



# Post-Harvest Innovation Programme Impact Assessment Report

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## 1. Executive Summary

The Post Harvest Innovation Programme (PHI) is a public-private partnership between the Department of Science and Technology (DST) and the Fresh Produce Exporters' Forum (FPEF) which is directed at developing innovative technology in the post-harvest leg of the value chain for fresh fruit exports.

The mission-level goal of PHI is to engender a culture of innovation by providing funding opportunities to deserving applicants that will creatively seek solutions for the technology gaps identified in the fruit export value chain. Between 2008 and 2014, the investment of public funds in PHI will total R30-million.

The purpose of this report is to assemble an impact statement on how PHI projects contribute to research and innovation in the post harvest arena for fresh fruit and to present recommendations for FPEF, the custodian of PHI, on how the programme could develop into a third phase, after the present phase, PHI-2, ends in 2014.

The study of PHI, based on stakeholder interviews, site visits and desk-top research found that the Programme makes its impact in the following ways:

1. Allowing the re-emergence of cross-sector research and innovation projects that benefit all fruit types. (A tradition that weakened in SA following deregulation in the 1990's)
2. Adding more resources into the research and innovation system for the fruit sector.
3. Supporting research and innovation efforts that have already been identified as priority areas that will be addressed by the industry, but ensuring additionality by allowing these existing research agendas to achieve more, sooner, than would otherwise have been likely.
4. Developing new areas of research and innovation
5. Supporting research and innovation in smaller export industries (sub-tropical fruit) and in new crops (persimmons, pomegranates) which are not part of the remit of the industry research bodies responsible for citrus and deciduous fruit, and which consequently have had less technical expertise focused on them.
6. Retaining quality researchers in the fruit / cold chain / post harvest arena so they are available to teach both industry members and research students as well as to react swiftly to urgent research issues.
7. Capacity building
  - by developing new researchers, including black researchers from South Africa and elsewhere.

- by conveying the results of research to the industry through workshops and publications
- by financing specialised research equipment and making it accessible to industry and academic researchers.

It proved impossible to provide a scientifically sound impact assessment to quantify the benefits of a programme of research and innovation that is only five years old and encompasses a wide range of projects across many parts of the complex value chain for fresh fruit exports.

#### PHI in figures

- The PHI funding has supported 54 projects, 25 of which are still in progress.
- PHI funding received, over 2008-2014: R30-million
- The PHI funding has been leveraged by partnering with other private sector and public sector research initiatives to boost the funding support for PHI projects by an additional R8-million.
- SA fruit exports in 2010: R16 billion

PHI has evolved over time and particular issues have come to the forefront which need to be addressed by FPEF in planning the third phase of PHI, beyond 2014. The most important of these are:

- The integration of PHI with wider patterns and cycles of long term research and innovation in the post harvest and agricultural sector.
- The formalisation of financial contributions to post harvest research and innovation from those involved with the fruit export industry (ie beyond the levies on exports which fruit growers presently pay to fund research).
- The need for 'impact pathways' for PHI research and innovation to be understood, pursued and monitored so that there is rigorous evidence to show funders of PHI that resources are being used effectively. PHI-3 would involve both new projects and efforts related to the adoption of various of the PHI-1 and PHI-2 projects by the sector and/or their commercialisation.

Developments and adaptations in all three of these areas are needed for PHI-3 to ensure that this important area for supporting and developing competitiveness for fresh fruit exports has a foundation that is secure and sustainable.

## 2. Terms of Reference of the Study

The study was undertaken by Martin Nicol (ODA) and Allan Taylor (Allan Taylor Consulting), who are independent consultants, not previously involved with the PHI programme or with FPEF. The Service Level Agreement provided for a twelve week process of research, stakeholder engagement and report preparation and set out the following terms of reference:

**“The Consultant** undertakes to provide the following Services as agreed:

1. Consultation with the various stakeholders, including 10 face-to-face interviews as well as telephonic interviews and field visits, with a view to ascertaining the continuing impact of the various interventions undertaken across the value chain during the two phases of PHI.
2. The preparation of a ten page ‘impact statement’ on the PHI programme, summarising successes, failures and ongoing work, in the context of innovation-based projects.
3. Conduct a one-day stakeholder workshop to verify the ‘impact statement’, to discuss ways of increasing the impact of future interventions under the PHI Programme, and to develop a sustainable funding model for PHI-3.
4. Participation in the report back sessions on project presentations on 03 and 04 July 2012.
5. Produce a comprehensive final report arising out of the aforementioned processes, and that, in addition, clearly addresses the following:
  - a. FPEF’s future role regarding post-harvest innovation in the fresh fruit industry and, hence, in PHI-3;
  - b. An assessment of the model adopted by the South African Minerals to Metals Research Institute (SAMMRI) as a possible way forward to achieving a sustainable operational and funding support model for PHI;
  - c. Ways in which the interventions under PHI can secure matching funding from the fresh fruit industry, to ensure that research is industry-relevant and directed to priority areas;
  - d. Sustainable funding streams for PHI (and Post-Harvest Innovation initiatives in general) within the current scope of Government support programmes and with a view of extending the partnership to other Government departments/agencies.”

### 3. Background to the PHI Programme

This report assesses the impact of a R30-m investment of public funds in the Post Harvest Innovation Programme for fresh fruit.

Between 2008 and 2014, the Department of Science and Technology (DST) will have invested R30-million in support for the Post Harvest Innovation Programme (PHI), a public-private partnership between the Department and the Fresh Produce Exporters' Forum (FPEF). FPEF, recognised by the DTI as the export council for the fresh fruit industry, is a voluntary association whose members are associated with approximately 70% of South Africa's fresh fruit exports. Total fruit exports are of the order of R16-billion a year and are dominated by citrus (41%), table grapes (24%) and apples and pears (21%). FPEF is a component of FruitSA (which also comprises the various associations of fruit growers) and it acts as the interface between industry and government in other critical areas, such as market access and the international marketing of South African fresh fruit.

#### Overview: The importance of post-harvest innovation and research

South Africa has a substantial history of research and innovation in agriculture (Liebenberg *et al* 2010). Agricultural R&D expenditure is hard to measure exactly (Liebenberg and Kirsten, 2006) but it approaches R2-bn a year – which is 3% to 4% of agricultural GDP. (Statistics South Africa P0441). For a number of structural and historical reasons, the greatest part of this expenditure today is devoted to basic science and to pre-harvest issues. Growers pay the levies on fruit exports and they are the main decision makers in allocation of research funds raised from this source. It is natural that they tend to focus on the farm-based problems rather than those experienced in the export chain off farm. There are still many growers who feel that the other parties benefiting from this industry (particularly the exporters) should be contributing their own funds to research, and in their view the postharvest issues fall in the exporters' domain.

As a result, our estimate is that less than 5% of research and innovation funding is devoted to post-harvest issues – but it is there that the value chain actually yields the greatest benefits. 'Pure' agriculture accounts for less than 3% of South Africa's GDP, but this proportion doubles when you include the rest of the value chain, from the farm gate to the retail shelf.

In this context, the PHI programme is clearly directing effort in the correct place. The projects which it funds also inspire and enable other stakeholders to invest their own resources in this area.

The impact study is part of an effort to record the impact of the PHI Programme, to recommend measures to enhance the impact of post harvest innovation and research on the SA fruit export sector and to ensure sustainable funding for the future. This effort is needed both to maintain South Africa's hard-won competitive position in the international fruit trade (South Africa is the second largest exporter of citrus fruit in the world) and to expand an industry that has positive spin off benefits for agricultural development, employment, foreign exchange earnings and food security.

### The intentions of the PHI Programme

The **vision** of the PHI Programme is: To transform the global competitiveness of the South African fresh fruit export industry by developing innovative technology in the post-harvest leg of the value chain.

The **mission** of the PHI Programme is: To engender a culture of innovation by providing funding opportunities to deserving applicants that will creatively seek solutions for the technology gaps identified in the fruit export value chain.

The **primary strategic objective** of the Programme is to develop and maintain the global competitiveness of the fresh fruit export industry.

The **function** of the Programme is to successfully allocate funding to post-harvest innovation projects that address identified technology gaps and industry needs, in accordance with a set of pre-determined evaluation criteria.

(from General Operating Guidelines, 2012)

### PHI 1 and 2

The PHI programme was launched in two phases to assist in identifying cutting-edge post-harvest interventions, which will make the country the preferred supplier abroad. The Programme was first launched in 2008 and was renewed in March 2011. The second phase of PHI will end on 31 March 2014 (Addendum to funding agreement, 2012). The total funding from the Department of Science and Technology was R30-m, an amount which has been leveraged by co-funding from industry bodies, by participation in larger projects with industry partners and through contributions in kind – from industry researchers, university departments and stakeholders in the fresh fruit value chain.

Phase One (PHI-1) of the project funded 29 different projects submitted by the fresh fruit industry to address post-harvest issues. These projects aimed to improve product

temperature control during transit; packaging; non-invasive fruit quality assessment; and post-harvest disease control, among others.

Phase Two (PHI-2), which has 25 projects still in progress, is aimed at studies that will improve the technological capabilities of the fresh fruit supply chain in a number of identified priority areas including post-harvest pathology and entomology, integrated packaging solutions, post-harvest treatment, energy efficiency and ICT, to ensure alignment with market demands across the various fruit sectors.

PHI-2 is also designed to support the development of human capital for the sustainability of the industry's innovation capability. The two areas being prioritised in the 'human capital development' portfolio are the gaining and maintaining of research graduates in the industry, and the integration of emerging farmers into the export value chain.

### PHI-3

Phase Three, planned to commence in 2014, would see the aim of the PHI's overall strategy broadening, so that the programme's impact on the areas identified in the funding application and monitoring processes is more clearly emphasised. PHI has evolved over time and particular issues have come to the forefront. The most important of these are:

#### **The integration of PHI with wider patterns of research and innovation**

The continuation of the PHI programme raises important questions about its integration with the wider strategies of agricultural innovation and R&D in South Africa. By their nature, innovation and R&D are long term endeavours and make the most efficient use of resources when there is sustainable funding and the careful, long term planning of its best use.

#### **The formalisation of contributions to research and innovation from the fruit export industry**

While government support for innovation and R&D is common amongst South Africa's competitors in the international fruit trade (see Appendix 7 for some examples), it is also reasonable to expect that a mature industry will make matching or comparable contributions. The environment for establishing this support is complex. The industry has changed beyond all recognition since the single channel marketing system for fruit exports was dismantled in the 1990's. This restructuring allowed fractions of the industry to pursue their own interests as large versus small, one fruit type versus others, direct exporters versus those working through agents etc. There is a large group of 'grower-exporters' who, in their role as growers already pay levies to support research. There are smaller

export sectors which do not have the capable research institutions long established in the citrus and deciduous fruit sectors.

### **The need for ‘impact pathways’ for PHI research and innovation to be pursued**

PHI-3 would involve both new projects and efforts related to the adoption of various of the PHI-1 and PHI-2 projects by the sector and/or their commercialisation.

Developments and adaptations in all three of these areas are needed for PHI-3 to ensure that this important area for supporting and developing competitiveness for fresh fruit exports has a foundation that is secure and sustainable.

### The Report

This Report therefore encompasses the following:

- An ‘impact statement’ on the PHI programme
- Recommendations for FPEF on what its role and stance should be regarding Post Harvest innovation in the fruit industry and PHI-3. This includes:
  - Assessing the usefulness and adaptation of the South African Minerals to Metals Research Institute (SAMMRI) approach in order to propose a way forward to achieving a sustainable strategy for PHI.
  - Considering how Post Harvest Innovation initiatives can secure matching funding from the fruit export industry, to ensure that research is directed to priority areas.
  - Seeking a sustainable funding stream for Post Harvest Innovation initiatives in the fruit sector that involves partnership with a wider range of government departments.

### Methodology

This report is based on a three-month research process which involved:

- Discussions with the CEO of FPEF, Mr Anton Kruger, and the Programme Manager, Ms Junette Davids (both of whom are members of the Programme Management Unit (PMU)).
- Background interviews with Prof. Mohammad Karaan, Dean of Faculty of AgriSciences, Stellenbosch and Mr Stuart Symington, CEO of the Perishable Products Export Control Board (PPECB). Mr Symington was the chair of the PMU from 2008 to 2011, and the main initiator of PHI in 2007 when he was CEO of FPEF.

- Participation in the report back sessions on PHI project presentations made on 14 and 15 June 2012 at Stellenbosch University.
- Consultation with the various stakeholders, including face-to-face and telephonic interviews and site visits, to assess the continuing impact of the various studies undertaken across the value chain in the two phases of PHI. (These engagements are listed in Appendix 1)
- The discussions at a stakeholder workshop held on 16 August 2012 to consider a draft of the 'impact statement', to review how to increase the impact of PHI programme activities in future and to consider the best way to assemble sustainable funding for PHI-3. (The list of attendees is given in Appendix 2)
- Feedback on the report from the PMU at its meeting on 10 September 2012, which led to its revision in the present form.
- Substantial 'desk top' research, reviewing the publications of the PHI Programme, funding agreements, PHI administrative documents and protocols, previous evaluations of PHI and general internet research. (The main items consulted are assembled in the Bibliography and Appendix 4, below.)

## 4. Impact of the Programme

The positive impact of the PHI programme for the SA fruit industry and fruit exporters is beyond question. The measurement and quantification of this impact is, however, extremely difficult.

This is partly because of the nature of research itself – one never knows which lines of enquiry will prove to be most valuable until the work has been done – and partly because the results of investment in research often take a long time to manifest themselves. It is not reasonable to expect ‘impactful’ results that contribute directly to the improved competitiveness of the industry, to be fully realised within just a few years.

PHI projects are extremely diverse, they are not testing different ways of doing the same thing, so impacts cannot even be assessed relatively. In addition, most PHI projects are linked in with wider research agendas – of industry and private sector research agencies, of universities and of companies. PHI contributes a component to a larger picture and its discrete, but valued, contribution is not easily measurable.

The impact statement remains confronted by the question: “What hard evidence is there that the PHI programme has had (and is having) a positive impact on the competitiveness of the fresh fruit export sector – and on the advantages for jobs, foreign exchange and agricultural development that one would expect as well?”

The further discussion of this issue needs to be preceded by a qualitative explanation of how the programme as a whole has yielded a range of outcomes that are positive for the fresh fruit export sector and for the country in general.

PHI has had a **positive** impact by:

1. Allowing the emergence of cross-sector research and innovation projects that benefit all fruit types.

This is, perhaps, the biggest benefit of PHI. It is extremely difficult to get funding from industry for cross-sector research. The deregulation of the agricultural sector in the late 1990’s had a disruptive effect on research agendas that were cross-cutting. In the wake of deregulation, each sector concentrated on its own issues. An effect was a reduced emphasis on post-harvest issues that were common across all fruit types and on the cold chain in general. PHI balances its awards of funding to allow a renewed focus on these common issues, which incidentally have positive spinoffs for the food cold chain in general, not just

fresh fruit exports. Cross-cutting projects include research on packaging – a common issue across the entire fruit industry but an area in which a common approach has been most difficult to pursue. 43% of PHI funding has been applied to projects that are relevant for all fruit types. (See Appendix 5 below for a listing of PHI Projects, the fruit types each addresses, the names of researchers and their contact details and an analysis of funding allocations.)

