenya, Somalia, Tanzania, Uganda.

- One at the Food & Agricultural Research Council (FARC) for the Indian Ocean Islands: Comores, Madagascar, Mauritius, Seychelles.

The regional organisational structure and mechanism proposed is as follows:-

**Regional Organisational Structure/Mechanism Proposed**

![Diagram of organisational structure]

(to be noted that Djibouti expressed the wish to join the Island Countries)
Workshop on The Formulation of Policies on Agricultural Information at National and Regional Levels for Eastern African Countries: Strategies & Resources, 12 - 16 December 1994, Mauritius

As a follow up to the Regional Workshop held in Seychelles on the identification of regional information needs, the CTA organised in collaboration with the FARC and the Ministry of Agriculture a workshop on the Formulation of Policies on Agricultural Information at National and Regional levels for the Eastern African Countries, at Pointe Aux Canonniers, Mauritius from 12th to 16th December 1994.

The main objectives of the workshop were to identify key areas for regional agricultural information programmes; to discuss on the most appropriate regional collaborative mechanisms following the proposals made at the Seychelles Workshop.

The key areas identified for information programmes: (i) Human resource development; (ii) Library & Documentation Services; (iii)Information Management Technology; (iv) Publication; (v) Extension.

The meeting came up with the constitution of a Committee for Regional Agricultural Information Programmes & Strategies (CRAIPS), in French CREPS, having the following representation:

- 10 members 5 of which are from ASARECA & 5 from the Indian Ocean Islands

The meeting also recommended that as a follow-up action a project proposal for specific information programmes for the region should be conducted. It is henceforth foreseen that the FARC would be called upon to play an important role as CTA's sub-regional focal point for the Indian Ocean Island Countries.

MAURITIUS AGRICULTURAL RESEARCH MANAGEMENT INFORMATION SYSTEM (MARMIS)

The MARMIS provides a standardised information system for the recording and monitoring of research activities within the different agricultural research institutions. The system provides for a common database structure and worksheet formats. It uses the CDS/ISIS as software and the Heurisko as an interface for information retrieval. The system components were discussed and proposed with the collaboration of all contributing institutions namely the DARE, the MSIRI and the Faculty of Agriculture.

Each collaborating institution will contribute its data to the FARC for the creation of a global MARMIS database, which will then be copied and made available to the collaborating institutions.

MINITEL

The FARC also acts as a SYFED point (Systeme Francophone d'Edition et de Diffusion). The MINITEL introduces new possibilities for on-line interrogation to a number of databases covering largely francophone literature. This should provide an interesting complement to existing search possibilities from CD-ROM databases at FARC. A second phase of the SYFED would be the installation of E-Mailing facilities at local institutions.
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TRAINING FOR AGRICULTURAL NEEDS BY THE FACULTY OF AGRICULTURE, UNIVERSITY OF MAURITIUS

A.M. Osman
Dean, Faculty of Agriculture, University of Mauritius

ABSTRACT

The paper presents a survey of the training in agriculture provided by the Faculty of Agriculture of the University of Mauritius preceded by a short historical survey of the early days starting in 1914 with the creation of the School of Agriculture.

HISTORY: MAJOR DEVELOPMENTS AND LANDMARKS

Although there has been some attempt at providing training in agriculture in the last century, more formal training can be said to have started in 1914 with the creation of the School of Agriculture under the Department of Agriculture established a year earlier. The first batch of diplomates of the School of Agriculture came out in 1916. About nine years after the creation of the School, the Mauritius College of Agriculture was founded. The laying of the foundation stone took place on 12th July 1923. When the latter opened its doors about two years later in 1925 under Harold Tempany, the School of Agriculture phased out.

The University of Mauritius as a legal and corporate entity was established in 1965 and in the same year, the first female student joined the College of Agriculture on the Diploma course. Three years later, in 1968, the College became part of the University and changed to its original appellation, the School of Agriculture, one of the then three constituents Schools of the new University. It is generally held that the University of Mauritius was to a large extent built on the strength of an already well established College of Agriculture. However, shortly after the College became part of the University, the former moved from its original seat to its present location ceding its magnificent stone building to the University Central Administration.

