SUGAR RESEARCH INSTITUTE OF FIJI

STRATEGIC PLAN 2014-2020
1.0 INTRODUCTION

Research has been conducted in the sugar industry of Fiji since the late 1890s. Initially, the CSR Company did all the research but they left Fiji in 1973. After the departure of CSR, the Institute was known as the Sugar Cane Research Centre. In 2006, it was renamed the Sugar Research Institute of Fiji and was set up under the SRIF Act of 2005. Although the Institute had been part of Fiji Sugar Corporation for many years, SRIF is now an independent organisation. It is desirable that the Institute remains independent so that it can provide advice that is truly independent.

The first Corporate Plan was prepared for 2010-2015, and it is now time to update that plan for the period 2014-2020. The plan is the SRIF Plan but was developed in consultation with the sugar industry stakeholders and is responsive to the needs of the industry as articulated by the stakeholders.

The research in the plan is industry driven. A process for commissioning research in the industry is being developed. Each of the six Action Groups in the Industry Strategic Action Plan (SAP) will present concept notes on issues of importance, and these issues will be considered by the Stakeholders’ Action Group (SAG) who will prioritise the issues. A shortlist of agreed priorities will then be presented to the Science Audit Committee of the SRIF Board which will indicate which issues can be researched by them and whether extra funding is required. If SRIF does not have the expertise to carry out the research, it will suggest where the expertise can be found. Once specific projects, funding and timeframe are agreed, SRIF will proceed to either directly undertake the research or coordinate the activities of delegated research providers. Monthly updates on progress will be provided to the SAG.

There are elements of the plan that have been based on the knowledge of SRIF staff from contact with similar research organisations or from reading the scientific literature. It is important that SRIF is aware of current trends in research so that the latest technologies can be tested in Fiji and, if successful, adopted by the industry.

The plan has an emphasis on technology transfer which is the key to transforming the productivity of the industry. SRIF has a considerable body of knowledge on a wide range of subjects, and this knowledge must be transferred to the industry in a timely and effective manner. The procedure for improving technology transfer is outlined in this plan.

SRIF must become the ‘Knowledge Centre’ for the Fiji sugar industry. It should invest time and resources in establishing networks, reviewing current scientific literature, evaluating industry developments both here and abroad, and being a repository for ideas from the stakeholders of the industry. Information gathered should be presented to industry meetings on a regular basis. As a knowledge centre, the organisation will set up new communication channels between itself and the rest of the sugar industry. It will engage with stakeholders during November and December 2013 to identify where knowledge services are
required and where it can add value. This will be undertaken as an agenda item for the SAG meetings. Knowledge services may extend through sugarcane production, harvesting and transport, milling and processing, quality-based payment systems and other areas covered by the SAP. An international industry-watch will be established and two-way communication channels with the industry launched. A dedicated area of the SRIF website, a monthly sugar industry e-Bulletin and/or email updates will be set up and activated from February 2014 onwards.

2.0 MISSION

To contribute to the emergence of a competitive sugarcane industry in Fiji through excellence in appropriately targeted research and supporting technology transfer combined with international engagement, the development of supporting knowledge services, and a strong and sustained industry communications strategy.

3.0 CORPORATE GOAL

To be responsive to the needs of the growers, millers and other key stakeholders to create a more productive, sustainable and profitable sugarcane industry.

4.0 PRIORITIES

As outlined in this plan, SRIF will work towards its corporate goal during this six-year period to deliver against seven priorities.

1. Plant Improvement – an efficient, modern plant improvement program delivering improved varieties to the industry
2. Crop Protection – a crop protected from weeds, pests and diseases
3. Crop Improvement – crop potential reached by applying optimum husbandry
4. Technology Transfer and Knowledge Services – research outputs transferred effectively to cane growers with international best practice, case studies and industry developments gathered, interpreted and presented in a manner that is contextualised to Fiji
5. Sugar Milling – an efficient and profitable sugar milling industry
6. Capacity Building – an organisation committed to improving the skills of its staff with an emphasis on core research competencies but also including project management, communication and proposal development.
7. Corporate Management – an efficiently run organisation with strong governance and reporting measured against international standards and performance benchmarks.
5.0 CORE OBJECTIVES

The core objectives of SRIF are to provide the research, technology transfer and knowledge services necessary to achieve the goals set out in the Industry Strategic Action Plan. The key goals are:

- Average cane yields in excess of 70 t/ha by 2020
- A TC/TS ratio of 9.5 by 2020
- To reduce the cost of farming while improving yields of cane
- To protect the environment of Fiji.

6.0 VISION FOR THE FUTURE

What will the sugarcane industry in Fiji be like in 2020? If the industry strategic action plan and this SRIF strategic plan are followed, it should be possible for the industry to have an average cane yield in excess of 70 t/ha and a tc/ts of about 9.0. However, in an environment of increasing levels of competition and resource constraint, this will require stronger collaboration between all stakeholders in the industry. The commercial viability of sugarcane production needs to be proven to growers and a new emphasis on commercialisation and productivity engendered. The industry needs to be supported by strengthened and more targeted supporting services related to research, technology transfer, knowledge, harvesting, transport and milling. An integrated approach and stronger alignment between all industry players is required. A new urgency now faces the industry with the prospect of exposure to sugar sales at world prices. The sugar industry must also be immediately viewed as a sugarcane industry with new revenue streams opened in areas such as co-generation and ethanol production. Internationally, such revenue streams are seen as essential and intrinsic elements of commercial viability and risk reduction and this has implications for supporting research. The industry is at a critical transformation point. Smart research, technology transfer and knowledge services are urgently required to make informed decisions, build crop performance and improve industry competitiveness.