2. Adding more resources into the research and innovation system for the fruit sector.

The average of R5-m a year, contributed by the PHI programme to addressing technological gaps in post harvest and cold chain issues, compliments investments by other industry players. Most directly, the statutory levies on fruit exports, paid by the growers of exported fruit are, in part, applied to research and development. Citrus Research International and FruitgroScience, for example, invest some R40-m and R28-m a year respectively in supporting research projects that cover the entire value chain – both pre-harvest and post-harvest. The Agricultural Research Council deals with fruit issues in its post harvest section, but the great bulk of its annual parliamentary grant of over R700-m (which covers all sectors of agriculture) is devoted to pre-harvest. Individual private sector growers and exporters also undertake or commission particular research projects. Private sector research companies, such as ExperiCo Fruit Technology Solutions (formerly part of Capespan and now part of Farmsecure) undertake post harvest research for clients all over the world. South Africa's universities rely on industry commissions not only to fund research programmes (including postgraduate student bursaries), but also to provide a testing ground for students.

3. Supporting research and innovation efforts that have already been identified as priority areas that will be addressed, but ensuring additionality by allowing these existing research agendas to achieve more, sooner, than would otherwise have been likely (such as promoting ethical trade issues, carbon footprint, Agrichemical database, Cripps pink apple research and many other scientific projects).

PHI research projects contribute to the pool of industry knowledge which is available for innovative application.

4. Developing new areas of research and innovation (such as Tonnage off Tar, gains from better efficiencies in energy use, and the radio frequency identification device project).

PHI projects have been funded in areas that go beyond what the industry research bodies have been able to fund (given both their financial constraints and their bias towards pre-harvest issues).

5. Supporting research and innovation in smaller export industries (sub-tropical fruit) and in new crops (persimmons, pomegranates) which are not part of the remit of the industry research bodies responsible for citrus and deciduous fruit, and which consequently have had less technical expertise focused on them.

South Africa is in a relatively good position to increase the diversity of the crops it grows, both for export and for reasons of local and regional food security.

6. Retaining more researchers in the fruit / cold chain / post harvest arena so they are developing skills and experience and are available to teach both industry members and research students as well as to react swiftly to urgent research issues.
7. Capacity building by developing new researchers, including black researchers from South Africa and elsewhere.

As an example, PHI has supported research projects at the Tshwane University of Technology, an institution that is still building its reputation in agricultural research.

8. Capacity building by conveying the results of research through workshops and publications.

Some PHI research results have been communicated to growers and exporters through media such as the SA Fruit Journal, and *fresh NOTES* - a technical update published by Fruitgroscience - as well as through formal publications, such as the PHI-supported manual "Harvest to Home – Citrus Advanced Trade Chain Manual 2010".

9. Capacity building by financing specialised research equipment and providing for its wide availability to industry researchers.

PHI has funded the purchase of a Controlled Atmosphere Temperature Treatment System (CATTS) unit which has the potential to develop new, environmentally friendly, ways of killing insect pests. Installed at the University of Stellenbosch, the unit will be properly maintained (in terms of an SLA with the PHI programme) and will be available to the industry as well as to research staff and students. It is possible that commercial CATTS units could be manufactured in SA, if the research proves that CATTS treatments can control SA pests.

PHI has made, and is making, a positive contribution to the environment for post harvest innovation. It has directed new interest, across the industry, into post harvest /cold chain/ logistics issues and has sought to transfer findings and experiences to the fruit export sector. It has pulled people together to deal with 'choke points' in the supply chain, which affect the entire industry.

PHI projects have been redirected, as experience has been gained, towards more sustainable and useful interventions. For example, there was initially an effort focused narrowly on getting a few emerging farmers to export some of their output directly to overseas clients. While some success has been achieved, the project has been redirected to help a greater number of emerging farmers improve their operations so that they can enter the 'formal' local fruit market and possibly export some of their crop via agents or large farmer-exporters. (Small farmers find it impossible to fill a whole container at once and to be confident of consistent quality in small consignments).

PHI interventions have implications for national food security and food safety. This is not part of the mission of PHI, but a valuable consequence of successful projects.

The net impact of the PHI programme as a whole has been positive. There are ample grounds to conclude that it is very worthwhile for FPEF to find a way of continuing its support for post harvest innovation after the PHI-2 funding from the Department of Science and Technology has been disbursed.

As has been stated in point 2, above, the PHI programme does not intervene in the area of post harvest innovation alone. It is a small player in the arena of agricultural and logistics research and 'post-harvest' research which has a long and proud history in South Africa and which is populated by many institutions that are active in funding research and innovation. Several of these institutions, and many of the academics and scientists associated with them, have international reputations of long standing. The PHI programme, with all its positive contributions, has not been about opening up a new continent for exploration. Rather it funded an additional 'exploration expedition' that drew on the skills of established exploration parties and often went over ground already mapped or already intended for survey. The impact of the PHI programme has to be interpreted within the wider context of agricultural research and development in South Africa.

The mission and objectives of the PHI Programme set out the specific areas in which impact is expected (see page 9 above).

As the department responsible for the national system of innovation, the DST responded favourably to the FPEF's motivations for a dedicated programme that would

target post harvest innovation in fresh fruit exports, overwhelmingly the largest fresh produce export sector.

<b>Table 1: Summary of SA fresh produce exports</b>	<i>Exports 2010</i>	
	<i>Rands (millions)</i>	<i>Percentage</i>
H02: <b>Meat</b> and edible meat offal	493	2%
H03: <b>Fish</b> , crustaceans, molluscs, aquatic invertebrates nes	3,191	15%
H04: <b>Dairy</b> products, eggs, honey, edible animal product nes	543	3%
H06: Live trees, plants, bulbs, roots, cut flowers etc	459	2%
H07: Edible <b>vegetables</b> and certain roots and tubers	443	2%
H08: Edible <b>fruit</b> , nuts, peel of citrus fruit, melons	15,545	75%
<b>SUBTOTAL (fresh produce)</b>	20,674	100%

Source: dti trade database SA Export Value HS8 (Annually)

### “Hard” impact goals

The 2011/2012 PHI Annual Report envisaged that the impacts of the PHI programmes would be quantified by estimating direct effects on potential for foreign exchange earnings, increased volumes, markets, etc. Table 2 illustrates increased rand earnings from fruit exports since 2008.

**Table 2: South African Fruit Exports**

<i>Millions of Rands</i>	<i>Exports 2008</i>	<i>Exports 2009</i>	<i>Exports 2010</i>	<i>Exports 2011</i>	<i>% shares 2008-10</i>
Nuts	380	455	737	1,015	4%
Bananas	3	2	2		0%
Dates, figs, pineapple, avocado, guava	399	321	467	N/A	3%
Citrus	5,643	5,294	6,574	N/A	41%
Grapes	3,065	3,407	3,654	3,397	24%
Melons, watermelons and papaws	26	31	25	24	0%
Apples and Pears	2,894	3,121	3,000	3,336	21%
Stone fruit (apricot, cherry, plum, peach, etc)	482	643	641	786	4%
Other	338	343	446	548	3%
<b>H08- Edible fruit total exports</b>	<b>13,230</b>	<b>13,615</b>	<b>15,545</b>	N/A	<b>100%</b>

Source: dti trade database SA Export Value HS8 (Annually)

While these issues are indeed indicators of sectoral success, they are not realistic indicators for the PHI programme itself, as many other activities within government and industry also influence these outcomes. The need is for indicators which are specifically linked to PHI activities.

The present application and monitoring documentation for PHI projects (which echoes or adopts points from the funding applications of FruitgroScience) covers a wide range of areas where impact is recognised. These (in no particular order of priority) are:

1. Women Empowerment
2. Emerging Farmer Development
3. Increased Exports
4. Increased Employment
5. Competitiveness of the Industry
6. Technology development, products and patents
7. Human resources development/training - the number of students and support personnel that will be trained through the project. (e.g. MSc, PhD, Post doc).
8. Publications (press releases, popular articles, industry journals, peer-reviewed scientific journals)
9. Presentations/papers that could be delivered to industry and research community
10. Transformation (opportunities for blacks and women to participate in the project)

The appropriate focus for evaluating impact of the PHI programme is its mission statement, as developed in the unfolding set of guidelines that filter the funding applications.

It has not proven possible in the time available for this study to assemble a comprehensive list of all the items listed above, even for the completed projects in PHI-1. References, particularly to the 'countable' items under points 6 to 9, are indeed made in the regular publications and reports on PHI, but these are not comprehensive.

Numerous references to PHI-funded research were found in issues of the *SA Fruit Journal* and in *fresh NOTES* which were not listed in the PHI publications or in the administrative records of the projects.

### The attribution problem

It is hard to isolate and measure the impact of "PHI research" from the associated research undertaken by institutions, companies and academic departments. PHI projects use the same researchers and facilities and may fund only part of a wider, longer-term project. PHI funding may benefit a project within a larger programme consisting of various related projects. As stated above, the measurement and quantification of the impact of PHI over the short period it has been funded is extremely difficult. Research and innovation successes are rarely the result of short term

interventions. Prof Vaughan Hattingh of Citrus Research International stated at the PHI workshop:

“Assessing impact is complex because it is all additive. It is very hard to separate out the effects of one research project from the platform of research to which it contributes. This is why you need a higher level evaluation. You cannot meaningfully segregate the content of the PHI programme from the bigger picture of research.”

An exception to this would be projects that are totally unrelated to existing research programmes, such as many of the cross-sector projects (Tonnage off Tar, etc.) that would otherwise not be funded because of the difficulty of getting buy-in and equitable sharing of costs from different industries. In these cases it ought to be possible to record the degree of uptake, the extent of the benefits, and to whom they have flowed.

The PHI programme has published three substantial, attractive and informative brochures covering forty of the projects that it has funded and inspired (an additional 12 projects have been inaugurated in 2012):

- Post-Harvest Innovation Programme (2008) “Brochure I”, pp.94
- Post-Harvest Innovation Programme (2009) “Brochure II”, pp.106
- Fresh Produce Exporters’ Forum (2012a) “Post-Harvest Innovation Programme 2012”, pp.136

These describe each of the projects, the technology and knowledge gaps that each aims to address, and the results so far. Details are summarised, giving the outcome of completed projects and setting out the benefits for the industry. Contact information is given for the ‘principal investigator’ in each case, to allow interested readers to follow up directly.

#### Evidence of impact: contributing to a culture of innovation

Administrative data assembled from the records of the PHI programme in mid-2012 yielded a count of 29 students who are directly associated with PHI projects (2 post doc, 4 PhD, 13 Masters, 6 Honours and four BSc). 8 publications in academic journals were listed, with an additional 5 publications that are in press. The analysis of this information, however, revealed a number of publications related to PHI outputs that had not been captured in these numbers. In addition, the PHI brochures (2008, 2009 and 2012) refer to online resources, technology transfer workshops, procedural manuals and documents written in a ‘popular’ and more accessible format. These outputs are, arguably, more relevant in contributing to a culture of innovation because they advocate adoption of research findings that emerge from projects. It is recommended that, in addition to recording outputs indicated as performance indicators for the PHI programme, FPEF should, in the future, aim to undertake a

detailed study and analysis of the research outcomes related to each project and to keep this register updated, as a living record of the impact of the work.

### Select examples: Tracing a impact pathway for PHI projects

PHI is a young programme, five years in implementation and barely two years since the first tranche of PHI-1 projects received their final funding allocations. It is also extremely diverse, attending to technology gaps at many different points along the value chain. These two factors, along with the ‘attribution problem’, make the assembly of quantitative impact data complex and costly. International agricultural research entities have confronted the problems of impact assessment in different ways (See Appendix 4, below). In general however, impact assessments are usually contemplated only three to four years after an intervention has been completed and candidates for impact assessment have to be above a certain size to merit the effort that is needed to assemble data of a quality that can yield meaningful conclusions.

We give here three examples of PHI-linked research interventions and their impact pathways:

#### 1. Control of post harvest fungal disease in table grapes

PHI supported in vitro testing of effects of essential oils, a small aspect of a bigger project directed at finding alternative ways to delay post-harvest decay in table grapes. (FPEF 2012a). The traditional treatment with SO<sub>2</sub> is prohibited for grapes certified as organic (Romanazzi *et al* 2012) and the SA fruit export industry is generally under pressure to limit the use of chemicals. The research, undertaken by the ARC and the CSIR, obtained funding from the Technology Innovation Agency (TIA) to see if the results can be commercialised. This is still a long way from having an impact on the table grape export industry. The process, if it is successful, has to be accepted by customers and importing countries and it has to be adopted by the industry. The economic impact of the research will only be observable at some time in the future.

#### 2. Flesh browning in ‘Cripps Pink’ apples

PHI and FruitgroScience co-financed a research project to understand why flesh browning develops within some ‘Cripps Pink’ apples in South Africa. This is part of long term, international research effort involving Stellenbosch University and Experico, which has continued (with other funding) since the study to which PHI contributed was completed. The research contributed to training MSc students and to generating publications (such as Bergman *et al* 2012). But the findings were not categorical —“...these results are still preliminary...must be comprehensively tested...prior to full commercial application”. Internal browning is a serious problem when it occurs. It undermines the confidence of markets in the quality of our fruit. But the recommendations that have been

derived from the research are hard to sum up after only one to two years of work. The Pink Lady research is of great importance to the industry, but it has not yet reached a stage at which they can be confident in describing a handling/treatment protocol that will work in all circumstances. A longer period of research is needed – and this work is still going ahead. (Interview with Dr Ian Crouch). The impact pathway for this PHI project is confined to the research outputs themselves (which are contributing to scientific knowledge about the problem) and to the training and experience gained by students associated with the project. The economic effects on the fruit industry, if any, will not be observable for many years.

### 3. Efficient energy usage in the supply chain

“When you visit a farm, all the activity is seen in the packhouse. But the packhouse, typically accounts for only 10% of energy use. 85% or more of energy is used by the cold stores. 97% of the carbon footprint for fresh fruit is created in the post harvest part of the value chain.”

– Interview with Koos Bouwer, engineer and cold-chain expert

The PHI programme has added great value to the present range of projects that deal with improving energy efficiency in the fresh fruit cold chain. In fact, the extent of energy use in the cold chain generally, was unknown until this work began – with a PHI grant – in 2008. Now the methodologies that are used to measure and monitor energy use in the fruit cold chain have been applied much more widely within agro-processing, to include other perishable products and other parts of the cold chain.

In 2009, benchmarking was done on six of the biggest apple packhouses and in 2010 this was extended to medium sized apple operations and then to the citrus sector. Over fifty energy benchmark analyses have been done. Each one also generates an action plan to manage energy use in future.

There have been follow-up efforts through seminars and web-information to get the industry to think about energy efficiency for the future. FruitgroScience held such a conference in October 2010 to get pack house action on energy efficiency. (The original Packhouse Action Group was disbanded after deregulation in 1997 due to competitive edge securities and reluctance to share information.)

Other cold stores – for chicken and meat etc. – got similar programmes of the ground and a large supermarket chain took the same methodology in 2011 to monitor and improve their energy efficiency. According to Koos Bouwer, this all got off the ground because of the PHI programme’s support for the initial benchmarking investigations.

This opened the way for co-operation with UNIDO which has a world-wide project to address energy use and sustainability, one part of which explicitly tackles issues in agroprocessing. UNIDO is formally linked with the CSIR, the Department of Energy and the dti's Industrial Energy Efficiency (IEE) Improvement Project. The CSIR launched a project through its South African National Cleaner Production Centre (NCPC-SA) that provides a totally subsidized energy audit. Now any fruit packhouse and cold store can get a free audit of their energy use and efficiency. This takes about three days and would cost an average operation about R20,000. Producers are reluctant to spend this sort of money. It is only after this data allows estimates to be made of how much money they can save from improvements in energy efficiency that they see the value of this service. "You need a subsidy to get the ball rolling and show where savings are possible and what their impact will be on profitability". By July 2012 there had been an impressive response with 45 requests from the industry for audits. These have now all been scheduled and four have been completed.

The PHI programme, over five years, has been a significant part of efforts to deal with energy efficiency issues in the industry. It was a PHI-funded project that started a process, which now has many partners. It started with the deciduous fruit, expanded to citrus and now has even been taken up by supermarket chains.

