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Rural Industries Research and Development Corporation

Fostering Collaborative Regional Development in Biobased Industries

A Case Study – Stage 1

A report for the Rural Industries Research and Development Corporation

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Foreword

Tropical North Queensland's economy is heavily reliant on agricultural industries, such as sugar, tobacco and dairy, which are undergoing structural adjustment. In contrast, and largely in response to this adjustment, there is an emerging and diverse biobased industry sector in Tropical North Queensland. It is built on existing regional assets including rich and diverse ecosystems, a strong traditional and diverse agricultural base and core regional competencies.

With advances in modern technology and better understanding of biosystem processes, efficient and effective commercial exploitation of crops for the biotechnology, industrial, pharmaceutical, nutraceutical and renewable energy and fibre markets are now experiencing rapid growth worldwide. This mega-trend is being driven by the underlying desires of consumers for better health, improved quality of life, the use of more natural products and concerns about the sustainability of non-renewable resources. These key drivers have the potential to transform the composition of agricultural industries and farming systems practices in Australia in the years to come.

Industry clusters are a global phenomenon widely credited as being a key mechanism in achieving and sustaining competitive and comparative advantage for regional economies. However there is a lack of agreed upon tools and models for monitoring their development and measuring their performance and impacts on regional economies. There are none specifically oriented to development of biobased industry clustering.

This publication reviews the scope, nature and stage of development of those biobased industry sectors, as the precursor for development of a longitudinal study aimed at developing and trialling innovative tools and methods of measurement and monitoring for industry cluster development. It also draws from this review some conclusions and suggested direction for future industry cluster development.

This report, an addition to RIRDC's diverse range of over 1500 research publications, was funded from RIRDC Core Funds and forms part of our Human Capital, Communications & Information Systems R&D program, which aims to enhance human capital and facilitate innovation in rural industries and communities

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Peter O'Brien
Managing Director
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Abbreviations

ATFI	Australian Tropical Forest Institute
ATSRAC	Atherton Tablelands Sustainable Regions Advisory Committee
BioNQ	Biobased Industries of North Queensland **
CAPS	Commercial Agroforestry Production Systems
CERF	Commonwealth Environment Research Fund
CREDC	Cairns Region Economic Development Corporation
CTAR	Centre for Tropical Agri-Tech Research
DSDI	Queensland Department of State Development and Innovation
DoTaRS	Department of Transport and Regional Services
EPA	Queensland Environmental Protection Agency
FNQ ACC	Far North Queensland Area Consultative Committee
DPI&F	Queensland Department of Primary Industries and Fisheries
GRP	Gross Regional Product
HDL	High-density lipoprotein
IT	Information Technology
JCU	James Cook University
LDL	Low-density lipoprotein
MAP	Modified Atmosphere Processing
MDIA	Mareeba-Dimbulah Irrigation Area
MTSRF	Marine and Tropical Sciences Research Facility
NIR	Near Infrared
NSDA	Network for Sustainable and Diversified Agriculture
SARS	Severe Acute Respiratory Syndrome
TNQ	Tropical North Queensland

** Not strictly an abbreviation as this is the proper name adopted for the industry cluster.

Contents

Executive Summary

The emerging biobased industry sector in Tropical North Queensland (TNQ) has adopted a cluster based approach to facilitation of its development as best practice regional economic development.

This is based on global evidence that clusters are a key mechanism in achieving and sustaining competitive and comparative advantage in regional economies. However there is a lack of agreed-upon tools and models for monitoring development and measuring their performance and impacts on regional economies. There are none specifically oriented to biobased industry clustering.

This project has sought to collect industry data to better define the scope and nature of the regional industry. The data will be used to identify possible barriers and opportunities for industry development and assess options for implementation, monitoring and measurement of industry cluster development. The project provides baseline data for a proposed longitudinal 5 year study of cluster development, which would develop and trial proposed innovative monitoring and measurement techniques, as well as seek to optimise outcomes for the industry. A major conclusion drawn from this current project is that the regional industry presents an ideal opportunity for such a longitudinal study. The immature and fluid stage of the industry offers the opportunity to study the evolution of biobased industry cluster development from embryonic stages. This opportunity has not been instigated elsewhere in Australia. This, combined with the innovative techniques proposed, will introduce a ground breaking research project.

Industry Scope and Development Environment

Important features of the emerging regional biobased industry are:

- high levels of energy driving diverse projects and emerging sectors
- high level of biodiversity and optimal growing conditions for biomass production
- strong core competencies, including significant new public R&D infrastructure
- the concept of ‘tropical knowledge’ underpins regional potential, with important markets for commercial outcomes being the 42% of the world’s population living in the tropical zone of the Earth.

The contemporary industry situation has evolved in the context of three overlapping, interacting and cumulative responses to market conditions for traditional regional agriculture.

The first involved crop diversification, the second value adding and the third, still emerging, being the concept of exploitation of crops and endemic natural “biomass” as bio-factories in the fields of biotechnology, industrial, pharmaceutical, nutraceutical and renewable energy industries. This last response is in line with a strong global trend that promises to revolutionise the world’s agricultural and manufacturing industries, which will have a profound impacts on rural communities. Global drivers of this trend have been reinforced by a reasonably complex set of co-existing local influences.

The energy and diversity of projects built up in regional biobased industries, especially over the last six years has been remarkable, given the conservative, traditional regional farming sector on which it is based. This in the authors’ opinion is a key catalyst for the prospects for future growth and industry success.

Value Chain Map

In such a fluid situation, it has not been possible to collect detailed data on all individual enterprises and projects due to privacy laws and sensitivities, together with considerations of commercial-in-confidence. However a 'Value Chain Map' has been developed which provides a clear picture of the emerging regional industry as a system.

R&D Capacity

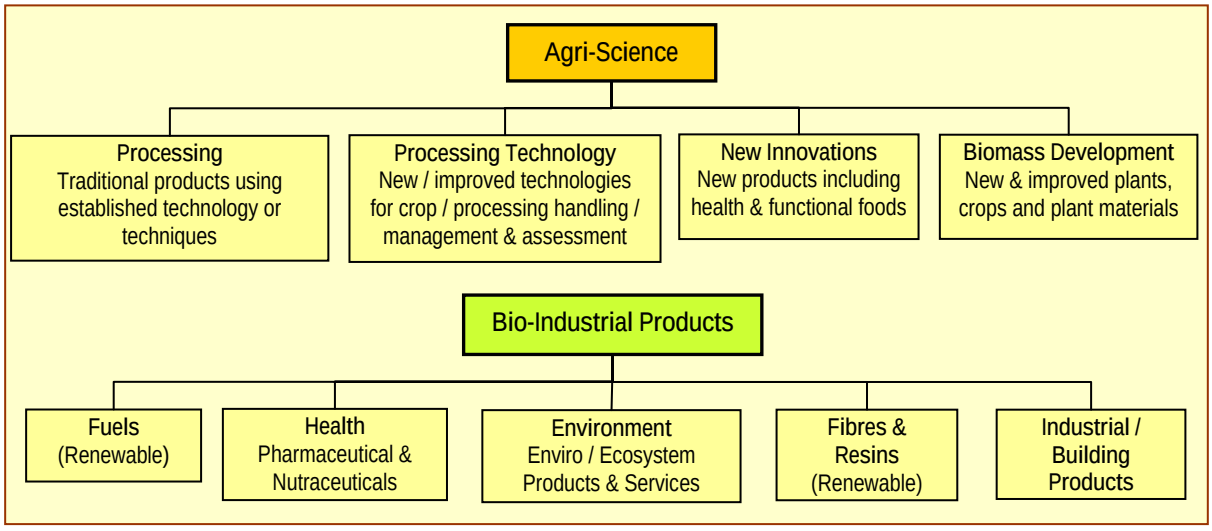
Research and development capacity is also rapidly expanding in the region. There are current and major enhancements being undertaken in publicly supported research and development capacity for biobased industries through entities such as the Australian Tropical Forest Institute and Centre for Tropical Agri-Tech Research at James Cook University, Queensland Department of Primary Industries, and the Commonwealth Scientific and Industrial Research Organisation. There is also a considerable amount of research and development work being undertaken through private individuals and consortiums.

Projects, Products and Concepts

The biobased industry sector in Tropical North Queensland has only recently moved through a second wave of innovation and diversification, focussing on value adding to regional crops. The third wave, with a focus on sophisticated food, fibre, beverage and other agri-products using bio-sciences and a bio-industrial approach to product development is quite recent. An interesting feature of this is the amount and range of innovation and energy that has emerged over the last five years, which would have been difficult to imagine being generated in a very conservative, traditional farming community environment five or six years ago.

This study would emphasise this aspect of industry development as an important pointer to future sector prospects. The projects that are now emerging are by and large serious propositions backed by reasonable business cases, and include: Commercial Agroforestry Production Systems, Ecobiotics, Clonal Solutions, VMR Pty Ltd, Bamtek (TBL Vision), Bundaberg Sugar – Arriga Mill, Papyrus Australia, Bamboo Growers, Bagasse Pots, Effluent Conversion, Cairns Fatman, Mungalli Creek Dairy, Daintree Vanilla and Spices, Envirotec, Stevia, Ma:Mu Native Plant Comercialisation, Cocoa and Chocolate, Teneree Technologies, Fruits Wines.

The wide diversity of current biobased industry enterprises and projects in the region represent an industry cluster with two streams, with a number of sub-sectors falling under each:



Constraints and Barriers

There are four common constraints and barriers faced in the development of these sectors. These are:

- Gaps in Business Skills
- Flaws in Business Structure and Depth
- Capacity to attract Capital and / or Investment
- Program Eligibility (to Government support for mentoring)

Cluster Development

The principal opportunity for industry cluster development derived from this project flows from the early, fluid stage of sophisticated biobased industries in Tropical North Queensland.

In terms of overall industry sector development through cluster development, there are three principal areas of constraints:

1. there are very limited resources available for facilitating and fostering cluster development
2. industry diversity and lack of depth in each sub-sector render it difficult to draw together communities of common interest to drive industry collaboration
3. the early stage of development of most business enterprises means there is a tendency for potential cluster champions to be focussed internally, rather than on the bigger industry picture

To address these and to realise biobased industry opportunities and cluster potential, a number of strategies have been suggested for consideration by BioNQ:

- Conduct a general review of cluster development to date against the ‘cluster development flow chart’ and identify those that require refinement
- Survey cluster industry members and potential members to identify what they consider their greatest needs
- Workshop survey results with industry sectors and review the applicability of the above common objectives and ‘target board’
- Analyse core industry needs and methods of delivering them through cluster activities
- Review scope of membership sought with a view to engaging the whole industry value chain
- Support development of a regional small business incubator facility and facilitate access to other business development services for cluster members in recognition of the nature and stage of industry development
- Seek out potential industry champions and form a group representative of emerging sub-sectors
- Develop the case for more cluster facilitation resources and lobby for them
- Develop a marketing plan involving champions as flag bearers
- Prepare an action plan, with reviews initially six monthly

Implications

The project has described a diverse biobased industry sector with a number of emerging streams, at an early stage of development. It reinforces the view that it presents an excellent opportunity to develop a longitudinal study to monitor and evaluate the cluster as it develops. The study would aim to build a best practice model for monitoring, measurement and evaluation of cluster initiatives, as well as its subsequent impact to the regional economy of Tropical North Queensland.

It has also highlighted a need to re-visit strategies for cluster facilitation. This is considered a critical sticking point to the successful formation of a biobased industry cluster in the region ─ one which promises to catalyse significant business development in the region (based on equivalent overseas cluster development examples).

Further, the industry diversity and level of energy apparent in current industry development initiatives, coupled with the industry potential due to regional assets and core competencies point to it being a priority for the region to allocate sufficient resources to industry cluster development so as to optimise industry outcomes for the region.

Recommendations

This preliminary project has drawn to attention the significant potential of adopting an industry cluster framework to drive the development of the emerging biobased industries sector in tropical north Queensland. In order to capitalise on this opportunity, it is recommended that:

- A business case be developed to secure additional cluster facilitation resources for BioNQ – the biobased industries cluster under the auspices of the Cairns Region Economic Development Corporation
- A re-visit of cluster development strategies be instigated with the benefit of the inputs provided by this project
- A longitudinal study into cluster development be specifically developed to assist in fostering collaborative regional development in biobased industries.

Introduction

Rationale

There is an emerging biobased industry sector in Tropical North Queensland (TNQ) which is at an early stage of development. It is ill-defined and there is a lack of hard industry data at a regional level.

Regional industry stakeholders have adopted a cluster based approach which has included the formation of an industry organisation, 'BioNQ' – 'Biobased Industries North Queensland'. Evidence for the validity of this approach flows from two sources:

- Outcomes achieved by other industry sectors in North Queensland that have adopted the clustering concept, and
- The experience of regions internationally that have adopted a clustering approach to biobased industry development and are now accepted as major biobased industry centres.

The benefits of clusters for productivity and innovation are becoming better known, with a large and growing body of case studies documenting their characteristics and evolution over time (Porter *in* Solvell et al., 2003; Linde 2003). Clusters generate investment and innovation outcomes at a local and regional level. Innovation, the smart application of knowledge, depends on connectivity, and clusters are a proven method of encouraging collaboration and connectivity between businesses and research institutions, and between businesses and governments (CAP 2005, Appendix 3).

Despite these successes, there is a lack of definitive data on clustering processes as they develop and less than optimal tools available for monitoring and measurement of this development. In addition, the application of an industry cluster approach as applied to this industry is also quite new and untested in TNQ. Despite international experience, it has not been adopted elsewhere in Australia.

The TNQ industry sector is therefore seeking to create a best practice model for industry development, including appropriate monitoring and measurement tools to better facilitate assessment of progress.

This project seeks to gather industry data to better define the scope and nature of the regional industry. The data will be used to identify possible barriers and opportunities for industry development and assess options for implementation, monitoring and measurement of industry cluster development.

As such, the project is stage 1 of a two stage project. The second stage is anticipated to be a five year research program designed to:

- document the processes of the cluster as it develops
- annually study the regional industry to track growth
- evaluate the impact of the cluster upon industry development and
- to develop an accurate, annually reviewed statistical profile of biobased industries in North Queensland in order to assist local, State and federal governments with policy, program and infrastructure planning.