The year 1968 was also eventful in that it marked the production of the first female awardee (Diploma) in agriculture at the very time the College was to become part of the University and no longer on its own as an educational institution. The first output of graduates (B.Sc Hons. Agric.) of the University School of Agriculture was in 1973 while the first postgraduates (one M.Phil and one Ph.D) came out in 1981.

In 1993 the School of Agriculture became the Faculty of Agriculture, one of the five Faculties of the University. This year (1995) thus marks eighty-one years of formal training in agriculture provided by the Faculty of Agriculture at levels ranging from certificate to degree/higher degree and diploma.

STUDENT OUTPUT

The number of students who successfully completed their course at the Faculty of Agriculture over the 81 years (1914-95) of its existence is summarised in Tables 1(a), 1(b) and 1(c) in relation to

(a) output from 1914-95 (pre and post University years)
(b) output from 1914-68 (pre University years)
(c) output from 1968-95 (post University years), respectively.
Table 1(a): Student Output (1914-95) - (Past 81 years)

1. Certificate (since 1914) 712*
2. Diploma (since 1914) 806 (768 + 38**)
3. Degree (B.Sc) (since 1968) 215 (188 + 27**)
4. Higher Degree (M.Phil/Ph.D) 6

TOTAL 1739 (Av. 21.47 p.a)

* includes an estimated 300 from the College of Agriculture (pre University years)

** estimated output for 1994/95

Table 1(b): Student Output (1914-68)
(College or pre-University years)

1. Certificate 300*
2. Diploma 354

TOTAL 654 (Av. 12.11 p.a)

* estimated. Actual figures not available

Table 1(c): Student Output (1968-95)
(since forming part of University)

1. Certificate 412
2. Diploma 452 (414 + 38*)
3. Degree 215 (188 + 27*)
4. Higher Degree 6 (M.Phil/Ph.D)

TOTAL 1,085 (Av. 40.19 p.a)

* estimated for 1994/95

From 1914-95, 1739 students (an average of 21.47 students per annum) successfully completed their course. In the College or pre-University years (1914-68), an estimated 654 students (an average of 12.11 students per annum) completed their course while in the University years (1968-95) the student output was 1085 (an average of 40.19 students per annum). As can be seen the post- College or University years were a period of rapid expansion as the average student output per annum was over three times that of the College days. This situation reflects in part the higher demand for agriculture and agriculture related courses to meet the requirements of the country and of an expanding economy.
Table 1(d) which gives the evolution of the student output in the Faculty over the last 10 years (1985-95) shows a generally increasing trend.

**Table 1(d): Student Output of the last 10 years (1985-95)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Higher Degree</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
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<td>3</td>
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<td>Degree</td>
<td>11</td>
<td>8</td>
<td>14</td>
<td>-</td>
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<td>8</td>
<td>12</td>
<td>27</td>
<td>27</td>
<td>135</td>
</tr>
<tr>
<td>Diploma</td>
<td>34</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6</td>
<td>11</td>
<td>21</td>
<td>28</td>
<td>23</td>
<td>38</td>
<td>161</td>
</tr>
<tr>
<td>Certificate</td>
<td>-</td>
<td>26</td>
<td>9</td>
<td>33</td>
<td>24</td>
<td>17</td>
<td>25</td>
<td>14</td>
<td>12</td>
<td>-</td>
<td>160</td>
</tr>
<tr>
<td>TOTAL</td>
<td>46</td>
<td>34</td>
<td>23</td>
<td>33</td>
<td>46</td>
<td>40</td>
<td>54</td>
<td>55</td>
<td>63</td>
<td>65</td>
<td>459</td>
</tr>
</tbody>
</table>

* Estimates

**STUDENT INTAKE AND POPULATION**

Although the annual student intake and overall student population have increased significantly in the University years, the Faculty of Agriculture, in spite of its much longer existence, remains the smallest Faculty on campus.

This is due *inter alia* to the following reasons:

(a) an ‘explosion’ in demand for several novel and non-traditional courses in new areas such as management, engineering, pure science and computer science not previously offered in pre-University days

(b) rapid changes in the country of the economic and social landscape

(c) a build up over the years of the Faculty’s long history, of trained technical and scientific manpower in agriculture leading to a stabilisation/slowing down of demand

(d) regulation of the student intake to steady output and prevent an oversupply.