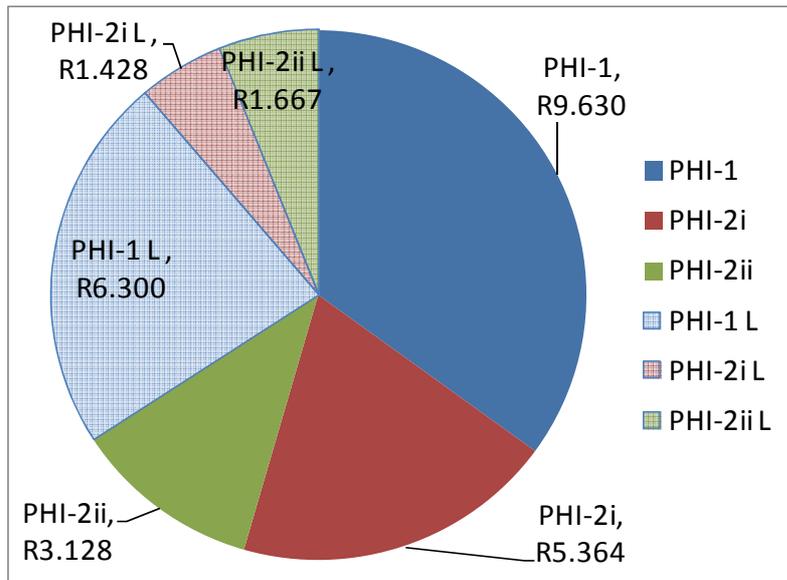
The energy research field provides two avenues of investment:

- Investment in energy efficiency (less use of energy)
- Investment in renewable energy (use of energy from renewable sources that have a lower carbon footprint)

Both avenues assist to reduce the carbon footprint of the cold chain, but the nature of the research differs and the returns from investment in one or the other (or both) need to be weighed up. It is often more expensive to use renewable energy.

The impact pathways for this PHI project (which is reflected in PHI-2 at zero cost because of the NCPC subsidy) (FPEF 2012a) have been clear and unusually immediate – but quantifying the effects in a scientifically sound manner is difficult and costly. Also, the fact of undertaking an audit has no impact unless the action plan is actually adopted, something which may require additional investment on the part of the packhouse or cold store and training for changes in the organisation of work.

## Leveraging funds to enhance the impact of PHI projects



**Figure 1: PHI funding compared with funding leveraged for PHI projects** (the suffix L indicates the funds from other sources leveraged against the direct funding provided by the PHI Programme)

PHI-1: 86 project applications valued at R41.6-m were received. 29 technology transfer and research projects were awarded to a value of R9.63-m. An additional R6.3-m was leveraged for these projects from other organizations (Business Plan, May 2009). For three projects, over 80% of funding was contributed by partners. For the remaining projects, partners contributed 17% on average.

PHI-2 (First Call, January 2011): 65 project applications valued at R96-m were received. 15 technology transfer and research projects were awarded to a value of R5.364-m. An additional R1.428-m was leveraged for these projects from other organizations (PHI Annual Report, April 2012). On average, 21% of project costs were contributed by PHI partners.

PHI-2 (Second Call, February 2012): 18 project applications valued at R6-m were received. 11 technology transfer and research projects have been awarded to a value of R3.128-m, with other organisations contributing an additional R1.667-m. (PHI Annual Report, April 2012 and Summary of 2<sup>nd</sup> call allocations, August 2012) On average, 35% of project costs were contributed by PHI partners.

### **Need to demonstrate that PHI improves the performance of the industry**

The participants at the workshop and all the stakeholders that were interviewed said that public funding of PHI has been most welcome, extremely useful, and should continue.

After two ‘rounds’ of PHI funding and five years of experience, there are many suggestions on how the impact of PHI projects and the allocation of PHI funding could be improved. These issues are dealt with below.

But the draft impact assessment presented by the consultants came in for pointed criticism at the workshop.

Government – and the DST – provide funding support for a wide range of R&D and innovation projects<sup>1</sup>. These range from the successful (such as the Square Kilometre Array telescope and the recent UCT discovery of a potential cure for malaria), to the failed and abandoned (the pebble bed nuclear reactor and the Rooivalk helicopter). Some government support is for human resource development – to increase the numbers of scientists, engineers and PhDs in the country. Some is for research, such as the DST-NRF South African Research Chairs Initiative (SARChI) (one of which is the South African Research Chair in Postharvest Technology at the University of Stellenbosch). And some is for improved economic impact, addressing the challenges of unemployment, poverty and inequality in South African society.

A lot of PHI funding has gone into research – in the priority areas where knowledge and technology gaps have been identified. It has added to the pool of research findings that future generations can draw upon. But the purpose of the PHI programme has always been economic impact.

The fruit export industry needs to demonstrate that PHI improves the performance of the industry.

This needs to be shown by hard data – and this was identified as a fundamental weakness in the impact assessment.

However, workshop participants did acknowledge that demonstrating economic impact is difficult. The impacts most prized by government – jobs, exports, transformation – are rarely the result of a single intervention in the value chain. Many forces combine to produce the results that are observed. Even if all indicators of impact are moving in a positive directions, this is not proof that a particular, discrete, intervention was a contributor. The impact could have been unaltered – or even greater – in the absence of the intervention.

An FPEF reviewer of the draft of this report commented:

“The fruit export industry cannot expect quantum changes in performance based on any research intervention funded by PHI or any other source. The system is

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<sup>1</sup> Businesses can also claim tax deductions for R&D spending.

largely efficient and streamlined due to decades of experience and adaptation, so changes are small and tend to have small impact. The collective result, however, is a continual improvement.”<sup>2</sup>

The DST objectives for PHI-2 were grouped under three headings:

- Ensure the global competitiveness of the South African fresh fruit export industry.
- Provide a platform for facilitating and supporting R&D in post-harvest technology in high priority areas, building critical mass and institutional capacity to support innovation in this sector.
- Provide capacity building to enhance the technology assimilation capabilities of businesses, with particular focus on emerging producer exporters.

These are then associated with activities and specific outputs (workshops, students, publications, emerging farmer exporters registered as FPEF members ...) which will be reported upon in the normal progress reports up to March 2014 (when PHI-2 ends).

The outcomes of the programme are harder to measure – and, indeed, are not accompanied by specific indicators:

- A fruit export industry that is mindful of the increasing competitive challenges and discerning overseas markets as well as global post-harvest challenges.
- A fruit export industry that is continually seeking innovative methods and technologies to sustain its global competitiveness.
- Strengthened capacity in the fresh fruit industry in the area of R&D in post-harvest technology.
- Improved participation of emerging farmer exporters in mainstream activities of the industry and sustainability of their businesses.

In confronting the question of how to demonstrate that PHI projects have a positive impact on the industry, two suggestions emerged from the workshop.

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<sup>2</sup> Recognising “the incremental, complex nature of major technological changes” and the ‘creative accumulation’ that builds upon, rather than disrupts, previous technologies, is necessary even in the area of biotechnology, which has been widely promoted by academics and consultants as being subject to a “biotech revolution” (Hopkins *et al.* 2007). These authors also question whether the biotech sector has been well served by biotech being hyped as a revolutionary technology that will yield remarkable results in a short period of time – provided it is fed with large sums of money. “If biotechnology is following the pattern of technological change described by historians rather than the revolutionary model, we would expect it to generate returns over decades rather than years.” (Also see Cooper, 2011:52/3 and Godin, 2004:687 who in his review of OECD research states that “... After nearly 50 years of studies, one still looks in vain for hard data on the links between science, technology, and productivity.”)

The one was to ask the DST to clarify the criteria for awarding funds and to state exactly what it expects from PHI projects. This would be built into the reporting framework for each project individually.

The second was to take a detailed look at each project undertaken to date. Success can be measured with the right criteria, related to the parameters the project knows it can influence. (Useful data towards this end will come from the questionnaire FPEF has sent enquiring about the workshops, information brochures, publications and academic theses related to each project.)

While more details on criteria and clear agreement on indicators will be very useful, the best way forward is for PHI-3 to plan for measuring impact on the industry from the outset. (We can accept that the achievement of such impact is already, evidently, agreed upon when funds are initially allocated as proposed projects are assessed against their intended goals.)

How is the fruit industry going to satisfy itself that PHI improves the performance of the industry? This question has to be posed and answered if PHI is to be ramped up to a new level and if it is to secure funding support from both government and industry.

#### Planning for impact and demonstrating impact

The careful selection of projects – and of research teams – is a requirement for success, but its demonstration requires application over time. This means that the ‘file’ on each PHI project needs to stay ‘open’ even after the project funding has been paid out. There needs to be an institutional mechanism to keep tabs on developments following the formal ending of each project. This is because many of the impacts will be only be visible over a longer period of time.

Some PHI projects will lead on to innovative products or procedures that find their way through the ‘innovation value chain’ towards commercialisation. The involvement of the Technology Innovation Agency (TIA) would be an initial marker of impact, although not all innovations that take this route are guaranteed eventual success.

Other PHI projects, that do not require TIA involvement, also can be seen to move through stages indicating success and impact:

- Publication of results
- Popularisation of results (workshops and brochures)
- Adoption of results
- Testing and evaluation of impact (There is a continuum here)
  - Not successful – abandoned
  - Partially successful – research redirected
  - Partially successful – retained, although below expectations

- Partially successful – retained after improvement
- Fully successful – retained

This still will not resolve the measurement requirement in every case. It may be, for example, that the presence of carbon footprint measures in South Africa and efforts to reduce the carbon footprint of fruit exports give overseas customers confidence to retain SA as a supplier. But this will be only one aspect of the decision – quality, price and delivery on time will still remain critical. The monitoring proposed above is still not going to provide a specific measurement of impact, in such a case.

Nevertheless, an effort to track and record the impact of PHI projects continually over time will build up a reporting base that ought to provide solid justifications for the industry and for government to support post-harvest innovation in the fruit sector over the long term.

The adoption of the results indicated by the research has traditionally been a major hurdle. There are many examples (not only within PHI projects) of research proving positive impacts but which that have not been adopted by industry, for various reasons. In some cases the trouble of training people and of adding to long established procedures have been the reason, particularly where the benefit is difficult to quantify in monetary terms whereas the cost is easy to avoid. Somewhat irrationally, people in the industry may look for some high tech intervention when a low cost, simple intervention can largely address their concerns. Monitoring whether research results are adopted or not can lead to pro-active steps to make the research results more accessible and more widely used. It is not just a question of PHI keeping records, but of finding ways to use the information the records reveal. Appendix 4, below, assembles a selection of recent Impact Assessment research and guidelines which can assist to construct a framework to judge the impact of PHI projects (past and future) for PHI-3.

### **Shortcomings identified within PHI programme**

Some of the impacts of the programme present challenges when considering the need for a long term future for PHI. This is also a commentary on the difficult environment in which PHI operates, where there is intense competition both for funds and for competent researchers and where the defence of ‘turf’ is often a requirement for the protection of (legitimate) sectoral interests.

#### Fragmentation of research agendas

PHI has probably unwittingly further contributed to the fragmentation of research agendas in the SA agricultural sector through the *ad hoc* nature of the PHI programme

and thus contributes to the pervasive negative tendencies that characterise our national innovation system.

The research system in agriculture is both fragmented and 'silo-ed'. Co-operation and co-ordination are present, but uneven, and there are nodes of excellence and scientific leadership.

In the environment we have today, it is often easier to start a 'new' initiative than to get repeated and sustained funding for a long term research programme. The disorganization of agricultural research generally and the lack of an integrated research agenda favours the emergence of 'pet projects', which hinge on personal or political relationships and are vulnerable to changes in the administration of government departments or parastatal bodies. Decision makers in government take on the aspect of patrons, whose undertakings may be summarily disregarded by a sudden successor.

However, it has to be acknowledged that turf defence is a necessary survival strategy in this uncertain and volatile situation!

The efforts to create an authoritative National Agricultural Research Forum (NARF), with a broad representation of key R&D stakeholders in the agriculture sector to set the national agricultural research agenda appear to have effectively failed. NARF has been moribund since 2009.

#### Disruptive of efforts to plan long term research agendas

Short term funding, as welcome as the additional resources are, disrupts the efforts to set and follow research agendas based on industry priorities. The PHI funding has been short term and by its nature is unpredictable. This has been particularly disruptive for CRI and FruitgroScience which have sometimes been asked by PHI to co-fund parts of the PHI research at times dictated by PHI's receipt of funds, rather than at times in sync with the established annual budgeting and planning cycles of the historically-established research entities in the fruit sector. PHI has not consulted closely with research roleplayers in the fresh fruit industry in deciding which applications to fund and on the timing of funding cycles. This has reduced the potential positive impact of PHI funding.

#### Duplicating the assessment of research applications

The PHI application evaluation for citrus and apple and pear projects mirrors and duplicates what research roleplayers in the fresh fruit industry (particularly CRI and Fruitgro Science) do already. Apart from creating discontent, the fact that PHI was not able to integrate its research agenda in these areas with that of the traditional, long

term planners of research for citrus and apple and pear growers represented a missed opportunity.

### Dropping of projects that show potential

It is always tough to decide to drop the funding of projects which have been supported. Research never fails, it gets re-directed, so funders rarely face a decision where funding has to come to an end because the research has 'failed' (unless there is a political decision, as in the case of the pebble bed nuclear reactor!). As an example, we can mention two potentially innovative/successful projects from PHI-1 that were not funded in PHI-2.

They are mentioned not because they were dropped, but because it is not clear how the decision was made not to continue funding. The one is the Tonnage off Tar project which was 'concluded' because of strikes in Transnet in 2010 and the failure of Transnet Freight Rail to appoint an appropriate person to drive the initiative to move fruit exports onto rail. South Africa's rail system ought to be one of the outstanding contributors to the competitive advantage of SA fruit exports. It could increase productivity and efficiency, reduce costs and lower the carbon footprint of fruit exports. The obduracy of Transnet was frequently mentioned in interviews – whether considering the ports or the railways – but the huge advantages that would be gained by an efficient rail system for fruit transport surely merit a long term effort on this issue.

The second is the project that investigated the application of a kafirin coating on pears. The research yielded positive and promising results but required a different solvent from the alcohol used by the CSIR, which posed both a fire and a consumption risk in the packhouses. The CSIR promoted this project and secured PHI funding for it, but failed to follow up when the Experico researchers alerted them to the impossibility of using an alcohol-based solvent. The CSIR made no application for PHI-2 funding and the project was dropped. (A CSIR researcher said that they had no commercial partner to continue with the research, but the CSIR commercialisation department did not respond to requests to clarify the situation.)

The point being suggested here is that PHI did not follow through on these two projects – it terminated one because of a (predictable!) set back and failed to get a clear reason on why the second was not continued. The efforts were not completely wasted – the experiences and research results could be taken up in future – but the momentum of both projects has been compromised.

### **Points with positive and negative characteristics**

While some PHI projects have been marked by useful international collaboration (for example, the CRI research projects with Spain funded in PHI-1 and extended in PHI-2,

and the Commonwealth Secretariat project to compare the SA fresh fruit logistics chain with Chile and New Zealand) the PHI projects, with their intended focus on innovation, may not draw sufficiently on overseas research findings. Some commentators said some projects were ‘re-inventing the wheel’, repeating research already completed overseas. This still can have great benefits, if overseas knowledge is adapted for use in local contexts.

While some projects do not involve path-breaking research, in the context of skill scarcity they do have an important and useful impact in training a new generation of researchers, assisting students to develop the technical capacity to do research in future and building the capacity of research units.

### Challenges that hamper the impact of PHI

What are the challenges that PHI-funded projects face in improving their impact potential?