This research is to adopt systems modelling combined with economic (econometric) research and measurement techniques as tools. The combination of these, especially applied to industry cluster theory and practice, represent an innovative and potentially groundbreaking approach.

Background to the Project

The TNQ economy is heavily reliant on agricultural industries that are in long term decline. This is in part due to global factors that over time have been causing a trend line of lower commodity prices. Traditional core regional industries of sugar, dairy and tobacco have all been affected in varying degrees.

The region has developed a strong tourism industry over the past 30 years, which now rivals the size of the regional agricultural sector and has outstripped the agricultural sector in GRP for many years. This increasing reliance and specialisation, together with the exposure of that industry to adverse impacts from global events, (SARS, bird flu, terrorism, transport disruptions, fuel prices), increasingly exposes the region to an unacceptable level of risk.

At the same time the region is also recognised as having significantly high levels of biodiversity. To some extent both agriculture and the tourism industry are based on this regional attribute.

With advances in modern technology and better understanding of biosystem processes, efficient and effective commercial exploitation of crops for the biotechnology, industrial, pharmaceutical, nutraceutical and renewable energy and fibre markets are now experiencing rapid growth worldwide (Holden et al., 2003). This mega-trend is being driven by the underlying desires of consumers for better health, improved quality of life, the use of more natural products and concerns about the sustainability of non-renewable resources (RIRDC 2000). These key drivers have the potential to transform the composition of agricultural industries and farming systems practices in Australia in the years to come.

BioNQ is a biobased industry cluster operating in the TNQ Region. It was formed in May 2002 in response to industry demand, with the assistance of Queensland Department of Primary Industries, Cairns Region Economic Development Corporation and the Atherton Tablelands Sustainable Regions Program.

Cluster members have defined biobased industries as "*the innovative utilisation of renewable biological and agricultural resources to sustainably develop responsible industries, technologies, products and processes*".

[Note: Biobased industries in this example are not exclusively equivalent to "bio-industries", a term generally used to describe, or is synonymous with, entities pertaining to the biotechnology industry].

BioNQ members generally fall into three categories:

- those working on R&D to commercialise new products or technologies based on established or emerging agricultural sectors in the region
- those working on biodiscovery R&D to commercialise new compounds through bio-prospecting using the regional biodiversity, and
- members in the biobased industry supply chains.

There are significant linkages between each of these groups of members.

Biobased industries are a relatively new sector in TNQ and with its intrinsic reliance on outcomes from research, the failure rate for emerging businesses is potentially greater than for other industry sectors. It is anticipated that a collaborative clustering approach will increase the rate of business success. However a lack of industry data makes it impossible to understand the nature and trends of the industry, identify barriers to growth, or anticipate future needs.

The project is intended to directly benefit biobased industry enterprises through the application of the best practice clustering model proposed and an ability to clearly demonstrate industry position and progress to attract resources to meet needs as they develop. In addition over half of BioNQ members

are in the first membership category above – attempting to diversify and / or value add to the existing agricultural base. This will potentially reduce the social and economic impacts associated with decline in regional commodity based agricultural industries.

The need for regions to better engage with the 'knowledge economy' and increase their rate of innovation has been widely recognised. The Queensland Government's Smart State initiatives recognise this and the importance of realising the potential competitive and comparative strengths of biobased industry development in TNQ.

Apart from direct benefits, flow-on effects from growing the regional biobased industries include:

- broadening the regional skills base
- enhancement of environmental sustainability
- contribution to growth in other industries such as IT, engineering and tourism
- Increased participation of Indigenous people in innovative industries based on traditional remedies and foods.

Objectives

The project aims to:

1. Map biobased and related companies in TNQ

2. Gather detailed information about each biobased industry company

3. Define the existing biobased industry sectors / sub-clusters in TNQ

4. Implement a cluster based approach to developing biobased industries in TNQ

Methodology

A profile of regional biobased industries and sub-clusters will be developed to provide base-line data about the industry, turnover, workforce & skills issues, barriers and opportunities for industry growth. This data will also provide the basis for ongoing cluster evaluation and monitoring planned for subsequent years.

Surveys seeking information about company size, employment, turnover markets, stage of development, products, services technologies, barriers and opportunities will be delivered using a combination of phone and mail surveying to maximise response rates and minimise costs. The survey will cover cluster and non-cluster member businesses in the region. Businesses surveyed will have to qualify under the biobased industries definition adopted by BioNQ:

"The innovative utilisation of renewable biological and agricultural resources to sustainably develop responsible industries, technologies, products and processes"

They are also to be currently engaged in proof-of-concept or commercialisation activities.

Businesses to be surveyed will be identified by:

- utilising existing databases such as those developed by BioNQ, Cairns Region Economic Development Corporation (CREDC), Queensland Department of State Development and Innovation (DSDI), Queensland Department of Primary Industries and Fisheries (DPI&F), James

Cook University (JCU), Environmental Protection Agency (EPA), Atherton Tablelands Sustainable Regions Advisory Committee (ATSRAC), Far North Queensland Area Consultative Committee (FNQ ACC), Network for Sustainable and Diversified Agriculture (NSDA), and regional Shire Councils
- identifying businesses through listings in the Telstra Directory and discussions with regional accountants and bank managers
- advertising in regional media to encourage businesses to self-select for the survey.

Data will be managed and analysed with the SPSS statistical package

Once the data has been collated and analysed, a series of cluster workshops will be held to develop long-term cluster-based strategies to overcome barriers to industry growth and maximise opportunities. These strategies will form the basis of future cluster initiatives to be implemented on completion of this project and be evaluated as part of the long-term cluster evaluation project planned to commence flowing completion of this stage 1 project.

Industry Scope & Development Environment

Biobased industries in Tropical North Queensland are presently, predominantly based on traditional production systems and products, with only a small number of enterprises in current production of what could be termed high technology, knowledge intensive products or services.

However there is a disparate range of current and planned projects and initiatives that are likely to entirely change the character of these industries in the medium term. It is these that are more likely to define opportunities and needs for industry cluster development than the existing industry activities on which they are in most cases based.

A review of enterprises involved in biobased industries identified 42 industry types aggregated into the following 12 broad sectoral categories. Data sources included those indicated in the methodology (page 3).

Total FNQ Biobased Industries	Total	%
Aquaculture	20	1.99%
BeeKeepers	8	0.80%
Forestry	20	1.99%
Fruit	82	8.17%
Sugar	29	2.89%
Wineries/Vineyards	4	0.40%
Livestock	94	9.36%
Farmers / Growers - other	610	60.75%
Agriculture (food machinery)	24	2.39%
Consultants & Researchers	45	4.48%
Bio-analysts & Bio-Technologists	15	1.49%
Others- AgriBusiness/BioIndustry Misc.	53	5.28%
Totals	**1004**	**100.00%**

Farmers plus other agricultural producers represent by far the largest segment and there is currently an upsurge in on-farm experimentation and innovation, sometimes in association with researchers. An analysis of regional patent applications indicates that the rate of innovation and the search for new

products has increased markedly since 2002, particularly in the application category 'Agricultural and Food Machinery' (Kleinhardt-FGI, 2005).

The types of activities and products produced by these enterprises can be said to be the outcome of three cumulative levels of response to industry and market conditions. The time frames in which these have occurred have overlapped and gathered momentum over the last 10 - 15 years or so.

Regional commodity production (e.g. tobacco, sugar, peanuts, maize, potatoes, dairy) has been made progressively less viable by the impact of global markets, competition from lower cost countries, industry de-regulation and removal of regulated industry protection measures. The global trend has been to lower and lower commodity prices, which at the same time are being pressed by higher input costs (cost-price squeeze).

The first level response was to diversify crops. This led to a plethora of new crops being introduced in the region, often without adequate support mechanisms in terms of market research, distribution systems and technical support. These crops included a range of tropical horticultural crops (e.g. mangoes, lychees, longans, avocados, coffee and many others), essential oil crops (e.g. tea tree), small crops and fresh water aquaculture (e.g. red claw crayfish).

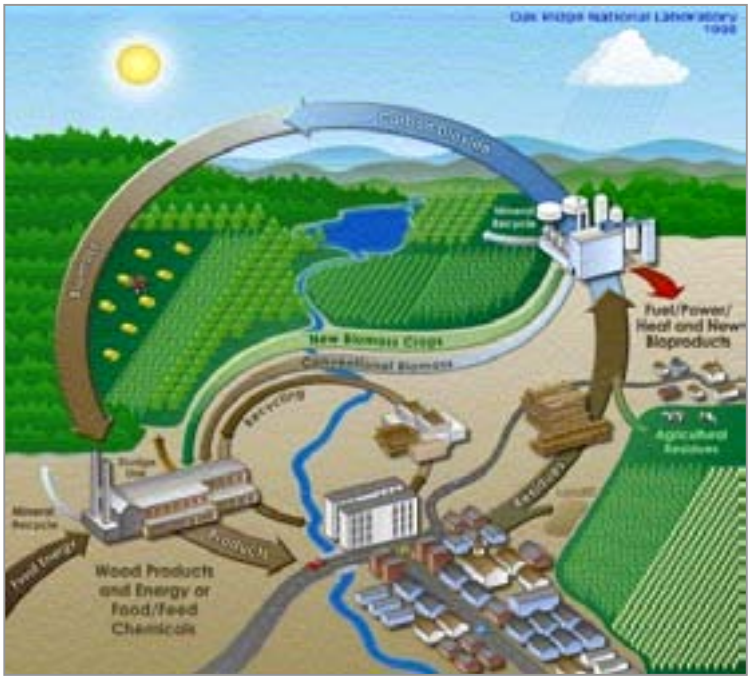
Many have not been particularly successful due to domestic market oversupply, market access and other issues mentioned in the last paragraph. This does not indicate blanket failure, as new crops are now certainly successfully grown and new markets opened up. In most cases the issue is the rate of return for growers of some crops (exacerbated by higher freight charges / access to southern domestic markets). In the case of some, where there is sufficient market demand, such as in coffee, the industry sector is continuing to progress.

The next (second) response level has been to develop opportunities for value adding commodities produced. This created a range of experiments and products, notably fruit wines and dried fruits. These value added products are still emerging, with the fruit wine sector now showing promise of moving from an experiment to an established industry sector.

The third response level has been relatively recent and is only now gathering momentum. This is in the nature of an extension to the concept of value adding. It adopts the concept of the commercial exploitation of industrialised crops as "bio-factories" in the fields of biotechnology, industrial, pharmaceutical, nutraceutical and renewable fibre, fuel and energy industries. This third wave is experiencing massive growth worldwide (BioProducts Canada, 2003), and has the potential to revolutionise the agriculture and manufacturing industries in rural communities in many industrialised nations (Green Business Network, 2003), including Australia (Holden et al., 2003).

Globally this is being driven by consumer desires for improved health, the desires of pharmaceutical manufacturers and governments to reduce cost of therapeutic drugs and renewed concerns about the long-term availability and effects of petroleum-based products.

A supplementary concept or ethos is the adoption of a *closed loop system*, which is generally understood as a process where the linear or open based industrial processing of take, make and waste, is replaced by the more environmentally approved cyclical or closed (loop) processing methodology, where the waste or output from one system or industry is used as an input for another (Garner and Keoleian, 1995) – (refer to the figure below). There is a lot in common between closed loop systems and the concept of *industrial ecology* (refer for example to the International Society for Industrial Ecology, 2002).



An example of a closed loop agri-industrial system in a biobased rural community, where carbon, industrial by-products and wastes are turned into a range of bioproducts and resources — minimising greenhouse gas emissions, resource depletion and environmental impacts.

Locally the drivers have been a reasonably complex set of relatively recent, co-existing influences. The creative meshing of these and development of effective interactions are central to evolution of the biobased industry cluster/s BioNQ seeks to develop to its full potential. Significant contemporary local drivers are:

- Australian Greenhouse Office incentives
- dairy industry de-regulation
- sugar industry reforms associated with significant funds available to develop industry options
- ethanol industry Blueprint instigated by the Queensland Government
- the Queensland Pharmaceuticals Action Plan
- growth in regional bio-technology research capacity in the form of James Cook University, reflected in the Australian Tropical Forest Institute complex, supported through the Queensland Government 'Smart State' strategy, and the Tropical Biotechnology Laboratory based at Mareeba DPI&F, and
- opportunities created by the recently announced Marine and Tropical Sciences Research Facility, supported by a $40M allocation through the Commonwealth Environment Research Fund.