The evolution of the overall population of registered students in the University years (1968-95) is given in **Table 2** below. Apart from a reduced population in the eighties (1979/80 to 1986/87), the average annual population outside this period has remained generally steady, at an average of 140 for all levels of training, both on a part time and full time basis. The average population in the University period is 116 compared with an estimated population of 12 in the pre-University period. The big increase in student population reflects, to a large extent the broader range of agriculture-based courses offered by the Faculty since the University days.
### Table 2: Population of registered students

<table>
<thead>
<tr>
<th>Year</th>
<th>Higher Degree</th>
<th>Degree</th>
<th>Diploma</th>
<th>Certificate</th>
<th>Total</th>
<th>Full Time</th>
<th>Part Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 68-Dec.69</td>
<td>-</td>
<td>-</td>
<td>68</td>
<td>74</td>
<td>142</td>
<td>68</td>
<td>74</td>
</tr>
<tr>
<td>Jan 70-June 71</td>
<td>-</td>
<td>-</td>
<td>81</td>
<td>71</td>
<td>152</td>
<td>119</td>
<td>33</td>
</tr>
<tr>
<td>1971-72</td>
<td>-</td>
<td>13</td>
<td>67</td>
<td>58</td>
<td>138</td>
<td>80</td>
<td>58</td>
</tr>
<tr>
<td>1972-73</td>
<td>-</td>
<td>26</td>
<td>64</td>
<td>32</td>
<td>122</td>
<td>90</td>
<td>32</td>
</tr>
<tr>
<td>1973-74</td>
<td>-</td>
<td>27</td>
<td>78</td>
<td>63</td>
<td>168</td>
<td>96</td>
<td>72</td>
</tr>
<tr>
<td>1974-75</td>
<td>-</td>
<td>30</td>
<td>99</td>
<td>28</td>
<td>157</td>
<td>97</td>
<td>60</td>
</tr>
<tr>
<td>1975-76</td>
<td>3</td>
<td>20</td>
<td>109</td>
<td>27</td>
<td>159</td>
<td>89</td>
<td>70</td>
</tr>
<tr>
<td>1976-77</td>
<td>5</td>
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<td>85</td>
<td>25</td>
<td>140</td>
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<td>1977-78</td>
<td>6</td>
<td>32</td>
<td>77</td>
<td>25</td>
<td>140</td>
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<td>54</td>
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<tr>
<td>1978-79</td>
<td>9</td>
<td>28</td>
<td>80</td>
<td>-</td>
<td>117</td>
<td>74</td>
<td>43</td>
</tr>
<tr>
<td>1979-80</td>
<td>8</td>
<td>28</td>
<td>60</td>
<td>-</td>
<td>96</td>
<td>62</td>
<td>34</td>
</tr>
<tr>
<td>1980-81</td>
<td>9</td>
<td>17</td>
<td>37</td>
<td>-</td>
<td>63</td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td>1981-82</td>
<td>11</td>
<td>4</td>
<td>21</td>
<td>15</td>
<td>51</td>
<td>28</td>
<td>23</td>
</tr>
<tr>
<td>1982-83</td>
<td>6</td>
<td>-</td>
<td>41</td>
<td>28</td>
<td>75</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>1983-84</td>
<td>6</td>
<td>13</td>
<td>49</td>
<td>20</td>
<td>88</td>
<td>46</td>
<td>42</td>
</tr>
<tr>
<td>1984-85</td>
<td>5</td>
<td>11</td>
<td>42</td>
<td>-</td>
<td>58</td>
<td>36</td>
<td>22</td>
</tr>
<tr>
<td>1985-86</td>
<td>3</td>
<td>39</td>
<td>65</td>
<td>-</td>
<td>107</td>
<td>57</td>
<td>50</td>
</tr>
<tr>
<td>1986-87</td>
<td>4</td>
<td>53</td>
<td>17</td>
<td>12</td>
<td>86</td>
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<td>52</td>
</tr>
<tr>
<td>1987-88</td>
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<td>54</td>
<td>9</td>
<td>133</td>
<td>65</td>
<td>68</td>
</tr>
<tr>
<td>1988-89</td>
<td>4</td>
<td>65</td>
<td>37</td>
<td>67</td>
<td>173</td>
<td>73</td>
<td>100</td>
</tr>
<tr>
<td>1989-90</td>
<td>5</td>
<td>36</td>
<td>28</td>
<td>34</td>
<td>103</td>
<td>50</td>
<td>53</td>
</tr>
<tr>
<td>1990-91</td>
<td>4</td>
<td>56</td>
<td>52</td>
<td>20</td>
<td>132</td>
<td>87</td>
<td>45</td>
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<tr>
<td>1991-92</td>
<td>7</td>
<td>37</td>
<td>56</td>
<td>29</td>
<td>129</td>
<td>78</td>
<td>51</td>
</tr>
<tr>
<td>1992-93</td>
<td>14</td>
<td>39</td>
<td>55</td>
<td>15</td>
<td>123</td>
<td>84</td>
<td>39</td>
</tr>
<tr>
<td>1993-94</td>
<td>12</td>
<td>55</td>
<td>64</td>
<td>13</td>
<td>144</td>
<td>108</td>
<td>36</td>
</tr>
<tr>
<td>1994-95</td>
<td>12</td>
<td>50</td>
<td>75</td>
<td>-</td>
<td>137</td>
<td>117</td>
<td>20</td>
</tr>
</tbody>
</table>

