Searching for sustainable farm management through risk discourse.

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Abstract:

The citrus industry in the Riverland region of Australia experiences cyclical crises: in 2004-5 the bottom fell out of the orange market. Much to the dismay of the Riverland horticulturalists, the South Australian state government released reports that diagnosed the industry's problems and advocated prescriptions from a narrow economic perspective. This article proposes an alternative construction of feedback appropriate for the sustainability context. This feedback informs bottom-up decision making processes: its underlying assumptions extend beyond the interests of any one orchard in considering the needs of the local catchment. This alternative decision-making and stewardship-reporting information is constructed on holistic concepts of risk that integrate technical, scientific, economic, and socio-political consequences of horticultural activities. It stands in direct contrast to the narrowly configured profitability and productivity feedback that emphasise the economic aspects of horticulture and ignore its socio-ecological consequences.

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1. Introduction

The citrus industry is the second largest horticultural sector in the Riverland and it accounts for 4% of the local economy. Its 1.1 multiplier effect [1] indicates that it has a greater economic impact on the region. Consequently, the recent crisis in the industry is cause for alarm: 4,500 tonnes of Valencia oranges were dumped for want of a market during the 2004-5 season (compared to 800 tonnes wasted in June 2004)[2]. Every economic crisis has socio-political reverberations. In this instance, it has culminated in two reports[3] prepared by Primary Industries and Resources South Australia (PIRSA, 2005 a, b) and the third that has been released in conjunction with Rural Solutions SA (2005). These reports diagnose the causes of the crisis and provide strategic prescriptions that are intended to ensure a viable industry in the future. PIRSA's analysis of the 2004-5 crisis in the industry has identified the following contributory factors:

- Uncertainty resulting from a combination of uncertainty inherent in predicting citrus yields, and the absence of specific contracts between growers and packers/juice processors, contributed to opportunistic grower behaviour in speculating on spot prices;
- Higher average cost of production in Australia compared to foreign competitors especially in Frozen Concentrate Orange Juice market;
- Absence of objective indicators regarding fruit quality: such feedback could reduce uncertainty in the demand-supply relationship.

See Appendix K for summary and critique of PIRSA's diagnoses and prescriptions. An overview is set out below. With regard to uncertainty as a contributory factor, PIRSA (2005a) prescribes:

- Reviewing current forecasting arrangements (p. 20);
- Acknowledging the "inextricable link" between oranges sold as fresh fruit and those for juice. These 2 parts are to be connected by contractual arrangements (p.21): in other words, it would link growers and packers in a "more cooperative framework" (p.23), curbing grower behaviour of opportunistically speculating on anticipated supply shortfalls. Developing "long-term horizontal strategic alliances among growers and/or packers" as well as "vertical alliances between growers and packers" because "a

[1] Source: PIRSA (2005 b, p. 37, 40).
[2] Source: PIRSA (2005 a, p. 15).
[3] These reports (details below) are public documents and are available at http://www.pir.sa.gov.au/pages/agriculture/horticulture/citrusindustryreview.htm:sectID=449&tempID=1

1. The growing juice gap – opportunities for South Australia?
2. South Australian fresh citrus – issues and prospects.
3. South Australian citrus industry: situational analysis.

More specifically, the first 2 reports provide a S. Australian perspective while the third (prepared in conjunction with Rural Solutions SA) provides global, national and state perspectives.

> simple reliance on the market is not an effective way to manage the complexities of coordinating supply to numerous markets (domestic, export and juice)" (p.23).

On the question of average cost of production, PIRSA (2005a, p. 17) predicts a shortage of locally grown Valencias and an accompanying increase in imported FCOJ. However because it assumes that low-cost citrus producing nations like Brazil and the People's Republic of China would not pose a threat to the Australian industry in the medium term, it continues to advocate increasing the Riverland supply of Valencias albeit at a lower cost of production. The cost of growing citrus is to be reduced by increasing the size of the orchards through buyouts or cooperative management of common assets.