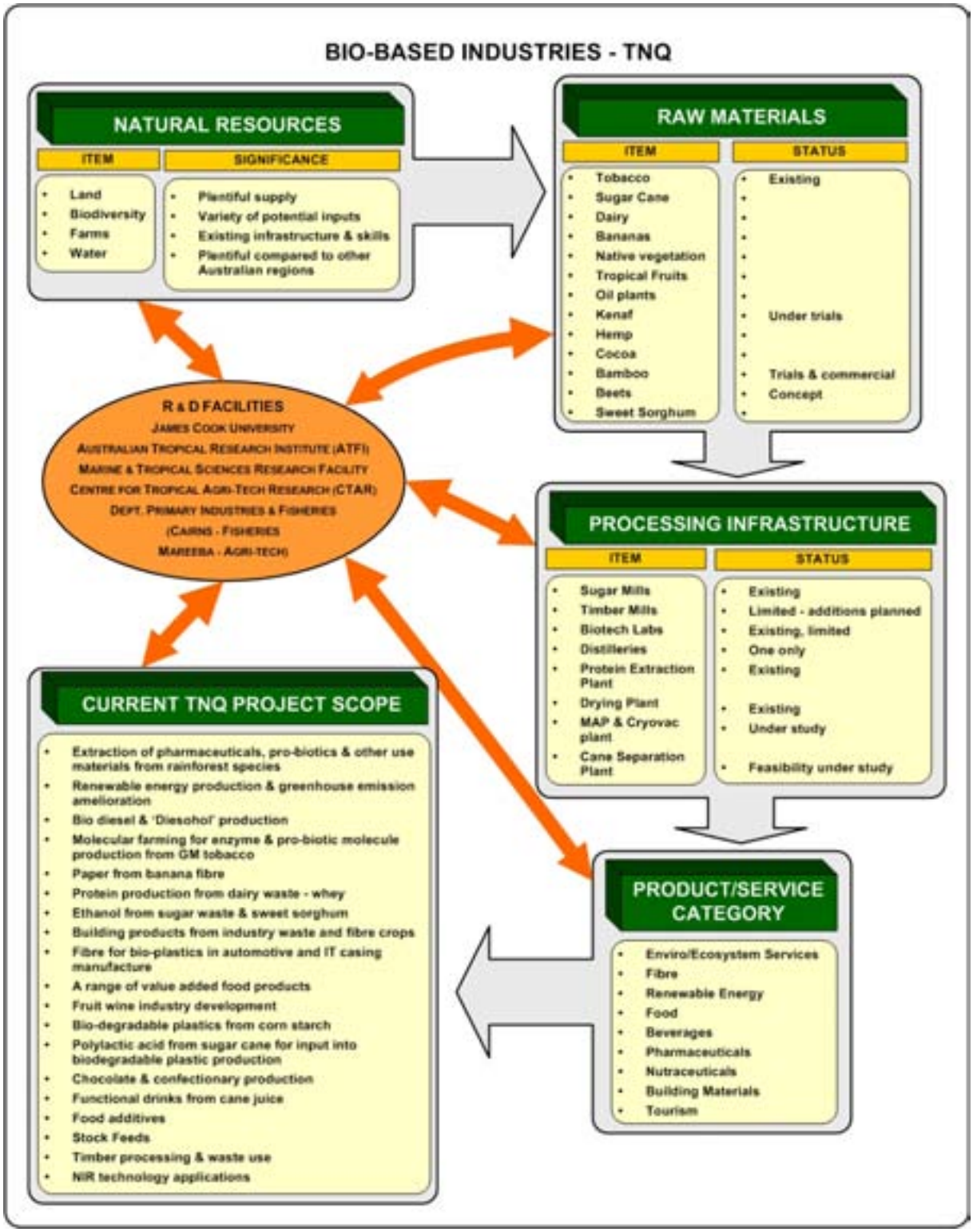
What have been described as second and third level responses to industry conditions in particular have produced a plethora of projects and initiatives, but as yet few tangible commercial enterprises. The view has been taken that the biobased industries in Tropical North Queensland cannot be adequately described by mapping existing enterprises alone in such a fluid and rapidly evolving situation. This is especially as the aim of this project is the future development of a robust industry sector though industry cluster facilitation. Key projects and initiatives that appear to have most depth at this stage are therefore included below as a means of fully identifying the scope and nature of TNQ biobased industries.

In all cases it has not been possible to collect detailed data on individual enterprises. Where it does exist in data collections, privacy considerations have precluded access, while the entities concerned have also been sensitive about access to specific data since they see themselves in a sensitive environment — trying to gain competitive advantage with new products.

In a more formal sense, a significant proportion of projects are commercial in confidence. In such cases, only very general references can be included.

Value Chain Map

An overview of the whole regional biobased industries system, current and proposed, is provided by the following diagram:



The above encompasses the full spectrum of regional biobased industries activities. These can be considered as falling generally into two overlapping streams. This is useful for the purpose of distinguishing common interests and market orientation, which are important in industry cluster formation.

One approach seeks to produce new, better, or novel products traditionally produced through agriculture. These include functional foods and building materials.

The other is an industrial approach, which regards crops as a feedstock for a refinery process. It has an emphasis on developing renewable feed-stocks for industrial processes; the most notable replacement target being fossil fuels. It has been claimed this approach represents a new industrial revolution.

The respective approaches could be termed *agri-science*, the other *bio-industrial*, with both evident in regional biobased industries.

Significant components of the regional value chain and activities in both streams are considered in the following sections. These include some food and beverage areas. The BioNQ definition has deliberately not excluded food from its definition of biobased industries (in contrast to overseas examples, viz. the US and Canada). This seems important in a region such as Tropical North Queensland. With such an extensive traditional agricultural base, it is to be expected that a good proportion of regional "biobased industries" activity will be directed to food production (or the value-adding component of this). However this then creates a problem of definition. How novel, innovative and how much science content does a food production activity need to be to qualify as "biobased industry" for the purposes of the definition? Even those that may not appear to qualify on the face of it may be capable of development. Fruit wines for instance may have functional health benefits not yet identified, proven and marketed.

R&D Capacity

There are current and major enhancements being undertaken in regional publicly supported research and development capacity for biobased industries, described below. There is also a considerable amount of research and development work being undertaken through private individuals and consortiums, which is more difficult to describe due to its commercial in confidence nature.

Australian Tropical Forest Institute (ATFI) Complex

The Australian Tropical Forest Institute (ATFI) is to be built on the Smithfield campus of James Cook University, with loan funding from the Queensland Government. The concept is a tangible reflection of the regional direction in building core competencies in Tropical Expertise.

CSIRO will be a key partner. Other organisations collaborating on the project include:

- Queensland Department of Primary Industries and Fisheries;
- Queensland Department of State Development and Innovation;
- Queensland Environmental Protection Agency;
- Australian Department of Environment and Heritage

ATFI, with its associated entities, is for the purpose of conducting research and commercialisation of ideas generated in the tropical landscape. For example an MOU with JCU provides the basis for locating a Queensland branch of the Australian Plant DNA Bank Ltd (as Biobank QLD) at the Institute and discussions are underway to establish a Centre to undertake joint research and development activity in plant biotechnology and biodiscovery.

It is expected that the Institute will produce spin-off knowledge-intensive, biotechnology oriented business enterprises over time through its operations. The model comprises a business entity which manages its research and commercial functions and a building which forms the physical location for the hub for all such activities. It will include a business manager, whose focus will be on achieving

commercialisation of research outcomes for all partners, as per the model adopted by the Australian Institute of Marine Science, based in Townsville.

A major source of funding to could support research within this facility through 'CERF' – *Commonwealth Environment Research Fund* has recently been announced. The ATFI concept will now expand to include the previous Rainforest CRC, and the terrestrial node of the Marine and Tropical Sciences Research Facility (MTSRF).

Centre for Tropical Agri-Tech Research (CTAR)

James Cook University has established a Centre for Tropical Agri-Tech Research on its Smithfield campus. The Centre is intended to act as a key link between plant biotechnology research, sustainable agricultural practices and economic and educational expertise sourced within its own schools and the regional tropical agri and bio-industries.

University schools concerned are Tropical Biology, Business, Marine Biology and Aquaculture, Earth Sciences, Mathematical and Physical Sciences and Information Technology.

Agreements are in place with various divisions within the Queensland Department of Primary Industries and Fisheries for collaborative arrangements. These include the Rapid Assessment Unit, investigating the application of non-invasive technologies for the inspection and assessment of the quality and safety of fruit and other crops and the Molecular Farming Unit.

As an initiative that includes the aim of increasing collaborative effort in commercialising research outcomes, the Centre aims to contribute to high technology and knowledge intensive business start-ups in the region.

Queensland Department of Primary Industries and Fisheries

DPI&F has research facilities oriented to tropical agriculture and freshwater aquaculture and fisheries based on the Atherton Tablelands, wet tropics horticulture at South Johnstone, as well as marine fisheries and aquaculture research facilities based in Cairns. Apart from more traditional agronomic and horticultural research and a suite of projects in fisheries and new species with aquaculture potential, DPI&F has cooperative projects with other institutions mentioned above and a concept for development of an "Integrated Sustainable Bioindustrial Farming System" for the Mareeba-Dimbulah region on the Atherton Tablelands (Holden, et al., 2003).

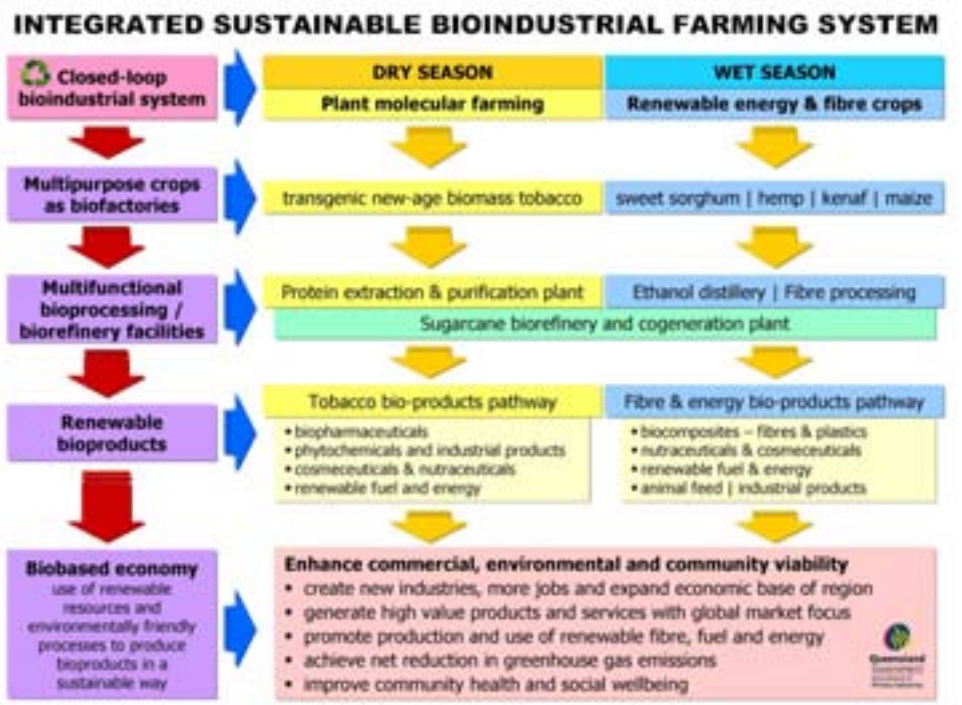
This envisages integration of tobacco based molecular farming with biomass options for renewable ethanol and power generation in a closed loop bioindustrial process that incorporates a sugar cane based biorefinery on a year round production basis. It is based on molecular farming, biorefinery and bioprocessing concepts described as follows.

Plant molecular farming (PMF), also known as biopharming — the use of transgenic science to produce pharmaceutically important and commercially valuable proteins in plants such as tobacco and corn, has generated tremendous interests from the pharmaceutical and biotechnology industries recently. These plants are not used for food, feed or other agricultural commodities, but rather as biofactories that produce recombinant proteins considered too complex or expensive to manufacture through other means, such as chemical synthesis, cell culture or transgenic animals (SABIC, 2003).

Biorefinery — the biorefinery concept is gaining popularity as a model to maximize the value of biomass resources. Based on the petroleum refinery industry concept, which refines crude oil and natural gas into numerous petrochemicals and fuels, biorefineries process biomass feedstocks into renewable energy, fuel and a wide variety of bioproducts. Each additional product produced in turn adds value to the total economic return of the biorefinery (Biomass R&D Initiative, 2001).

Bioprocessing facility — similar in concept to a biorefinery, where renewable feedstock is converted into bioproducts through biological agents (e.g. microbes or enzymes) and bio-chemical engineering.

A diagram of the proposed bioindustrial farming system concept follows (Holden, et al., 2003):



The major component of the system is the exploitation of transgenic new-age tobacco as the primary crop for plant molecular farming in the "dry" season, in rotation with sweet sorghum or other dedicated energy or fibre crops in the "wet" season. Local sweet sorghum studies conducted in collaboration with Mossman Sugar Mill and CSIRO have identified suitable varieties and production practices, with yields of ~90 tonnes/ha fresh weight (in 100 days) and potential ethanol yield of 4,500 L/ha from the extracted syrup (Tonello, DPI&F unpublished data). Sweet sorghum also acts as an important break crop to control pests and diseases in the following tobacco crop, minimising use of pesticides and enhancing product useability. Its high fibre content also makes it suitable for cogeneration, and its waxes could potentially be used in the production of octacosanol (polycosanol), a nutraceutical ingredient known for its cholesterol lowering effect (Taylor et al., 2003).

A commercial research entity has also been engaged in plant molecular farming (focussing on transgenic tobacco) and is now considering moving its field operations to the TNQ region. The N.Q. Co-op Ltd, based in Mareeba, has also recently led a consultancy assignment to assess the potential and feasibility of integrating sugar and tobacco biofactory concepts into a broad bioindustrial strategy for the Atherton Tablelands.

CSIRO

CSIRO, as mentioned above, has been involved with various research components that relate to biobased industries development in TNQ. Of particular note is their effort to promote agro-ecological systems practice-change to traditional wet tropics agriculture (principally sugar cane based farming systems). Through their Sustainable Ecosystems Division, they have developed and conducted collaborative research with biobased industry partners towards a sugar-fibre-timber agri-industrial clustering concept called CAPS (for Commercial Agroforestry Production Systems). CAPS is covered in the next section of the report.

Projects, Products and Concepts

As indicated previously, the biobased industry sector in Tropical North Queensland has only recently moved through a second wave of innovation and diversification. This focussed on value adding to regional crops and is still a strong theme. The third wave, with a focus on sophisticated food, fibre, beverage and other agri-products using bio-sciences and a bio-industrial approach to product development is quite recent. An interesting feature of this is the amount and range of innovation and energy that has emerged over the last five years, which would have been difficult to imagine being generated in a very conservative, traditional farming community environment five or six years ago.

This study would emphasise this aspect of industry development as an important pointer to future sector prospects. The projects that are now emerging are by and large serious propositions backed by reasonable business cases. The following can be claimed to be a comprehensive, but not necessarily entirely complete review of current activity. It is highly likely that there are a number of others that are not yet public knowledge.

Commercial Agroforestry Production Systems

Commercial Agroforestry Production Systems (CAPS) is a concept created by TBL Vision and CSIRO for development of a cohesive sugar–fibre–timber system in North Queensland as a framework to drive diversification and provide solutions to the issues facing the sugar industry sector. It considers crops as output streams for input into major regional primary processing facilities, which in turn would produce a range of materials to form the basis for value added products. Central features are total utilisation of the biomass produced and the waste streams from each level of processing being used as input for other production processes.

The concept has become a project within CSIRO's National Flagship program "Water for a Healthy Country". It is also listed as a case study for the region in the FNQ NRM regional NRM Strategic plan.

A report on the viability of product and processing options the system might consider was commissioned by the CREDC industry cluster BioNQ in 2004 and recently released to DoTaRS (BioNQ 2005)

While many of the biobased product options identified in the report are concepts only at this stage and require full feasibility testing, there are also a number of projects proceeding, which are separately identified below.