The research, technology transfer and knowledge services outlined in this plan are designed to respond to this challenge. Whilst many areas of research require, by necessity, long-term planning horizons, the immediate challenges facing the sugarcane industry are recognised and a new focus has been placed on the coming four-year period to 2017. SRIF will engage directly with industry and growers to work on immediate, practical steps that can help to improve crop performance and industry productivity. New communication channels and a more pro-active approach to stakeholder engagement will ensure the organisation is kept in-tune with the immediate concerns of the industry. A responsive program of demonstration and industry-led research activities will be actively managed to ensure that SRIF adds value and can retain its position as a key potential contributor to industry success.
The labour and productivity experience of recent years means that Fiji must immediately find ways to introduce some level of mechanisation to the harvest process. This will bring problems as well as benefits. More trash will go to the mill, which will reduce sugar content, there will be damage to the fields from the effect of heavy machinery, and cane will be lost from the extractors of the machines. However, the problem of finding labour to cut the cane would be reduced, and it is possible that the fields would be in better condition after harvest than they are now. If the cane is cut green, the resulting trash blanket will be useful to reduce weed growth and retain moisture. Small harvesters are likely to be more suitable than large harvesters in Fiji, and these harvesters should have less effect on the fields. Resolving this issue requires careful consideration of options, practical analysis and decisions regarding appropriate systems for Fiji. SRIF can contribute to this process through its knowledge services, strengthening cooperation with FSC and the growers.

When quotas for sugar from the EU cease in 2017, the industry may have more difficulty in selling its sugar on world markets as Fiji is not located close to major markets. This will require a greater emphasis on market intelligence, industry trends and prices. Asia is a growing market and, with increasing wealth, the demand for sugar is likely to rise. Consumers are also increasingly sensitive to environmental issues and product provenance. As an island producer with a rich sugar-producing heritage, combined with its Fairtrade Certification and environmental qualities, there are many opportunities for Fiji to build a compelling story to help market its sugar. SRIF Knowledge Services have a role to play in this regard and can help to ensure examples, case studies and industry trends are spotted, contextualised and transmitted to the industry.

The production of ethanol rather than sugar and new cogeneration projects are already being initiated by FSC and are included in the Strategic Action Plan. This has implications for varietal choice and finding an appropriate balance/mix between sugar and fibre. This will be reflected in SRIF trials and demonstration activities, and there will be active engagement with the industry to ensure potential bottlenecks are anticipated and the appropriate research response made.

The importance of good communication between all stakeholders cannot be emphasised too strongly. Then, if the industry decides to change direction as mooted above, SRIF will be ready to respond in a positive way.

7.0 INDUSTRY PRIORITIES

The industry strategic action plan identifies priorities for the Grower Advisory Team. Issues where SRIF can add considerable value include

- **A zero tolerance** weed control program
- Advice on best agricultural practice
- Continue sugarcane seed nursery program
- Recommended rates and timing of fertiliser application
• Use of organic matter to improve soil structure/basic fertility levels
• Basics of crop planning and the ratoon/re-plant cycle
• New varieties with good sugar content to maximise the opportunity of the QBPS.

The SAP update in October 2013 identifies the importance of practical, grower-oriented, demonstration and lead-farm establishment to compensate for the limited resources available to support the extension services. In a period of resource constraint and time pressure, any disconnect between the research program and immediate on-farm and industry requirements could be damaging to the prospects for industry recovery and the relevance of SRIF as a key source of knowledge and expertise. This strategic plan is mindful of this issue and commits SRIF to playing its role both through the provision of immediate and coordinated support to the FSC/Fairtrade Grower Advisory Plan and its associated grower training, lead farm and demonstration activities. SRIF has the resources and expertise to make a valuable contribution to this work and will actively engage with the relevant industry partners in this respect. There should be a Memorandum of Understanding between SRIF, FSC and Fairtrade to ensure that each of the partners has a complete understanding of what is expected from them.

An effective seed production and planting program is an essential requirement to increase crop productivity and industry competitiveness. The industry is suffering from an acute shortage of sugarcane and growers are slow to plant the new sugarcane varieties that are being introduced by SRIF and multiplied by FSC. A stronger integration of effort between both organisations is envisaged to address this issue. There is no point in having a portfolio of new and productive cane varieties if growers are not planting them. SRIF is mindful of this issue and commits to playing its role in not just breeding new varieties but also demonstrating their potential under commercial farming conditions. Farm demonstration activities, including sample gross margin analysis, will be developed by SRIF to ensure effective technology transfer and adoption of new varieties by growers.

A similar approach will be required with respect to soil fertility management, usage of inorganic fertilisers and biocomposts, and optimum approaches to weed control.

These priorities have been taken into account in the preparation of this strategic plan. In addition, there has been consultation with several groups of growers to ascertain their views on the priorities for SRIF.

8.0 CORPORATE STRATEGIES

• Strategy 1 – Strengthen the relationship between SRIF and its stakeholders

SRIF is the only organisation providing research services to the Fiji sugarcane industry, but its contribution to the industry is not well understood by its
principal clients, the cane growers and the Processor, FSC. In addition, research outputs are not always presented to the growers in a timely and effective manner. In addition, SRIF needs to find new ways of engaging with not just growers but also the wider industry. In response to the immediate challenges that the sugarcane industry now faces, SRIF has much to offer. It has the resources and networks to help the industry adapt and can be a vital agent in helping the industry to survive. Enhanced communication and a focus on innovation, flexibility and adaptive research is required.