With regard to the need for objective and measurable quality standards, quality is to be ascertained by "specifying and monitoring the way in which the fruit is grown" as the quality of oranges is not evident at the point of sale (PIRSA, 2005a, p. 24). It is hoped that monitoring these proxies (of quality) would reduce uncertainty by identifying the proportion of the harvest to be sold as fresh fruit, and hence the residual remaining for juice. On the one hand, PIRSA notes that there are indications that the industry is already collaborating to develop standardised terms of contract in this regard. On the other hand, it unproblematically extends the implications of collaboration to economies of scale:

> "One implication of strategic alliance contracting of the desired sort is that the quality systems and other investments required to nurture the relationship tend to be of an up-front nature and this is a factor, additional to those mentioned above, that increases the economies of scale" (PIRSA, 2005a, pp. 24-5).

Perhaps this logic arises from the presumption that policing quality standards would make it easier to access export markets. However the harsh reality is that world trade is shaped by political priorities and national interests, instead of quality of produce.

It is important to understand the reasoning behind PIRSA's theoretical lens (in evaluating its reports on the industry) because this lens has been (implicitly) used to frame the problem (diagnosis) as well as shape its prescriptions. Such critical review of its reports would increase the likelihood of people embracing the consequent diagnoses and prescriptions because the revised realities should better reflect day-to-day realities. However, it is not usual for economic reports to state their perspective openly because mainstream economists often assume that their market oriented perspective is the only way to represent the real world. Nevertheless, we have come across the name of an economist, Oliver Williamson, in one of PIRSA's (2005b) reports. There is a strong indication that PIRSA's diagnosis and prescriptions have been constructed on Williamson's transaction cost economics (in conjunction with the long run average production cost curve function):

"Opportunism is a critical consideration in many economic undertakings and some academic writers have described the institutions of a modern economy, its firms and industry organizations, legal systems, etc as attempts to control opportunism (Williamson, 1985). Those institutions which survive are those that control opportunism most efficiently. That means the strategy is primarily about finding efficient means to assure quality, means that will not be undermined by opportunistic behaviour. It is about improved contracting, better collaboration and organisational innovation, all of which require transparency in dealings and long term relationships built on trust" (PIRSA, 2005b, p. 54, emphases original).

Whilst the economic perspective occupies centre stage in PIRSA's inquiry, we assert that there are greater challenges facing this region and the agricultural community in general. These challenges: the dangers that society confronts daily, but which are excluded from PIRSA's spotlight on economic performance. These dangers include the increasing toxicity of the soil, worsening water pollution and the consequences of global warming. Even though these sustainability concerns are already visible, they have been cast aside as aberrations in public discourses dominated by conventional economic emphasis on productivity and quality. PIRSA's reports make reference to these dangers in an incidental manner perhaps because neo-classical economic tools do not provide the means of acknowledging, or engaging with, these concerns:

"PIRSA has been assisting other sectors in developing strategic plans that aim to focus the joint efforts of industry and government on addressing the issues that are critical to long-term growth that is both profitable and sustainable" (PIRSA, 2005a, p.25, emphasis added).

"This report sets out a range of initiatives open to the industry….It will also use its Triple Bottom Line monitoring of economic, environmental and social outcomes to assess and monitor the industry's strategic direction" (PIRSA, 2005b, p.6, emphasis added).

"Finally it is important to note that the citrus industry has become more environmentally aware in recent years …awareness is also reflected in changes to irrigation methods" (PIRSA, 2005b, p. 35).

Not surprisingly, the local horticultural community's response has been less than sceptical.

"…Not surprisingly and not wanting to be too hard on the report I found it to be a total waste of time…Like many growers I was looking for answers: why we received nothing for juice fruit, why thousands of tonnes here [South Australia] and 36,000 tonnes of fruit in Victoria have been dumped, why are our export and domestic markets returning in some cases less than packing costs and why is our US exports affected by rot" (Chappel, T., 2005, "Citrus review a waste of time", Community Viewpoint, Murray Pioneer, Sept 30).