Ecobiotics

This is a commercial enterprise established in 2000, which has developed a business based on discovery and commercialisation of new bioactive chemicals from tropical rainforests for a range of applications in the pharmaceutical and agrochemical industries. Collection and biodiscovery strategies for chemicals for use in 11 therapeutic areas have been designed to date. These include five anti-cancer agents, two new antibiotics, fungicides and a chemical that has proven effective in treatment of golden staph.

Clonal Solutions

This is a spin off company (established in 2004), from Yuruga Nursery (established in 1985), one of the largest employers on the Atherton Tablelands. Clonal Solutions is a research and development enterprise, which has developed sophisticated cloning techniques for mass propagation of new varieties in volume for forestry and agriculture.

It is the only nursery in Australia with the technology to mass-produce elite hybrid eucalypts, and millions of these clones have been despatched to timber plantations throughout Australia from Darwin to Albany. Text books and horticultural institutions in Australia until very recently taught that cloning of eucalypt species could not be done.

The firm has also negotiated with Yates Ltd to secure the sole Australian rights to mass produce Saltgrow™ salt tolerant eucalypts. These elite clones have been specially bred for their ability to grow in saline soils and, being commercial timber species, are productive solutions for the rehabilitation of salt-degraded land.

VRM Pty Ltd

This Townsville based enterprise offers inoculated remediation products and tailored inoculation programs aimed at management of waste circumstances through microbial balancing. This includes specific inoculation to waste systems at various industry types, preparation of cleaning products which provide on-going microbial benefits, preparation of fertiliser supplements which contain microbial elements for enhanced plant uptake and reduced environmental loss. Primary clients are Local Government Authorities seeking treatments for sewage ponds.

Bamtek (TBL Vision)

This enterprise is developing a project for establishment of cane separation processing plant capacity in the region and has reached the stage of developing commercial samples.

The technology has the potential to deliver a 'total crop utilisation approach' by processing and separating all component parts of the sugar cane as input material for a range of products. A major barrier to viability encountered by past projects using this technology is the relatively small scale of production.

The output components and potential products are:

Rind - the hard wood-like outer section of the cane stalk, which can be used to produce:
- some low purity juice
- hardwood lumber, corepanel housing panels, oriented strandboard, medium density fibreboard, particle board, cement board, or pulp & paper.

Pith - the soft pithy interior of the cane stalk which can be used to produce:
- high purity sugar bearing juice
- medium density fibreboard, particleboard, cement board, high fibre flour, animal feed, ethanol production, beverages, or amorphous, plantation white or liquid sugars.

Dermax - the thin epidermal layer, which bears or contains:
- Most of the compounds contributing to the formation of molasses.
- All of the valuable natural wax found on the sugar cane stalk.
- Up to 3% of the total fiber (2% of the total weight of cane).
- All of the abrasive mill-wearing silica, dirt, colour.
- Can be used for the production of high value natural cane wax using standard extraction equipment, inks, polishes, and sterols for the production of pharmaceutical grade products.

The natural wax is a source of policosanol (or polycosinol), which is a relatively new product that has been successful in managing cholesterol in the human bloodstream, reducing the levels of LDL (low-density lipoprotein) or 'bad' cholesterol and raising the levels of HDL (high-density lipoprotein) or 'good' cholesterol.

Bundaberg Sugar - Arriga Mill

Bundaberg Sugar is investigating the feasibility of producing ethanol at its Atherton Tablelands mill and prospects of using mixed feedstock in addition to sugar cane components. As such it links with the Integrated Sustainable Bioindustrial Farming System concept reported above under the auspices of the Queensland Department of Primary Industries and Fisheries and NQ Co-operative.

Papyrus Australia

This enterprise has developed a process to produce chemical free paper/cardboard from banana plant waste, without the need to use water in the process. It is also claimed to use only a fraction of the energy required in a typical wood chip paper production plant. This is a public company, recently floated and quickly fully subscribed.

Bamboo Growers

There are now some 40 bamboo growers in the region who are collectively planning production of a marinated and pre-packed bamboo shoot product to commence shortly. Timber or bamboo fibre products are also under development.

Bagasse Pots

This business converts bagasse waste from sugar mills into a range of biodegradable pots for plants aimed at the nursery and forestry trade. Being organic and with added nutrient value, it provides a ready source of nutriment to the growing plant either during nursery production phase or after being directly planted out in the field (thus reducing nursery fertiliser input costs).

Effluent Conversion

This single operator business converts the content of on farm effluent dams (especially dairy and piggery) into fertiliser. This resolves a disposal issue for farmers and reduces the environmental impact and risks associated with these holding dams.

Cairns Fatman

This business re-cycles waste oil from commercial cooking operations by converting it into fertiliser and stockfeed. It also has the capacity to produce bio-diesel.

Mungalli Creek Dairy

This enterprise produces and sells a range of biodymanic/organic yoghurts and other dairy products which also utilise rainforest fruits grown in the region. It has completed product development to expand its range into hard cheeses.

Daintree Vanilla and Spices

This enterprise has patents pending on pollination and processing systems for vanilla, which are claimed to make regional production of vanilla viable. A proposal to develop a processing facility is being developed.

Envirotec

This is not directly a biobased industry enterprise, but is closely associated with certain biobased industry development. The firm has developed innovative and award winning energy efficient refrigeration, dehydration and blast freezing technologies. The dehydration and blast freezing processes, apart from energy efficiency, produce better quality dried fruits which retain a higher proportion of nutrients than traditional methods. The technologies have global application and are increasingly being commissioned by several overseas companies and governments as well as in a local processing project near Mareeba.

Stevia

Australian Stevia Mills has expressed interest in the cultivation of Stevia in the Mareeba-Dimbulah Irrigation Area (MDIA), based on studies of the eastern coast of Australia. These indicate that the MDIA may be one of the better sites for production.

Stevia (*Stevia rebaudiana*) is a sweet herb whose extract has been used extensively as a natural sweetener in a number of countries for over 30 years (notably Japan, China, Korea and Brazil). The extracts from leaves (steviosides and rebaudiosides) and stems are non-caloric, and are heat and pH stable. These extracts are up to 200 – 300 times sweeter than sucrose and have been reported to promote stable blood sugar levels, making them suitable for consumption by diabetics (AAFC, 2004).

With worldwide concerns about the rising incidence of obesity, type II diabetes and tooth decay, caused by excess consumption of calories, alternatives to sucrose are being consumed in increasing quantities. Other uses of stevia extracts are as colour and odour enhancers, antioxidants and as aging agents and catalyst for alcoholic beverages (Baby, et al. 2004).

Ma:Mu Native Plant Commercialisation

The Ma:Mu Aboriginal community in Innisfail, south of Cairns is involved in a 'bush tucker' project involving a range of partners, including James Cook University Rainforest CRC, Innisfail TAFE, Johnstone Shire Council and Far North Queensland ACC, with connections to CREDC Tropical Foods Cluster. It is consists of a number of associated sub-projects.

Wild plant varieties are being scouted and sourced, a nursery established to trial a variety of species and breeding program commenced. Nine trainees have been recruited, who are undertaking Certificate levels II, III and IV in Horticulture, plus Conservation and Land Management Diplomas.

This project aims at domestication of selected wild species to produce cultivars to tap into the growing bush foods market and in cultivation of plants with therapeutic and pharmaceutical potential.

Cocoa and Chocolate

Trials of cocoa at DPI&F's Centre for Wet Tropics Agriculture at South Johnstone have been proceeding for a number of years. These arose from the observation that world cocoa production is unstable, with serious disease issues, predictions for supply shortfalls and rising prices. There also has been little previous research on varietal selection and improvement. Key considerations for an Australian based industry are in gaining efficiencies in management and harvesting operations.

Trials across Northern Australia have indicated the wet tropical coast of Queensland as being the best location for cultivation. North Queensland has also been identified as a promising base from which to access the growing confectionary market in Asia, especially with other local industries being sugar and dairy. The Tablelands dairy industry also has the attribute of lacking an after-taste said to be present in most Pacific Rim dairy products that is apparently unpleasant to the Asian palate.

One Mossman based sugar farmer has now converted to cocoa production and there are at least two commercial in confidence, unrelated projects for development of regional chocolate factories.

Cocoa contains flavonoids that are regarded as having potent antioxidant activity, which in early-stage research, show potential for the promotion of cardiovascular and immune health (Nutraingredients, 2003). It thus may be exploited in various product formulations for the healthcare industry (with functional or nutraceutical properties).

Teneree Technologies

This enterprise is seeking to commercialise a BioDiesel product from African oil palms, which will conform to American Standard D6751 (US) that covers B100 (pure BioDiesel) into standard diesel engines. Product claims include that it is bio-degradable, improves engine lubrication, and is about as toxic as salt. The company is also looking at the potential to develop a range of other products from oil palm biomass, particularly resins for use in natural fibre composites with a collaborating research body in Queensland.

Fruit Wines

Fruit wines have been produced in the region as a hobby and a novelty for some time, with a degree of expertise developed on a small scale. They fall somewhere between the description of crop value adding and applied biotechnology. The businesses now being developed are on a commercial scale and in a number of cases they are backed by commercial winemaking expertise, either through the founder / owner or through imported expertise through training and coaching.

A contributor to its development has been an increasing recognition of the potential collaborative links between the regional tourism industry and agriculture (Roberts 2000). One of the spin offs from this recognition has been a push to develop a recognisable 'tropical cuisine', supported by the hospitality sector of the tourism industry. Fruit wine has been considered a novelty, for tourism purposes, not on the same level as grape wines. This is still the case but may not always be so as expertise improves. It has already been demonstrated that there is a significant export market to China and other Asian destinations, where grape based wines are not necessarily the tradition and palates and tastes differ to western cultures.

There are now eight established fruit wineries in the region, including a distillery using fruits to make liqueurs. This represents growth since collection of the data for the industry review reported above. There are also others at an advanced stage of planning that may or may not eventuate. Wineries and others interested have formed an industry association, Tropical North Queensland Wineries Inc., which reportedly has 20 members. The established operations are:

Endeavour Valley Winery	Cooktown
DeBruey's Boutique Winery	Mareeba
Golden Pride Winery	Biboohra (Mareeba)
Mount Uncle Distillery	Walkamin
Murdering Point Winery	Silkwood East
Pacific Blue Wines	Herberton
Paradise Estate Wines	Mission Beach
Shannonvale Tropical Fruit Wine Company	Mossman

Both the Endeavour Valley Winery and Pacific Blue Winery also have grape vines and offer wines from these. Pacific Blue is the oldest winery, previously known as Fosters Vineyards.

The Golden Pride Winery was the first commercial fruit winery and probably the largest in terms of both investment and turnover. It has also exported product but found it could not supply in sufficient quantities to reliably supply market demand.

All operations are small in terms of employment, being family businesses for the most part, with the addition of some casual labour.

Other Current Developments

The following is a summary of other current projects listed together to meet commercial in confidence considerations and other sensitivities:

- **Buffalo Dairy Products** – one dairy farmer has converted his herd to buffalo and is now producing buffalo based product for which a range of health benefits are claimed

- **Pumpkin Seed Oil –** organic production of pumpkin seed oil from a particular variety - trials underway

- **Spirits Production - Milk–** development of a milk fermentation plant for the production of spirit based beverages infused with bush food flavours – feasibility in progress

- **Coconut** – Current research into production of fibre and oils

- **Spirits Production – Starch base** – development of a beverage spirit from starch extracted from existing regional crops – feasibility study in progress

- **Cotton Seed Coating** – development of a coating for cotton seed for animal consumption with the advantages that it is easy to dispense, results in lower methane production and better ruminant processing leading to better conversion rates – commercialisation stage reached

- **Noni Juice –** Health benefits are claimed for Noni plant juice, which provides an ingredient for functional drinks. A processing plant is being developed for a plantation of Noni in Babinda. There is also a plantation in Pormpuraaw, an Aboriginal community located on the eastern shores of Cape York Peninsula.

- **Native Plant Trials – Pesticides** – trials are underway on the efficacy of native plants in companion plantings to crops as natural pesticides for biological control of insect pests.

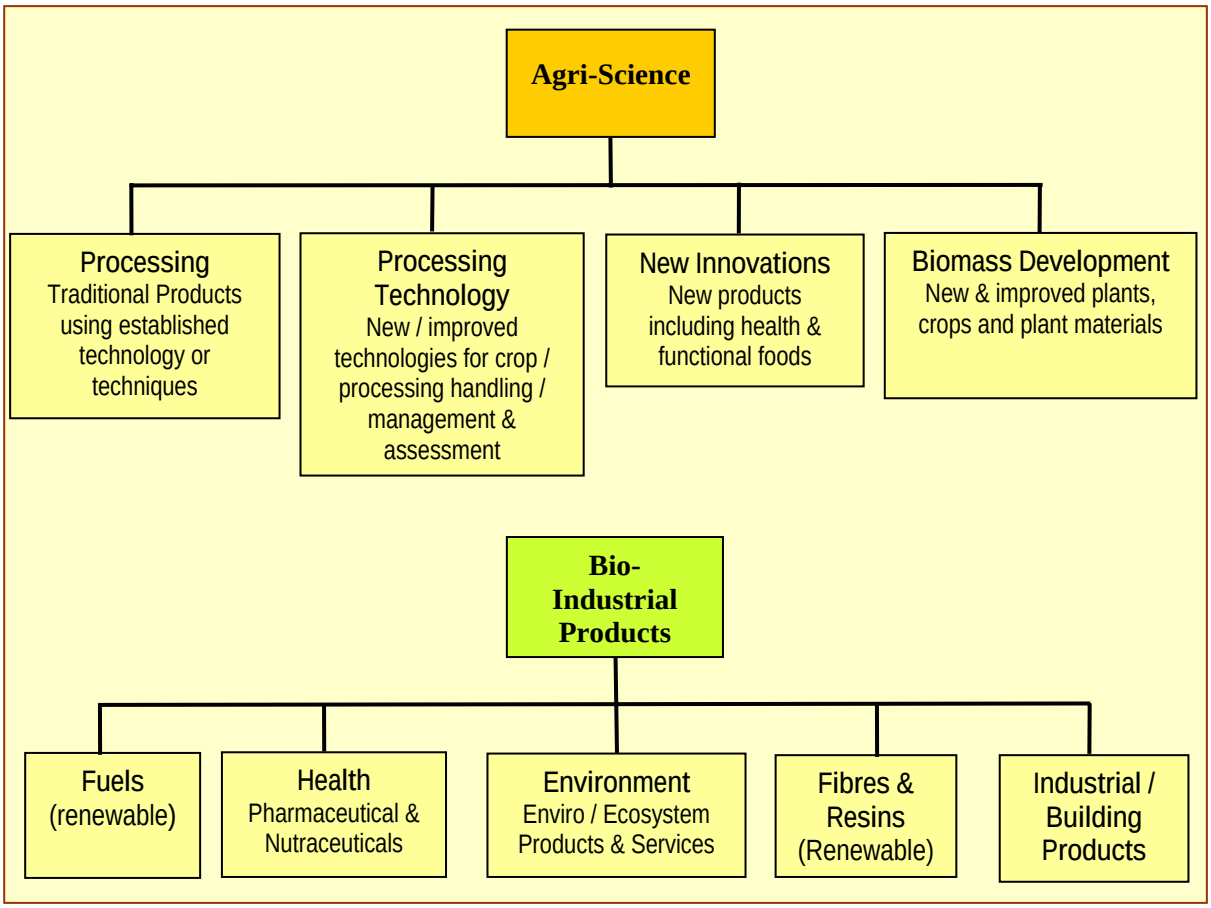
- **Medicinal Hemp** – plans being developed to produce oil from hemp for therapeutic benefits