An interesting trend is the increasing population of female students joining the Faculty for the various agriculture and agriculture-related courses since the historic joining of the Diploma course of the College of Agriculture by the first female student in 1965. The male and female student.
populations (4:3 ratio) of the current year (1994/95) are given in Table 3 by way of illustration. It shows the large number of female students joining courses at the Faculty. Previously held prejudices are thus fast disappearing.

Table 3: Student Population – 1994 - 95 (current year)

<table>
<thead>
<tr>
<th>Courses</th>
<th>No of Registered Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year</td>
</tr>
<tr>
<td>1 M.Phil/Ph.D</td>
<td>6</td>
</tr>
<tr>
<td>2 Diploma / B.Sc in Agricultural Science &amp; Technology</td>
<td>1</td>
</tr>
<tr>
<td>3 Diploma / B.Sc in Agricultural Science &amp; Technology</td>
<td>2</td>
</tr>
<tr>
<td>4 B.Sc (Hons) in Agriculture</td>
<td>3</td>
</tr>
<tr>
<td>5 B.Sc (Hons) in Food and Agricultural Biotechnology</td>
<td>3</td>
</tr>
<tr>
<td>6 B.Sc (Hons) in Agriculture</td>
<td>4</td>
</tr>
<tr>
<td>7 B.Sc (Hons) in Agriculture in-service</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
</tr>
</tbody>
</table>

COURSES

(i) List of courses offered

The lists of courses offered in the College and University years are given in Tables 4(a) and 4(b). They show the much broader range of part time and full time courses offered since the Faculty became part of the University. These courses reflect a broadening of the requirements of the agricultural sector. Several of these courses are for the non-sugar sector thus showing a shift in emphasis from the traditional sugar or sugar orientated courses.

It is interesting to note the running previously by the Faculty of Agriculture of a Certificate and a Diploma Course in Medical Laboratory Technology. The need for such courses was felt by the local health authorities and in the absence of an appropriate unit at the University, the courses were run and administered by the Faculty. Such courses are no longer run at the Faculty of Agriculture.

Table 4(a): List of courses offered - 1914 to 1967

(Pre University years)

Diplomas

1. Combined Diploma Course (Agriculture and Sugar Technology: 1916-1963)
2. Diploma in Agriculture: 1964 onwards (till 1971)
Certificates

1. Certificate in Sugar Analysis
2. Certificate in Sugar Cane Cultivation
3. Certificate in Sugar Technology
4. Certificate in Tropical Agriculture

Others

1. Course of instructions for registration as Agricultural Chemists
2. Course of instructions for the examinations of the City and Guilds of the London Institute of Sugar Technology.