"The release of two citrus industry reports on Friday has been labelled a 'political stunt' by Loxton North grower Ron Gray. Mr. Gray said the reports, prepared by Primary Industries and Resources SA for the State Government, did not tell growers anything they did not already know about the state of the industry…Mr. Gray said that the suggestions presented in the reports as solutions to the citrus crisis would not work in the industry. 'They are

> telling us that we should form co-operatives, but we had them years ago and they failed' he said" (Murray Pioneer, 2005, " 'Stunt' says citrus grower", Sept, 27).

> "An interesting issue raised at the Citrus Growers of SA Annual General Meeting was the recommendation that growers boost the size of their operations. In theory this sounds fine, but it may not be so easy for those struggling growers to reinvest further into the same industry, and the question is will they even have the heart to take on more of the same?…Primary Industries and Resources SA chief executive Jim Hallion was spot-on when he said we are in the right place in the world to deliver the best quality fruit to the world. But, now more than ever, the business involves so much more than just growing a good crop" (Editorial, 2005, "Citrus outlook jury still out", Murray Pioneer, Sept, 27).

This article picks up the thread from the last assertion by Jim Hallion and it is structured as follows: it firstly takes a step back and locates this crisis in the broader context of the sustainability of human activity in the face of impending climatic consequences attributable to global warming. This article will argue that the challenges confronting the industry are much wider and deeper than those identified in PIRSA's reports: they relate to the sustainability implications of the industry itself. Consequently, we will articulate a more holistic alternative to PIRSA's diagnoses-prescriptions by constructing a broader diagnostic frame to facilitate a shift in mindset: this shift is fundamental for constructively engaging with the challenges of the 21st century.

Our framework engages with the risk of cultivating citrus: it becosmes a means of diagnosing the problems, seeking out solutions and providing accounts to stakeholders. It is hoped that the risk management approach proposed here may encourage the formulation of public policies that address impending social and environmental threats, which could have even more devastating and penetrating consequences on the economics of growing citrus than the current collapse of the fruit-for-juice market. There is little point in merely worrying about the loss of future market share when the very resources that are used to grow the produce are being slowly, but surely, destroyed by the practices that are applied in earning a living. Therefore the future of the farming community is to be found in the meaning and implications of this ambiguous and politicised term, sustainability. The task ahead involves formulating better understanding of sustainable horticultural practices by providing appropriate feedback that does not restrict responses to any one perspective, be it the economic, social and/or environmental dimensions. Because the solution to the broader problem of socio-environmental degradation cannot be confined within the boundaries of individual private properties alone, holistic feedback should encourage constructive dialogue among stakeholders. Such dialogue should enable every individual to acknowledge and accept responsibility for the health of the local region because sustainable development is a regional (and global) challenge that requires a corresponding scale of response (following Brunckhorst, 2000).

2. Global warming in twenty-first century civilisation: manifestation as risk society

The characteristics of a sustainable society will be drawn from Ulrich Beck's (1993) "risk society", or post-Industrial society. He explains that the industrial phase of developed countries had been driven by the logic of control, as institutional and human citizens took advantage of the abundance of natural resources and expanding markets to pursue economic growth with little consideration for non-economic costs. It has resulted in unacceptably high levels of socio-environmental degradation. On the one hand, this state of degradation raises serious doubts about whether this rationale and its growth fetish may be sustained. On the other hand, society still has to live and function within these (inherited) conditions of socio-environmental degradation: thus this society is called risk society because of the likelihood that its continued (and unproblematic) adherence to the logic of control could aggravate the state of degradation.

Despite painting a gloomy picture, Beck is optimistic that society will rise up to the sustainability challenge and develop reflectively: in practical terms, it involves reforming consumption habits and production methods. We moderate Beck's optimism by asserting that this reform will not occur uniformly across all sectors. It will initially take place where the dangers posed by Beck's risk society are the greatest (namely where it poses greatest danger to the livelihood of local communities), and its ethos will gradually diffuse out to the rest of society as citizens experience the consequences of global warming. The societal consequences are already here despite disagreements over whether global warming and climate change are even occurring: in the aftermath of hurricanes Katrina and Rita, Carlisle (2005) reports that insurance companies are re-considering whether weather related risks are insurable. Australia has experienced the braking effect of "insurance non-coverage" on its economy after the collapse of its insurance giant, HIH Limited. Further, the absence of legislations that spell out minimum greenhouse emission standards (in the US and Australia, the two non-signatories to the Kyoto Protocol), has resulted in greater uncertainty in the capital market: investors are refraining from investing in traditional dirty technology for fear of stricter environmental legislation in the future. They are also not investing in the more expensive clean renewable technology because there is currently no (legal) imperative to do so.