- **Cancer Agents – Milk** – research underway to identify anti-cancer agents in milk

Biobased Industry Cluster Development

Industry Sectors

The value chain map and foregoing description of current projects, enterprises and proposals suggest two principal industry sectors with sub-sectors mainly aligned under each, although there will be some cross-linkages. Some sub-sectors are mature and some emerging in the regional context:



Constraints, Barriers

For Individual Sector Businesses

The most common constraints and barriers experienced by small startup firms in regional areas fall into four categories. They apply equally to biobased industry firms and it is significant to note that the overwhelming number of enterprises and enterprise proposals listed in the previous sections fall into the category of small business / startup enterprise. A recent study into the feasibility of a technology small business incubator confirmed this (Kleinhardt 2005), as did a 2001 project on attraction of investment to regional Australia (Kleinhardt 2001) and a recent Australian Government sponsored report (2003) on small business in Australia.

The typical areas creating most common constraints to business development are:

- Gaps in Business Skills
- Flaws in Business Structure and Depth
- Capacity to attract Capital and / or Investment
- Program Eligibility

Gaps in Business Skills

Small businesses, especially those in biobased industries, typically have good technical skills. They can invent, produce and deliver their product or service. They may be good innovators and their products might be world beaters. This does not make a good business. They typically lack skills in market assessment and development, management - especially people and resources and in administrative skills, especially financial planning and management. They may be weak in only one, but often in all three.

Part of the difficulty lies in the scarce resources typically available to a small business. The founders often try to do everything.

There are many strategies already in place, aimed at small business capacity building. There is a plethora of publications, training courses and government services available which are designed to assist these start-ups. Perceived lack of time and resources limit participation and many small business people fall into the trap of 'working in their business' rather than 'working on their business'.

These factors are evidenced time and time again. The feasibility study for a small business technology incubator for the Far North Queensland region provided strong supporting evidence. A survey of technology oriented businesses included questions which asked respondents what they did best, what they do worst and what they needed most. All provided answers strongly consistent with the above.

At the same time most start up firms in particular cannot afford to seek professional services at market rates. There is also a mindset that resists paying for business advice in the face of scarce resources to develop the business.

What then are the strategies to address these issues apart from those initiatives already in place? Awareness raising and focus on key issues, together with comprehensive, accessible mentoring / coaching are the keys.

Awareness and Focus

Small business people firstly 'need to know what they need to know'. The basic messages are being lost in the plethora of materials and programs already in place. These are further confounded by the range of private products that all promise the latest fad or fashion that will surely guarantee business success.

The requirements of some government programs also confuse clients and they often lose their way.

A review of the material and messages being delivered to small business and some short, strong, basic, straightforward material is required. A guide through the maze of programs and initiatives is also required. The more difficult step required would be to obtain consensus amongst agencies to all adopt the same material.

Comprehensive Mentoring

Mentoring is already available, but the emphasis is on 'comprehensive'. That which is available tends to be quite thin on the ground and be quite short term, unless a firm can afford to engage professional assistance. Mentoring by its nature is long term. This is due to it being based on trust and mutual understanding. Mentor availability through existing programs is too short. Given that biobased industries by and large are high-technology and high-[capital]-risk ventures, enduring mentoring services are seen as critical.

Flaws in Business Structure and Depth

Investors generally invest in businesses not products. They will look at the people, competency levels, governance, management systems, financial capacity and stability. Promotion of an understanding of this and its implications for each business seeking investment must be (and hopefully already are), priorities for mentors and others giving business advice.

Capacity to Attract Capital and Investment

This is a very commonly quoted constraint for small business. Part of the difficulty is the scale of funding required. Typically it is too small to interest venture capitalists or to warrant the time, costs and complexity of a public float. Without a track record banks are unlikely to be interested; and if in a new innovative industry, will probably regard it as high risk in any event. Typically the only sources of finance are debt against assets, and / or their immediate circle, often described as 'friends, fools and family'. However, small businesses can take steps to improve their chances of attracting investment.

Understanding and Attitude

Small businesses seeking investment need to include in their investment attraction strategy an appreciation of what they are offering from the perspective of potential investors. Would they risk their money? What safeguards would they want if they were going to risk their money?

Connection with Investors

Small business in regional Australia suffer a disadvantage due to distance from potential investors. Physical distance between investor and investment location tends to increase the perception of risk. Distance from networks makes it difficult for enterprises to engage investors' attention. Distance in terms of cultural and experience makes it more difficult to build trust and understanding between enterprise and investor.

Regional pool development funds now under development may make a contribution to creation of funding conduits to regional small business. However investment opportunities tend to need matching with the particular portfolio interests of particular investors. There is little point in general marketing of an opportunity. For instance a biofuels opportunity needs to seek out investors interested in biofuels opportunities; functional foods need functional food investors, and so on. Regional investment pools therefore need complementary strategies to ensure matching between opportunity and investors.

On the face of it, the strategy proposed in the report *Regional Business - A Plan for Action,* to create a small business financing program would also appear to be a strategy with merit.

Program Eligibility

A variety of government assistance programs require applicant businesses to have been in business for a nominated period of time to be eligible. The reasons for this can be appreciated, but this may preclude innovative entrepreneurs, with a good business idea from accessing the assistance they need to convert their idea into a viable business.

Industry Cluster Development

Industry clusters have a life cycle, with needs varying during the cycle. In parallel with the cluster itself the initiatives driving cluster development also have a life cycle with differing needs at each stage. As noted before the TNQ biobased industry sector is at an early stage of development and the following, drawn from an analysis of two industry stakeholder workshops (Appendices 1 and 2), are the key barriers and constraints faced in terms of development of a successful industry cluster:

Scarce Resources

All cluster activities and development are currently being undertaken by a QDPI&F Officer, in time which can be made available between undertaking his regular duties. He is supported through whatever time the Chairman has while carrying out his other duties as a Head of School at JCU.

Global experience is that most successful industry clusters have a dedicated facilitator. At the same time the emergent nature of the TNQ biobased industry sector and lack of industry depth make it difficult to justify dedicated resources. A hard look needs to be taken at the priority and importance the region places on development of this sector. **It is the future potential rather than current reality that should drive resource allocation.**

Scarce resources have meant that the cluster has not been able to undertake a sufficiently robust formation and development process to date. A commonly accepted 'development ladder' follows the model represented in the diagram on the following page. While this model has generally been adopted, it needs to be followed up with more extensive and in depth facilitation and activity. This is especially in the following areas:

- Identification and engagement of champions
- Identification of advantages for participants and communities of interest
- Marketing
- Rules of engagement – communication systems to maximize face to face interactions

Industry Diversity and Depth

Previous sections have identified the diversity, sectors and emerging sub-sectors of the TNQ biobased industry. The lack of maturity and depth in terms of numbers of enterprises presents a dilemma. On the one hand, the diversity makes it difficult to identify a community of interest that would draw cluster members into collaborative arrangements. On the other hand the lack of critical mass in any one sub-sector makes it difficult to establish sub-cluster activities.

Business Development Stage

Many of the potential cluster members are in an early stage of their business development, with a proportion being as yet single operators. Their focus will understandably be on individual enterprise development and the typical constraints reviewed in the last section. They need very strong reasons to take time out from these activities to participate in cluster / collaborative activities.

Champions

Champions are central to cluster success and have most impact when drawn from industry enterprises. In view of the diversity of sub-sectors emerging, there is a case for more than one champion. However the business and sector development stages referred to previously make this difficult.

CLUSTER DEVELOPMENT FLOW CHART

(Kleinhardt-FGI 2002)

Opportunities

Industry Sector

The opportunities for development of a strong biobased industry sector in Tropical North Queensland are associated with:

- Tropical expertise
- Biodiversity encompassing rare and / or unique species in both marine, rainforest and dry tropics eco-systems
- A wide variety of soils and micro climates providing a range of growing conditions
- Extensive existing agricultural industries with infrastructure and commodities that provide a suitable base for research and development

Basically, the region has core competencies and market opportunities encompassed by the term 'Tropical Expertise'. The region has a rich, bio-diverse, natural environment and mature skills in sustainable tropical resource development and management.

Northern Australia is one of the few, if not the only advanced western style economy in the tropical zone of the world, home to some 42% of the world's population. Northern Australia has developed knowledge and products for tropical living which could be marketed to this huge market. It also has the sophisticated soft and hard infrastructure necessary to develop new 21st century specialised products tailored to this market. In biobased industries, these opportunities include:

- Environmental management and remediation services, flowing from expertise in research and management of two major, adjacent tropical World Heritage listed areas
- Tropical pharmaceuticals aimed at diseases endemic to tropical areas
- Use of tropical crops and native biomass / biodiversity to create value added derivatives and biotechnology products, including drugs, fibre products and foods;

This Tropical Expertise concept is beginning to penetrate regional economic development and business initiatives and impact their direction. Given the experience of regional development globally, building on core competencies and creating world class specialisations will tend to build critical mass over time, as was found to be the case with the regional tourism industry. There should be a tendency over time for more regional business start ups to specialise in these areas and to attract others from outside the region seeking to capitalise on regional skills and expertise.

Industry Cluster Development

The principal opportunity for industry cluster development derived from this project flows from the early, fluid stage of sophisticated biobased industries in Tropical North Queensland.

Globally it is clear that the most successful regions are those which have evolved strong networks and high levels of collaboration, with specialisations based on core competencies. They feature free flowing information and interactions between all regional institutions, business, government and education. High levels of trust have been developed and earned, yet there is no complacency, with learning highly prized. There are high levels of dialogue and real communication as opposed to 'meetings'. Face to face communications lead to intuitive learning, flowing through the regional economy to underpin innovation and fresh energy.

Due to the early stage of industry development and as yet small scale, the opportunity is to build a regional industry based on the global best practice experience summarised above.

A supplementary opportunity is to take up the opportunity to record successes and failures, monitor and measure progress towards this vision and so build a comprehensive set of tools and case study for

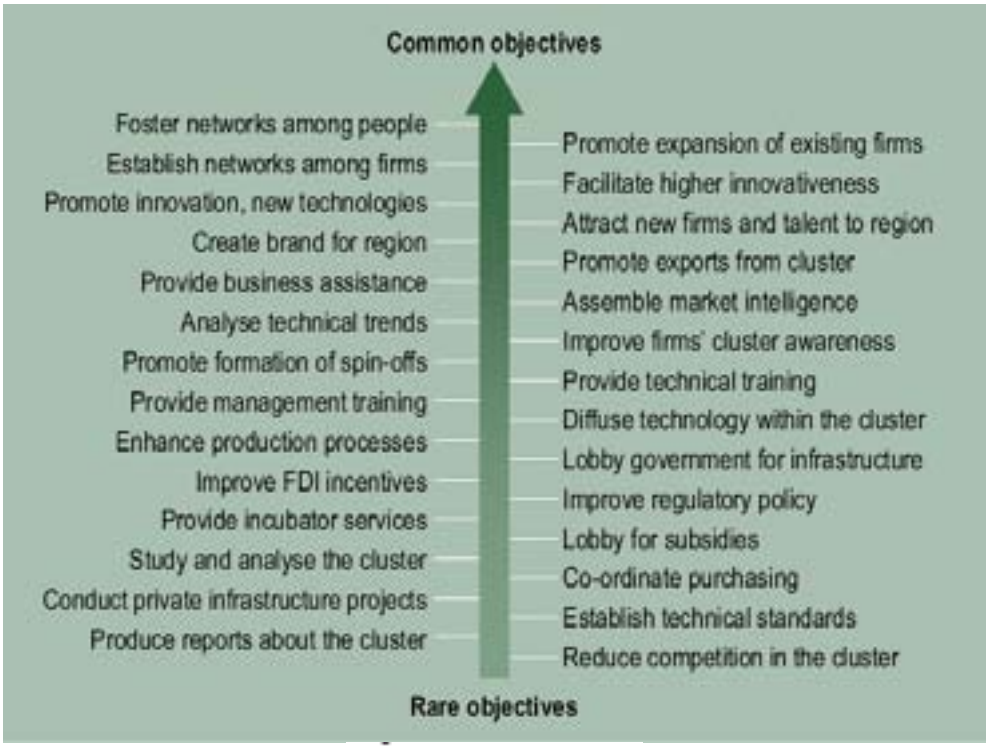
development of regional biobased industries from the ground up. This has not been attempted before, although there are reports on biobased industry cluster development in other regions.

Cluster Strategies

Development of this report is a key strategy in itself in development of a strong TNQ biobased industry cluster. Reviewing the scope and nature of the regional sector is intended to provide data on which to develop effective strategies. The following are therefore only broad-based initial strategies for review and building upon by the cluster.

