

## *Research and Development Strategy Programmes*

### **Key challenges**

Simply put, the challenge facing the FFI CRC is to develop Profitable Perennial™ technologies (plants and systems) that will demand to be rapidly adopted, driven by their profit advantage compared with existing options. Associated with this adoption will be benefits to the natural resource base, and the challenge is to design the new systems in ways which maximise these benefits.

The full complexity of this challenge arises because of the need for:

- Multiple perennial technologies to meet the wide array of circumstances within and between farms (variation in climate, soils, current technologies, competing new technologies, social circumstances and context etc)
- Limits to perennial adaptation and application (perennial plant species, forms etc vary widely in their adaptation and therefore their patterns of potential use)
- Timeliness of response (developing and comprehensively testing the plants and systems rapidly enough to meet end user and investor expectations while dealing with long running systems)
- System complexity (manage the conflicts between profit advantages from input intensification and technical and financial risk associated with more complex systems)
- Systems integration (need to evaluate new perennial technology as components of wider systems)
- Profit and natural resource trade-offs (best profit opportunities for perennials might not match)
- Adoption drivers (large profit advantages will result in rapid adoption but for smaller advantages the rate and extent of adoption will depend on information flow to potential users).

Recognition of these challenges has been fundamental to the strategy for FFI CRC and its structure that involves:

- Focus of efforts based on
  - commercial impact potential (concentrate research efforts on those opportunities identified as having greatest benefits if successful with strong emphasis large per hectare profit advantages and large potential scale of application)
  - analysis of best opportunities to link profit and natural resource advantages with emphasis on water and biodiversity enhancement
  - clearly defined products to be delivered by the research.
- Embrace system complexity
  - recognise that new plants generally need new systems requiring integration of plant improvement and system development
  - new perennial systems are embedded in wider bio-physical and economic landscapes
  - based on our capacity to understand and model the complexity to generate general understanding from our research.
- Balance research portfolio
  - short term opportunities will generally be adaptation of systems or opportunities created by CRC Salinity
  - highly innovative initiatives with substantial profit benefits but which have longer delivery lead time and risks
  - profit and industry-driven initiatives integrated with NRM initiatives that influence system design.

- Emphasise delivery
  - establish relevance by early stage engagement with stakeholders and end users
  - identify the products that will be the focus for commercial partner engagement
  - recognise that rate and extent of adoption will depend on information flow from public and private extension.

## Research Program Structure

The structure of the research program is focused to produce industry relevant outputs that will change the nature of farming, create new industries and inform the management of catchments.

- Three programs focus on key elements of the farm enterprise
  - Future Livestock Production
  - Future Cropping Systems
  - Farming Saline Landscapes
- One program will deliver a farm enterprise base for new industries
  - New Woody Crop Systems
- Three programs concentrate on enterprise risk mitigation through management of catchments
  - Biodiversity and Water
  - Farming Saline Landscapes
  - Economic, Social and Policy Analysis.

All will be supported by an Education and Training program and a Commercialisation and Utilisation program.

The strong emphasis on industry linked programs is designed to support the development of industry-ready products. Potential cross-program linkages and linkages between Profitable Perennials and their NRM implications will be captured and integrated at the project level. The importance of economic drivers will result in participation of researchers with economic analysis skills being embedded in most projects.

## National and International linkages:

FFI CRC is national in scope (southern, temperate Australia) and will have an international profile in its focused arena of interest.

National initiatives will involve workshops on subjects of main scientific interest (at least one a year) and FFI CRC organised conferences every second year. This activity will be supported by strong communications initiatives, featuring a quarterly newsletter (based on 'Focus on Salt' with its circulation of 6,000) detailing scientific activity and progress within the CRC. In addition, it will generally support its partners in maintaining good scientific communication and networking.

International linkages will be both formal project partnerships and less formal collaborations. FFI CRC will build on existing close relationships with:

- INIA Uruguay – collaboration in breeding key *L. corniculatus*
- Swedish Institute of Agriculture – salt tolerant grasses
- N.I. Vavilov Institute of Plant Industries, Russia – perennial plant genetic resources
- Land Institute, USA – breeding perennial cereals
- University of Sussex, UK – salt tolerant breeding
- University of Alicante Spain – perennial legume development

- Washington State University – breeding perennial cereals
- Experimental Institute for Forage Crops, Lodi, Italy – perennial legumes and grass improvement.