1. There is a lack of co-ordination with the research agendas of other research bodies in choosing projects. (There is a need for a *modus operandi* that recognises, and works around, the failure of the National Agricultural Research Forum).
2. Funding is given for two years, which not long enough for most projects, particularly those linked to the fruit season. (At least three years was suggested by university-based researchers, a term that would also cover most Masters research, and would be long enough to do good work.)
3. Much of the research is done at or in collaboration with higher education institutions (HEIs). This has a positive impact for capacity building, but academics and students respond to narrow incentives – centering on degrees and publications. Universities (and their staff and students) are not yet really encouraged, assisted and incentivised to take projects beyond the applied research stage. This mitigates against the applied research being taken further to the prototype and commercialisation stages. There are exceptions such as with the applied research done by PHI projects in the energy field where commercial application is being actively pursued. There exists therefore the need for a greater emphasis on developing a mechanism/process to move beyond applied research to a state of prototype development and commercialisation.
4. For sustained impact, the PHI programme needs a dynamic “face” for its leadership in the long term. This would be someone who can communicate authoritatively with the industry, with researchers and with government. Currently the PHI programme exists in a facilitative environment with the

programme being managed by a unit of FPEF. However it is recognised that the longer term sustainability of the PHI programme probably requires a degree of institutionalisation although preferably within a non-bureaucratic framework. There are various models and suggestions for this which need to be explored.

5. The tension in terms of the allocation of state and private sector resources between commercial (largely white) growers and industry and the emerging small (largely black) growers could be managed more cooperatively by the various role-players. This requires ongoing engagement within the sector. Apart from Human Capacity Development-specific matters where emerging growers are targeted, any innovation that breaks ground for the commercial side of the industry should potentially assist the emerging sector as well. PHI will assist the emerging growers best by recognising that their needs are often very different to the commercial sector. Not every PHI project will be relevant. It makes more sense to use the existing project with emerging farmers as a foundation on which to build a really strong and well funded program (with multiple underlying projects) to provide emerging growers with the skills and assistance they need to become commercial. This should, ideally, not be housed in the PHI programme, but integrated with industry programmes to reach out to emerging farmers. Both the deciduous and citrus industries have substantial budgets and existing projects and expertise in their transformation portfolios, and both industries can benefit from a more coordinated approach that attracts funding.
6. There needs to be a careful balance struck between awarding research projects to the established centres of research excellence and providing an opening for new (or previously neglected) centres to develop. There is indeed a strong argument to be put forward that funding should be targeted at established centres of research excellence. Resources are limited and spreading the funding widely across institutions instead of focusing on the centres of excellence will dilute PHI's impact. The industries themselves have taken approach of spending their money where they know they can get a return, viz. at the centres of excellence (many of which have been established over time using industry funds). At the same time, it is necessary, from a 'political' point of view, to align PHI with government policy around research development. Funding projects supervised by one of the SARChI professors, assisting in the development of researchers and graduates, is the sensible leveraging of an existing investment. But not all of these chairs have been awarded at "established centres of research excellence". State funding for research is also being channelled to universities and universities of technology that have yet to prove themselves as reliable research partners. The idea of spreading funding 'equally' does not make sense, but it does make sense for the agricultural research community (of which PHI is a part) to support post harvest research capacity at designated institutions which are not yet recognised as being "established".

7. PHI has used national newspapers to solicit funding applications, and this, predictably, has led to applications by unknown researchers. Some of the applications have been extremely poor – but all proposals were reviewed and ranked by independent Project Evaluation Teams (PETs) consisting of experts in their particular field. Funding was allocated strictly on that basis, so the lists were “properly prioritised”. The effort that has to be devoted to ‘weeding out’ poor applications arguably reduces the positive impact of the PHI programme. But it would not be constructive to restrict applications for PHI funding only to ‘established’ researchers and institutions.

## COMMENT

The PHI programme needs to retain:

- Its support for researchers, research programmes, researcher development. (“It is the lack of enough quality researchers, not the lack of money that is the biggest problem”.)
- Its close involvement with and active organisation of post-harvest stakeholders who are not growers.
- Its advocacy for the importance of the export market – export success is a potent measure of international competitiveness in food production and thus in food security.
- Its valuable linkage with DST as the custodian of the national system of innovation.

## 5. The Future of the PHI Programme [including Recommendations]

### Impressions and leads from the workshop

The workshop held at STIAS on 16 August 2012, proved extremely useful both in providing direction for the revision of the impact statement (in the previous section of this report) on measuring the impact of the PHI Programme and in generating recommendations for FPEF on what its role and stance should be regarding Post Harvest innovation in the fruit industry in the future, looking towards PHI-3.

### The example of SAMMRI

#### - the South African Minerals to Metals Research Institute

As part of the brief the consultants agreed to assess the applicability of The South African Minerals to Metals Research Institute (SAMMRI) to the PHI Programme, primarily to assess whether SAMMRI was a possible example “to achieving a sustainable **operational** and **funding support model** for PHI” [from the SLA].

SAMMRI was set up as follows:

“The South African Minerals to Metals Research Institute (SAMMRI) was launched in November 2010. SAMMRI is a joint venture involving the mining industry, the Department of Science and Technology and Universities and has as its primary aim the promotion of high level research and development in minerals processing in South Africa in order to address the dual challenges of developing new appropriate technologies for the minerals processing industry and the provision of adequate numbers of highly trained engineers for the industry. It is hoped that potential sponsoring companies and research institutions who are interested in our activities will find the information on this site of value.” [from SAMMRI website]

SAMMRI sets out to:

- expand research capacity throughout South Africa,
- develop human capital in the form of increased numbers of highly skilled people with post-graduate degrees,
- achieve a substantial return on investment arising from improved processing performance, and
- promote long-term innovative research in the area of mineral processing and the concomitant development of world-class technologies

“Although the primary emphasis of the research will be on long-term objectives aimed at ensuring that the country is able to sustain a successful and technologically innovative mineral processing industry for the next 20 to 30 years, SAMMRI projects will also include shorter term objectives which represent so-called quick wins for the industry.” [SAMMRI website]

SAMMRI is managed by a Governing Board consisting of representatives of the Founding Companies and of other persons who are assessor members. Eight Founding Companies provided funding to match the launching grant made by the Department of Science and Technology.

SAMMRI currently has funded 9 projects as part of their 2011-2012 pilot programme. In total the project was funded to the tune of R3-million for the initial phase although they had proposed a budget of R7.7-million.

The Institute is supported and administered by the University of Cape Town’s Centre for Minerals Research. The work of SAMMRI is efficiently presented in their own website ([www.sammri.com](http://www.sammri.com)) and also includes details of research being funded and undertaken.

The significance of the SAMMRI example for PHI lies in the way this research effort on behalf of the mining sector has been led by the mining industry. The industry came together, identified the research needs, contributed funding and asked for a contribution from government, given the key place of the mining sector in the SA Economy. The relationship between SAMMRI and the DST is of particular interest.<sup>3</sup> DST contributed funds to match industry contributions, but not for research. It only gave money for funding students. This started as a 50/50 partnership with the mining companies, but the intention is to increase the industry share to 75%. It is the mining companies on the board who decide on the research priorities and how to allocate the funds. DST has an advisory and monitoring role. It is not a voter on the Board, but it attends the four annual meetings. SAMMRI is not a legal entity. The DST's contract is not with SAMMRI, but with UCT. (The responsibility for good management of the funds lies with the University). The SAMMRI CEO is a UCT professor who works on SAMMRI. Members of the SAMMRI board cannot apply for funding for their projects. SAMMRI is, of course, not the only mining initiative that is funded by government. Its relevance for PHI lies in its character as an industry-led initiative, supported by DST.

#### Some observations:

- The mining sector and the fruit sector are very different. In mining there are relatively few role-players whilst in the fruit sector there are a large number of diverse role-players. Thus, whilst it might be possible to easily organise the mining sector role-players it is quite different in the fruit sector, partly because there are different shapes, sizes and models of operation in the sector.
- The PHI programme, in particular, is tied in to the historical institutions, funding flows and structures which have managed fresh fruit post harvest research in the past, first for a highly regulated single channel marketing system and then for a deregulated system that is struggling to maintain coherence. The institutional environment for post harvest research and innovation can be improved only by recognizing, and building onto, existing industry structures in the fruit sector. The SAMMRI model, framed for the mining sector, may be suggestive, but it should not be seen as being instructive, except for its character as an industry-led and industry funded initiative, to which the DST contributes.
- Because mining is historically a much more important sector in the SA economy there are very different levels of state interest and support for the two sectors.
- However, various aspects of the structure and functioning of SAMMRI – in particular the leading role played by private sector mining companies – could be useful to the FPEF and the PHI Programme going forward and these are dealt with below.

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<sup>3</sup> This information is drawn from the comments of Mr Llanley Simpson at the 16 August PHI Workshop and the PMU meeting on 10 September.

## The imperative of sustainable funding for PHI

One of the questions put to the workshop was whether the PHI programme should “Grow or go”. There was implicit agreement that PHI-3 could not simply be a repeat of PHI-1 and PHI-2. It is imperative that all post harvest innovation should develop within the long term vision that is required for any programme that seeks both to establish which technologies and procedures are better than those presently in use, and to assist in industry wide adoption of improvements. The PHI programme up to now, for all its great contributions, has been hampered in its effectiveness by its short term nature and by its imperfect integration into existing industry research agendas. Workshop participants agreed PHI should be retained and that it should ‘grow’, but it can only grow if it has sustainable funding and is linked in to other industry research efforts. This will require changes in structure and governance.

A plan for sustainability also demands that Post Harvest Innovation initiatives should secure some measure of matching funding from the fruit export industry. This will help to ensure that research is directed to priority areas and that it is undertaken with the intention to promote economic impact.

The export fruit sector is dominated in volume by citrus and in value terms by citrus and table grapes, apples and pears. CRI and FruitgroScience provide industry-linked Research and Development and technology transfer services across whole value chain for their members. This level of research support is not institutionalised for table grapes and for other export fruit sectors – although they also rely on university researchers, the ARC and commercial providers such as Experico (or FruitgroScience) to contribute expertise in dealing with post harvest issues.

There were convincing arguments put forward at the workshop that the PHI programme – both in its funding application evaluations and in its project management – duplicates capacities and functions that are already in place within CRI and FruitgroScience. It makes sense for funding available through PHI for post harvest innovation in these sectors to go directly to research roleplayers in the fresh fruit industry for inclusion in their portfolio of prioritised areas for post harvest research and innovation (which have short- medium- and long-term aspects already.) This should be done on the basis of clear guidelines on the sort of projects that such funding should support.

The PHI programme does have a valuable role to play however in projects that cut across many export fruit types and address problems that the fruit export industry faces collectively (eg. Energy efficiency, fair trade, carbon footprint...). PHI also plays an important role in directing effort to new fruit export sectors and the sectors that do not have dedicated research institutions in place (either for reasons of history or because of a lack of volume or statutory levies).

## **A governance structure and agenda to increase industry 'buy-in' for post harvest innovation in the fruit export sector**

There is a growing trend for collaboration to take place in non-bureaucratic forms. These take the form of networks, forums, matrix structure and virtual organisations. Often these bodies have no legal persona and often no fixed office location. For normal collaboration one of these examples will often work provided there are no matters that require finance and staff, both of which do require a legal persona.

In such instances the legal persona is contracted out to another body or organisation that specialises in administration or has sufficient capacity for the administration required. So established research bodies, academic institutions, and various private sector companies will provide this service.

The Post-Harvest Innovation Programme is an example of a collaboration but which does not have staff or financing of its own. This service is provided by the Fresh Produce Exporters' Forum which manages the PHI Programme on behalf of a Project Management Unit.

A strong proposal from the workshop was that the PHI Programme should take on a more sustainable format and have an institutional feel about it but without the bureaucratisation that goes with it. This would require, for instance reviewing the name of the organisation, its governance and management structures, and the manner in which decisions are taken about the work being conducted such as research projects and how these are allocated and contracted out.

In addition, a clear and inclusive governance structure should facilitate raising additional funding from the private sector particularly if the private sector see "what is in it for them".

The South African Metals to Minerals Institute (described above) is a good example of such a structure. If the PHI Programme were to follow this example it could continue to be administered by FPEF under the auspices of Fruit SA in the same manner that UCT administers SAMMRI on behalf of the mining industry.

The following initial recommendations in respect of the PHI Programme begin the conversation as to how it could be structured:

- PHI has already developed a certain brand recognition which perhaps would be interfered with if the name was changed. It is also a good acronym because it is short and easy to say. Although PHI-3 is intended to have a new institutional structure, the link with PHI-1 and PHI-2 is important to keep. It is often very difficult to build a new name – and why do so if the basic product is a success? If,

for institutional reasons, PHI moves from being a programme to, for instance, a research institute or an initiative, it could simply be kept as PHI. Alternatively if there was a compelling imperative to do so it could be renamed to something such as the Post-Harvest Innovation and Research Institute or Initiative PHIRI (as an example).

- The establishment of a Board consisting of approximately 15 key role-players in the fresh fruit industry including a selection of industry research management entities, exporters, state agencies, government departments and experts/specialists in the field. Ideally no individual board member should qualify for any PHI research funding at any time whilst serving on the board, although provision may need to be made for exceptional circumstances.
- The establishment of a small independent panel (up to 5 members) to assess the nature and funding of block grants, projects and programmes. This panel will make recommendations to the Board based on its assessments.
- The development of a memorandum of understanding in terms of which the organisation operates including the institutional arrangements made with FPEF to manage and administer the organisation. (This can build on the existing terms of reference and operating guidelines as set out in the 2012 PHI annual report).
- The development of clear guidelines for the allocation of funding to projects and programmes including the possibility of block grants based on concise bids for funding to established research structures (such as the research roleplayers in the fresh fruit industry). Consideration must also be given to whether and what levels of matching grants would be required and under what circumstances.
- The development of collaborative linkages with other sectors for instance the domestic fruit market and vegetables primarily for the purpose of sharing any information and research that may be more broadly applicable than just the fruit export sector. This could contribute to the overall development of agricultural sector and give added impetus to national priorities such as food security concerns and critical employment initiatives.
- Development of efficient communication and information sharing mechanisms, including through the use of a website and web based applications.

### **Partnership with a wider range of government departments**

Whilst the PHI Programme has primarily been funded by the Department of Science and Technology, mainly because of the DST's interest in innovation and research including through agencies such as TIA, the NRF and the CSIR, it is necessary for the longer term sustainability of the programme to engender an interest from other government

departments through developing a network of useful contacts in government and publicising the work being done.

These include:

- Department of Trade and Industry for marketing and for trade agreements
- Department of Agriculture Forestry and Fisheries for Market Access, Sanitary and phytosanitary requirements, research and development and for linkages with the Agricultural Research Council
- Department of Energy for energy efficiency and carbon footprint issues
- Department of Water and Environmental Affairs for issues related to water usage and scarcity
- Department of Transport for roads
- Department of Public Enterprises in relation to Transnet.

## **6. Summary of recommendations for FPEF**

1. FPEF should maintain its leadership role related to post harvest innovation
2. Keep the PMU as the 'sounding board' for guiding PHI beyond 2014
3. Make a proposal to DST regarding "PHI-3" by April 2013
4. Develop a sustainable governance structure for PHI-3
  - Expand the governance structures for PHI-3 to include industry research management entities
  - Maintain a strong programme management and leadership capability within FPEF
  - Incorporate a long term monitoring and evaluation framework for PHI (including impact assessment).
5. Improve communication and information sharing related to PHI
6. Develop linkages with the industry, using PHI
7. Pursue partnerships with government departments

### ***1. FPEF should maintain its leadership role related to post harvest innovation***

FPEF should see itself as the promoter of an integrated agenda for post harvest innovation for the fruit export industry. In this role, it operates to harmonize sectoral interests (which vary considerably in power) and provide leadership and guidance for the industry in the area of post harvest and cold chain research and innovation.