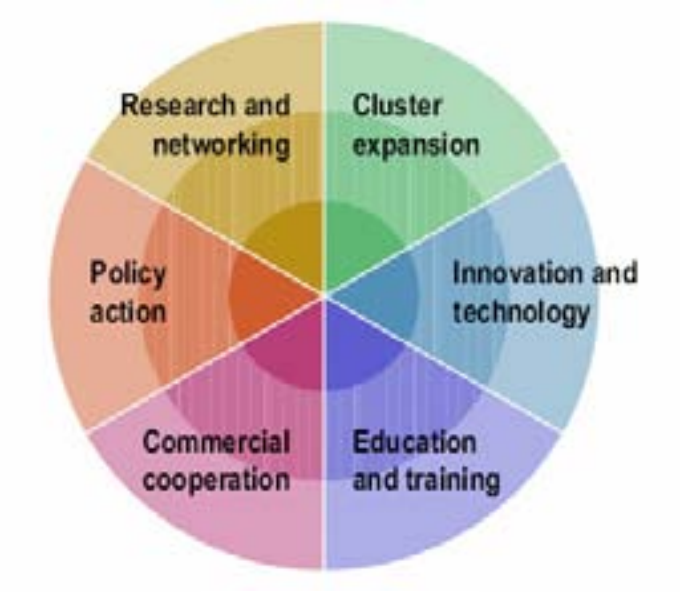
Basic to cluster development is a 'community of interests', upon which can be built common goals, and mutually beneficial activities, which provide reasons for interactions, through which learning takes place and trust is built.

The 'Cluster Initiative Green Book' (Solvell et al., 2003), includes a review of objectives adopted by cluster initiatives globally and ranks these from those rarely adopted to those most commonly adopted, as listed in the following figure:



Cluster initative objectives
Listed in order of frequency
Source: GCIS 2003

The same publication categorises these to develop a 'target board' for cluster initiatives as follows:



The Cluster Initiative Target Board

From the above, a number of key strategies emerge as those for consideration by BioNQ at this stage in its life cycle:

- Conduct a general review of cluster development to date against the 'cluster development flow chart' and identify those that require re-visiting
- Survey cluster industry members and potential members to identify what they consider their greatest needs
- Workshop survey results with industry sectors and review the applicability of the above common objectives and 'target board'
- Analyse core industry needs and methods of delivering them through cluster activities
- Review scope of membership sought with a view to engaging the whole industry value chain
- Support development of a regional small business incubator facility and facilitate access to other business development services for cluster members in recognition of the nature and stage of industry development
- Seek out potential industry champions and form a group representative of emerging sub-sectors
- Develop the case for more cluster facilitation resources and lobby for them
- Develop a marketing plan involving champions as flag bearers
- Prepare an action plan, with reviews initially six monthly

Discussion of Results

During the course of the project, it was found that it was not possible to source data on the TNQ biobased industry sector in as much detail as intended. This was due to commercial in confidence and other industry sensitivities, as well as existing data collections not able to be accessed due to privacy considerations.

The emerging nature of much of the industry also means it is likely to change rapidly. It was therefore found equally important to capture current projects that may not as yet be associated with a commercial entity. From one perspective the industry is in fact better described at present through the scope of current projects than statistics on current commercial entities.

However the industry picture that has been assembled does go a long way to providing a benchmark on which to base further study and provide input for formulation of strategies and decisions on facilitation of industry cluster development.

Implications

The project has described a diverse biobased industry sector with a number of emerging streams, at an early stage of development. It reinforces the view that it presents an excellent opportunity to develop a longitudinal study to monitor and evaluate the cluster as it develops. The study would aim to build a best practice model for monitoring, measurement and evaluation of cluster initiatives, as well as its subsequent impact to the regional economy of Tropical North Queensland.

It has also highlighted a need to re-visit strategies for cluster facilitation. This is considered a critical sticking point to the successful formation of a biobased industry cluster in the region ─ one which promises to catalyse significant business development in the region (based on equivalent overseas cluster development examples).

Further, the industry diversity and level of energy apparent in current industry development initiatives, coupled with the industry potential due to regional assets and core competencies point to it being a priority for the region to allocate sufficient resources to industry cluster development so as to optimise industry outcomes for the region.

Recommendations

This preliminary project has drawn to attention the significant potential of adopting an industry cluster framework to drive the development of the emerging biobased industries sector in tropical north Queensland. In order to capitalise on this opportunity, it is recommended that:

- A business case be developed to secure additional cluster facilitation resources for BioNQ – the biobased industries cluster under the auspices of the Cairns Region Economic Development Corporation
- A re-visit of cluster development strategies be instigated with the benefit of the inputs provided by this project
- A longitudinal study into cluster development be specifically developed to assist in fostering collaborative regional development in biobased industries.

Appendices

Appendix 1: Force field (situation) analysis – BioNQ workshops (Oct + Nov 2004)

Workshops facilitated by Peter Holden (DPI&F, Mareeba).

Participants: BioNQ members and invited representatives from state and federal governments, regional development organisations and businesses with a stake in biobased industries development in the Cairns region.

Workshop aims:

1. Identify and rank key driving and restraining forces affecting the BioNQ industry cluster (specifically) and biobased industries development (generally) in TNQ
2. Use information to devise action agenda to:

    a) maintain or strengthen the driving forces (ensure they don't become a negative force)
    b) restrict the size / magnitude of the restraining forces (and try to turn them into driving forces).

The situation defined: BioNQ and biobased industries cluster performance / progress

Driving forces = positive forces that help the cluster to perform / progress
Driving forces identified and ranked:
1. Synergy of like-minded people to drive biobased agenda
2. Potential for business sustainability through wealth creation / commercialisation
3. Mentoring and networking opportunity – share knowledge base
4. Opportunity to create critical mass in region
5. Support from PricewaterhouseCoopers - provision of "home base" for monthly meetings
6. Social interaction at meetings
7. Support from CREDC
8. Management of commercial-in-confidence issues in/from R&D businesses
9. A body to assist in attracting and leveraging public and private funding $$$$
10. Aspirational target - to be peak industry body in region

Restraining forces = Negative forces that affect cluster's performance
Restraining forces identified and ranked:
1. Lack of resources to market and promote biobased industries activities generally
2. Loss of independent cluster facilitator from CREDC
3. Small core of existing members driving the group
4. Lack of clear understanding by community of "bio-industries" (i.e. not just about biotechnology)
5. Limited documented commercial project success from opportunities created through BioNQ
6. Lack of commitment /will by businesses & organisations to belong to /or join BioNQ
7. Loss of key industry contacts in region
8. Funding lag and lack of funding availability/ accessibility
9. Limited potential / opportunities to communicate with industry members in region

END.

Appendix 2: BioNQ – Biobased Industries Cluster Fishbowl Enneagram

20th January 2005

Workshop facilitated by Brian Prove (DSDI, Cairns).

Participants: BioNQ members and invited representatives from state and federal governments, regional development organisations and businesses with a stake in biobased industries development in the Cairns region.

This focus exercise, utilising a *Fishbowl Enneagram* process, was undertaken as an adjunct to the Force Field (Situation) Analysis conducted in October + November 2004.

Background: It was identified during the November FFA exercise that for the industry cluster to go forward, members needed to take a step back and look at the finer niggling issues head-on. The questions that needed to be considered included:

- What is the current state and identity of the cluster (i.e., who are we and where are we)?
- How functional is our relationship, how well do we work together?
- How are we handling information critical to this community and is there a will to continue working together?
- What is the intention of the cluster going forward?
- What ground rules do we need/require to move ahead?
- What are the critical tensions/issues/dilemmas that we have either individually or as a cluster?
- What is the new context/structure/way of working together that is needed?
- Who will do what and when? What do we actually need to do (relate back to intention of the cluster)?
- How well do we reflect, adjust, learn and move forward (i.e., deep learnings)?

The following annotations are from the dialogue generated from the *Fishbowl Enneagram* exercise. It is intended that actionable key findings from this session will be combined with the *Force Field Analysis* results and incorporated into a future action agenda.

[There was difficulty in trying to relate some of the discussion back to the specific order of questions on the agenda, so these have been lumped together under 3 groups of questions:]

1. What is the current state and identity of the cluster (i.e., who are we and where are we)?
2. How functional is our relationship, how well do we work together?
3. How are we handling information critical to this community and is there a will to continue working together?

- Tendency to focus on getting the $'s rather than on how to use the $'s. Funding is affecting what the cluster wants to do i.e., bound by the objectives of the funding.
- Same people around table/haven't attracted new people with new ideas
- Need to keep momentum going with new people & "passion" – members need to drive the cluster.
- Identity – on website, but BioNQ is not well known outside the group
- Original focus – forum for people who have an idea to discuss it in a non-threatening and confidential setting i.e. "business incubator". This is OK for current members but still threatening for outsiders (versus other forums)
- Have expectations of current members been met? Is the current structure meeting member's needs? Different for each member, depending on their needs
- Need to talk about your customers – who are they? What do they want?
- What do our customers want? (Who are our customers? Do we know?) – Initially the group members; if current members aren't satisfied, they may leave.
- Is there a will to continue in this format? – Yes, there is a desire to carry on. Perhaps there are opportunities lost on the way, but it's not necessarily a bad thing to be in now.

4. What is the intention of the cluster going forward?
5. What ground rules do we need/require to move ahead?
6. What are the critical tensions/issues/dilemmas that we have either individually or as a cluster?
7. Who will do what and when? What do we actually need to do (relate back to intention of the cluster)?

- Desire to move on/grow but need critical mass!!
- Need to get some runs on the board. We were the customer and we still are. Need to create more opportunities. How do we measure it? At the moment it's about membership numbers, but it could be others. Stability, commitment – this drives the cluster – we don't want to lose this – recognise the attributes that sustain the cluster.
- Need to move beyond current focus and try to provide a service for others.
- Different levels of service – e.g. some may be happy with current service but others may want access to more formal services

- Why does this cluster persist when others have fallen? – personalities and commitment
- More engagement, how do we make this happen? Focus to date has been on "managing" the cluster rather than on implementation and engaging the "bio-industries" and associated groups (councils, etc); strategic intent hasn't changed. Perhaps need to separate management of cluster from its actions – in engaging the region.
- Waiting for results of RIRDC mapping exercise to identify potential members; Malanda report, etc will greatly assist in this process.
- Group is well organised and has clear strategies but has recognised the need to change/rethink direction.

8. What is the new context/structure/way of working together that is needed?
9. How well do we reflect, adjust, learn and move forward (i.e., deep learnings)?

- Are we a network or a cluster?
    - Network = custodians of knowledge, connections, support/mentoring
    - vs Cluster = economic outcomes; a network of businesses coming together for commercial gain.
    - BioNQ = a network, initially formed with intent of commercial gain, but biotech/tropical expertise is a new industry ➔ evolutionary process.

- How to continue as an effective network/engage with the community?
    - Need clear vision
        - what is main function of group?
        - who are our customers?
        - what are their needs?
        - how do we meet their needs?

- Need to tell the region what the cluster is doing. What's the impact? Tell it in everyday language to the public (easier said than done – who's going to do it when resources are limited?).
- All relates to tropical knowledge in a large way.
    - Need to advertise what BioNQ can offer
        - tropical expertise and knowledge?
        - other organisations/community also have knowledge and expertise to contribute
        - communicate the successes

    - Commercial connections are critical – will make it sustainable – it's what makes us survive.

    - Management structure – network is the starting point – continuum – to a true cluster. At some point in time, the network was formed for commercial gain. We're not an industry that's been here for 100 years. We're a cluster still, but we need to grow from this network to a cluster…marketing is one mechanism…

- Success of members should acknowledge BioNQ's involvement in getting them there.
- Build the group until it becomes economically efficient/ sustainable at some point in time. We need to compensate BioNQ – self-perpetuating?

- Is it critical to have a full time coordinator? This is dependent on continued funding; need to build to financially stable position to warrant a coordinator; currently, govt funded position/lose when funding stops.

- Alternative – no. people with different skills/expertise to fill different roles (administrative, marketing, etc). Approach to have BioNQ facilitated by its members. Share the workload – e.g. rotate executive positions.

    - identify the skills/experience required and if not available within the group, target new members who have the skills
    - flexible management structure
    - every member has a role

- Main function of the group is agent of change – progress change – help people to do that
- Selling strategy? – need dedicated position to promote group. Suggest we find someone in the group to do that?

Appendix 3: The Role of Clusters in Technological Development (CAP, May 2005)

The role of clusters in technological innovation

Submission to the House of Representatives
Standing Committee on Science and Innovation

Inquiry into pathways to technological innovation

Clusters Asia Pacific Inc.
May 2005

Contents

1. Background

The House of Representatives Standing Committee on Science and Innovation seeks to compile a series of case studies of successful technological innovations, and the pathways to commercialisation.

Moreover, the recently released Australian Government's 2004-5 Innovation Report *placed strong emphasis on the need for increased collaboration between industry and research organisations in order to achieve the desired outcomes of increased innovation and commercialisation of innovation.*

Clusters Asia Pacific Inc. (CAP) is vitally interested in this subject, and this submission documents some case studies for the attention of the Standing Committee. We would be most interested in attending any hearings in order to provide supporting material and further explain how clusters can provide robust pathways to innovation.

CAP's specific interests

By way of background, we are an organisation comprising professionals involved in facilitating the development of industry clusters to generate investment and innovation outcomes at a local and regional level. CAP has a substantial track record in utilising clustering techniques to build the collaborative framework necessary for innovation.

The outcomes we seek are in three areas:

Innovation – this involves the development of improved systems to commercialise research, connect researchers with industry, build research consortia and diffuse technology. Government agencies continually wonder about how to get firms to collaborate – we have documented evidence of superior techniques and real outcomes in this field.

Investment – clusters often develop as a result of investments in research or education facilities, airports, transport hubs, water infrastructure etc. Our members are variously involved in infrastructure audits and business analysis associated with such investments.

Trade/Aid – CAP was the first agency to promote 'linking clusters' across countries to generate two-way trade and investment opportunities. We also intend to build clustering concepts into aid activities in the Asia Pacific region. The UN and World Bank place great emphasis on capacity-building - clustering concepts are a proven means of delivering this.

The benefits of clustering concepts have been widely discussed in recent years. It was triggered by the seminal work of Professor Michael Porter ('The Competitive Advantage of Nations') in the late 1980s. Since then others around the world have done a substantial amount of research on clustering and collaboration.