Table 4(b): List of courses offered - 1968/69 to 1994/95
(University years)

Higher Degrees

M.Phil/Ph.D (by research)

Degrees

1. B.Sc (Hons) Agriculture
2. B.Sc (Hons) Crop Science and Production
3. B.Sc (Hons) Food and Agricultural Biotechnology

Diplomas

1. Diploma in Agricultural Science and Technology (*Diploma/ Degree Combination*)
2. Diploma in Agriculture
3. Diploma in Agriculture (*Rodrigues*)
4. Diploma in Agriculture and Sugar Technology
5. Diploma in Agriculture, Fisheries & Natural Resources
6. Diploma in Medical Laboratory Technology
7. Diploma in Sugar Technology

Certificates

1. Advanced Certificate in Ruminant Production and Health
2. Certificate in Agricultural and Environmental Studies (*Rodrigues*)
3. Certificate in Agroforestry
4. Certificate in Animal Production
5. Certificate in Cane Cultivation
6. Certificate in Medical Laboratory Technology
8. Certificate in Ruminant Production and Health
9. Certificate in Sugar Analysis
10. Certificate in Sugar Cane and Interline Crop Production
11. Certificate in Sugar Cane Production
12. Certificate in Sugar Cane Production and Sugar Manufacture
13. Certificate in Tea Agronomy and Technology
(ii) **Types of Courses**

Courses are of two types. Outside regular courses there are in-service courses. In-service courses are those which are specially mounted and run on request from both the public and private sectors for their personnel. To run such courses the Faculty often has to make special arrangements to meet the requirements of the requesting institution. Courses are provided at all levels from certificate to degree. As an illustration, the Certificate in Sugar Cane Production has been run for the Farmers Services Corporation, the Diploma in Agriculture (Rodrigues) for the Ministry of Rodrigues and the B.Sc in Crop Science and Production for the Mauritius Sugar Industry Research Institute. The Faculty has thus responded to the specific needs of both the public and private sectors.

Taught courses range at all levels, from certificate to diploma and degree levels. However, so far there has been no postgraduate taught courses such as the M.Sc. This is now being contemplated.

Non-taught higher Degrees (M.Phil and Ph.D) are based entirely on research. Initial acceptance to higher degrees is largely governed by general University regulations. However, final acceptance of a qualified candidate is dependent on available facilities and suitable academic supervisors, local or overseas.

(iii) **Objectives**

One of the main objectives of the Faculty is to cater for local requirements, principally government, research institutions (e.g. MSIRI, DARE and FARC) and the private sector.

In meeting its objectives, the Faculty places emphasis on the quality of its training and the production of well trained professionals and technicians.

(iv) **Facilities available for teaching and research**

Over the years the Faculty has considerably consolidated its own facilities for training as well as for research by students. However, it also makes use of ancillary and other support facilities elsewhere at the University. The following main facilities are available at the Faculty:

(a) **Laboratories:**

- Chemical (including soil) sciences laboratories
- Biological sciences/Biotechnology laboratories (For biotechnology the present facility is restricted to tissue culture. Plans are underway for the installation of new equipment for an adequate biotechnology laboratory)
- Food science and technology laboratory (Plans are also underway for an expanded food science and technology laboratory)
- Specialised research laboratories.

(b) A University Farm to provide *inter alia* facilities for farm practicals and research.

(c) A three acre Crop Museum which contains a wide collection of live plant species of economic importance including weeds.

(d) Facilities elsewhere at the University (e.g. the Computer Centre, Sugar Technology Laboratory, Faculty of Science Laboratories and, ‘Centre SYFED’ - a documentation centre).

(v) **Servicing of courses**
Courses at the Faculty are serviced by three categories of teaching staff:

(a) Faculty of Agriculture academics
(b) Other University Faculty staff
(c) Non-University staff from various institutions such as the Ministry of Agriculture & Natural Resources, DARE and the MSIRI.

In calling upon the services of non-university staff, the Faculty makes certain that such staff are suitably qualified to ensure that a high standard of training is maintained. At the same time students benefit from experience and expertise not available at the University.

(vi) Research in training

Research forms an important aspect of undergraduate training. In their final year, undergraduate students have to present a dissertation based on a piece of guided research largely as a training exercise. Increasing emphasis, well reflected in the weightage of final year results, is being placed on such an important exercise. Dissertations cover a broad range of topics reflecting academic staff teaching and research areas and sometimes student’s preferences.