It has earned the right to play this role because of its successful launch of the PHI Programme in 2008 and because of the way it has guided the programme towards success and achievement.

The PHI Programme is a logical accompaniment to FPEF's responsibilities in promoting the marketing of SA fresh fruit abroad and in promoting issues of improved and wider market access. The advance made through the PHI programme can help to strengthen the reputation of fresh fruit imported from South Africa and contribute to building and maintaining the reputation of "Brand South Africa".

### ***2. Keep the PMU as the 'sounding board' for guiding PHI beyond 2014***

Despite the recommendations made in this report, FPEF should draw on the resources of the existing PMU to frame proposals for continuing PHI beyond 2014. Continuity is very important, an issue that was not fully addressed in the

transition between PHI-1 and PHI-2. The PMU should remain “in office” until the contract with DST ends in March 2014. (It is recommended that the governance structures for “PHI-3” are expanded.)

**3. *Make a proposal to DST regarding “PHI-3” by April 2013***

This time target will make it feasible for PHI-3 to begin in April 2014, without the break in momentum experienced between PHI-1 and PHI-2.

**4. *Develop a sustainable governance structure for PHI-3***

The governance structure for PHI-3 needs to be based on the experience and lessons of PHI Programme to date and planned for implementation from April 2014. This involves at least two aspects:

- ***Expand the governance structures for PHI-3 to include industry research management entities***

PHI-3 needs to be better integrated into the research structures in the SA fruit sector and into the industry itself – this is essential to provide the long term perspective that is necessary for a sustainable programme in post harvest innovation and also to secure a fair share of industry resources for promoting post harvest innovation.

A specific recommendation is to include research roleplayers in the fresh fruit industry within the governance structures of PHI, in recognition of their carefully chosen project portfolios, over long and short timeframes, that cover post harvest issues. (The table grape sector and the subtropical fruit sector – which were not represented at the PHI workshop – also need consideration in this regard.) Within deciduous, citrus and subtrops there are postharvest groupings (e.g. Cold Chain Forums) that specifically address postharvest issues. The chairs of such forums could be included on the PHI board together with their funders (such as CRI, FruitGro and Subtrops).

- ***Maintain a strong programme management and leadership capability within FPEF***

FPEF should plan to continue being the legal persona responsible for the management of PHI funds and project administration.

- *Incorporate a long term monitoring and evaluation framework for PHI (including impact assessment)*

The ‘selling point’ for PHI-3, for both private sector and public sector funders must be the impact that PHI projects have on the performance of the fresh fruit export sector. As many of these impacts unfold over time, it is necessary to record and analyse the way PHI projects have this effect and, where feasible, to measure its extent. This will happen more easily if funds are channelled through research roleplayers in the fresh fruit industry (such as CRI/FruitGro/Subtropics). PHI must, however, replicate this monitoring for the cross-cutting projects where no single industry “owns” the research project (and, hence, doesn’t monitor it as closely as it should be monitored).

#### **5. *Improve communication and information sharing related to PHI***

The existing channels used for sharing information related to PHI projects should be deepened and extended to include web-site and web-based applications. PHI has an extraordinary range of projects – related to logistics, climate change, fair trade and assistance to emerging farmers, as well as scientific issues – that deserve wider publicity and appreciation.

#### **6. *Develop linkages with the industry, using PHI***

PHI ought to be promoted both to increase ‘uptake’ of project findings by FPEF members and to entice non-members of FPEF to join and support the organisation.

#### **7. *Pursue partnerships with government departments***

FPEF should invite partnerships with government departments, even if funding is not a direct consequence. A network of contacts across government is useful in lobbying for public support and to illustrate the benefits that can be created, for all stakeholders, by effective public-private partnerships (as exemplified by the DST-FPEF partnership in the PHI Programme).

### **Reflection:**

At the start of the impact study, it was expected that the main challenge for the future of the PHI programme was to demonstrate its impact in order to secure long term, committed funding from government, which would probably be beyond its current funding partner the Department of Science and Technology.

At the end of the research and engagement process, it appears that the structure of PHI needs to change in order to enhance its impact in PHI-3. The structural changes are needed to integrate the Programme better into the long term research agenda for the fruit industry and to provide an institutional form to which both public and private sector can contribute sustainable funding. There is also a need to provide, within the PHI programme, for the ongoing assessment of the 'impact pathways' which flow from the research and innovations projects supported by PHI.

## 7. References and Appendices

### Bibliography

#### PHI Publications

FPEF (Fresh Produce Exporters' Forum) (2012a) "Post-Harvest Innovation Programme 2012", pp.136

Post-Harvest Innovation Programme (2009) "Brochure II", pp.106

Post-Harvest Innovation Programme (2008) "Brochure I", pp.94

van Broembsen, L. (ed) (2010) *Citrus - Advanced Trade Chain Manual - Harvest to Home, the fresh fruit trade chain* (Fresh Produce Exporters Forum, South Africa), pp.125

#### Funding contract PHI-1:

"Contract for funding between Department of Science and Technology and Agricultural Research Council and Fresh Produce Exporters' Forum for the Implementation of the Post-Harvest and Cold Chain Technology Innovation Programme", November 2007, pp. 22

DST/FPEF (2006) "Business Plan for a Post-Harvest and Cold Chain Technologies Innovation Programme - The South African Fresh Fruit Industry", 12 December 2006, Prepared jointly by Unit for Manufacturing, Technology Transfer and Local Innovation, Programme 5: Socio-Economic Partnerships, Department of Science and Technology, and the Fresh Produce Exporters' Forum, pp.18 (Annexure A to the contract for funding)

#### Funding contract PHI-2:

"Project funding agreement Number DST/CON 0063/2011 to manage the Post Harvest Innovation (PHI) programme by and between DST and FPEF", 3 March 2011, pp.27

First Addendum to Agreement Number: DST/CON 0063/2011 (2012) - extending the effective date of PHI-2 until 31 March 2014

Fresh Produce Exporters' Forum (2011b) "South African Post-Harvest Innovation Programme - Business Plan, April 2011, pp. 20 (Annexure A to the contract for funding)

#### Other PHI Documentation

ARC/FPEF/DST "Business Plan for an Expanded and Extended Post-Harvest and Cold Chain Technologies Innovation Programme - The South African Fresh Fruit Industry", May 2009, pp.28 [includes the criteria used to select PHI-1 projects]

- Ferreira, J. (2010) "Report on the assessment by the stakeholders of the Post-harvest innovation programme", 17 April 2010 (6 pages plus 3 appendices)
- FPEF (2012b) "South African Post-Harvest Innovation Programme 2 - Annual Report of 2011/12 (Mar 2011-Mar 2012)", pp.32 (submitted to DST, April 2012)
- PHI (2012b) "PHI-2 Western Cape-Based Projects: oral presentations on progress of projects", Tuesday, 3rd July 2012 at Stellenbosch University <programme, pp.1>
- Post-Harvest Innovation Programme (2012c) Project Application 2012", Application form template pp.7
- Post-Harvest Innovation Programme (2012d) "Annual / Final Report", Reporting form template pp.4
- Post-Harvest Innovation Programme (2012e) Annexure A: Terms of reference of the implementation agent (FPEF), the Programme Management Unit (PMU) and the Programme Coordinator (PC), (As at 30 April 2012) pages 26 to 28 in FPEF 2012b
- Post-Harvest Innovation Programme (2012f) Annexure B: General Operating Guidelines, (As at 30 April 2012), pages 29 to 32 in FPEF 2012b
- "Understanding the South African fruit export supply chain, by Malcolm Dodd, Manager of Post Harvest Innovation Programme (Fresh Produce Exporters Forum)", 29 October 2010, 51 slides

### ***South African Minerals to Metals Research Institute (SAMMRI)***

- "New institute launches pilot research programme", *Mining Weekly*, 2nd September 2011
- South African Minerals to Metals Research Institute website :  
<http://www.sammri.com/>
- SAMMRI proposal to DST, 2009, pp.116 < funded by DST>
- "Minerals to Metals" (extract from UCT Research Report 2010)

### ***Websites***

- AllFresh Conference 26-7 October 2011 website:  
<http://www.allfresh.co.za/program.html>
- Citrus Growers' Association of Southern Africa [www.cga.co.za](http://www.cga.co.za)
- Citrus Research International website: <http://www.citrusres.com/research/index.htm>
- Citrus Research International [www.cri.co.za](http://www.cri.co.za)
- ExperiCo Fruit Technology Solutions [www.experico.co.za](http://www.experico.co.za)
- Farmsecure Technologies [www.farmsecure.co.za](http://www.farmsecure.co.za)

FPEF (Fresh Produce Exporters' Forum) website [www.fpef.co.za](http://www.fpef.co.za)  
Fruitgro Science [www.dfptresearch.co.za/](http://www.dfptresearch.co.za/)  
Hortgro Services [www.hortgro.co.za](http://www.hortgro.co.za)  
Horticulture Research Institute (HRI) [Egypt] [www.horticulture-egypt.com/hri/](http://www.horticulture-egypt.com/hri/)  
National Agricultural Marketing Council (NAMC) [www.namc.co.za](http://www.namc.co.za)  
National Agricultural Research Forum NARF website:  
<http://www.nda.agric.za/daaDev/sideMenu/others/RTD/NARF.html>  
National Planning Commission <http://www.npconline.co.za/>  
Perishable Products Export Control Board (PPECB) website: <http://www.ppecb.com/>  
PPECB Cool Chain workshop: CCA Workshop "From Field to Fork" Cape Town, October  
2010 <http://www.ppecb.com/events/cca-workshop-201cfrom-field-to-fork201d>  
South African Subtropical Growers' Association (Subtrop) [www.subtrop.net/](http://www.subtrop.net/)  
South African Table Grape Industry (SATI) [www.satgi.co.za/](http://www.satgi.co.za/)  
The SA Fruit Journal/Vrugte Joernaal: website <http://www.safj.co.za>

### **General Bibliography**

ARC Annual Report 2008/9, (dated Aug-09), pp.144  
ARC Annual Report 2009/10, RP 204/2010, pp.194  
Cooper, D., (2011) *The University in Development: Case studies of use-oriented research* (HSRC Press) downloadable from <http://www.hsrcpress.ac.za>  
Crouch, I., Bergman, H. and Viljoen, H. (2011) "Efficacy of SmartFresh<sup>sm</sup> applications to palletised cartons of apples", ExperiCo (Fruit Technology Solutions), pp.8  
CSIR (n.d.) Definitions of the "Technology Readiness Levels" (TRLs)  
DAFF (2010a) "The declining contribution of Agriculture to GDP: Is the role of agriculture becoming less important?", Compiled by Economic Research Division, Directorate: Economic Services, March 2010, pp.9  
DAFF (2010b) "Estimate of the contribution of the agriculture sector to employment in the South African Economy", Compiled by: Directorate: Economic Services, Department of Agriculture, Forestry and Fisheries, August 2010  
DAFF (2011a) Report on Food Security by Directorate: Economic Services - Production Economics Unit - March 2011, pp.25  
DAFF (2011b) Report on Agricultural Productivity in South Africa by Directorate: Economic Services - Production Economics Unit - March 2011, compiled by Mapula Ramaila and Sandile Mahlangu, pp.22

- De Beer, G., Paterson, A. and Olivier, H. (2003) "160 Years of Export - The History of the Perishable Products Export Control Board", pp.92
- Department of Agriculture, Forestry and Fisheries (2011c) "Competitiveness of selected South African agricultural product exports in the EU-27", Directorate: Economic Services and Directorate: International Trade, pp.38
- Department of Agriculture (2008) "National Agricultural Research & Development Strategy", October 2008 pp.43
- Department of Agriculture (2007) "National Agricultural Research & Development Strategy", pp.44
- Department of Science and Technology "10-Year Innovation Plan", DST, 2008
- DST (2012) Ministerial Review Committee on the Science, Technology and Innovation Landscape in South Africa pp.202 (Nongxa Committee)
- Dodd, M.C. (2007) Deciduous Cold Chain Forum: Purpose Document: Pre-Cooling, Packaging and Container Workgroup, pp.10
- FPEF (Fresh Produce Exporters' Forum) (2011a) "Fresh Fruit Export Directory South Africa 2012", pp. 132
- GCIS (2011) South Africa Yearbook 2010/11 – Chapter 3: Agriculture, Forestry and Fisheries, January 2011
- Godin B. (2004) "The new economy: What the concept owes to the OECD" *Research Policy* **33** (5): 679-690 , July
- Hopkins, M.M., Martin, P.A., Nightingale, P., Kraft, A. & Mahdi, S. (2007) "The myth of the biotech revolution: An assessment of technological, clinical and organisational change" *Research Policy* **36** (4): 566-589 , May
- Liebenberg, F., Pardey, P.G. and Kahn, M (2010) "South African Agricultural Research and Development: A Century of Change", Staff Paper P10-1/ InSTePP Paper 10-01, Department of Applied Economics, University of Minnesota, January 2010, pp.69.
- Liebenberg, G.F and Kirsten, J. F. (2006) "South Africa: coping with structural changes" (International Food Policy Research Institute), pp.32 downloaded from <http://repository.up.ac.za/handle/2263/2530>
- Lorentzen, J., Manamela, A., Muller, L. and Gastrow, M (2010) "A technology gap analysis of leading firms in Cape Town: Background paper for the study on Cape Town's future competitiveness and the global knowledge economy", 2nd draft: 15 October 2010
- Mather, C. & Greenburg, S., (2003) "Market liberalisation in post-apartheid South Africa: The restructuring of citrus exports after 'deregulation'" *Journal of South African Studies* **29** (2), 393-412.