SRIF needs to play a major role in technology transfer of research results and knowledge to industry stakeholders. This should be done in collaboration with extension staff from FSC, the Fairtrade organisations and other industry stakeholders. A novel and proactive approach is required that maximises the use that is made of new technologies such as text-based messaging combined with more traditional approaches. The Grower Advisory Team will face considerable challenges in not just reaching out to farmers but sustaining a two-way flow of information and engagement. They will need help and SRIF is mindful that SRIF has an important opportunity to add value in this regard. This also provides it with an opportunity to stay in contact with the immediate concerns of its clients and be responsive to their needs.

At present, growers are probably aware that SRIF breeds new varieties but do not appreciate the research effort into weed control, fertilisers, and crop protection. More communication and practical demonstration is required in this regard and to the new focus that SRIF is committing to in relation to technology transfer, industry-led research and knowledge services.

- **Strategy 2 - Increase quality of research undertaken by SRIF**

  When funding to the Sugar Cane Research Centre was reduced in the late 90s, some experienced staff left SRIF. When funding was restored in 2006, many young staff were recruited. Some of these staff members had limited qualifications, and SRIF has been very active in improving the skills of these staff through tertiary education and training courses. This skills enhancement will continue and will improve the quality of research in the period 2014-2020.

- **Strategy 3 – Emphasise technology transfer of SRIF research results to stakeholders**

  As discussed under strategy 1, SRIF needs to be more involved in technology transfer. SRIF recognises that the industry is facing an immediate and very serious challenge to build its competitiveness. Whilst not abandoning its investment in longer-term research projects, the organisation is willing to play its role in the exceptional industry recovery effort that is required and outlined in the SAP. For a period of three years, from 2014 to 2016, three senior staff from SRIF will be mostly devoted to technology transfer and other research staff will allocate significant amounts of their time as well. This will support practical, field-based demonstration and extension-training efforts that are fully integrated with the FSC/Fairtrade Grower Advisory Plan. This will include SRIF facilities
and equipment. Additionally, SRIF will allocate substantial time to the development of the new set of knowledge services referred to. As industry recovery is secured, this allocation will be revisited at the end of the three year period.

- **Strategy 4 – Increase collaborative and interdisciplinary research nationally and internationally**

SRIF can improve its research outcomes by increasing involvement in collaborative research and interdisciplinary research. SRIF staff have good contacts in overseas institutions and should have opportunities to be involved in collaborative research. This is assisted by the ACP-SRP program which encourages ACP countries to collaborate in research; SRIF is involved in several such collaborative projects, and these will benefit the Fiji sugar industry. Involvement in the ACP-SRP program is also advantageous as SRIF staff are aware of research being undertaken in other ACP countries. If there is a Phase 2 of this program, SRIF staff should actively seek collaborative projects.

To date, SRIF has had limited collaboration with other research organisations in Fiji, but there are opportunities for collaboration with the universities and the Ministry for Primary Industries, and these will be explored. Involvement with students at the universities, for example, can deliver research results inexpensively and could create opportunities to attract good students to SRIF after graduation.

- **Strategy 5 – Explore and utilise alternative sources of funding**

The current funding of SRIF from the three stakeholders is sufficient for a basic program of research but is inadequate to provide essential infrastructure, equipment, and to conduct innovative research projects. However, the proposed reduction in funding from the stakeholders will create difficulties for SRIF as it has to provide 20% of the funding for any EU-funded project.

SRIF has been fortunate to obtain funding from the European Union to enable it to construct some excellent infrastructure and to purchase excellent equipment for the organisation. EU funding is expected to cease in the near future, and it is important that SRIF finds alternative sources of funds so that it can partake in research that will deliver benefits to the industry.

Apart from funding bodies such as EDF, NZaid and Ausaid, it may be possible for SRIF to generate funds by providing services such as land preparation, planting and fertilisation, and possibly by commercial sugarcane production.

Additionally, by extending the role of SRIF to place a greater emphasis on technology transfer and knowledge services, combined with steps taken to add value in relation to other FSC-led revenue generating activities, there is an important opportunity for SRIF to benefit from funding or fees that may arise from a refreshed and broadened mandate that is valued by the industry.
9.0 SRIF’S PRIORITY PROGRAMS

9.1 Program 1 - Plant Improvement – an efficient, modern plant improvement program delivering improved varieties to the industry

A plant improvement (or plant breeding) program is the cornerstone of most sugarcane research organisations. Improved varieties are required to increase productivity but also to protect the crop against destructive pests and diseases. Modern sugarcane breeding programs require state-of-the-art infrastructure and advanced statistical power to deliver productive new varieties efficiently and at minimal cost. SRIF has excellent facilities purchased with funds from the EU. Several staff members have been trained in the most advanced statistical programs.

During consultations with industry while gathering information for this plan, it was clear that growers require varieties with higher sugar content to gain maximum benefit from the QBPS payment system, and they also require varieties that perform well in hilly conditions. At present, only Mana performs well in such conditions and Mana does not have good sugar content early in the crushing season.