Farming communities are in the front-line of environmental degradation because unsustainable management practices continue to damage the primary assets that farmers depend on, land and water. Consequently, community members are working cooperatively and reflectively together to reduce continued degradation of catchment areas: such communities have been called action network groups (following Carley and Christie, 2000). Responses to the sustainability challenge have to be constructed collectively because sustainable management of resources cannot be confined within individual farm boundaries.

This concept has already been advocated through the UN's Biosphere concept of resource rehabilitation (Brunckhorst, Bridgewater, Parker, 1997): it has in turn informed the concept of closed commons practised in New England, Australia (Brunckhorst and Coop, 2000). The sustainability ethos of networked communities permeates out to the rest of society, increasing awareness and knowledge about risk associated with unsustainable practices. Ultimately, the state (spurred on by threats to the national rate of investments) will be forced to take regulatory action to address growing unease about the longer-term consequences of global warming and other forms of pollution. The market itself has, and will continue, to engage with this emerging reality by creating new instruments that reward responsible behaviour, such as carbon credits and marketable water rights. However, no one single response is sufficient to address the degradation that exists in risk society.

3. Definition of sustainability

What does sustainability mean? Elkington (1999a, b) has coined the term Triple Bottom Line as a way of engaging with this ambiguous reality: unfortunately it has become a means of obscuring the need to consider radical changes in consumption patterns and production methods (Tokar, 1997). Elkington also does not provide guidance as to how the three bottom lines are to be constructed so as to engender reflective behaviours and decisions. Korhonen (2003) provides insight into the complexities in formulating sustainable practices: he describes the process of adapting to sustainability challenges as juggling the social, environmental and economic priorities. One of the farmers interviewed in a 2003 study carried out by one of the authors captured the uncertainty and ambiguity (despite the immediacy) of the problem by defining sustainability as "slowing down the rate at which the window is closing" on agriculture (Saravanamuthu, 2007).

4. Implications of uncertainty and ambiguity surrounding sustainability

There are several implications arising from the uncertainty and ambiguity surrounding the meaning of the term, sustainability: its vagueness means that the search for sustainable practices has to be informed by feedback on the consequences of decisions made, which in turn has to be continually updated (or revised) in line with increasing knowledge about the holistic impact of human behaviour on the eco-system, bio-diversity etc (Saravanamuthu, 2006b). Feedback cannot be confined to economic indicators alone because economic measures are constructed on assumptions that reinforce the logic of control, which has already culminated as risk society (Saravanamuthu, 2004). On the one hand, the economic dimension is important because society will not embrace reform (in the interest of greater sustainability of resources) if it jeopardises people's livelihoods. On the other hand, society cannot continue on the path of development that has delivered industrial prosperity because its pace of growth (and control logic) cannot be sustained.

The approach proposed here firstly acknowledges that humans are an integral part of nature. Humans share an interconnected relationship with other forms of matter and the relationship manifests as a dynamic eco-system. In other words, societal actions shape, and are shaped by, the state of the atmosphere (climate), water resources, vegetation and biodiversity. This notion of interconnectedness is the foundation of Eastern philosophies as well as worldviews of native communities, which advocate a closer socio-spiritual bond with the land. Here we use an interpretation of the Eastern *Vedic* philosophy to develop appropriate feedback systems. The *Vedas* have been traced back to 5000 BC. We apply a *Vedic* interpretation that has informed Gandhi's politico-moral struggle to identify sustainable economic and social strategies for an independent India: that is, we draw on his strategy of *satyagraha* that had been used to challenge the imperialist ethos in British India. Gandhi's *satyagrahic* mode of engagement is central to the formulation of an alternative development model because it asserts that people are empowered when they accept responsibility for the other (including nature). *Satyagraha* aims to emancipate society from the circular logic of unsustainable growth by creating the space for stakeholders to reflectively reform consumption patterns and production methods. Conversely, non-*satyagrahic* attempts to reform merely reinforce private interests instead of promoting responsibility for the other (be it another person or nature). Such reform fails because people's fear of the unknown causes them to consent to the circular logic of the unsustainable growth fetish (Saravanamuthu, 2005).