- Melo, O. et al (2012) “Does Sanitary and Phytosanitary regulation stringency affect developing countries exports? Evidence from Chilean fruit exports.” Paper prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguacu, Brazil, 18-24 August, 2012 downloaded from <http://ageconsearch.umn.edu>
- National Planning Commission (2012) “National Development Plan 2030: Our Future – make it work”, pp.489
- Nongxa Committee – see DST, 2012
- Statistics South Africa “Gross domestic product Fourth quarter 2011” *Statistical release P0441*
- Symington, S. (2008) “‘Staying Ahead of the Global Pack’ [Creating Sustainable Competitive Advantage in the Marketing of South African Table Grapes to the United Kingdom in the Deregulated Era]”, unpublished MSc dissertation, UCT Department of Economics, pp. 237
- Symington, S. (2010) “Ethical Trade in our Value Chain” – presentation

### **Press Articles**

- ‘Ethical business practices go beyond labour issues’, 29 April 2011, ftwonline
- “[Transnet] Strike action blamed for fruit sector’s massive losses”, ftwonline, 7 December 2010
- “Apple producers form global alliance”, [www.fruitnet.com](http://www.fruitnet.com), 15 February 2011
- “Double Prize win for SU Postharvest Technology students in France”, SU AgriSciences Newsletter Issue 50 June 2011, (report dated May 17, 2011 on SU website)
- “Farmsecure Agri Science makes progress”, Fred Meintjes, 25 January 2012 [fruitnet.com](http://fruitnet.com)
- “Farmsecure Agri Science: revolutionizing agri science in South Africa” SA Fruit Journal April/May 2012, p. 39
- “Fruit exporters now faced with an additional challenge” [ethically produced fruit], ftwonline, 31 August 2009
- “Is congestion surcharge 'morally indefensible'?", ftwonline, 21 June 2010
- “Rail utility studies new citrus, mining logistics options for Limpopo”, Engineering News 21st July 2011
- “Round-The-Clock At Golden Harvest”, CBN 05 Aug 2011
- “SA port body asks for steep increase”, Business Report, August 10 2011
- “Transformation of fruit exports lagging”, Farmers Weekly 11 November 2011
- “Transnet develops new port pricing plan”, Business Report October 11 2011

### *Bibliography related to some PHI Projects*

- Bergman, H., Crouch, E., Crouch, I., Jooste, M. & Majoni, J. (2012) "Update on the possible causes and management strategies of flesh browning disorders in 'Cripps Pink' apples", *SA Fruit Journal* March/April 2012, pp.56-9
- Buchner, S (2006) "Coating of pears (var. Packhams Triumph) with kafirin protein and its effect on postharvest physiology and shelf-life", dissertation for MSc (Agric) Food Science & Technology, submitted to the Department of Food Science, Faculty of Natural and Agricultural Sciences, University of Pretoria, pp.157; viewed 120611 < <http://upetd.up.ac.za/thesis/available/etd-02242012-113144/> >
- Buchner, S., Kinnear, M., Crouch, I.J., Taylor, J. and Minnaar, A. (2011) "Effect of kafirin protein coating on sensory quality and shelf life of 'Packham's Triumph' pears during ripening" *Journal of the Science of Food and Agriculture*, 91:2814-2820.
- Citrus Growers Association of Southern Africa "Citrus on Rail Strategic Growth", Project 6/2009 - Update: 01/02/2010 pp. 22 (Mitchell Brooke, Logistics Coordinator, CGA)
- Confronting Climate Change (2010) "The South African Fruit & Wine Industry Carbon Calculator – The Protocol - Version 2 – November 2010", pp.35
- Crouch, I. (2010) "Quality management of pome fruit with focus on post harvest" *fresh NOTES* (23) Dec 2010 (a technical update published by Fruitgroscience)
- Experico (2010b) "Determination of effective packaging formats for deciduous and citrus fruit with special reference to uniformity, fruit quality maintenance and strategic global warming requirements CLIENT : PHI/DFPT SEASON : 2008, 2009 and 2010 PROJECT STATUS : Year 2/2, pp.141.
- Experico (n.d. c.2009/10) "The effect of a kafirin protein coating on the overall post-storage quality and ripening of Packham's Triumph and Forelle pears", PROJECT NUMBER: P 09-09 CLIENT: CSIR SEASON: 2009 YEAR: 1, pp.26; SEASON: 2010 YEAR: 2, pp.10
- FruitgroScience (2011) "A strategic investment framework for FruitgroScience for pome and stone fruit", prepared by David Farrell, (Blue North) August 2011, pp.20 [Hard copy, Version 3.0]]
- Packhouse Action Group website  
<http://www.eepacs.co.za/PublicPages/EEpacsContent.aspx?pg=Home>>
- Romanazzi, G. et al (2012) "Recent advances on the use of natural and safe alternatives to conventional methods to control postharvest gray mold of table grapes", *Postharvest Biology and Technology* 63 (2012) 141–147
- Viljoen, H.W. 2011. Effect of gamma irradiation as a mitigation treatment on storage quality of plums. *SA Fruit Journal*, 10(4): 73-75

## List of Abbreviations and Acronyms

ACIAR	Australian Centre for International Agricultural Research
ARC	Agricultural Research Council
CATTS	controlled atmosphere temperature treatment system
CEO	Chief Executive Officer
CGIAR	Consultative Group on International Agricultural Research
CRI	Citrus Research International
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Fishing and Forestry
DCA	Dynamic Controlled Atmosphere
DST	Department of Science and Technology
DTI	Department of Trade and Industry (National Department)
FAO	Food and Agriculture Organisation of the United Nations
FPEF	Fresh Produce Exporters Forum
GRAS	generally regarded as safe
ICMAS	Integrated Crop Management Assessment System
IDC	Industrial Development Corporation
IFPRI	International Food Policy Research Institute
IPAP	Industrial Policy Action Plan
NPC	National Planning Commission
PHI	Post Harvest Innovation Programme (funded by DST)
PMU	Programme Management Unit (of the PHI Programme)
PPECB	Perishable Products Export Control Board
R&D	Research and Development
SAMMRI	South African Minerals to Metals Research Institute
SU	Stellenbosch University
TIA	Technology Innovation Agency
UCT	University of Cape Town

## Appendix 1: Interviews and site visits

### *Face to Face Interviews*

[preparatory interviews were conducted, before the project started, with Mr Stuart Symington, CEO, PPECB, Plattekloof, 1 June 2012 and Prof. Mohammad Karaan, Dean of Faculty of AgriSciences, Stellenbosch University 31 May 2012. The consultants also had the benefit of comprehensive briefings from Mr Anton Kruger (CEO FPEF) and Ms Junette Davids (Programme Coordinator, Post Harvest Innovation programme)]

- Mr Hugh Campbell, FruitgroScience, 2 July 2012
- Mr Henk Griessel, Quality Assurance Manager, Tru-Cape, 5 July 2012
- Mr Andy Connell – DoleSA, 6 July 2012
- Dr Malcolm Dodd, PHI-1 / Stellenbosch University, 16 July 2012
- Prof Vaughan Hattingh, Citrus Research International / Stellenbosch University, 16 July 2012
- Prof Lise Korsten, Department of Microbiology and Plant Pathology, University of Pretoria and PMU member , 17 July 2012
- Prof Dharini Sivakumar, Department of Crop Science, Tshwane University of Technology, 17 July 2012
- Prof Mike Kahn, board member for R&D, Agricultural Research Council, 19 July 2012
- Mr Jaco Smit, New Product Development & Market Access Manager, Capespan Exports: Monday 13 August
- Fruitways: Mr Hein Keulder, CEO; Mr Jaco Moelich, Product Manager Fruitways Marketing, Mr Pieter Neethling (Packhouse technical issues) Tuesday 14 August

### *Phone Interviews*

- Dr Ian Crouch, Experico, 22 June 2012
- Dr Filicity Vries, ARC, 26 June 2012
- Dr Nomusa Dlamini, CSIR, 13 July 2012
- Ms Jacomien de Klerk, Citrus Academy, 25 June 2012
- Mr Koos Bouwer, 5 July 2012
- Mr Alf Hartzenburg, Senior Project Manager Western Cape - Industrial Energy Efficiency Project, National Cleaner Production Centre of SA, 20 July 2012
- Dr Johann Ferreira, consultant - Meshfield, 7 August 2012
- Mr Francois Hugo Pomona Fruits (<http://www.pomonafruit.com/>), 8 August 2012

### *Site visits*

- Attended oral presentations on PHI-2 projects based in the Western Cape, Stellenbosch University, 3 July 2012. Presentations by :-
  - Dr Elke Crouch
  - Prof. Linus Opara (and research students)
  - Mr Dawie Scholtz
  - Mr Dawie Moelich
  - Dr Paul Cronje
  - Dr Malcolm Dodd
  - Ms Colleen Chennells
  - Mr Pensanai Zanawe (MSc Student) (for Ferdie Ungerer)
  - Ms Sarah Le Grange
- Site visits to Dampies Boerdery, Ceres; Trevors' farm, Wolseley and Experico, Stellenbosch, 4 July 2012
- Department of Microbiology and Plant Pathology, University of Pretoria, 17 July 2012
- Department of Crop Science, Tshwane University of Technology, 17 July 2012

## Appendix 2: Definition of Innovation

The Nongxa Committee, formally known as the Ministerial Committee on Innovation, reported to the Minister of Science and Technology in March 2012. It adopted “an inclusive view of innovation as being the capacity to generate, acquire and apply knowledge to advance economic and social purposes” (DST 2012).

The report explains:

*“There are several implications of adopting the broad definition, the first being that it includes both the R&D-driven search for frontier technologies as well as the forms of learning and adaptation that might be market led or socially driven.*

*“The concern is that notions of innovation that are overly conflated with science and technology obscure the salience of other forms of innovation that are vital for economic growth, for the prosperity of livelihoods in a developing country context, and for the capacity of government to deliver on its mandate. Indeed, the critique has been levelled that South Africa’s system [of innovation] has tended to favour ‘big science’ at the expense of the formal business sector, emerging enterprises, public sector innovation and community-level development. A definition that embraces this full range of domains is one that acknowledges the complexity of the urgent need to transform the economic and social fortunes of the population, with implications for the transformative work that is required in every corner of society to achieve sustainable futures.*

*“Innovation should thus be understood to include both the production and technologising of new knowledge as well as the ways in which existing knowledge (local or imported) is adapted for local contexts. Innovation is thus an activity (indeed, an imperative) that belongs in all settings, no matter how sophisticated or modest the technologies at hand. In other words, the practice of innovation (or applied learning) needs to be radically domesticated into the grasp of all citizens, in all spheres of activity, making each citizen an engineer of transformation, growth and sustainability.*

*“An implication of this is the need for a policy framework that provides for the full spectrum of innovative activities (from leading-edge, new-to-the-world developments at the one end, to functional imitation at the other), and to accommodate these in the indicators used to check on how well the country is doing as an innovative society.”*

This is an important definition, as the allocation of funds by the PMU is based partially on the degree of innovation shown by the proposals. In this broad definition practically all the R&D currently funded by industry would be classified as innovative. The PMU has been striving to fund projects beyond ‘business as usual’ – projects showing a higher degree of “creativity”.

### Appendix 3: Attendees at the workshop on 16 August

Name	Organisation	Position
Mr Allan Taylor	Allan Taylor Consultancy	Consultant
Dr Martin Nicol	ODA	Consultant
Mr Anton Kruger	Fresh Produce Exporters' Forum	CEO
Ms Junette Davids	Fresh Produce Exporters' Forum	Programme Coordinator
Mr Mduzuzi Ngcobo	PPECB	Manager: Research & Development
Prof Lise Korsten	University of Pretoria	Head of Plant Pathology, University of Pretoria
Prof Linus Opara	Stellenbosch University	Research Professor and SA Research Chair of Post-harvest Innovation, Stellenbosch
Mr Llanley Simpson	DST	Director
Mr Abrie de Swardt	Capespan	MD: Capespan Export
Mr Hugh Campbell	HORTGRO Science	General Manager
Prof Vaughan Hattingh	CRI	CEO
Prof Malcolm Dodd	Consultant	Consultant (Programme Coordinator PHI-1)
Ms Angelique Marais	Fruitways	
Dr Martin Taylor	ExperiCo	General Manager
Prof Michael Kahn	ARC R&D Committee	Chairperson
Ms Rizwana Mia	TIA	
Mr Graeme Matthews	ASDA	
Ms Khathutshelo Patience Mphumbude	DAFF	Research Analyst – on PHI-1 PMU
Dr Johan van Zyl	ARC - Infruitec	
Dr Filicity Fries	ARC - Infruitec	

## Appendix 4: References on impact assessment of agricultural research

There is a substantial academic and institutional literature on impact assessment related to agricultural research. Impact Assessment is one element within the broader area of Monitoring and Evaluation, that traces whether research is adopted and taken forward and with what results.

“Many years may pass between the initiation of a research project, the production of a research-derived innovation and its ultimate diffusion into farmers’ fields and beyond.” (Kelley *et al* 2008)

According to Walker *et al* (2008), the defining characteristic of *ex post* Impact Assessments is their timing as they take place after a program or project has generated the intervention being assessed and sufficient time has elapsed and experience accumulated to assess the intervention’s performance in terms of longer-term economic, social, and environmental consequences. *Ex post* Impact Assessments “contribute primarily to accountability by demonstrating impact to donors and other stakeholders, and secondarily to learning about the effectiveness of agricultural research.”

In the reference list below, Kelley *et al* (2008), Walker *et al* (2008) and particularly the detailed and programmatic Davis *et al* (2008), are of particular relevance for FPEF in planning a framework for PHI-3 that allows the tracking of the impact pathways of PHI programme investments.

Davis *et al* (2008) utilizes a “a benefit–cost and results mapping framework that traces progress:

- from the R&D and extension inputs to outputs that are adopted by the next users
- through to final users to result in outcomes—that is, changes in practice, products and policies.”

Davis J., Gordon J., Pearce D. and Templeton D. (2008) *Guidelines for assessing the impacts of ACIAR’s research activities* (Australian Centre for International Agricultural Research, Publication Code: IAS058, pp.117, downloaded from <http://aciarc.gov.au/publication/IAS058>

Dodd, M., Cronje, P., Taylor, M., Huysamer, M., Kruger, F., Lotz, E. and Van Der Merwe, K. (2010) “A review of the post harvest handling of fruits in South Africa over the past twenty five years”, *South African Journal of Plant and Soil* : 25th anniversary edition, Vol 27, Issue 1, Pages: 97-116

- Gertler, P. (2009) "Evaluating Program Impact: Some 'Random' Thoughts", 23 slides - presentation slides for NONIE conference, Cairo, March 31st , 2009, downloaded from <http://www.worldbank.org/ieg/nonie/members.html>
- Kelley, T., Ryan, J. and Gregersen, H. (2008) "Enhancing *ex post* impact assessment of agricultural research: the CGIAR experience" *Research Evaluation*, 17(3), September 2008, pages 201–212
- Leeuw, F. and Vaessen, J. (2009) "Impact Evaluations and Development: NONIE Guidance on Impact Evaluation", (Washington: Network of Networks for Impact Evaluation) pp. 148, downloadable from <http://www.worldbank.org/ieg/nonie/guidance.html>
- Thirtle, C. and J. Van Zyl. "Explaining total factor productivity growth and returns to research and extension in South African commercial agriculture, 1947-91." *South African Journal of Agricultural Extension* 23(1994):21-27. [available at SA Library 5500 – cited by Liebenberg *et al*, 2010, uses methodology developed by the precursor institution to IFPRI ]
- Torero, M (2009) "Cases: Real constraints in doing impact evaluation of agricultural projects", presentation slides for NONIE conference, Cairo, March 31st , 2009
- Walker, T., Maredia, M., Kelley, T., La Rovere, R., Templeton, D., Thiele, G., and Douthwaite, B. (2008) "Strategic Guidance for Ex Post Impact Assessment of Agricultural Research". Report prepared for the Standing Panel on Impact Assessment, CGIAR Science Council, Rome, pp. 95, downloaded from <http://www.fao.org/docrep/011/i0276e/i0276e00.htm>

### *Web Resources*

- Website of the of the Standing Panel on Impact Assessment (SPIA), a sub-group of the Consultative Group on International Agricultural Research (CGIAR) Independent Science and Partnership Council: <http://impact.cgiar.org/about>
- International Food Policy Research Institute Impact Assessment web page: <http://www.ifpri.org/book-25/ourwork/researcharea/impact-assessment>
- The Agricultural Science and Technology Indicators (ASTI) initiative: <http://www.asti.cgiar.org/>
- NONIE (Network of Networks for Impact Evaluation) website: <http://www.worldbank.org/ieg/nonie/>

## Appendix 5: Analysis of PHI-1 and PHI-2 projects

**Table A5:1 – Analysis of beneficiary sectors**

<i>Rank</i>	<i>BENEFICIARY:</i>	<i>PHI CONTRIBUTION</i>	<i>Percent</i>
1	All fruit sectors	R 6,966,138	43%
2	The citrus industry	R 2,377,666	15%
3	The citrus and deciduous fruit sectors	R 1,640,009	10%
4	The subtropical fruit sector	R 1,230,082	8%
7	The pome fruit sector	R 1,154,346	7%
5	The deciduous fruit sector	R 1,043,125	6%
6	The deciduous and subtropical fruit sectors	R 901,400	6%
8	The table grape industry	R 666,329	4%
9	The stone fruit sector	R 397,667	2%
		R 16,376,762	100%