Plant breeding programs typically have four main components

- Introduction of varieties
- Cross-pollination
- Selection
- Biotechnology

9.1.1 Introduction of varieties

All plant breeding programs need to introduce varieties from other breeding programs on a regular basis to widen the genetic base available for making crosses. In Fiji, there was a period of about 20 years when no new varieties were introduced, and there is evidence that this reduced the genetic base of the germplasm available for crossing. Introduction of new varieties has recommenced, but more needs to be done.

In addition to introducing varieties, it is possible to introduce sugarcane seed from some countries, and this provides much needed genetic variation. Some seed has already been obtained, and there is scope for more such introductions.

Prior to 1990, plant breeders in Fiji were involved in a major introgression program. In this program, the sweet noble canes, *S. officinarum*, were crossed with wild canes, principally *S. spontaneum*, and backcrosses of the progeny to sugarcane varieties were made. Much of this material is still available, and needs to be used in the breeding program to add to the genetic variability.
Key performance indicators

- Introduce at least 20 new varieties each year
- Source varieties from at least four different countries
- Introduce seed from 30 crosses each year.

9.1.2 Cross-pollination

Cross-pollination is the process of crossing a female variety with a male variety to produce crosses. Each individual of a cross is genetically different, so crossing creates a lot of genetic variability which is essential for a successful selection program.

Because the ACP-SRP program funded two plant breeding research projects, SRIF has very good facilities for cross-pollination. Unlike many other sugarcane breeding programs, SRIF can make crosses without fear of pollen contamination, so that they can be sure that the progeny of the cross all have the same parents. This enables SRIF to adopt family selection which is the subject of one of their research projects. Using sophisticated statistical techniques, the results of family selection trials will enable the breeders to estimate the breeding value of the parents. The statistic estimated is called a Best Linear Unbiased Predictor (BLUP). This will greatly enhance the chances of making superior crosses in future years.

Characterisation of the germplasm collection is necessary to assist in choosing parents for crossing.

The efficiency of the cross-pollination program would also be enhanced if there were a database system in which the characteristics of the parent varieties were stored, along with the results of previous crossing campaigns. With such a system, computer programs could be written to enable the breeders to choose the crosses with most potential using the parents that are available for crossing.

SRIF has been funded to conduct a project to cross sugarcane with Erianthus which is a grass that is similar to sugarcane. Erianthus has many desirable characteristics such as tolerance to wet and dry conditions, excellent ratooning ability, and resistance to pests and diseases. However, it has low sugar content and is difficult to use in crossing. This project is risky but has the potential to produce useful varieties in the future.

The sugarcane industry has requested varieties with higher sugar content to take advantage of the quality payment system to be implemented in 2014. There is more genetic variability early in the crushing season than later in the season, so there is an opportunity to breed varieties with higher early sugar content. A small sub-program to breed for this character should be carried out. This will entail identifying a group of parent varieties that have early sugar content, crossing within that group, selecting progeny that have the high early sugar character, and crossing those progeny in another round of crossing. Rapid
progress from selection for the character is likely. Selection for high sugar content later in the season will happen in the main program.

SRIF should also commence a sub-program for the production of “energy” canes. It is difficult to define what is meant by an “energy” cane but it is usual to assume that such canes have much higher fibre content. Most breeding programs have a large amount of genetic variability for fibre content, so it is relatively easy to breed for higher fibre. This may not be the case in Fiji because of the narrow gene pool but, by using backcross progeny from the S. spontaneum introgression program, it should be possible to breed useful varieties with higher fibre in 8-9 years. These varieties will not have very good sugar content as it is impossible to have both high fibre and high sugar content; a balance between the two is required. If the Erianthus introgression program is successful, the progeny from the program will be very useful for this sub-program.

At present, the Fiji sugarcane industry is operating with very low fibre content, so an increase to 15-16% should be relatively easy. Such varieties should be easy to mill but may have lower sugar content than current varieties. If, however, fibre contents of 20% are envisaged, there will be difficulties in harvesting and milling.

Key performance indicators

- Make at least 500 biparental crosses each year
- Make 50 crosses with Erianthus each year
- Make 40 crosses with spontaneum hybrids
- Per cent of crosses with good germination greater than 50%
- Estimate BLUPs from family selection trials by 2015
- Characterise 300 parent varieties by 2017
- Have an operational plant breeding database by 2015
- Commence a small high early sugar program in 2014
- Commence an “energy” cane breeding program in 2014.

9.1.3 Selection

Selection of new cane varieties is a time-consuming and difficult procedure. Typically, a variety selection program starts with a very large population of individual seedlings (at least 25,000 but can be over one million in some countries) and the sugarcane breeder has to select the best individuals. It is important to use the best techniques to optimise the chances of selecting the best genotypes.

Family selection of original seedlings has been shown to be superior to individual selection, the system used in most cane breeding programs. SRIF is evaluating family selection in an ACP-SRP funded project but should adopt family selection as a routine practice while the experimental data are being obtained. This system of selection, apart from giving greater gains from selection, is more efficient in terms of manpower and cost.
For stages 2 and 3 of the program, it is necessary to use visual selection. If mechanical harvesting becomes more common in Fiji, it may be possible to weigh cane at these stages of selection, which would improve the accuracy of results obtained. Breeders should keep a watching brief on this issue.

Stage 4 trials are very important, as selections from this stage are considered for release to the industry. Therefore, it is essential that the trials be conducted using good statistical techniques including good plot technique. If there are large gaps in the trials, random variation increases and results are not reliable. A simple test of the variability is to measure the coefficient of variation (CV).