In addition FFI CRC will:

- Support international travel to and from Australia for workshops and conferences of relevance. A specific initiative will be support for the 2<sup>nd</sup> International Salinity Forum to be held in Australia in 2008
- Financially support students as part of the Education and Training program, to undertake parts of their postgraduate training overseas where valuable
- Direct publication of research results to international journals, given the advantages that this delivers in enhanced two way flow of information relevant to FFI CRC research initiatives.

## ***Research and Development Programs***

### **Future Livestock Production (Program 1)**

The viability of livestock production in Australia depends on ability to maintain or enhance profitability, under pressure from negative terms of trade. There are subsidiary challenges associated with maintaining the health of the natural resource base, dealing with market demand for 'green' production systems and the realities of a variable and changing climate. The extent and complexity of this challenge demands that, in looking for solutions, we explore beyond incremental change, to technologies that offer substantial potential for profit improvement.

New systems based around Profitable Perennials™ offer the potential for such a shift. The innovative approach offered by the Future Livestock Production Program (FLPP) is to identify and develop new perennial plants that can be managed to create a new feed availability profile at the paddock and farm level. This feed base can then be analysed and managed to create opportunities for more intensive livestock production systems. CRC Salinity has pioneered this approach with EverGraze (*More livestock from perennial\$*) whose objectives are set to produce a 50% increase in farm profit and 50% reduced leakage to groundwater. FLPP will expand application of this approach to other environments and production systems, for instance use of new shrub systems in mixed farming in 'Enrich'. Stretch targets will be set in all cases (generally in the range 30-50%) to link research activity to major system innovation delivering both profit and NRM dividends. In addition Enrich will identify and exploit natural chemicals from perennial plants to reduce inputs of animal medications and treatments as a practical way to deliver 'green' production systems.

#### ***Research Products***

- 1.1 EverGraze Plus – More livestock from perennial\$ and More livestock from native perennial\$ grasses in the high rainfall zone (>500 mm)
- 1.2 Forage cultivars (chicory, lotus or perennial Medicago) – from PastureSearch
- 1.3 New acid tolerant perennial forage cultivars – from PastureSearch
- 1.4 A new herbaceous forage for the warm season, summer dominant or high rainfall zone with a commercially released management and utilisation package - from PastureSearch with application in EverGraze
- 1.5 Enrich – new shrub-based livestock production system for landscape and natural resource health in the low/medium rainfall zone
- 1.6 New shrub cultivar (Atriplex) – from Florasearch.

Central to the approach being applied by FLPP is the ability to have focused but integrated project teams with skills covering aspects including pasture breeding, agronomy, livestock production, NRM (mainly related to hydrology) and bio-physical and economic modelling. FLPP has a team with an established track record of innovation and collaboration. They provide the opportunity for drive substantial industry change through their combined efforts.

|   |   |
|---|---|
| <b><i>Program Leader</i></b>  | <b><i>Time Commitment (as Full Time Equivalent – for each year)</i></b> |
| Dr David Masters  | 0.7   |
| <b><i>Key Researchers</i></b>   | <b><i>Time Commitment (as Full Time Equivalent – for each year)</i></b> |
| Dr Dean Revell  | 0.4   |
| Dr Brian Dear   | 0.6   |
| Ms Angela Avery   | 0.6   |
| Dr Andrew Thompson  | 0.5   |
| Mr Paul Sanford   | 0.7   |
| Dr Greg Lodge   | 0.5   |
| Dr Phillip Vercoe   | 0.2   |
| <b><i>Private Sector Participants</i></b>                             |   |
| Australian Wool Innovation, Meat and Livestock Australia and Landmark |   |

## Future Cropping Systems (Program 2)

The challenge facing Future Cropping Systems (FCSP) is to introduce a profitable perennial component into existing annual plant-based production systems, while delivering a substantial profit and natural resource enhancement dividend. Most of Australia's crops are grown on farms that mix crop and livestock enterprises. The area devoted to such system is approximately 35mha with less than half this area cropped annually. Lucerne, the most widely used perennial in the cropping zone is grown on less than 3 m hectares, providing wide scope for substantially increased use of perennial pastures when appropriate plants and systems are identified. The environmental diversity of situations across Australia in areas where mixed crop/pasture based livestock systems are practical (low and high rainfall Mediterranean and warm seasonal wet/dry) drives the need for multiple perennial based systems, each with their associated drivers and constraints.