Secondly, the framework has to reflect growing awareness/knowledge of human-nature interconnectedness. It has to be a means whereby feedback informs management actions, and lessons learned from these actions should in turn inform how the feedback is reconstituted. Consequently, this framework becomes a means whereby members of networked communities provide accounts of their actions to each other, as well as to other stakeholders (such as the product market and state regulators). In short, it is an accountability framework that drives, and is in turn, driven by, increasing knowledge about eco-systems, bio-diversity, climate change, water pollution, salination etc. Thus, the framework is a vehicle to provide accounts that emphasise means over ends within a cultural context of experimenting with better ways of carrying out business activities (Saravanamuthu, 2005). It should reduce the economic growth's dichotomisation of means from ends.

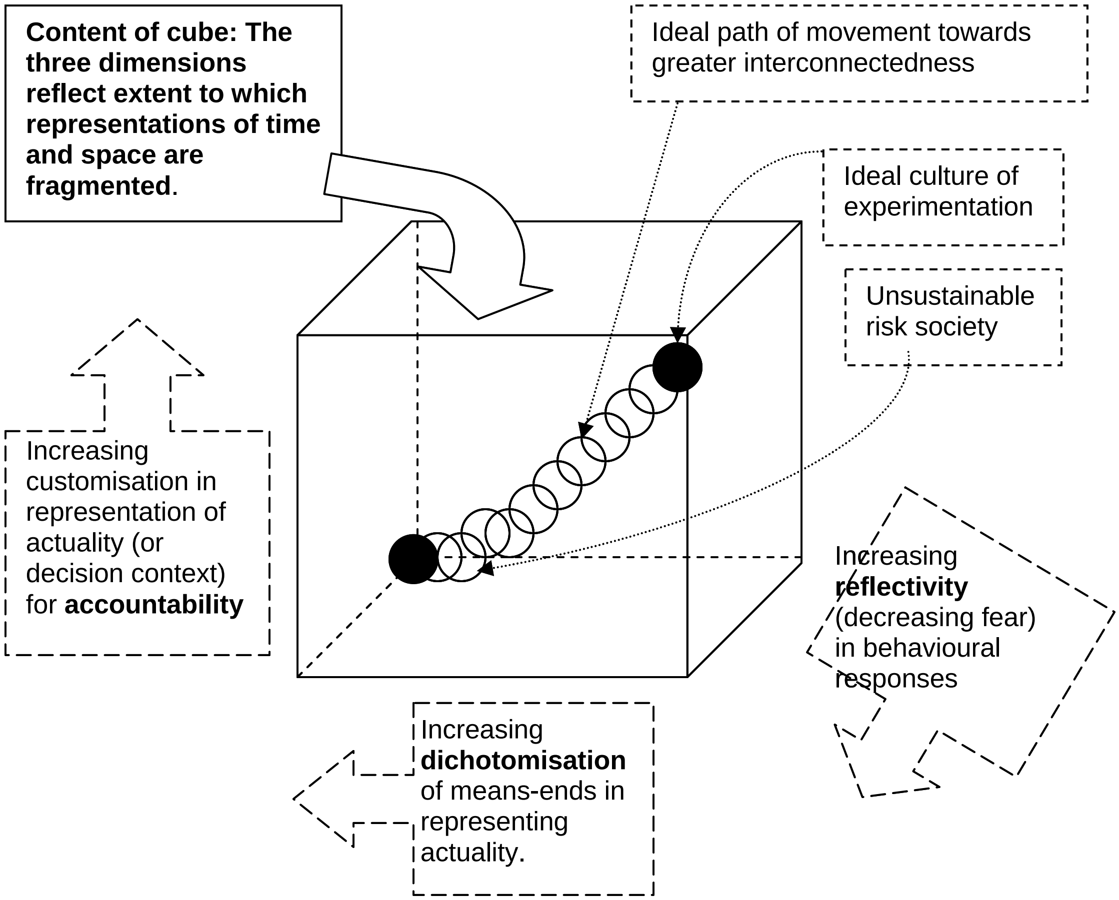
Thirdly, the proposed vocabulary of accountability has to connect the farmer to regulators and consumers. How is this to be achieved when the meaning and implications of the term, sustainability, are ambiguous? Here it is argued that sustainability cannot be represented using a single definitive ethos and/or measure: for instance, the accounting discipline has conventionally prioritised profitability, productivity, efficiency and yield as the primary indicators of (acceptable) performance. This single dimensional approach cannot be justified any longer: there is a need to acknowledge the multi dimensional aspects of performance. It involves engaging with the conventional notion of externalities, namely, the social, ecological and environmental facets of performance (Saravanamuthu, 2004, 2006 a).