Stage 4 trials are normally planted on sites with minimal variability. Consequently, there are none of these trials on sloping or hilly country where variability is greater. Therefore, no yield data are available from these sites, and it is necessary to plant demonstration plots of leading varieties on the sites to determine their suitability. This was requested by the industry and has commenced.

SRIF has a critical role to play in the release of improved varieties and in the nursery program. New varieties and uptake by growers of these varieties will be essential to reach the SAP productivity targets. Given the exceptional situation the industry is now in, SRIF will match its emphasis on breeding by prioritising the rate and extent of grower uptake. This will be integrated with the work of the Grower Advisory Team.

**Key performance indicators**

- Family selection adopted in 2014
- CVs for yield of cane in Stage 4 less than 15%
- CVs for sugar content in Stage 4 less than 5%
- Plant demonstration plots of promising varieties in sloping and hilly country
- Grower uptake of new varieties representing 6% of new cane planting in the year of release.

**9.1.4 Biotechnology**

Many breeding stations have spent millions of dollars on trying to use marker-assisted selection and to improve varieties using genetic engineering. To date, markers are not being used for selection in any cane-breeding program and no genetically modified varieties have been released. In view of this lack of progress, SRIF should not attempt to use either technique. If there is a major breakthrough, this situation will need to be re-evaluated.

However, there are some biotechnology techniques that are immediately useful. In particular, there is a PCR technique to determine if progeny from an Erianthus cross are true hybrids or the result of pollen contamination. SRIF has been
sending DNA of putative hybrids to Mauritius or Australia to determine hybridity, and this is expensive. The PCR test should be adopted. Putative hybrids identified could then be tested by the DNA method subsequently.

Another technique that should be adopted is a method for obtaining DNA fingerprints of varieties. This provides a definitive method for deciding if a variety has been correctly identified.

Key performance indicators

- Use the PCR test to check for hybridity in Erianthus progeny
- Have DNA fingerprints on 50 varieties by 2015 and do an additional 50 in each subsequent year
- Keep a watching brief on developments in Biotechnology
- Use molecular techniques to identify diseases.

9.2 Program 2 - Crop Protection – a crop protected from weeds, pests and diseases

The protection of crops from the ravages of weeds, pests and diseases is one of the most important functions of a research organisation like SRIF. Fiji is fortunate that it only has one serious insect pest (cane weevil borer) and serious diseases are largely under control. Weeds, however, are not under control, and control of weeds has to be a major focus for SRIF and the industry. SRIF also has to be vigilant about the incursion of exotic pests and diseases.

Actions to be taken on these three issues will be considered under the following

- Weeds
- Pests
- Diseases.

9.2.1 Weeds

SRIF has conducted trials on the response to applying herbicides at different times. The results have shown that, if herbicides are applied correctly and at the appropriate time, cane yields will be greatly enhanced. However, weed control in the sugarcane industry is poor, and there is an urgent need for an extension campaign to teach growers about the appropriate methods for controlling weeds, both manually and with herbicides.

In Labasa mill area, there are several grass species that are weeds in cane fields. Grasses are difficult to control as sugarcane is also a grass and will be killed by herbicides that kill the grass weed species. An innovative program to control these weeds is required.

A potential issue with herbicides is that some of them may be deemed to be environmentally unsuitable, and there are few effective, alternative herbicides
on the market. There are also questions about the quality of some of the herbicides. SRIF staff need to be aware of other potential herbicides and to test them under Fiji conditions.

*Key performance indicators*

- **Plant at least three demonstration trials showing the benefits of weed control in each mill area**
- **Number of grower meetings and events regarding weed control**
- **Number and circulation of both traditional grower publications regarding weed control and also ICT-based interaction via mobile phone and other appropriate channels**
- **Plant at least two trials to test methods for control of grass weed species by 2015.**

### 9.2.2 Pests

The cane weevil borer is the only serious pest of sugarcane in Fiji. Unfortunately, manually harvested cane in Fiji leaves a lot to be desired as there are numerous stalks left on the ground and the cane stalks are cut too high. Not only does this waste cane that should go to the mill, it also provides conditions on which weevil borers thrive. This will be a difficult problem to solve until mechanical harvesting is used more extensively.

Control methods that are being investigated include the use of entomopathogens and pheromone traps. This work should continue. There is also scope for testing varieties for preference studies – there is no doubt that weevil borers prefer some varieties to others, and a non-preferred variety could be useful for reducing pest numbers.

Nematodes may also be a problem, but they are notoriously difficult to work with. Nematicides are expensive and highly dangerous chemicals, and should only be used in an emergency. However, use of a nematicide to determine if nematodes are causing a loss in yield should be considered. Also, some varieties may be more tolerant of nematodes.

In the longer term, termites may also be a problem for the industry.

*Key performance indicators*

- **Assess whether pheromones are an economical method of control of cane weevil borers by 2016**
- **Develop at least one entomopathogen for control of cane weevil borer by 2016**
- **Plant two trials of leading varieties to test for cane weevil borer preference by 2015.**
- **Hold at least two grower awareness events about good harvesting practices in each mill area each year**
9.2.3 Diseases

The diseases of traditional concern in Fiji are ratoon stunt (RSD), Fiji leaf gall and downy mildew. Recently, there has been a suggestion that orange rust has arrived in Fiji but this has yet to be confirmed. Yellow leaf syndrome has also been reported – this disease is most serious in stressful conditions and is probably worse in 2013 because of the prolonged drought.