Profit will be the primary driver of change, both in the short and longer term. The program will use bio-economic modelling of integrated crop-based systems to focus its investment targets and then to demonstrate the profit advantages of the new systems as they emerge. FCSP will have a balance of short (system modification and adaptation) and longer term (system innovation and creation) outputs and products from its activities. It will focus on increasing the extent and performance of perennials in the non-crop element of the mixed farm systems with profit coming from increases in both crop and livestock performance. FCSP will also scope the potential of a highly innovative option – development of a perennial cereal crop. Activities will include:

- New systems incorporating perennials that have more productivity and salinity and/or hydrological benefits, tested through participatory research
- System development and enhancement with perennials focusing on situations where these perennials are commercially available or near to market
- Salt and water-logging tolerant wheat, perennial wheat, drought/grazing tolerant forage legumes.

**Research Products**

- 2.1 EverCrop – new farming system in each of 3 agro-climatic zones
- 2.2 Drought tolerant forage legume cultivar – from PastureSearch
- 2.3 EverCrop Decide – new crop systems analysis tools that integrate production and conservation objectives
- 2.4 Feed grain quality salt/waterlogging-tolerant wheat
- 2.5 Salt/waterlogging-tolerant wheat suitable for biofuel
- 2.6 Breeding material for bread quality salt/waterlogging-tolerant wheat
- 2.7 Prospectus for development of perennial wheat

The FCSP team has capacity to identify gaps in current farming practice and the imagination and systems analysis skills to overcome them with superior farming systems built on innovative technologies. This work, reviewed to be of international standard, will be done in partnership with the well organised industry networks and farmer groups. The main NRM driver in this program is dryland salinity, but we are mindful that its relevance, on- and off-site impacts and urgency, varies in different regions. We will encompass other water-related environmental issues where relevant, with multiple natural resource benefits unified through minimising the negative hydrological footprint.

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| <b>Program Leader</b>  | <b>Time Commitment (as Full Time Equivalent – for each year)</b> |
| Dr Anna Ridley   | 0.6  |
| <b>Key Researchers</b>   | <b>Time Commitment (as Full Time Equivalent – for each year)</b> |
| Dr Michael Robertson   | 0.5  |
| Dr Michael Francki   | 0.3  |
| Dr Phillip Larkin  | 0.3  |
| Dr Tim Colmer  | 0.4  |
| <b>Private Sector Participants</b>   |  |
| Grains Research and Development Corporation, Meat and Livestock Australia and Landmark |  |

**New Woody Crop Industries (Program 3)**

The CRC Salinity focused on screening prospective native woody species for crop and product potential. A short list of promising species and products suitable for wheatbelt conditions has been generated. Commercial interest in woody biomass resources has increased strongly, coinciding with major changes in global markets favourable to large volume woody biomass production and utilisation, e.g. climate change, CO<sub>2</sub> emissions control and escalating energy costs. The challenge facing the New Woody Crop Industries Program (NWCIP) is to overcome impediments to commercial performance of biomass supply with a cost structure to meet anticipated increased demand.

We aim to develop woody perennials systems that will address three key performance parameters: i) provide a sink for surplus water from adjacent agricultural land; ii) be profitable; and iii) deliver biodiversity protection/enhancement and other improvements in NRM.

The impediments to rapid commercial development are:

- Genetics: selecting of superior cultivars from the vast native genetic resource and breeding superior varieties
- Water availability and yield: woody plants have large water-use potential and create large soil-water deficits, but clever planting design is required to enable them to maximise capture of additional water and thereby maximise yield
- Harvest: low cost biomass cannot be produced from short-cycle (shrub) crops without a low-cost harvester.

NWCIP will build on existing genetic improvement activities to bring superior varieties of the most promising species to market in the shortest possible time. It will model the natural processes of surface water redistribution after rainfall on agricultural land to predict how much water is available for woody crops, and couple this to growth models to predict yield. The program will become a respected knowledge broker in harvester development and lead preparation of a business case to win funds for development.

#### **Research Products**

- 3.1 Wyalong' mallee seed – from Florasearch
- 3.2 Prospectus for prototype commercial harvester for short-cycle woody crops
- 3.3 Client feasibility reports for biomass supply and processing industry investment
- 3.4 Prediction capability with woody crop production from farm layouts with access to variable water inputs.