CAP has been a major contributor to the body of research, and in applying the research results to develop best practice cluster methodologies and tools that facilitate innovation, industry capability building, international competitiveness and export outcomes.

CAP argues that innovation is essentially the smart application of knowledge, and finding more imaginative ways of doing business. However this depends on connectivity in various forms – without it, innovation rarely occurs. The direct relevance of clusters is that they are a proven method of encouraging collaboration and connectivity between businesses, between businesses and research institutions (e.g. universities, CSIRO) and between businesses and government.

This submission argues that if the Australian Government is serious about research collaboration and commercialisation, it should develop a detailed cluster policy. AusIndustry's Business Network Program provides a foundation.

2. The role of clusters in the innovation process

There is misinformation about industry clusters. A simple definition is that they are groups of independent companies and associated institutions (e.g. TAFEs, universities, research institutions) that are:

- Collaborating and competing;
- Geographically concentrated in one or several regions - although the cluster may have global dimensions;
- Specialised in a particular field, linked by common technologies and skills;
- Either science based or traditional;
- Have some form of governance i.e. they have a proper cluster management.

The worldwide literature indicates that high-performing clusters have a positive influence on:

- Innovation and competitiveness;
- Skill formation and information;
- Growth of long term business dynamics.

> 'The cluster approach focuses on the linkages and interdependencies among networked actors for bringing about innovation (systemic activity that requires an active search process).'
>
> - OECD Working Group on Innovation & Science Policy

An industry cluster is an advanced form of business network that involves public sector organisations and addresses infrastructure issues (which business networks rarely do).

- They provide a focal point for investment
- Assist in commercialisation of research
- Build value chains into export markets
- Identify champions to drive engagement process.

Clusters can also address environmental and social issues.

Innovation is a process which creates new knowledge and through this knowledge generates economic growth, environmental sustainability and social well-being. It involves the development of improved systems to commercialise research, connect researchers with industry, build research consortia (e.g. Australian Mineral Industry Research Association) and diffuse technology (e.g. Australian Microelectronics Network). Cluster facilitators (mostly CAP members) have demonstrated superior techniques for collaboration and can document real outcomes.

Clusters often develop as a result of investments in research or education facilities, airports, transport hubs, water infrastructure.

Clusters support firm leadership

The biggest challenge in getting organizations to collaborate is to find a group of CEOs with a common mindset. Often a lead company is needed to leverage other companies into the collaboration agenda.

For example, Priority Engineering Pty Ltd, in Adelaide (MD Mr. Peter Page), has been and still is involved in bringing other companies into collaborative agendas in the advanced manufacturing field. The process was assisted by the role of a facilitator from the City of Playford who worked with the companies to achieve their target outcomes.

Clusters support research & market linkages

Clusters can be demanding customers for R&D Centres and Universities. Clusters can help set priorities for R&D institutions. Clusters can become incubators without walls. They surround R&D programs, allow then to grow, develop etc.

Support from the Chief Scientist

Australia needs to shape a program that kick-starts new companies and helps them grow towards global opportunities.

Western Sydney has the power to develop powerful regional ICT and biotechnology clusters, and become a role model. Regional collaborations which concentrated on innovation and excellence would deliver significant economic results.

A prime example of this approach is the marine science cluster, where a range of organisations have collaborated for work on toxins from cone shells – this cluster has cost about $20 million in funding, but now looks like delivering a return of around $200 million. Not every venture will be a winner, but when you get the right focus and clustering for critical mass, that is what will happen.

- Australia's chief scientist, Dr. Robin Batterham, Global Knowledge Economy conference, Sydney - November 2002

Incremental innovation

While disruptive innovation can involve new technology (e.g. podcasting, wireless networks) and is favoured by the investment community, it also can involve new methods of doing business (e.g. Aussie Homeloans).

However the number of disruptive innovations is small in comparison with the power of market driven **incremental innovation**, a key driver of which is "what customers demand". Most incremental innovation occurs in either:

- Procedural
- Personnel
- Process, or
- Structural activities.

Incremental innovation in conjunction with the often unrecognised transformations in business models and in the competitive behavior of firms, are the vital ingredients for sustained long-run business performance. Clusters provide the framework for incremental innovation.

3. Australian experience

This section provides an overview of some of the cluster activities in Australia designed to facilitate improved innovation outcomes.

A. The Applied Collaborative Innovation Alliance

The attached paper by Frank Wyatt summarises cluster initiatives developed through an alliance between Business SA and Enterprise Partnerships Pty Ltd and addresses many of the issues being covered by this inquiry.

B. The Water Industry Alliance in South Australia (www.waterindustry.com.au)

The Water Industry Alliance is a cluster of companies and associated businesses associated with the Water Industry. The intent is to build better integrated leverage from closer alignment with and the involvement of public research institutions such that the Alliance embraces innovation, investment and export development.

The original function of the cluster model always envisaged synergistic leverage from greater integration between the functions of applied research and commercialization in building a creative culture of entrepreneurship. Following an initial focus on developing linkages between the players, the

Alliance has now moved to further capture the original intent by way of seeking to develop a platform and process for engagement and enablement of linkages between applied research [public and private] and commercialisation.

Ref: Cluster Innovation System Report *WaterIndustryAlliance* Report | Appendices

C. Innovation and the Knowledge Economy

Innovation and the Knowledge Economy (City of Playford Publication Dec 2003) outlines how the City of Playford, an industrial council in northern Adelaide, is developing local solutions to addressing issues of globalisation.

The report includes input and case studies on best practice supply chain management, entrepreneurship, clusters, cities and a practical guide to building business networks, by national and international experts Rod Brown (Australia), Dr Peter Brain (Australia), Charles Landry (United Kingdom), Ryan, Giblin & Green (Ireland), Des Masters (Australia), Bryan Moulds (Australia) and Alistair Nolan (OECD, Paris). This report was written and compiled by Rodin Genoff and Graeme Sheather.

D. Clusters Innovation and Investment

Clusters, Innovation & Investment reports on the latest developments and thinking on industry clustering approaches from around the world.

This book is essential reading for policymakers, industry practitioners, businesses and research agencies. Topics include:

- The importance of clusters to Australia
- 'Scotland the Brave' - the Scottish approach
- The Competitiveness Institute conference in Glasgow - the key issues according to world experts
- The 'Linking Clusters' initiative
- Overview of Australia-New Zealand clusters

E. Food for Thought

The City of Playford's *Food for Thought Report* was launched by SA Treasurer Rob Lucas at the Manufacturing Prosperity Conference.

After interviewing over 100 companies and stakeholders 24 action agendas were developed covering:

- Environmental management
- Economic infrastructure
- Market development
- Industry development.

The report concluded with a chapter on innovation. The authors found that most of the innovation undertaken by small to medium sized enterprises is incremental in nature.

Outcomes of the project included formation of new company networks and regional road infrastructure initiatives. The project stretches from Northern Adelaide into the Barossa and Adelaide Hills.

F. Cairns Regional Economic Development Corporation

The Cairns region has one of the most developed and effective cluster group formulas in the world. Based on a philosophy of regional businesses competing collaboratively in the global marketplace, the system has proven success in assisting the growth and development of a diverse range of industry sectors.

Each industry cluster operates autonomously while remaining under the umbrella structure of CREDC. This allows for industry-driven economic development with tangible and holistic support from other clusters and economic and management expertise from CREDC. Some of Cairns' key clusters are:

- Australian Tropical Foods
- Aviation
- BioNQ
- Cairns Region Flowers
- Cairns Region Engineering Network
- Creative Industries
- Ecofish TNQ
- Information Technology
- Northern Developers Industry Association
- Sports TNQ
- Study Cairns
- Super Yacht Group Great Barrier Reef

For details see www.credc.com.au

4. Overseas experience

G. European Commission

The European Commission in their *Final report of the expert group on enterprise clusters and networks 2002,* "recognises that clusters and networks are important settings for the development and growth of SMEs because they help improve productivity, increase innovation capacity, facilitate the commercialisation of innovation and generate high employment. At a higher level, clusters and networks enhance the economic as well as the social growth of the region or nation hosting them.

The Commission experts suggest that policy towards clusters should be based on public authorities supporting embryonic and existing clusters rather than trying to create them from scratch.

The EC experts argue that basic policy on clusters should provide a framework for dialogue and inter-firm cooperation as well as cooperation between small enterprises, higher education and research institutions, public and non-public organisations at local national, European and International level. Public sectors should limit themselves to providing a catalytic role.

Regional dimensions

The European Union is providing 400 million euros to assist the less-favoured regions to cope with globalisation, while promoting economic and social cohesion in the EU. Their thinking is to develop competitive assets based on innovation, rather than competing on costs (particularly wage costs) - such an advantage can be swiftly eliminated in a globalised economy.

The rationale is that the links in innovation systems are weaker, more fragmented or nonexistent in certain EU regions - firms are smaller, less innovative; little tradition and business culture re business networking; branch plants may be simply exploiting regional cost advantages; public agencies are not facilitating value chain networking through local subcontracting; SMEs are finding it difficult to access public funds for innovation/networking; government programs have long lead times for payment and implementation; universities in less favoured regions tend to be young, and have weak relationships with the private sector. Sound familiar?

Behind the EC thinking is the burgeoning literature about networks, regional competitiveness and innovation processes. This has gone on for at least two decades, viz.:

- 'industrial districts' from the Italian school
- 'innovative milieux' from the francophone and Spanish school
- 'regional innovation systems' via the Scandinavians, and
- 'learning regions' via the Americans, et al.

The common thread to each of these concepts is that localised networks are critical because they generate intense knowledge exchange (personal contact, economic/technological transactions, worker mobility etc.) and flexible and multidirectional networking among different agents (finance, technology centres, universities, firms, public agencies, business consultants, higher education). These localised networks are imbedded in social/institutional infrastructures that foster cooperation, trust and

reciprocity, facilitate the flow of strategic information, nurture alliances, and generate external economies.

H. Sweden

VINNOVA, the Swedish Government's Agency for Innovation Systems, is working for sustainable growth, through funding of problem-oriented research and the development of effective innovation systems.

Its prime objective is to obtain increased return on R&D investments through:

- strengthening the research component in innovation systems;
- supporting problem-oriented research;
- supporting areas with a high growth potential;
- promoting internationally competitive innovation environments; and
- supporting a national system of incubators and stimulating new R&D-based enterprises.

Regional Innovation Systems

Vinnova explains that these systems are the vehicle through which firms, research institutions and government interact, collaborate and drive (contribute to) the innovation process within a regional context.

A regional innovation system exists when most innovative firms are active within the context of a regional network or cluster. Vinnova argues that such a cluster must interact and collaborate with research organisations; institutions for collaboration; venture capitalists; local and central government bodies. Linkages between these various actors are essential for turning knowledge into competitive advantage.

Social innovation

Vinnova explains social innovation as the development of new ways of thinking, the creation of new ways of doing things (i.e. products, services or processes), experimenting with them, accepting them and using them in human, economic, technologic and social activities.

This is often a prerequisite for technological innovation – for example:

- How you interact, do things and think.
- The structure and the process of organising
- Social capital ("tacit" knowledge, values, attitudes, regional identity etc.)

Social and technological innovations are created in collaboration between different regional actors, networks and systems. The regional innovation and renewal capacity depends on the dynamics and functionality of the collaboration. viz.

- Shared values and a regional vision
- The ability to focus on growth areas
- Integration of resources
- Internal and external marketing

Ref: www.vinnova.se

I. USA

There is a strong body of US research that points to regions with strong universities tending to be more prosperous and innovative. The most obvious examples are America's leading technology companies emerging out of Silicon Valley (home of Stanford University) and Boston (home of Harvard and MIT). There is now fresh and compelling evidence to this claim in a new study by Bruce Kirchhoff & Catherine Armington, *The Influence of R & D Expenditures on New Firm Formation and Economic Growth*. The study was funded by the U.S. Small Business Administration, the Ewing Marion Kauffman Foundation, and the National Commission on Entrepreneurship.

The study argues that R&D spending increases innovation, competitiveness etc. The study confirms that R&D spending also has a strong effect on start-up business activity. It notes that a common criticism of university research is that it takes too long to create market opportunities. However the authors find that the lag time between the investment of R&D is shorter than previously expected.

The study notes that Schumpeter's argument that "creative destruction" enables newly-formed firms to commercialise inventions that increase overall demand. These firms "destroy" existing markets structures and redistribute wealth among the remaining firms. This theory and later findings confirm that while smaller firms cannot make the level of investment that larger firms make, their ability to commercialise technology and create new markets causes them to generate more innovations per R&D dollar than big firms. The knowledge generated spills over, and leads to innovative clustering that is prevalent in R&D intensive industries. These clusters form the base of a networked entrepreneurial community.

The study notes that researchers have often lacked empirical data to support this claim. The Census Bureau's database (the Longitudinal Establishment and Enterprise Microdata Set) made it possible to study all regions of the U.S. and to assess the impact of universities, such as the University of Iowa at Iowa City, the University of Alabama, University of Missouri at Rolla etc.

The report also argues:

- thinking of universities only in terms of research dollars is dangerous. The university's role as a "talent magnet" probably ranks as its most important contribution to entrepreneurial development.
- Other roles matter - entrepreneurs agree that the existence and strength of local entrepreneurial networks often determines their personal and community success.
- Universities can help jumpstart entrepreneurial networks - forming incubators, partnering with entrepreneurs, providing leadership and mentoring; publicly supporting their local entrepreneurs.

J. OECD

The OECD's Working Group on Innovation and Science Policy circulated a report in 2001arising out of its work on national innovation systems. The main points are:

- *Innovation seldom takes place in isolation but is systemic. The notion of a cluster is centered around linkages between (firm and non-firm) actors needed for bringing about innovation.*
- *Clusters are networks of production of strongly interdependent firms (including specialised suppliers) linked to each other in a value-adding production chain.*
- Clusters mostly also encompass strategic alliances with universities, research institutes, knowledge-intensive business services, bridging institutions (brokers, consultants) and customers.
- Proximity to shared resources (e.g. technological competence, key client, specialised labour) can be of importance to the functioning of clusters, although clusters are not exclusively or by definition regional or local.
- The cluster approach focuses on the linkages and interdependencies among networked actors for bringing about innovation (systemic activity that requires an active search process).
- The cluster approach offers a menu-approach …those involved in upgrading clusters can pick and choose, depending on the needs of the actors in a cluster.
- Cluster studies can in practice be used as a working method for policy making (i.e. policy learning) and as an economic development tool for strategic business development.