A serious threat to the industry is an incursion of smut disease. Leading varieties are being tested in Australia for resistance. However, if the disease enters Fiji, there will be major consequences for productivity, and the breeding program will need to produce resistant varieties rapidly. It would be advisable to prepare a smut incursion plan – BSES, in Australia, prepared such a plan and this proved useful when the disease entered the east coast of Australia. It may be worth considering testing of a large number of varieties for resistance to smut in Indonesia as BSES did. This would be expensive and would have to be funded externally, assuming the Indonesians are prepared to do it.

Downy mildew has not been seen in commercial fields for ten years, so is not a serious threat. There is concern about the testing method, and it would be worth trying the method used by BSES in Papua New Guinea.

Fiji leaf gall is not currently a major problem but it does exist in the industry and duruka (Saccharum edule), which is widespread, is susceptible. Therefore, testing of new varieties is important, and susceptible varieties should not be released. An improved method for testing for resistance has been developed in Australia, and should be tested in Fiji.

RSD is almost certainly endemic and must be causing losses in productivity. The clean seed scheme is vital to limit the damage. The ELISA method for testing for the presence of RSD has not been successfully implemented, and it is urgent that this be overcome. There is interest in rating varieties for resistance to RSD in the hope that a resistant variety could be identified. As RSD can be controlled by the use of clean seed, it is not desirable to place an added burden on the breeding program. However, if many farmers do not use the clean seed, a resistant variety would be useful.

Key performance indicators

- **Produce newsletters about harvesting practices in each mill area twice a year.**
- **9.2.3 Diseases**

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**Key performance indicators**

- **Develop a smut incursion plan by 2015**
- **Commence testing varieties for resistance to smut in Indonesia by 2015 if agreement can be reached with the Indonesians**
- **Publish a report on the resistance testing method for downy mildew used in PNG by September 2014 including quantification of the impact of the disease on production**
- **Adopt the improved method for testing for resistance to Fiji leaf gall**
• Get the ELISA method for testing for RSD operational by 2014
• Plant 30 ha of hot-water-treated cane of commercial varieties each year for distribution of 300 t of cane to FSC extension staff in the following year
• Plant demonstration plots in collaboration with FSC extension staff showing the difference between cane planted from clean seed with cane planted from farmer’s cane – at least three trials per mill area.

9.3 Program 3 - Crop Improvement – crop potential reached by applying optimum husbandry

Crop Improvement is essentially about Agronomy and good crop husbandry. An important issue is fertilisation as the crop will not prosper without adequate fertiliser. A major problem in Fiji, as discussed in the industry strategic action plan, is that much of the fertiliser is used by weeds if weeds are not controlled during the establishment phase of the crop.

For fertiliser to be applied at the optimum rate, it is necessary to conduct a soil test. This is an important function of SRIF. Demonstration trials showing the correct application of fertiliser (after a soil test) compared with the farmer’s usual practice would be beneficial.

The cost of inorganic fertilisers is also an issue. There is an opportunity to test biofertilisers and biocompost to determine if they can replace some of the inorganic fertiliser. Another possibility is the use of a nitrogen-fixing bacterium, Azetobacter. Intercropping with leguminous crops will add nitrogen to the soil, and that would be beneficial. It is also possible to use legumes as cover crops in the fallow period in which case nitrogen would not be required in the plant crop.

A major issue that agronomists will have to deal with is the effect of mechanical harvesters on the cropping system, if they are used extensively. Compaction can be a serious issue if large harvesters are used but is less likely to be a problem with small harvesters which would be more suitable under Fijian conditions. Mechanical harvesters can damage the stool and lead to poor ratooning, so this would need to be assessed. With mechanical harvesting, a dual-row cropping system should be considered.

At the present time, there is very little irrigation in the sugarcane industry but irrigation would be beneficial in drought conditions. Systems such as drip irrigation and centre pivot irrigation are either too expensive or impractical under Fijian conditions, but sprinkler irrigation or flood irrigation could be considered.

There is a phosphorus project funded by the ACP-SRP being conducted in association with the Mauritius Sugar Research Institute. Phosphorus levels in Fiji are low, and this project is assessing the P in runoff on three different slopes and with three different intensities of rainfall. The project will also develop a P index to improve fertiliser recommendations.
Trials to test responses to different rates of nitrogen and lime are being conducted. Although sugarcane soils in Fiji are acidic, previous research has shown little response to applications of lime. The current research will be taken to second and third ratoon and is using a range of rates, so it should provide definitive results. If the pH of soil is too low, there is a risk of aluminium toxicity and major nutrients will become unavailable. Current practices are depleting the levels of calcium and magnesium in the soil so that application of lime and gypsum will become increasingly important.

**Key performance indicators**

- Test at least 2000 soil samples taken by FSC staff from farmers’ fields each year
- In 2014, devise 3 alternative strategies for reducing the cost of inorganic fertilisers, plant trials, and assess the economic and environmental benefits
- Work on mechanical harvesters with FSC Engineers during the 2014 harvest season to identify suitable machines and possible effects on soil and ratooning
- Complete the ACP-SRP project on phosphorus by 2015 and adopt the P index in recommendations to farmers
- Plant three demonstration trials in each mill area showing the difference between correct fertiliser application and the method used by many farmers
- Complete three nitrogen and lime trials in 2014, 2015 and 2016 and, in collaboration with extension services, use the results to refine fertiliser recommendations.