The program team will integrate delivery of its knowledge to commercial developers in the form of commercial feasibility assessment of specific regional project proposals across southern Australia.

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| <b>Program Leader</b>  | <b>Time Commitment (as Full Time Equivalent – for each year)</b> |
| Mr John Bartle   | 0.8  |
| <b>Key Researchers</b>   | <b>Time Commitment (as Full Time Equivalent – for each year)</b> |
| Mr Michael Bennell   | 0.5  |
| Dr Richard Harper  | 0.3  |
| <b>Private Sector Participants</b>                                   |  |
| Enecon Pty Ltd, Renewable Oil Corporation and The Oil Mallee Company |  |

## **Farming Saline Landscapes (Program 4)**

Our objective is to have 2,400 producers (25% of the farmers suffering from salinity) using 'best bet' technologies on over 350,000 ha of saline land, to increase their whole-farm productivity by over 10%, by 2014. The program will achieve this objective by researching and developing revegetation, water, soil, animal, crop and pasture management practices that are: (a) compatible with enterprise and regional demands; and (b) able to overcome the landscape, soil and water constraints of a range of environments. Particular emphasis will be placed on working with commercial partners and developing practices that are demonstrably profitable. The intellectual property generated will be packaged into training courses, services and physical products and commercialised.

Central challenges to the program are:

- Identification of additional agriculturally useful salt-tolerant plants (building on efforts in CRC Salinity)
- Strategies to manage water and preclude salt build up at the soil surface integrating engineering and plant options
- Strategies to maximise the impact on profit from the integration of salt land production into wide farming systems
- Develop saline production systems that are robust enough be used in highly variable saltland environments
- Understanding of how adoption and commercialisation of saline land farming practices can be achieved.

#### **Research Products**

4.1 HIGHPak – improved performance livestock and pasture management packages for saline land

4.2 New salt-tolerant pasture legume and grass cultivars – from PastureSearch

4.3 New salt-tolerant halophytic shrub cultivars – from Florasearch

4.4 National Saltland Service Centre – a vehicle for the delivery of new tools, products and services

4.5 SALTCAP – land capability assessment tool for plant-based saline land management

4.6 SALTDecide – hydrological modelling tool to measure the impact of water management using integrated plant-based and engineering interventions both on-site and off-site

This program aims to develop and commercialise a suite of profitable farming practices for the various classes of saline land across Australia. The research team includes many of the key scientific resources available in Australia in this specialised area and it is linked to strong capacity in farming systems and technology adoption.

| <b>Program Leader</b>     | <b>Time Commitment (as Full Time Equivalent – for each year)</b> |
|---------------------------|--|
| Dr Richard George         | 0.8  |
| <b>Key Researchers</b>    | <b>Time Commitment (as Full Time Equivalent – for each year)</b> |
| Dr Edward Barrett-Lennard | 0.6  |
| Dr Nicholas Edwards       | 0.25   |
| Professor Zed Rengel      | 0.3  |
| Dr Andrew Craig           | 0.5  |
| Mr Greg Hamilton          | 0.4  |
| Dr Phillip Nichols        | 0.3  |

#### **Private Sector Participants**

Australian Wool Innovation, Meat and Livestock Australia and Grains Research and Development Corporation

## Biodiversity and Water (Program 5)

The challenge faced by the Biodiversity and Water Program (BWP) is to link strategies and actions for managing agricultural land to its implications for biodiversity enhancement and water management. The CRC provides a unique opportunity for natural resource scientists to work collaboratively with agriculturalists, economists, sociologists and other specialists to deliver multiple benefits from farming landscapes. Apart from the major direct benefits arising from biodiversity and potable water, the program recognises that natural resource degradation is a significant direct cost and risk to the profitability of agricultural enterprises. Consumer responses to off-farm adverse environmental impacts also threaten market share.

Delivery of natural resource benefits will be greatest if they are linked to profitable changes in agricultural systems. Core work of the program will centre on developing:

- Management and decision packages that promote farming systems that integrate production and biodiversity
- Catchment models and management strategies for new perennial vegetation systems that maintain water quantity in priority water supply catchments, while improving water quality.

The risk-based decision tools and assessment products developed by the program will make an important contribution to policy development and decisions at catchment-scales with implications for farm enterprises in various geographic zones, and assist the development and application of market-based instruments. These tools and products will be developed to take into account climate risk and variability.