For higher degrees (M.Phil and Ph.D) entirely by research, the output has been rather low reflecting in part the small size of the Faculty in terms of academic staff number. To circumvent such restrictions, collaboration with outside research institutions and universities, local and overseas, are sometimes resorted to. For example, some higher degree students conducting their research at the Faculty are supervised by MSIRI senior staff while research students working entirely at the MSIRI are registered for a higher degree at the Faculty. Such a development is a healthy sign of collaboration between the University and research and other institutions outside.

While fees for post postgraduate studies are minimal for home students (Rs 1810* per annum as registration, Students’ Union membership, Library and other resources fees), the latter may benefit from a number of research scholarships or grant schemes for higher degrees offered by the University of Mauritius, TEC, FARC and the MSIRI.

(*about US$ 100 at current rate).

DIPLOMA/DEGREE SCHEME

(i) The Scheme

The main training programme is related to the diploma and degree. In the previous scheme with separate Diploma and Degree streams, entry requirements were as follows:

(a) Five ‘0’ levels or equivalent (including English Language) for a 3-year full time diploma and
(b) Three ‘A’ levels or equivalent for a 3-year full time degree.

In view of the increasing number of applicants with ‘A’ levels in Mauritius, a new 4 year (2+2) full time Diploma/Degree combination has been introduced since 1990 to supersede the former scheme. Entry requirements are now three ‘A’ levels or equivalent. In the new scheme, the first two years are spent on the Diploma stage which also represent the first two years of the Degree course. At the end of the first two years, successful students obtain their Diploma. Diplomates with satisfactory performance may then proceed to the next two years of the degree course. At the end of the diploma stage students may opt for different degree options such as B.Sc Agriculture, B.Sc Food & Agricultural Biotechnology or B.Sc Crop Science & Production. Although the number of options is limited at present, a wider range of new and revised options is envisaged for the future e.g in Horticulture, Food Science and Agricultural Engineering.
The two schemes are illustrated in Tables 5 & 6.

Table 5: Diploma/Degree Schemes

A. Former (separate Diploma & Degree streams)
   '0' Level: Diploma - (3 yr FT)*
   'A' Level: Degree - (3 yr FT/4 yr PT)*

B. Current (since 1990) (Combined streams)
   'A' Level: Diploma/Degree combination (2 yr + 2 yr = 4 yr FT).
   (*FT = Full time; PT = Part time)

Table 6: Diploma/Degree Schemes (Graphically)

A. Old Scheme

<table>
<thead>
<tr>
<th>'O' Level</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Diploma (3 yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>'A' Level</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>Degree (3 yrs)</td>
</tr>
</tbody>
</table>

B. New Scheme

<table>
<thead>
<tr>
<th>'A' Level</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diploma</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DEGREE OPTIONS
- Agriculture
- Crop Science & Production
- Food and Agricultural Biotechnology
- Other options

(ii) Advantages

The main reasons for and advantages of the new scheme can be summarised as follows:

(a) There is a large number of applicants with ‘A’ level in Mauritius nowadays.
(b) It is less wasteful in that a student not successfully completing the degree programme can secure a diploma.
(c) It is more flexible.
(d) It allows quick response to needs.
(e) It allows new degree options to be introduced or existing options to be phased out.
However main disadvantages are that:

(a) The 4 year programme for a degree is rather long. However, this is a growing trend in Universities in the U.K.

(b) There is at the moment some uncertainty for students until the end of the second year as to the option to be offered. However, this situation will be remedied in future.

(iii) Curriculum

The diploma/degree curriculum as a whole has both practical and academic orientations. The diploma is broad based to allow entry into the different degree options. The diploma/degree course is at the moment partly modular. By 1996/97 courses will be completely modularised in line with University policy. In addition, courses are based increasingly on a continuous assessment system. Also in keeping with changes generally at the University, the Faculty is moving from the traditional three-term system to a two-semester system with the same total of thirty teaching weeks excluding examinations.

(iv) Modules/Half Modules

Modules and half modules in the first two years of the diploma are given in Table 7.