**9.4 Program 4 - Technology Transfer and Knowledge Services** – research outputs transferred effectively to cane growers with international best practice, case studies and industry developments gathered, interpreted and presented in a manner that is contextualised to Fiji.

Technology transfer is the key to improving productivity in the Fijian sugarcane industry. This plan outlines some methods for improving transfer of knowledge to farmers.

SRIF does not have dedicated extension officers. However, it is essential that research results from SRIF are communicated effectively to cane growers. As outlined in the industry strategic action plan, technology transfer needs to be a joint activity between SRIF, FSC and Fairtrade. As indicated above, this activity should be formalised with a Memorandum of Understanding.

There are a number of important issues that can be demonstrated effectively to cane growers by using demonstration plots and organising a group of farmers to visit the sites to see for themselves what can be done. One simple way to do this is to hire a bus, fill it up with cane farmers, and take them to the demonstration plots where the work will be discussed. The discussion should include the costs of the treatments applied, the benefits obtained, and the likely profit from the treatment.
In previous programs, demonstration plots for various issues have been detailed. These are

- Weed control
- Varieties
- Effect of clean seed
- Effect of appropriate fertilisation

Unfortunately, much of the work done by SRIF is unknown to growers. It is proposed that SRIF staff will be involved in presenting the demonstration trials to farmers so that the farmers get to know the staff and to appreciate the work that they do as well as benefitting from the experience. SRIF staff will have to allocate some of their time to this task; three staff will allocate most of their time to technology transfer and other research staff will allocate significant portions of their time.

SRIF has the equipment to make videos of subjects of interest to the industry. These videos could be shown during the bus trips or at special meetings organised for growers. It may also be possible to have the videos shown on TV. Fact sheets on topics of importance for growers are also useful for extending information.

A second method for transferring knowledge to farmers is by the use of mobile phones. This method has been used in a pilot project in Swaziland and has been an outstanding success. In Swaziland, irrigation specialists trained extension officers from the milling companies on the optimum methods for scheduling irrigation and, then, the specialists and the extension officers trained the farmers. Information is sent to the farmers frequently and the farmers can then calculate the available soil water and can work out when to irrigate. Productivity has improved and electricity costs have been reduced. The program will be extended to all smallholder farmers and will include information on other farm activities such as use of herbicides and fertilisers. The cost of the text messages will be met by the industry.

In Fiji, it is not proposed to run a pilot project but to include all farmers who have mobile phones. Obtaining the phone numbers will be an industry task as it is envisaged that phone numbers would be collected in the gangs, passed to the sectors and then to SRIF where the database will be held. A dedicated clerk will operate the computer system using software that is used to send multiple text messages. Messages will be sent at least once a week on issues such as weed control, fertilisers, varieties, and use of clean seed for planting. This will be a collaborative program between SRIF, FSC and Fairtrade and will require considerable effort from all. However, the benefit of reaching most farmers will make this worthwhile.

SRIF staff will also make regular broadcasts on radio. The topics should usually be relevant for the time of year but general interest stories will also be included.
Key performance indicators

- SRIF staff to devote increased time to technology transfer and knowledge services
- Demonstration trials to be presented to farmers from 2014
- Demonstration trials to be presented in each sector of the industry each year
- The cost/benefit ratio of the technologies being demonstrated to be calculated and discussed
- Effectiveness of the demonstration trials to be assessed via a survey one year after the visit to a sector – how many farmers have adopted the technologies shown to them? What results have they got?
- Prepare two videos per year to be shown to growers
- Six Fact Sheets to be prepared per year
- Develop the mobile phone messaging system and have it operating by the end of 2014
- SRIF staff to make at least 30 radio broadcasts per year.

9.5 Program 5 – Sugar Milling - an efficient and profitable sugar milling industry

SRIF does not employ any mill technologists at present. However, the SRIF Act includes functions for SRIF with respect to milling. Therefore, it is imperative that SRIF employ at least one mill technologist to work in collaboration with staff of FSC. Initially, a young graduate will be placed with FSC for a year as a mill chemist and then sent overseas to obtain a postgraduate degree. On return, the technologist will be able to conduct research to benefit the sugar milling industry.

The above is a long-term plan. As there is immediate concern for the future of the industry, it is desirable to obtain advice from a contract mill technologist with wide experience in the sugarcane industry. This advice should enable the industry to employ more efficient processes and reduce losses of sugar. There are competent and experienced technologists in Australia who could provide this advice.

FSC is interested in cogeneration, and this is enhanced by efficient energy generation and use. The ACP-SRP program has a project based in Mauritius in which consultants are made available to ACP countries to assess their energy generation efficiency. There is no cost to the client, so it would be advisable to make use of the service, and this could be organised by SRIF in collaboration with FSC.

If FSC wants varieties with higher fibre content for cogeneration, it should advise SRIF what level of fibre they can handle in the mill so that SRIF does not release varieties with fibre levels that will create problems not only in the mill but also in the field during harvest.
Key performance indicators

- **SRIF to employ a mill technologist by June 2014**
- **The mill technologist to receive post-graduate training, starting in 2015**
- **SRIF to contract an eminent sugar technologist to assist FSC with an assessment of its processing efficiency in 2014**
- **SRIF to arrange for a consultant from Mauritius to assess the energy efficiency of FSC mills in 2014**

**9.6 Program 6 - Capacity Building** – an organisation committed to improving the skills of its staff with an emphasis on core research competencies but also including project management, communication and proposal development.