### *Research Products*

5.1 Management and decision packages that promote farming systems that integrate production and biodiversity outcomes.

5.2 BioRisk – risk-based decision tool for managing hydrology to achieve biodiversity targets and improved production.

5.3 CAT Plus – catchment decision tool for perennial vegetation strategies to protect water resources in catchments.

5.4 Risk assessment products and management strategies to protect biodiversity from weeds and genetic pollution and to minimise weed control costs.

Much of the research work will be undertaken with target practitioners such as farmers, CMOs and government agencies. Thus the tools and packages developed will directly address existing problems. This approach will not only lead to focused, applied research, it will form a major pathway for adoption of the strategies and tools developed by BWP.

The ability to collaborate within the CRC with other programs that have vital expertise – such as Farming Saline Landscapes and Economic, Social and Policy Analysis – will play an important role in the Biodiversity and Water Program's success.

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| <b>Program Leader</b>              | <b>Time Commitment (as Full Time Equivalent – for each year)</b> |
| Mr Ken Wallace                     | 0.5  |
| <b>Key Researchers</b>             | <b>Time Commitment (as Full Time Equivalent – for each year)</b> |
| Dr David Freudenberger             | 0.3  |
| Dr Glen Walker                     | 0.2  |
| Dr Craig Beverly                   | 0.65   |
| Dr Margaret Byrne                  | 0.3  |
| <b>Private Sector Participants</b> |  |
| Meat and Livestock Australia       |  |

## Economic, Social and Policy Analysis (Program 6)

This program plays a crucial role in advancing the commercialisation and utilisation of the CRC's research outputs. Economic modelling, conducted in collaboration with biological and physical scientists, will help to direct biological research in directions that are most likely to yield high commercial and economic benefits, and consequently likely to be widely utilised. It will provide information of crucial importance for promoting the transfer of CRC technologies to commercial landholders. It will allow improved NRM by quantifying trade-offs between economic and natural resource outcomes. It will contribute to the evaluation of CRC impacts.

Social research will also provide guidance for the CRC in its pursuit of new farm technologies that can be widely utilised. It will help the CRC understand social changes going on in rural areas that have implications for proposed new industries. These changes include farm-ownership turnover, demographic changes, the growth of non-commercial land ownership in some rural areas, and the dramatic growth of farm sizes in other areas. It will provide insights to scientists wishing to target their extension to regions, farming systems, or farmers for which new technologies are most appropriate and most adoptable.

### Research Products

- 6.1 Adoptability index – assessment tool for the potential adoption of FFI CRC products.
- 6.2 NRM Investment Framework – decision tool for selection of priority NRM investments.
- 6.3 Farm business/NRM simulation game (extension of 'Salty Business').

The new technologies and systems developed by the CRC will interact with government policies for their impact, especially in relation to NRM. Existing NRM policies are deficient in a number of respects, including their handling of the boundary between commercial and natural resource outcomes. The CRC will build on the very strong policy analyses conducted in CRC Salinity, and will extend policy analysis tools beyond salinity into other areas of NRM.

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|------------------------------------|--|
| <b>Program Leader</b>              | <b>Time Commitment (as Full Time Equivalent – for each year)</b> |
| Professor David Pannell            | 0.7  |
| <b>Key Researchers</b>             | <b>Time Commitment (as Full Time Equivalent – for each year)</b> |
| Dr Rick Llewellyn                  | 0.6  |
| <b>Private Sector Participants</b> |  |

## **Education and Training Strategy/Program**

An effective Education and Training Program will make a critical contribution to the FFI CRC's capacity building objective. Key elements of education and training are:

- Establishment of a nationally accredited training program for agribusiness and wider client networks, and
- Provision of industry ready science professionals for engagement with the wider research community, an important element in the 'pathway to adoption' for FFI CRC products.