**Table A5:2 – Analysis by Technology Gap / Cross cutting technology theme**

<i>Rank</i>	<i>Technology Gap / Cross cutting technology theme</i>	<i>PHI CONTRIBUTION</i>	<i>Percent</i>
1	Integrated packaging solutions (internal and external packaging and pallet platforms) [Logistics]	R 2,278,702	14%
2	Temperature and humidity control of product [Green Chemistry]	R 2,054,660	13%
3	Information systems for the compilation and dissemination of accurate and timely information to all stakeholders [Information]	R 2,020,875	12%
4	Alternative products and processes for post-harvest disease control [Green Chemistry]	R 1,690,039	10%
5	Energy efficiency in the supply chain [Energy]	R 1,630,080	10%
6	Post-harvest physiology	R 1,307,315	8%
7	Technology transfer	R 1,168,000	7%
8	Human capital development	R 960,000	6%
9	Post-harvest Pathology	R 901,400	6%
10	Logistics (rail, road, sea, etc.) [Logistics]	R 905,000	6%
11	Mitigation technology for sanitary and phytosanitary compliance	R 797,667	5%
12	Non-destructive, fruit quality assessment techniques	R 352,840	2%
13	Pre-harvest disposition to post-harvest disorders	R 310,184	2%
		R 16,376,762	100%

*Items in square brackets reflect the summary names used for PHI-2 (second call) projects.*

**Table A5:3 – Impact study on the Post-Harvest Innovation Programme - List of PHI-1 and PHI-2 projects**
**\*\*\* ORDER \*\*\***

Φ Ref No	Project description	Phase / Φ2 ii Ref.	Technology Gap / Cross cutting technology theme	PRINCIPAL INVESTIGATOR & CONTACT DETAILS:	DURATION:	PHI CONTRIBUTION:	CONTRIBUTION OF PARTNERS where revealed	LEAD INSTITUTION:	BENEFICIARY:
						Rands			
Φ25	Packaging solutions for citrus and deciduous fruit	PHI-1	Integrated packaging solutions (internal and external packaging and pallet platforms)	Dawie Moelich: +27 21 887 1134 / +27 82 886 7094 / dawie@experico.co.za	Three years	R 1,313,452		ExperiCo (Fruit Technology Solutions)	The citrus and deciduous fruit sectors
Φ22	Preventing soft landings and storage related disorders in export avocados	PHI-1	Temperature and humidity control of product	Dr Fans Kruger and Danie Lemmer: +27 13 753 7000 / +27 83 391 5822 / fransk@arc.agric.za	Four years	R 996,082	R -	ARC–Institute for Tropical and Subtropical Crops	The subtropical fruit sector
Φ12	Confronting climate change	PHI-1	Energy efficiency in the supply chain	Hugh Campbell and Shelly Fuller: H.Campbell: +27 21 882 8470 / hugh@fruitgro.co.za; S.Fuller: +27 21 461 1610 / shelly@climatefruitandwine.co.za	Three years	R 600,000	R 2,650,000	Fruitgro Science and Genesis Analytics	All fruit sectors
Φ16	Forensic pathology in the citrus supply chain	PHI-1	Alternative products and processes for post-harvest disease control	Prof. Lise Korsten: +27 12 420 3295 / +27 79 522 8476 / lise.korsten@up.ac.za	Three years	R 570,000	R -	University of Pretoria (Department of Microbiology and Plant Pathology)	The citrus industry
Φ18	An important message from ICMAS	PHI-1	Information systems for the compilation and dissemination of accurate and timely information to all stakeholders	Kobus Hartman and Sarah le Grange: Capespan Exports (Pty) Ltd	Three years	R 450,000	R -	Capespan Exports (Pty) Ltd	All fruit sectors
Φ03	Edible protein coatings on pears show potential	PHI-1	Post-harvest physiology	Dr Nomusa Dlamini and Dr Ian Crouch: Dr Nomusa Dlamini +27 12 841 3097 / nrldlamini@csir.co.za ; Dr Ian Crouch: +27 21 887 1134 / ian@experico.co.za	Two years	R 430,831	R -	Council for Scientific and Industrial Research (CSIR) and ExperiCo (Fruit Technology Solutions)	The pome fruit sector
Φ23	Movable rapid cooling has potential	PHI-1	Temperature and humidity control of product	Heini Nel: +27 21 880 2332 / +27 82 453 1040 / heini@arubacooling.com	One year	R 324,625	R -	Aruba Cooling	The table grape industry
Φ07	Illustrated guidelines on citrus post-harvest diseases	PHI-1	Technology transfer	Keith Lesar: +27 13 759 8033 / +27 82 335 7543 / keithlesar@cri.co.za	Two years	R 250,000	R -	Citrus Research International	The citrus industry
Φ10	South Africa and Spain collaborate	PHI-1	Technology transfer	Dr Paul Cronjé: +27 21 808 2689 / +27 84 447 1047 / paulcronje@sun.ac.za	One year	R 250,000	R -	Citrus Research International and Stellenbosch University (Department of Horticultural Science)	The citrus industry
Φ15	Optimising imazalil application in citrus pack houses	PHI-1	Alternative products and processes for post-harvest disease control	Dr Paul Fourie: +27 21 808 3721 / +27 83 290 2048 / phf@cri.co.za	Two years	R 250,000	R -	Citrus Research International and Stellenbosch University (Department of Plant Pathology)	The citrus industry
Φ17	Can GRAS compounds control citrus decay?	PHI-1	Alternative products and processes for post-harvest disease control	Keith Lesar: +27 13 759 8033 / +27 82 335 7543 / keithlesar@cri.co.za	Two years	R 250,000	R -	Citrus Research International	The citrus industry

**Table A5:3 – Impact study on the Post-Harvest Innovation Programme - List of PHI-1 and PHI-2 projects**
**\*\*\* ORDER \*\*\***

Φ Ref No	Project description	Phase / Φ2 ii Ref.	Technology Gap / Cross cutting technology theme	PRINCIPAL INVESTIGATOR & CONTACT DETAILS:	DURATION:	PHI	CONTRIBUTION OF PARTNERS where revealed	LEAD INSTITUTION:	BENEFICIARY:
						CONTRIBUTION: Rands			
Φ14	Improving the post-harvest quality of mangoes	PHI-1	Alternative products and processes for post-harvest disease control	Prof. Lise Korsten: +27 12 420 3295 / +27 79 522 8476 / lise.korsten@up.ac.za	Three years	R 234,000	R -	University of Pretoria (Department of Microbiology and Plant Pathology)	The subtropical fruit sector
Φ08	Building capacity in the trade chain	PHI-1	Technology transfer	Michelle Kruger: Junette Davids: +27 21 526 0474 / junette@fpef.co.za	Two years	R 230,000	R -	Fresh Produce Exporters' Forum	All fruit sectors
Φ21	Chroma meter technology provides accuracy	PHI-1	Non-destructive, fruit quality assessment techniques	Kobus van der Merwe: +27 21 809 3418 / +27 84 430 6555 / vdmerwek@arc.agric.za	Two years	R 215,125	R -	ARC Infruitec-Nietvoorbij	The deciduous fruit sector
Φ01	Evaluating green technologies to improve table grape quality	PHI-1	Post-harvest physiology	Dr Filicity Vries: +27 21 809 3424 / +27 72 776 4708 / vriesf@arc.agric.za	One year	R 203,989	R -	ARC Infruitec-Nietvoorbij	The table grape industry
Φ24	The effect of elevated storage temperatures on plums	PHI-1	Temperature and humidity control of product	Mariana Jooste: +27 21 808 3550 / +27 82 515 2187 / mjooste@sun.ac.za	Two years	R 203,000	R -	Stellenbosch University (Department of Horticultural Science)	The deciduous fruit sector
Φ04	Tonnage off Tar concluded	PHI-1	Logistics (rail, road, sea, etc.)	Sandra Baetsen: +27 79 877 3777 / sandra@fpef.co.za	Two years	R 200,000	R -	Fresh Produce Exporters' Forum	All fruit sectors
Φ05	Scrutinising South African fresh fruit export logistics	PHI-1	Logistics (rail, road, sea, etc.)	Sandra Baetsen: +27 79 877 3777 / sandra@fpef.co.za	Two years	R 200,000	R 900,000	Fresh Produce Exporters' Forum	All fruit sectors
Φ02	Factors influencing flesh browning in 'Cripps Pink' apples	PHI-1	Post-harvest physiology	Dr Ian Crouch and Dr Elke Crouch: Dr Ian Crouch: +27 21 887 1134 / ian@experico.co.za; Dr Elke Crouch: +27 21 808 4763 / elke@sun.ac.za	Two years	R 199,995	R -	ExperiCo (Fruit Technology Solutions) and Stellenbosch University (Department of Horticultural Science)	The pome fruit sector
Φ06	Understanding the citrus value chain	PHI-1	Technology transfer	Jacomien de Klerk and P-W van Wyk: +27 31 313 3364 / +27 82 496 5510 / jacomien@citrusacademy.org.za	One year	R 150,000	R 1,100,000	Citrus Academy and Media World	The citrus industry
Φ11	Efficient energy usage in the supply chain	PHI-1	Energy efficiency in the supply chain	Koos Bouwer: +27 82 887 8425 / bouweb@orangenet.co.za	One year	R 150,000	R -	Koos Bouwer Consulting CC	All fruit sectors
Φ19	Improved market intelligence in the South African fresh fruit Industry	PHI-1	Information systems for the compilation and dissemination of accurate and timely information to all stakeholders	Nkosana Mbokane and Stefan Conradie: Nkosana Mbokane +27 21 930 1134 / NkosanaM@ppecb.com; Jacques du Preez +27 21 870 2900 / jacques@hortgro.co.za	Three years	R 150,000	R -	Perishable Products Export Control Board and Hortgro Services	All fruit sectors
Φ20	Near infrared technology predicts browning in white, seedless table grapes	PHI-1	Non-destructive, fruit quality assessment techniques	Pieter Raath: +27 21 808 4784 / +27 82 418 4006 / pjraath@sun.ac.za	Two years	R 137,715	R -	Stellenbosch University (Dept of Viticulture and Oenology)	The table grape industry
Φ09	Pre-season workshops improve technology transfer	PHI-1	Technology transfer	Hannes Bester: +27 83 325 8379 / hannesbester@cri.co.za	Ongoing	R 100,000	R -	Citrus Cold Chain Forum	The citrus industry

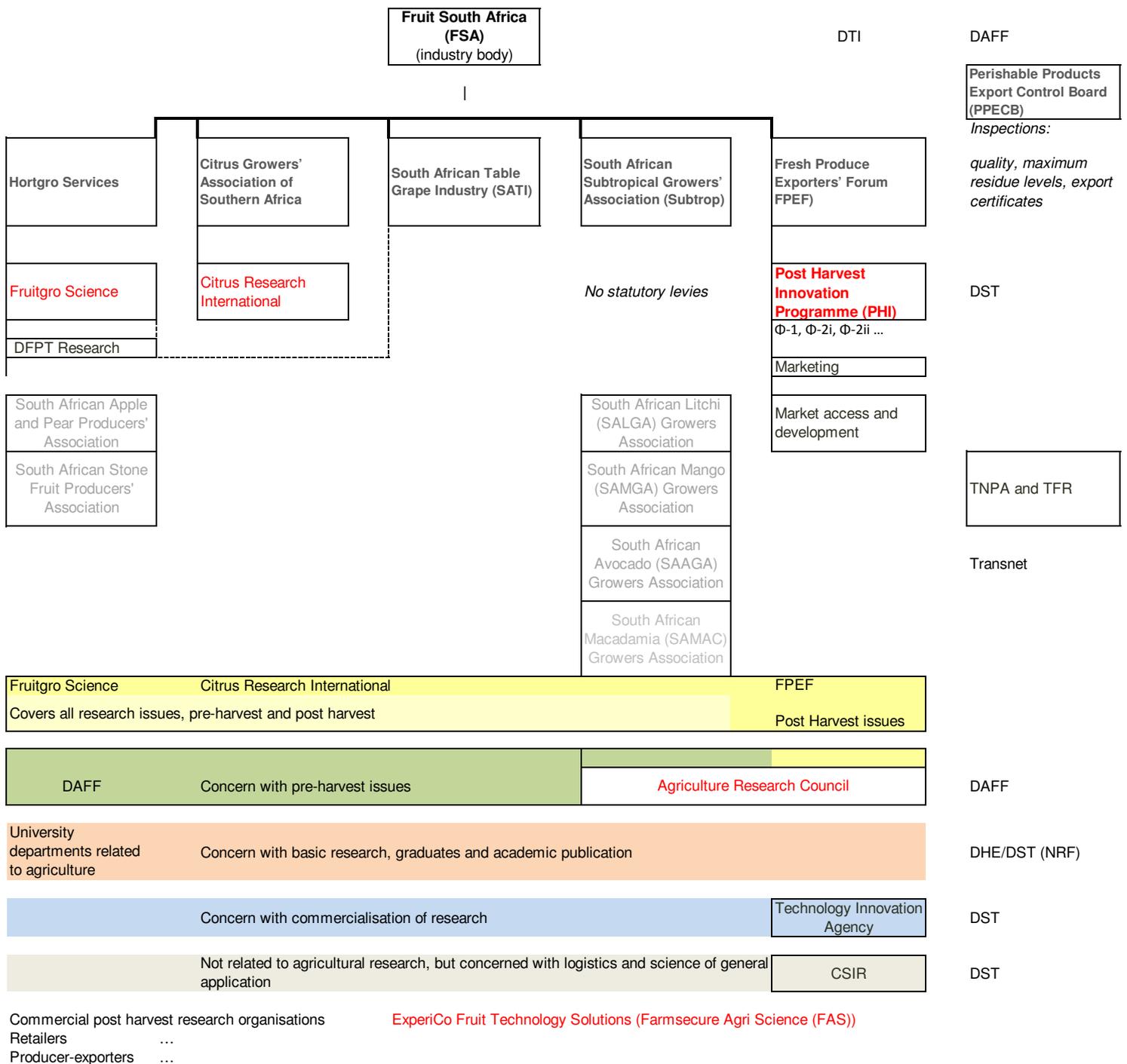
**Table A5:3 – Impact study on the Post-Harvest Innovation Programme - List of PHI-1 and PHI-2 projects**
**\*\*\* ORDER \*\*\***