SRIF has made a significant investment in the training of its staff. To date, two young men have completed Masters degrees in India, and the industry is starting to benefit from this training. More staff will complete Masters degrees in the next year or so, and some will complete Bachelor’s degrees. In addition, staff have been sent on training courses in France, Mauritius and Australia. Several staff have attended ISSCT workshops and ISSCT conferences. All of these activities have provided them with more knowledge and they have been able to create a network in their field of expertise.

The issue for SRIF now is for those staff to prepare project proposals for relevant research after doing a thorough review of the available literature. Staff should also be expected to prepare scientific papers on their work. If their papers are accepted by reputable journals or conferences, it is a credit to them and to SRIF.

It is also desirable for staff who have completed Masters degrees to consider enrolling for a PhD. This can be done internally or externally on a part-time basis, and the industry will benefit as the work done for the thesis must be on a topic of importance to the industry. Input from external supervisors will benefit both the student and the industry.

Specialised training in communication and project management will provide senior staff with the skills to communicate effectively with collaborators and farmers and to manage research and technology transfer activities efficiently.

Key performance indicators

- **Number of staff enrolling and completing a PhD degree**
- **Number of staff enrolling and completing a Masters degree**
- **Number of staff enrolling and completing a Bachelors degree**
- **Number of project proposals made and funded – 3 per year**
- **Number of scientific papers published – 2 per year**
- **Number of staff trained in communication and project management.**
9.7 Program 7 - Corporate Management – an efficiently run organisation with strong governance and reporting measured against international standards and performance benchmarks

SRIF has a problem in that it currently has no Board of Directors and no Science Audit Committee. This creates governance issues, but there is nothing that SRIF can do itself about this issue.

Management issues can be discussed under the following headings

- Administration
- Finance
- Information Technology
- Workplace Health and Safety
- Research
- Audits

9.7.1 Administration

The efficient management of an organisation is dependent on good management of resources and procedures. To be efficient, it is desirable to have a comprehensive package of policies and procedures on a range of issues including

- Office administration
- Security issues including security of ICT
- Library
- Leave
- Travel
- Motor vehicles
- Procurement
- Reports including quarterly reports and technical reports

*Key performance indicator*

- *A set of policies and procedures for the organisation to be completed by the end of 2015*

9.7.2 Finance

The Finance Department has a very good accounting package, but it does not seem to be providing the information on project management required by the researchers. A Management Information System (MIS) is needed so that research staff can access their budgets at any time. The MIS system should also be constructed to store progress reports in the system so that all information on SRIF’s research program is available in one place.

The Finance Department also needs to produce some detailed policies and procedures for the work that they do. This is needed in the event that a staff
member leaves and is replaced by someone who has no idea about the proper procedures.

**Key performance indicators**

- Develop a comprehensive MIS by 2016
- Write policies and procedures by 2014.

### 9.7.3 Information Technology (IT)

The IT group will probably be heavily involved in developing the MIS. However, this group also needs to develop a database system for storage and retrieval of data from all sections of the organisation. This has been an objective of SRIF for some time, but the single IT person had insufficient time to devote to the task. There is now a second person in IT who can take the load off the IT leader, and both of them can work on developing systems for the organisation as well as attending to the day-to-day issues regarding computers.

The IT group is also expected to develop a database system for the plant-breeding group as discussed above.

**Key performance indicators**

- Develop several modules for the storage of data in 2014
- Complete these storage modules by 2015.

### 9.7.4 Workplace Health and Safety (OHS)

Workplace health and safety is a vital component of any organisation. In a sugarcane research station, there are a number of activities that can be dangerous and some chemicals that are used in experiments are very dangerous. Therefore, procedures for the conduct of dangerous operations and use of dangerous chemicals should be mandatory. SRIF will develop Risk Assessment procedures and related paperwork together with Induction Schemes for all staff involved in medium to high risk operations.

Frequently, staff are working with general employees who usually have had a very basic education. It is important that such employees are reminded regularly about the correct procedures to use in many situations. If they are not following the correct procedures, they should be corrected and, if necessary, given a warning.

All staff should receive training in OHS from time to time.

**Key performance indicators**

- A Risk Assessment Procedures manual developed by the end of 2014
- Number of staff or employees found not to be following correct procedures
- Ongoing OHS/WHS training for all staff.
9.7.5 Research

All staff involved in research are involved in procedures that should be documented. In the case of plant breeding, there are many different operations in crossing and selection, and it is important that staff are aware of the correct procedures. A plant-breeding manual in which all the procedures are documented is a valuable asset for ready reference. The laboratory group already has a manual for methodologies and procedures for quality control. These may need updating from time to time. For example, the manual should include operation of the new Spectracane.

All staff will develop a set of documents outlining their work program, procedures and progress (updated quarterly) so that work can continue if a staff member leaves the organisation.

Key performance indicators

- The plant-breeding group will prepare procedures for the many operations involved in the program. It should be completed by 2015.
- The procedures manual for the laboratory group is up-to-date with all procedures used
- Number of staff who have developed documents outlining their work program, procedures and progress

9.7.6 Audits

Under the SRIF Act, SRIF is required to conduct field and factory audits. In the case of the factory, this will be very important with the introduction of the quality payment system in 2014.

Key performance indicator

- Conduct field and factory audits as required.