Fourthly, conventional accounting fragments holistic systems that are represented here through its constituent dimensions of time and space (Saravanamuthu, 2006 b). In contrast, socialised risk-management principles should minimise the chances that a reflective actor's actions may result in undesirable consequences (following Luhmann, 2005). Therefore, the framework of risk-based accountability advocated here will explicitly evaluate the impact of "dangers" posed by the cumulative effects of choices made previously (that has culminated in Beck's risk society): even though the outcomes of "dangers" are beyond the control of the individual, these dangers will colour the risk decisions of an individual. This risk management approach also will also ensure that feedback may be more readily tailored to meet local circumstances, thus minimising the chances of promulgating universal measures that are irrelevant to domestic conditions.

The risk management framework proposed here (Figure 1) is one that grants equal weight to socio-environmental and economic priorities by embracing the following tenets of responsible accountability:

- Customise feedback to suit local circumstances;
- Emphasise means over ends; and thus
- Increase the chances of a reflective behavioural response.

Figure 1 represents the interconnected and interdependent relationship between humans and nature through the 2 dimensions of time and space. As it is difficult to show "holistic" outcomes, Figure 1 represents it in reverse through the minimisation of the fragmentation of time and space. Human decisions/behaviour is influenced by feedback that preference actions that minimise spatio-temporal fragmentation of the human-nature relationship.



Key:
Height of square box represents degree of customisation in accountability.
Length of square box represents degree of means-end dichotomisation in representing actuality.
Width of square box represents range of reflectivity-fear behavioural response.

Figure 1: Framework governing the proposed risk management tool of accountability
Source: Saravanamuthu (2006c).

This framework will be applied in the following section using operational data of one of the horticulturalists (the co-author, Howie) who participated in a case study research carried out in 2003 by the other author, Saravanamuthu.

5 Case-study of citrus industry in the Riverland

This 2003 research (above) documented the lived experiences of a group of citrus growers who were experimenting with the sustainability ethos: it adds a social dimension to a CSIRO study (Colloff *et. al*, 2003), which had been carried out a couple of years earlier, because the CSIRO study had focussed on the economic, ecological and environmental aspects of sustainability only. Howie is a founder member of this group of growers, which subsequently incorporated itself as the Movement for Ecologically Sustainable Horticulture (MESH) in 2003. MESH is a community-based collaborative effort that seeks to ensure the long term sustainability of horticultural practices: it had emanated from the UNESCO's "Man and the Biosphere" program, which in turn had been established in the mid 1990s as an experimental site to restore a degraded area in the Riverland region of South Australia. This restorative programme was known as the Bookmark Biosphere, and it has recently been renamed the Riverland Biosphere. MESH's aim has been to promote sustainable horticultural techniques, and develop an eco-label endorsed by the Biosphere to market participants' produce. The eco-labelling scheme incorporates a hands-on education programme for horticulturalists and consumers alike: the vision is to enhance vertical and horizontal communication among stakeholders in the industry through a culture of learning and experimentation. This vision hinges on the establishment of an electronic database to accumulate holistic performance data and provide appropriate analyses to MESH members. One of the analyses could be a discursive risk management means of giving accounts to stakeholders: it will be developed in section 5.1. MESH was (and continues to be) comprised of a small group of growers who practise a range of horticultural practices (from conventional to organic) but who share a strong sense of environmental responsibility.