Table 7: Diploma in Agricultural Science and Technology
(first two years of B.Sc (Hons))

<table>
<thead>
<tr>
<th>SEMESTER 1</th>
<th>SEMESTER 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>HALF MODULES</td>
<td>HALF MODULES</td>
</tr>
<tr>
<td>1. Biochemistry and Food Chemistry</td>
<td>1. Practical Farming - Crops &amp; Farm Animals</td>
</tr>
<tr>
<td>2. Agricultural Botany</td>
<td>2. Crop Science &amp; Production I - Principles</td>
</tr>
<tr>
<td>5. Engineering Drawing</td>
<td>5. Instrumentation and Process Control</td>
</tr>
<tr>
<td>7. Sugar Technology I - Sugar Technology &amp; Sugar Extraction</td>
<td>7. Sugar Technology II - Analytical Methods</td>
</tr>
</tbody>
</table>
HALF MODULES: YEAR 2

<table>
<thead>
<tr>
<th>SEMESTER 1</th>
<th>SEMESTER 2</th>
</tr>
</thead>
</table>
| HALFW MODULES | HALFW MODULES |}

1. Microbiology & Genetics
2. Crop Science & Production II - Agronomy & Horticulture
3. Animal Health & Breeding
4. Statistics II
5. Agricultural Engineering
6. Introductory Nutrition, Microbiology & Food Processing
7. Surveying

1. Crop Protection & Breeding
2. Botany, Physiology & Agronomy of Sugarcane
3. Animal Science & Production II - Husbandry
4. Agricultural Economics & Management
5. Introductory Soil Science
6. Molecular Biology & Introductory Biotechnology
7. Sugar Technology III - Byproducts, Payment & Industrial Training

For the degree in the third and fourth years, module and half modules will depend on the degree options offered. By way of illustration, the modules and half modules are given for the B.Sc Agriculture option (Table 8).

Table 8: B.Sc (Hons) in Agriculture

HALF MODULES: YEAR 3

<table>
<thead>
<tr>
<th>SEMESTER 1</th>
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<td>HALFW MODULES</td>
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1. Economic Botany & Plant Breeding
2. Animal Physiology & Breeding
3. Fundamentals of Soil Science
4. Agricultural Experimentation
5. Agricultural Development & Food Policy
6. Crop Production I
7. Advanced Molecular Biology

1. Crop Physiology & Crop Protection
2. Economic Zoology & Animal Health
3. Agricultural Mechanisation, Soil & Water Conservation and Farm Structures
4. Agricultural Management and Production Economics I (Agriculture)
5. Agricultural Systems
6. Animal Production I
7. Human Nutrition & Food Analysis

HALF MODULES: YEAR 4

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<td>HALFW MODULES</td>
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1. Crop Physiology and Biochemistry I
2. Plant and Animal Biotechnology
3. Crop Production II
4. Animal Production II
5. Dissertation

1. Animal Physiology & Biochemistry I
2. Agricultural Produce Processing
3. Crop Production III
4. Applied Animal Nutrition
5. Dissertation
QUALITY OF DEGREES

Much importance is attached to the quality of the degree. For this reason degrees of the Faculty as elsewhere at the University, are externally moderated by examiners from reputable universities overseas. Faculty of Agriculture degrees have so far been moderated by academics of international standing from universities in the United Kingdom, namely Reading and London (Wye College). Such an arrangement ensures that quality is maintained at a high level and degrees are of international standard. Moreover, it facilitates recognition and helps in providing greater confidence in locally awarded degrees. Faculty of Agriculture degrees have been favourably reported upon by external examiners. Some impressions expressed by them are quoted hereunder:

(a) “I gained the impression that the School of Agriculture has two primary objectives so far as its degree students are concerned. First, it wishes to educate and train professional agriculturists for the specific and immediate needs of Mauritius. Secondly, it wishes to ensure that the degree which is awarded by University maintains a level which is internationally accepted and on a level with universities of repute in other countries.

I am happy to record that I believe that the School is achieving both objectives as indicated by my examination of the final degree students.”

(Prof. E.H. Roberts D.Sc., University of Reading, 1973).

(b) “I was impressed with the general standard of the scripts I examined, with the very few very poor answers to particular questions, and with high proportion of answers there were about as complete as they could have been. I was also impressed with the high standards of the projects and with the relevance of the whole of the examination to the economy of Mauritius. This made my examining much more interesting and rewarding than it has been at other Universities!”