In addition, postgraduate research will deliver a significant contribution to the body of knowledge generated by all research programs, and to the development of innovative new farming systems.

| <b>Number of expected post-graduate enrolments (commencements) for each year</b> |         |         |         |         |         |         |
|--|---------|---------|---------|---------|---------|---------|
| 2007-08  | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
| 15   | 20      | 15      |         |         |         |         |

The strategies we have developed for delivery of education and training are:

- A comprehensive postgraduate education program encompassing industry supervision of research students, accredited training in generic leadership skills, together with postdoctoral opportunities and access to conference and travel assistance will provide a cohort of industry ready FFI CRC graduates with capacity to influence contemporary Australian farming practices.
- A national program of accredited (Australian Qualification Framework) training in FFI CRC and NRM will be established. Extension specialists within Landmark and other influencers linked into adoption networks will have the opportunity to undertake this training. Program graduates will inform knowledge networks sustained by other support activities. Many graduates will be embedded within FFI CRC research programs, forming a key link in the programs' path to adoption and two way communications between research activities and industry.
- A number of innovative education projects will be developed including:
  - Provision of accredited training in NRM for PhD students
  - Post graduate level short courses that promote interdisciplinary knowledge for graduates employed in agribusiness and within wider client networks
  - Coordination of an internship program that will enhance the industry readiness of our research graduates, and provide opportunities for industry participants to participate in research.

| <i>5.2 Program Leader</i>          | <i>Time Commitment (as Full Time Equivalent – for each year)</i> |
|------------------------------------|--|
| Mr Scott Glyde                     | 0.6  |
| <b>Key Staff</b>                   |  |
| Scott Glyde (CSU)                  |  |
| Deb Slinger (NSW DPI)              |  |
| John Powell (CRC Salinity)         |  |
| Daryll Richardson (CRC Salinity)   |  |
| <b>Private Sector Participants</b> |  |
| Landmark and Kondinin Group        |  |
| MLA, GRDC and AWI                  |  |
| Primary Industry and NRM agencies  |  |

### **Governance Arrangements**

The core participants will incorporate a research company limited by guarantee to focus on effective utilisation and commercialisation processes that maximise adoption rates to achieve FFI CRC outcomes. This will include forming a Members Council to represent members’ interests. The council will appoint a nine-member skill-based board and be given responsibility for delivering the strategic direction for the company. The board will have an independent chair and a majority of industry or members independent of the research providers. The nature of engagement will be determined in accordance with the strategic fit of core participants, supporting participants and other stakeholders (figure 4). The strategic direction and purpose of the company is determined by members and embodied in the Commonwealth Agreement as reflected in the participants’ agreement and company constitution for implementation under the direction of the board. The participants’ agreement will set out the governance arrangements and objectives (meeting the objectives of the CRC Programme and partner investment) for contracting supporting participants and key responsibilities will be passed through from the Commonwealth Agreement. Members will meet annually in accordance with normal governance practice.

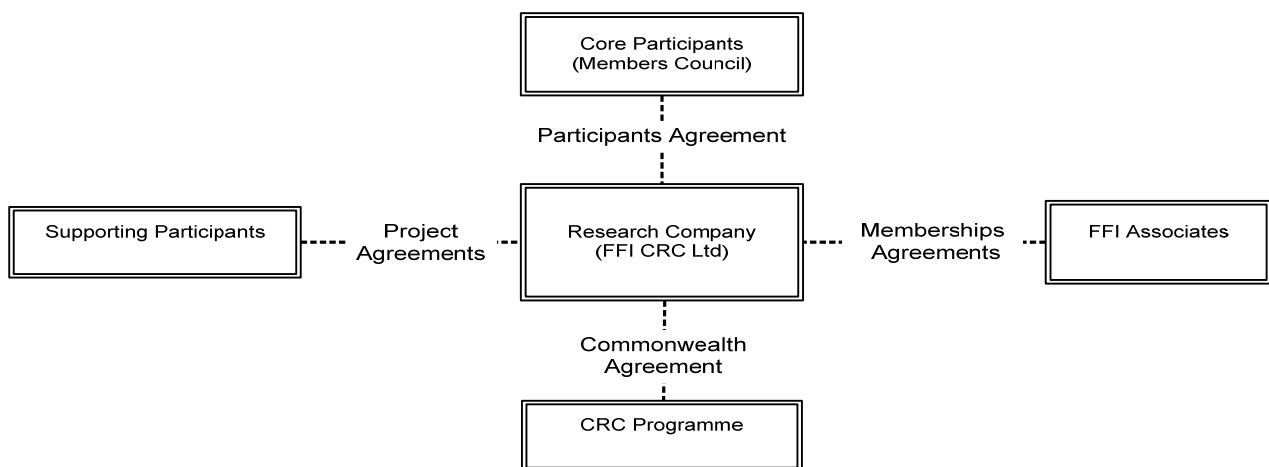


Figure 4. Relationship of partners to the Research Company