Φ Ref No	Project description	Phase / Φ2 ii Ref.	Technology Gap / Cross cutting technology theme	PRINCIPAL INVESTIGATOR & CONTACT DETAILS:	DURATION:	PHI	CONTRIBUTION OF PARTNERS where revealed	LEAD INSTITUTION:	BENEFICIARY:
				:		CONTRIBUTION: Rands			
Φ13	Gamma irradiation as a mitigation treatment for false codling moth	PHI-1	Alternative products and processes for post-harvest disease control	Hendrik Hofmeyr: +27 83 676 0301 / jhh@telkomsa.net	One year	R 59,482	R -	Citrus Research International	The citrus industry
Φ34	Packaging for the future	PHI-2	Integrated packaging solutions (internal and external packaging and pallet platforms)	Prof. Linus Opara: +27 21 808 4064/8 / +27 78 562 6446 / opara@sun.ac.za / skype: umezuruike	Two years	R 825,250	R 165,000	Stellenbosch University (Faculty of AgriSciences)	All fruit sectors
Φ39	The impact of microbial dynamics on fruit quality and safety	PHI-2	Post-harvest Pathology	Prof. Lise Korsten: +27 12 420 3295 / +27 79 522 8476 / lise.korsten@up.ac.za / skype: Lise.Korsten	Two years	R 616,400	R -	University of Pretoria (Department of Microbiology and Plant Pathology)	The deciduous and subtropical fruit sectors
Φ43	InfoHUB	12/2012	Information	:	13 months	R 600,475	R 600,475	PPECB	All fruit sectors
Φ28	Building post-harvest capacity in the supply chain	PHI-2	Human capital development	Marianne van der Laarse: +27 82 388 1000 / mvanderlaarse@pma.com / skype: Agrijob	Two years	R 600,000	R -	PMA Foundation for Industry Talent	All fruit sectors
Φ48	Good Cold Chain Practice	13/2012	Logistics	:	One year	R 505,000	R 170,000	CSIR Built Environment	All fruit sectors
Φ37	CATTS: an environmentally friendly mitigation treatment	PHI-2	Mitigation technology for sanitary and phytosanitary compliance	Dr Shelley Johnson: +27 21 808 2694 / +27 72 500 4365 / sjohnson@sun.ac.za / skype: shelley.a.j	Two years	R 400,000	R -	Fruitgro Science and Stellenbosch University (Dept of Conservation, Ecology and Entomology)	The deciduous fruit sector
Φ38	Packaging formats for certification in export fruit irradiation	PHI-2	Mitigation technology for sanitary and phytosanitary compliance	Dawie Moelich: +27 21 887 1134 / +27 82 886 7094 / dawie@experico.co.za	Two years	R 397,667	R 207,220	ExperiCo (Fruit Technology Solutions)	The stone fruit sector
Φ50	Model-based quantification of energy utilization and identification	18/2012	Energy	:	One year	R 380,080	R 30,000	Stellenbosch University	All fruit sectors
Φ29	Assisting smallholder farmers with fruit exports	PHI-2	Human capital development	Dawie Scholtz: +27 21 889 8008 / +27 82 824 2975 / dawie@fpf.co.za	One year	R 360,000	R -	D.J. Scholtz Consulting	All fruit sectors
Φ33	Reducing chilling injury in 'Star Ruby' grapefruit	PHI-2	Pre-harvest disposition to post-harvest disorders	Dr Paul Cronjé: +27 21 808 2689 / +27 84 447 1047 / paulcronje@sun.ac.za / skype: paul.j.r.cronje	Two years	R 310,184	R 307,322	Citrus Research International and Stellenbosch University (Dept of Horticultural Science)	The citrus industry
Φ40	Developing environmentally friendly post-harvest disease control	PHI-2	Post-harvest Pathology	Prof. Dharini Sivakumar: +27 12 382 5303 / +27 79 578 8129 / SivakumarD@tut.ac.za	Two years	R 285,000	R -	Tshwane University of Technology (Department of Crop Sciences)	The deciduous and subtropical fruit sectors
Φ45	DCA as a practical technology	07/2012	Green Chemistry	:	One year	R 276,020	R 69,006	ARC	The pome fruit sector
Φ49	Energy efficiency of cooling facilities in fruit cold chain	06/2012	Energy	:	One year	R 260,000	R 130,000	Tshwane University of Technol	All fruit sectors
Φ32	Radio-enabled technology creates transparency in the supply chain	PHI-2	Temperature and humidity control of product	Dr Malcolm Dodd: +27 21 674 4413 / +27 82 566 1150 / malcolm@alaceraer.co.za / skype: malcolm.c.dodd	Two years	R 254,933	R 63,733	Stellenbosch University (Department of Horticultural Science), Xsense and Sainsbury's	All fruit sectors
Φ26	Establishing an online South African agrochemical database	PHI-2	Information systems for the compilation and dissemination of accurate and timely information to all stakeholders	Kobus Hartman: +27 21 882 8471 / +27 82 801 5308 / jacobus@iafrica.com / skype: kobus.hartman	One year	R 250,000	R 100,000	South African Agrochemical Database Consortium	All fruit sectors

**Table A5:3 – Impact study on the Post-Harvest Innovation Programme - List of PHI-1 and PHI-2 projects**
**\*\*\* ORDER \*\*\***

Φ Ref No	Project description	Phase / Φ2 ii Ref.	Technology Gap / Cross cutting technology theme	PRINCIPAL INVESTIGATOR & CONTACT DETAILS:	DURATION:	PHI	CONTRIBUTION OF PARTNERS where revealed	LEAD INSTITUTION:	BENEFICIARY:
				:		CONTRIBUTION: Rands			
Φ35	Shedding light on mealiness in 'Forelle' pears	PHI-2	Post-harvest physiology	Dr Elke Crouch: +27 21 808 4763 / +27 82 818 4631 / elke@sun.ac.za / skype: elke.crouch	Two years	R 247,500	R 340,000	Stellenbosch University (Department of Horticultural Science)	The pome fruit sector
Φ51	Solar Power Decision Making Tool	10/2012	Energy	:	One year	R 240,000	R 72,000	RED Engineering (Pty) Ltd	All fruit sectors
Φ42	Electronic Signature and Document management solution (ESD)	08/2012	Information	:	3 months	R 230,400	R 175,120	Paltrack	All fruit sectors
Φ36	Establishing maturity guidelines for persimmon quality	PHI-2	Post-harvest physiology	Ferdie Ungerer: +27 21 874 2630 / +27 82 879 6818 / ferdie@redhillagri.co.za	Two years	R 225,000	R 75,000	Sharon Growers Group (Pty) Ltd	The deciduous fruit sector
Φ46	Biological control of post-harvest disease in the perishable fruit in	14/2012	Green Chemistry	:	One year	R 190,909	R 60,000	Stellenbosch University	The citrus and deciduous fruit sectors
Φ31	Citrus Cold Chain Forum facilitates technology transfer	PHI-2	Technology transfer	Hannes Bester: +27 13 759 8000 / +27 83 325 8379 / hannesbester@cri.co.za	Two years	R 188,000	R -	Citrus Cold Chain Forum	The citrus industry
Φ27	An international ethical standard for South Africa	PHI-2	Information systems for the compilation and dissemination of accurate and timely information to all stakeholders	Colleen Chennells: +27 21 855 3905 / +27 82 376 3453 / chennell@iafrica.com / skype: colleenchennells	Seven months	R 170,000	R 170,000	Hortgro Services	All fruit sectors
Φ41	Flexible, web-accessible search and reporting mechanisms	01/2012	Information	:	One year	R 170,000	R 50,000	SA Agrochemical Database Co	All fruit sectors
Φ47	Pallet Test Equipment	03/2012	Logistics	:	9 months	R 140,000	R -	Koos Bouwer Consulting	All fruit sectors
Φ44	Alternative postharvest disease control products and practices	17/2012	Green Chemistry	:	One year	R 135,648	R 310,000	University of Pretoria	The citrus and deciduous fruit sectors
Φ30	Energy efficiency audits for the fresh fruit industry	PHI-2	Technology transfer	Koos Bouwer: +27 82 887 8425 / bouweb@orangenet.co.za	ongoing	R -	R -	Initiative with SA National Cleaner Production Centre	All fruit sectors

# The landscape in which PHI operates



NB. General lack of subsidies from government (unusual internationally)

## Appendix 7: International examples

### Pointers from competitors – their support for post harvest innovation and R&D

Comments by workshop participants, and by interviewees, frequently referred to the levels of government support on post harvest issues given to fruit exporters in South Africa's competitor countries, particularly in South America, but also in Australia and New Zealand.

It is freely contended that while South Africa was a world leader in research and innovation for fruit exports up until the 1980's, this has not been the case since the industry was deregulated in the 1990's and the research agendas became fragmented. At the same time, South Africa's export performance in fresh fruit has been notable. In part, this has been due to the maintenance of competence in key areas of fruit and post harvest research. In 2010, for example, academic researchers for City of Cape Town found that "deciduous fruit producers in the Western Cape are close to the technological frontier in post-harvest technology" (Lorentzen *et al*, 2010). The evidence presented was described as being "indirect", but it is clear that there is a substantial existing base for post- harvest research and innovation, which can be maintained and strengthened by public and private investment in the future. This applies well beyond the deciduous fruit sector in the Western Cape.

During the course of the study – and in the workshop – various advances and developments were mentioned in a number of countries that were South Africa's "natural" competitors in the fresh fruit sector. These included Peru, Chile and Egypt and are dealt with briefly below.

Key factors for success in fruit export relate to, among others, market access, marketing, and sanitary and phytosanitary (SPS) requirements. In respect of the three countries mentioned above there is clearly strong state involvement in the industry either through regulation or marketing or both. The situation in South Africa is somewhat different in that state involvement has diminished especially in regard to single channel or coordinated marketing and the promotion of research into SPS requirements. Much of this is now left to the private sector or to public/private collaboration.

#### **PERU**

Since the mid-1980s, Peru has emerged as an important fruit exporter with the United States being one of the country's top export destinations. Peru's horticultural exports have grown at an annual rate of 16 percent, outpacing any other commodity group (Food and Agriculture Organisation of the United Nations (FAO)).

An investor-friendly business climate has contributed to the signing of several trade agreements, especially driven by the United States/Peruvian preferential trading relationship (some of which related incentives in return for reducing dependence on drug production and trafficking).

Several factors contribute to Peru's success: a favorable business environment, trade agreements, low labor costs, and a climate that favors production of many fruit and products. Nevertheless Peru still has to overcome a number of challenges, including infrastructure bottlenecks, risks due to limited export ranges, water management issues, and a complicated land tenure situation.

Peru has benefited from assistance from multi-lateral organisations such as the Inter-American Development Bank (IADB) and the World Trade Organisation (WTO) especially in respect of the technical cooperation in the area of food safety, plant health and related sanitary and phytosanitary (or SPS) requirements that have limited Peruvian exports in the past.

In addition, their market access and marketing initiatives are vigorously pursued and they are very active exhibitors and participants in the Fruit Logistica Fair, which is held every year in Berlin (Germany) and attracts over 2,500 exhibitors and 56,000 visitors from over 139 countries. In 2013, Peru will be the Guest of Honor or Partner Country in Fruit Logistica, a status conferred for its importance in the industry, the growth of its exports, the quality of its products, and for its economic stability, which is clearly an appeal to national and foreign investors.

Peruvian fruit exports are prioritised by the Peruvian government through its embassies and other channels.

Their recent success seems to lie in excellent quality, compliance and certification of their products, which meet the market requirements.

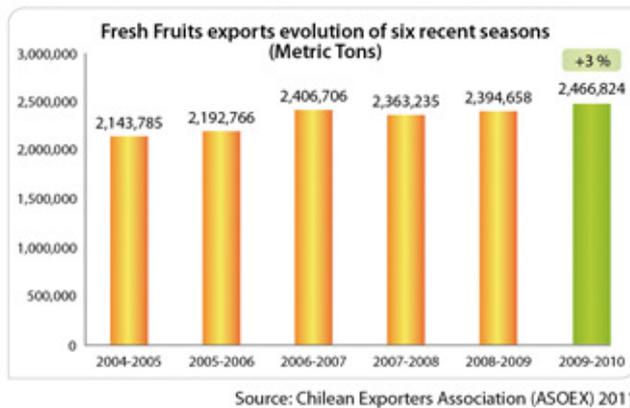
Peru has identified a number of priorities for training, internship, and projects to address SPS barriers for horticultural products. They include institutional capacity, development of national standards, assistance with remediation techniques, and eradication programs, particularly fruit flies. Overcoming EU technical requirements, including GlobalGap standards and pesticide residue requirements are also of interest to Peru.

## **CHILE**

Chilean fresh fruit exports represent 25% of the total agricultural and forestry exports and 50% of the agricultural exports of the country. The agricultural export sector in

Chile has evolved rapidly since the mid 70's with the economic liberalisation of the country's economy. Chilean destination markets for fresh fruit produce are diverse, numbering over 70 countries, although the European Union (EU) and United States (US) represent the most important markets. The presence of fruit fly free growing regions has been an important element in the capability of Chile to grow and diversify its range of products.

### Chile's Fresh Fruit Exports.



Chile has a very active industry exporter association ASOEX, which together with the Chilean Fresh Fruit Association promotes and markets their products in destination countries, especially the United States. They are also targeting new markets in India, China, Russia and Eastern Europe.

As for many other countries SPS regulations are becoming increasingly more vigorous and strictly applied. New regulations and standards frequently have a detrimental effect on exports especially from developing countries. Many developed countries and markets seem to be generating higher barriers to trade, primarily, it seems, out of self-interest. These include standards related to quality, packaging and labeling. (Melo, O. *et al*, 2012)

In response Chile has developed various institutional arrangements to support the fruit export sector with compliance with the increasing requirements imposed by destination countries. These measures include the role played by the Ministry of Agriculture and the Agricultural and Livestock Service, responsible for sanitary and phytosanitary regulations, and through assisting exporters and producers with export certification procedures and in the negotiation of SPS requirements. There has also been close collaboration between the private and public sectors to initiate programmes and instruments to help producers and exporters reach export standards. These focus on technical aspects, irrigation, Integrated Pest Management, pest monitoring, as well as Good Agricultural Practices and Quality Assurance Systems. (Melo, O. *et al*, 2012)

On the private sector side there is ChileGAP developed at the request from the Chilean Fresh Fruit Industry through the Chilean Exporters Association (ASOEX) that deals with the most widely accepted requirements on GAP made by international markets, and offers Chilean growers and exporters the tools to implement these GAP requirements, at the lowest possible

ChileGAP is working closely with NSF International (NSF), an independent, not-for-profit organisation committed to providing public health and food safety solutions, which recently acquired Davis Fresh Technologies, a frontline provider of food safety audits and consulting for the perishable food industry.

Davis Fresh's position in Chile (and also Peru) will provide additional audit services to meet the individual requirements of customers worldwide. This presence also complements NSF's work in nearly 100 countries, and provides Davis Fresh clients' access to organic certification with a combined organic and food safety audit.

## **EGYPT**

Whilst Egypt exports a number of fruit varieties the most significant by far is citrus. Citrus cultivation in Egypt has doubled in area over the past 25 years. New orchards were established especially in the "New Lands" (outside the Delta). By 2010 volumes were estimated to be close to 1 million tons of fresh fruits by the year 2010.

However inadequate sanitation and certification programs in the years up to 2003 contributed significantly to the poor sanitary status of the crop and therefore the diminished potential for export. A number of multinational organisations but most notably the GTZ assisted with the development of the Citrus Improvement Program (CIP) to establish a certification scheme in line with international standards, and to produce improved and pathogen-free planting material.

This has led to substantial beneficiation for the citrus industry and citrus exports especially to GTZ's home country, Germany.

As a result many of the Egyptian growers have started to adopt the highest quality standards, such as GLOBALGAP and others quality certificates.

This has been achieved through:

- Major developments in the citrus pack houses (including the adoption of international pack house standards) and post harvest practices
- Adherence to MRL residue levels to the different global markets
- The development of new markets (such as Sudan, Iran, China and South Korea) where SPS requirements are less stringent.
- The increase in the organic citrus production for export purposes.

The Egyptian fruit industry is supported by the Agricultural Export Council, which has issued regulations and policies to support the export process together with a well organised and state-funded Horticulture Research Institute (HRI). The HRI seeks to improve and develop the country's horticultural crops and increase productivity. It also seeks to reduce production cost and enhance water use efficiency. Elements of its research are aimed at extending the marketing windows to cope with the demands of international consumers.

FPEF works closely with the DTI and DAFF and with the PPECB on issues related to the marketing of SA fruit exports and complying with the rules and regulations for access to foreign markets. The efficiency, effectiveness (and generosity!) of government programmes in these areas can always be improved. Through launching the PHI programme, FPEF has inaugurated a third area where public funding can contribute to improved competitiveness and export performance for fresh fruit – that of Post Harvest Innovation.

While the success of the PHI Programme is evident – as set out above and in the three summary publications (PHI 2008, 2009 and FPEF 2012a) – the impact study and the workshop highlighted the need for PHI to be placed on a longer term, and sustainable footing, so that it can be properly integrated into national, long term agendas for research and innovation in the SA Fruit sector.