IT clusters feature high on the agenda of both policy-makers and innovation researchers. The cluster in Finland in which Nokia play a pivotal role (in its value chain 4,000 other firms are involved) is highly dissimilar from the case of Ireland (switch from FDI-based development strategy to developing an indigeneous ICT cluster) and the UK (various regional clusters historically strongly influenced by defence and spatial planning policies).

5. Concluding Remarks

This submission has highlighted the underlying rationale of clusters in promoting innovation at both the firm and regional level.

The particular relevance of clusters in the context of the Standing Committee's enquiry is that they provide pathways to innovation. Clusters are a connectivity mechanism at a number of levels:

- Engaging otherwise unconnected researchers.
- Engaging researchers with the 'right' type of companies i.e. those capable of taking research to the market.
- Linking Australian companies with overseas companies with a significant place in global markets.

There is a plethora of examples of Australian inventions failing the commercialisation test. In our experience, the chief failing is indeed the lack of robust innovation pathways. The standard excuses put forward for this are variously the lack of venture capital, the small size of the Australian market, the proliferation of SMEs, lack of faith in our home-grown science, and lack of government support.

CAP argues that these excuses are either a smoke screen or the symptom, rather than the cause. The overwhelming evidence is that the fundamental cause is that researchers and companies are wary of collaboration. In an increasingly competitive market place, people with ideas and intellectual property are reluctant to connect to others. As Frank Wyatt and Hugh Forde (SA-based CAP members) have realised, firms need to be taught how to collaborate. See Attachment 1.

The role for the Australian Government should thus to facilitate collaborative research efforts by funding a national cluster program. There are numerous precedents among other national governments – Canada and Sweden are two obvious examples.

The problem at the moment is that the State governments are picking up on the importance of clusters and Victoria, SA, NSW and Queensland have cluster programs in place. However the bulk of the public expenditure on R&D and its support mechanisms (e.g. Cooperative Research Centres, Centres of Excellence) are federally funded.

There is thus a huge opportunity for the Australian Government to use clustering concepts to achieve better innovation outcomes. We look forward to providing more detailed advice on how a clustering program might be established.

In the meantime, we would invite members of the Standing Committee to visit the Cluster Asia Pacific website www.capinc.com.au

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February 2005m

Glossary

biobased economy: an economy that uses renewable resources and environmentally friendly processes to develop products in a sustainable way. Improved understanding in biological, ecological and technological systems and changing consumer attitudes are making it possible to utilise biomass and waste organic materials in an efficient and economic manner — making possible an economy where industrial development is not adversely impacting on the environment and hence quality of life.

biobased products: commercial or industrial products, other than traditional food and feed, derived from biomass feedstocks. Biobased products include green chemicals, renewable plastics, natural fibres, and natural structural materials. Many of these products possess unique properties unmatched by petroleum-based products or can replace products and materials traditionally derived from petrochemicals. However, new and improved processing technologies will be required.

biobased technologies: those technologies that use biomass feedstocks as the raw material for making products or for producing energy.

biocatalyst: usually refers to enzymes and microbes, but it can include other catalysts that are living or that were extracted from living organisms, such as plant or animal tissue cultures, algae, fungi, or other whole organisms.

biodegradable: the attribute of a substance that can be broken down into simpler compounds by micro-organisms.

biodiesel: a biofuel produced through a process in which organically derived oils are combined with alcohol (ethanol or methanol) in the presence of a catalyst to form ethyl or methyl ester. The biomass-derived ethyl or methyl esters can be blended with conventional diesel fuel or used as a neat fuel (100% biodiesel). Biodiesel can be made from oil crops like soybean or canola, as well as animal fats, waste vegetable oils, or microalgae oils.

biodiscovery: the biodiscovery process typically involves the collection of samples of biological material; the discovery of bio-active compounds in those samples; and the development of a bio-product, such as pharmaceuticals, based on those bio-active compounds.

biocomposite: also known as natural wood/fibre composites, are materials made that include some type of natural material in its structure. All kinds of natural materials have been included or modified to be included in composite applications. Specialty crops like industrial hemp, kenaf, flax, soybean, guar, specialty timber and bamboo are being used to produce a range of modern biocomposites. Biocomposite fibres are increasingly being used in a range of applications: building materials, furniture, absorbents, insulation, adhesives and bonding agents, and biodegradable polymers for the auto and electronic industries. Biocomposite fibres are a renewable resource – unlike petroleum-derived products.

bioeconomic: an economy based on biological sciences and advances in related engineering disciplines and physical sciences.

bioenergy: the energy contained in material produced by photosynthesis (including organic waste) may be used directly or indirectly to manufacture fuels and substitutes for petrochemicals and other energy-intensive products. The production of energy from biomass, for example, can be direct (e.g., via combustion) or indirect (e.g., via conversion into ethanol or through gasification).

biofactory: the use of plants through molecular farming technology to produce plants that become “factories” without the need to build hard-infrastructure such as costly factories to manufacture a range of industrial products.

biofuels: fuels made from biomass resources, including the liquid fuels ethanol, methanol, biodiesel, and gaseous fuels such as hydrogen and methane. Conversion of biomass to fuels generally involves conversion to an intermediate (sugar or syngas) and then to a fuel by a catalyst.

biomass: organic matter available on a renewable basis. Biomass includes forest and mill residues, agricultural crops and residues, wood and wood residues, animal wastes, livestock operation residues, aquatic plants, fast-growing trees and plants, and the organic portion of municipal and relevant industrial wastes.

biomass resource: any plant-derived organic matter that is available for food, feed, fibre, energy, or biobased products on a sustainable basis. Includes agricultural food and feed crops, agricultural crop wastes and residues, wood wastes and residues, herbaceous and woody energy crops, aquatic plants, animal wastes, some municipal wastes, and other waste materials.

biopower: the use of biomass feedstock to produce electric power, through direct combustion of the feedstock, through gasification and then combustion of the resultant gas, or through other thermal conversion processes. Power is generated with engines, turbines, fuel cells, or other equipment.

bioprocessing: similar in concept to a biorefinery, where renewable feedstock is converted into bioproducts through biological agents (e.g. microbes or enzymes) and bio-/chemical engineering.

bioprospecting: the search for plant and animal species (and other biotic and biophysical resources) from which medicinal drugs and other commercially valuable compounds can be obtained.

biorefinery: a model to maximize the value of biomass resources. Based on the petroleum refinery industry concept, which refines crude oil and natural gas into numerous petrochemicals and fuels, biorefineries process biomass feedstocks into renewable energy, fuel and a wide variety of bioproducts. Each additional product produced in turn adds value to the total economic return of the biorefinery.

biotechnology: biotechnology is a term used to cover the use of living things in industry, the environment, medicine and agriculture. Biotechnology is used in the production of foods and medicines, the reduction of wastes and the creation of renewable energy sources. Recently, the word has come to refer more to the production of genetically modified organisms or the manufacture of products from genetically modified organisms [Biotechnology Australia].

catalyst: a chemical substance that increases the rate of chemical reaction without being consumed. Biological substances carrying catalytic functions are known as biocatalysts.

cellulose: the main carbohydrate in living plants. Cellulose forms the skeletal structure of the plant cell wall.

closed loop system: a process where the linear or open based industrial processing of take, make and waste, is replaced by the more environmentally approved cyclical or closed (loop) processing methodology, where the waste or output from one system or industry is used as an input for another.

energy crops: crops grown specifically for their fuel and energy values. These crops may include food crops such as corn and sugarcane, and non food crops such as poplar trees and sweet sorghum.

enzyme: a protein functioning as a biological catalyst. Enzymes accelerate (often by several orders of magnitude) chemical reactions that would proceed imperceptibly or not at all in their absence.

ethanol - C2H5OH: a colourless liquid that is the product of fermentation used in alcoholic beverages, industrial processes, and as a fuel additive.

feedstock: any material converted to another form or product.

f**ermentation:** the decomposition of organic material to alcohol, methane, etc., by organisms, such as yeast or bacteria, usually in the absence of oxygen.

fossil fuels: solid, liquid, or gaseous fuels formed in the ground after millions of years by chemical and physical changes in plant and animal residues under high temperature and pressure. Oil, natural gas, and coal are fossil fuels.

fuel cell: an electrochemical device that converts the chemical energy of a fuel directly to electricity and heat, without combustion.

greenhouse gases: gases that are transparent to solar radiation but that reflect infrared radiation (long-wave radiation produced by the solar-heated Earth) to trap heat in the Earth's atmosphere. Greenhouse gases include water vapor, carbon dioxide, methane, ozone, chlorofluorocarbons, and nitrous oxide.

industrial ecology: industrial ecology has been defined as the study of the flows of materials and energy in industrial and consumer activities, of the effects of these flows on the environment, and of the influences of economic, political, regulatory, and social factors on the flow, use, and transformation of resources. It is promoted as a way of finding innovative solutions to complicated environmental problems and facilitates communication among scientists, engineers, policymakers, managers and others who are interested in how environmental concerns and economic activities can be better integrated.

natural fibres: biomass fibres that are used to make paper products, some textile products, such as from cotton, and many types of rope, twine, and string. New products are being developed based on natural fibres including insulation, structural materials, reinforcing fibres for plastics or other composite materials, and geotextiles for soil erosion-control applications. These fibres are also being used to replace non renewable materials as fillers for many bioproducts.

nutraceutical & functional foods: these are food components that provide demonstrated health benefits above and beyond their basic nutritional functions. A functional food is similar to a conventional food, while a nutraceutical is normally isolated/ processed from a plant or animal source and sold in dosage form (e.g. as an over the counter health product).

oil refinery: an installation where crude oil is cracked and various fractions of oil (which have different weights, boiling points, and condensation points) are separated by distillation and treated to provide many different petroleum products.

pharmaceuticals: drugs and medicinal products.

plant molecular farming: (PMF) also known as biopharming — the use of transgenic science to produce pharmaceutically important and commercially valuable proteins in plants such as tobacco and corn.

polymer: substance consisting of large molecules that are made of many small, repeating units called monomers. Most of the organic substances found in living matter, such as protein and wood, are made of polymers. Many synthetic materials, such as plastics, are also polymers.

renewable (energy) resource : a resource replenished continuously or that is replaced after use through natural means.

starch: white, odourless, tasteless carbohydrate powder that plays a vital role in the biochemistry of both plants and animals, which convert starch to glucose for energy. Commercially, starch is made from corn or potatoes. It is used to make corn syrup and corn sugar, to sweeten foods, and in the paper and textile industries.

sugars: a number of chemical compounds in the carbohydrate group that are readily soluble in water; are colourless, odourless, and usually crystallizable; and are more or less sweet in taste. In general, monosaccharides and disaccharides are termed sugars. Sugars are not only used in foods but also are raw material for producing alcohols, acids, and other products.

References

AAFC (2004) *Stevia rebaudiana*: Its Biological, Chemical and Agricultural Properties. Agriculture and Agri-Food Canada http://res2.agr.gc.ca/london/faq/stevia rev e.htm

Australian Government (2003) *A Plan for Action – Regional Business* ISBN: 0-9751001-0-6, published by the Commonwealth Department of Transport and Regional Services

Baby,P.S., Joseph, R., Mathew, G., Mathew, S and Joy,P.P (2004) Stevia-A sweet herb. Indian Journal of Arecanut, Spices & Medicinal Plants. Vol.6(1).

Biomass Research & Development Initiative. (2001). *Biorefineries: revolutionizing the production of bioenergy and bioproducts*. www.bioproducts-bioenergy.gov/1201.html

BioNQ (2005) *Commercial Agroforestry Production Systems Project.* Report to Australian Government Regional Partnerships Funding Program

BioProducts Canada. 2003. *Making the transition to a biobased economy*. www.bio-productscanada.org

Clusters Asia Pacific (2005) The role of clusters in technological innovation. Submission to the House of Representatives Standing Committee on Science and Innovation, May 2005.

Garner, A. & Keoleian, G.A. (1995) *Industrial Ecology: an introduction* (National Pollution Prevention Centre for Hugher Education, University of Michigan: Michigan)

Green Business Network. 2003. *GreenBiz Essentials: Biobased Products*. GreenBiz.com.

Holden, P., Tonello, P., Weeden, B., Visini, J. and Smith, M (2003) *Sowing the Seeds for an Integrated Sustainable Bioindustrial Farming System:* Presenting a Case for the Future of the Mareeba-Dimbulah Region of North Queensland. 1st Australian Farming System Conference, Highfields, Toowoomba.

International Society for Industrial Ecology. 2002. ISIE News. Volume 2, Issue 2, June 2002. 1-8.

Kleinhardt-FGI Pty Ltd (2005) *Feasibility Study Report – Small Business Incubator Cairns Region.* (Unpublished Report)

Kleinhardt-FGI Pty Ltd (2002) *Industry Clusters – A Review – History, Theory and Practice*

Kleinhardt-FGI Pty Ltd (2001) *Preparatory Work for the Investment And Trade in Regional Australia Package* (Unpublished research material)

Linde, C. Bibliography of cluster profiles. http://data.isc.hbs.edu/cp/index.jsp

Nutraingredients. 2003. http://www.nutraingredients.com/news/news-ng.asp?id=38984-cocoa-wins-antioxidant

Roberts, R.H., (2000) *Benchmarking the Competitiveness of the Far North Queensland Region Economy* ISBN 0-646-3865-7

Rural Industries Research and Development Corporation (RIRDC). 2000. "New Pharmaceutical, Nutraceutical and Industrial Products: The Potential for Australian Agriculture" a report by Wondu Holdings Pty Limited. RIRDC publication No. 00/173. (RIRDC: Barton, ACT).

Saskatchewan Agricultural Biotechnology Information Centre (SABIC). 2001. Bioproducts and the Biobased Economy of the Twenty-First Century. *AgBiotech InfoSource* **Issue 64**, 1-3.

Solvell , O., Lindqvist, G., Ketels, C., (2003) *The Cluster Initiative Green Book.* www.cluster-reserch.org ISBN 91-974783-1-8

Taylor, J.C., Rapport & L. Lockwood, G. B. (2003). Octacosanol in human health. *Nutrition* **19**: 192-195