5.1 CSIRO study: Colloff *et al*., 2003.

The CSIRO study had segmented horticultural practices into 4 categories even though such black-and-white classifications had not been obvious in existing farms: high-tech, conventional, pesticide-free and organic horticulture (Figure 2).

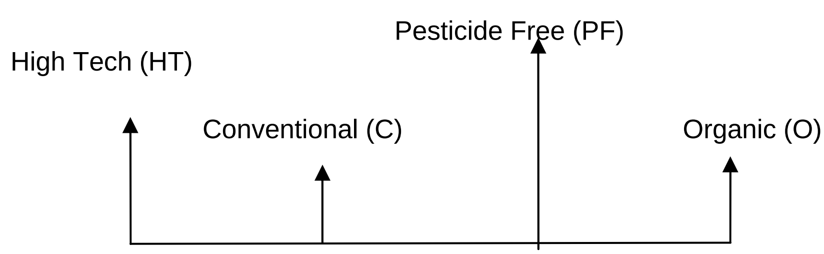


Figure 2: Continuum of horticultural methods as per Colloff et al., 2003.

Generally, the HT category implied the following traits:

- High usage of artificial chemicals in the form of pesticides, fertilisers;
- Intensive application of technology with aim to increase yield;
- High volume market;
- Growers depend on organised commodity market to sell volume of produce.

Traits of the C category:

- Traits similar to HT but generally less intensive use of artificial chemicals and technology;
- High yields as a means of minimising costs;
- Growers depend on (middleman) corporations to market the produce.

Traits of the PF category:

- PF differentiates its product from C by not using chemical pesticides;
- PF competes with HT and C in the market place as it is not sufficiently differentiated (like organic produce) to command its own niche market;
- Financially pressured to move to C or O.

Traits of the O category:

- Methods originate from heuristic methods of cultivation that involve studying effects of intervention on nature (see Bread from Stones: Julius Hensel);
- Rely on organic mulching to fertilise land, and limited use of copper, sulphur and whey to control pests and diseases;
- Growers belong to registering bodies such as (BFA or NAASA) that provide monitoring and audit certification process;
- Hence highly differentiated niche market.

Table 1 (below) summarises CSIRO's top four rankings of these horticultural categories using three different criteria of performance: cost minimisation, profit maximisation and efficient utilisation of energy. The CSIRO analysed 2 farms in each horticultural category: numerical digits have been added to the horticultural acronyms in Table 1 to distinguish between the two farms in each category. Tables 2 and 3 (in the Appendices) provide details of the summary rankings in Table 1 as well as the sizes of various farms.

Performance ranking of generic categories of cultivation	Based on economic criteria (Appendix: Table 2)		Based on sustainable energy usage (Appendix: Table 3)
	Cost minimisation	**Profit maximisation**	**GJ output/ GJ input**
1	C2	HT2	O2
2	PF2	PF1	O1
3	PF1	PF2	HT2
4	HT1	O2	PF2

Table 1: Performance ranking of generic horticultural categories based on competing criteria (from Tables 2 and 3 – see Appendix A and B respectively).

Table 1 shows that the performance of farms varies with whether the criterion applied is (dollar) cost minimisation, profit maximisation or, the ratio between energy generated and consumed.

Cost minimisation and profit maximisation criteria are based on Beck's logic of control, whereas efficiency in usage of energy represents an alternative logic of responsibility that is necessary to maintain a healthy interconnected relationship between human society and nature. The latter is implied in the socio-environmental framework (see Fig 1) because it fosters a culture of responsibility through the process of juggling the competing-yet-complementary social, economic and environmental priorities (following Korhonen, 2003).