(Prof. R.K.S. Wood FRS, University of London, 1987)

ACKNOWLEDGEMENTS

My thanks go to Mr M. Navjee, Senior Executive Assistant, for compiling the statistics and certain other information and to Mrs S. Auliar, Confidential Assistant, for typing the paper.

REFERENCES


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UNIVERSITY OF MAURITIUS. Annual Reports.
DISCUSSIONS

Q. I see that there are no projects related to livestock research at the University? Could you please comment?

A.O. The list varies from year to year and is dependent on the preference of the students and on the current situation.

B.H. The DARE would be interested to collaborate with the University in providing a list of research topics related to animal and livestock production.

A.O. We are very open to this suggestion and this is an example of the various forms of collaboration we can have with other institutions willing to have similar arrangements with us. Such arrangements may enable us to address certain specific problems.

Q. Do you know what the future needs of the Industry are and looking back in history how the students have found a relevant satisfying job and what's the future prospects and how you are going to assess that?

A.O. It is true that in theory we should look at market demands but this is very theoretical. You don't get the right statistics from the various people you ask. What is satisfying to note is that during the last 27 years we have had no problem of placement of students.

E.R. It is true of most agricultural degrees because on one hand there is professional training and on the other hand, there is the university education and I think as a university education itself, it is quite a good one because it contains components which are very relevant to all sorts of professions, jobs and activities which require certain amount of science, of technology and certain amount of management studies, of economics. I don't think that you do need to worry that the supply actually meets demand. It has to be the value of education whatever the person goes into would be my opinion. It has to be understood that the University education has value beyond professional training.

Q. For the products of the tissue culture lab, what are the channels for commercialisation, does the lab work only on orders received from producers?

Y.B. So far we have been working on orders received from producers, we are doing the hardening and they are costed. We have not ordered plants for the general demand.

Q. From the list of crops you are producing on order, it is not therefore possible for any other producer to purchase these plants?

Y.B. No, it is not possible, but for bananas it has been possible because it is being operated through the Development Bank of Mauritius Scheme.

R.A. Either tissue-cultured plantlets are imported from overseas or eventually they will be produced over here. If you are going to order from overseas, you need to have a minimum order which is normally high and which may suit requirements of large planters or estates but can be too high for a small planter. For the latter we have advised them to group themselves, so that they can actually order the minimum number but that in fact is not easy. So the Development Bank of Mauritius has developed a scheme, whereby they provide the money for importation for the small planters and then they sell the plantlets to the small planter at a subsidized price. But when we do start production ourselves, then we could provide in smaller numbers.

Q. Is there any protection to prevent someone from multiplying particular varieties, once acquired from FARC, by other conventional means?
R.A. If the variety or the plant is not covered by any propriety right, then the planter can do whatever he likes. Anything coming from the International Agricultural Research Organisations, that you can have access to, can be propagated freely. We foresee however problems related to patent rights and that is why we are considering joining UPOV.

Q. As a follow-up to this point, there is a new variety of onion in the pipeline, that person wants to establish Intellectual Property Rights in Mauritius, to which institution should he go to? The variety has been developed elsewhere, but it being produced here. The person wants to have a royalty on the basis of its Intellectual Property Rights.

R.A. It will be the Ministry of Trade.

Q. As from the evolution of the AFRC of UK to the BBSRC, I understand that the FARC of Mauritius is still in the phase of organisation, don't you see a trend in the future of the FARC similar to the British AFRC?

R.A. I might answer that question by next year.

E.R. The FARC as I see it developing here, in spite of the fact that Prof. Antoine looked at what is happening in U.K., is different. The FARC here has very practical objectives in what it does as it seems to me.

Q. What would be the process of setting up a National Agricultural Research Agenda? Would this process be handled in a coordinated fashion by the FARC, would it be an aggregation of the research agendas developed by individual institutions?

R.A. It will be FARC itself. DARE is not being merged into FARC. DARE will be a unit. There may seem to be duality of functions, but this is only an expediency which is needed at the moment.

Q. Is the Faculty of Agriculture considering a course in agricultural economics?

A.O. That would depend on the demand for such a course. The University is already running already a BSc course in pure economics and I don't know at this stage whether we might consider an Msc course in Agricultural Economics.