Table 1 reveals the inconsistency between the logic of control (embedded in conventional cost and profit calculations) and sustainability's ethos of responsibility. Furthermore, when performance is restricted to economic criteria, the lowest cost producer (C2) is not the most profitable (HT2) probably because of HT's capacity to access the more financially lucrative orange market. This is not the end of the story because the conventional computation of costs and profits has treated socio-environmental repercussions of horticultural techniques as "externalities", even though these very externalities have contributed to the emergence of Beck's risk society (and Luhmann's "danger").

Saravanamuthu (2006 a) demonstrates that the cost criterion and, (by extension) the profit criterion, are not appropriate means of assessing sustainable performance. It has been reflected in the following observation made by one of the organic horticulturalists (interviewed in 2003) about the "fact" that the cost analysis in Table 2 (see Appendix A) shows that O cultivation has higher input costs (ranked at 7 and 5) than C (at 6 and 1):

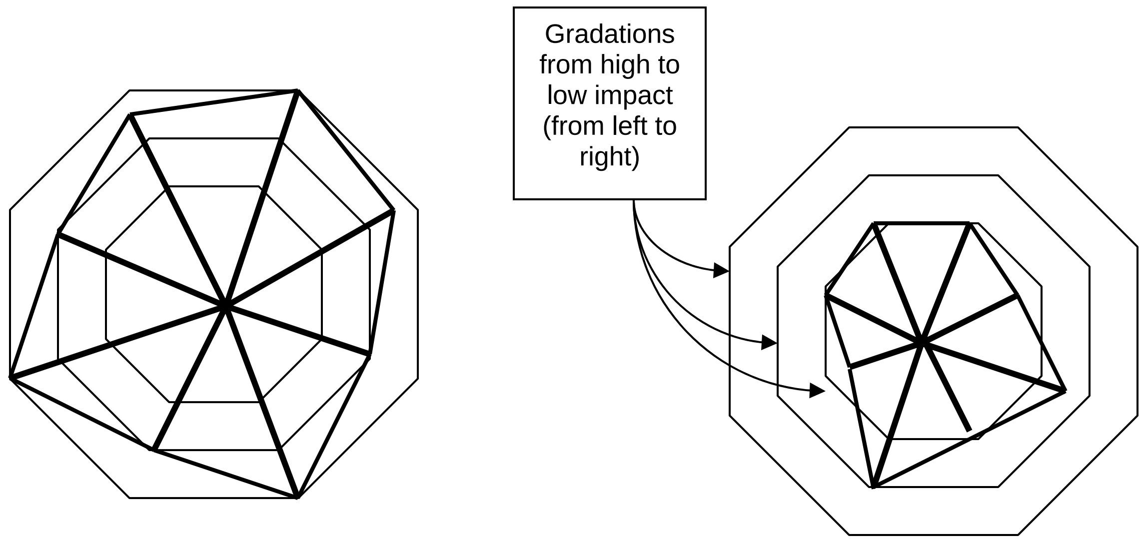
> "And I say it is absolute rubbish – I don't know where they get it from. For a start we don't use high cost chemicals…I know that from when we were conventional: we had chemical bills a year of about $7,000 to $8,000. That's completely gone….Where the problem lies, it is all in the head".

It is "all in the head" is colloquial speak for criticisms that the conventional construction of costs (and profits) are based on questionable assumptions which dismiss all consequences outside the private interests of an entity as "externalities". Although it may be argued that farms of different sizes are not strictly comparable (due to the presumption that the larger farm enjoy economies of scale), the Canadian National Farmers' Union's (2003) counter argument exposes the myth that large-scale farming (reliant on expensive technology) is more efficient and price competitive than smallholdings. The CSIRO data (in Table 2) sends mixed messages as to whether the HT cost of production has been recovered through higher yields, economies of scale and fruit prices (see comparative data for HT1 and HT2). It also reveals that the variation between the 2 properties in the HT category for input costs and profit per hectare is greater than in either the PF or O categories.

When performance is recalculated by energy (generated versus utilised), both organic categories surpassed other groups as net energy contributors (instead of energy consumers). The inconsistency in ranking between performance criteria is also reflected in the wide swings in inter-generic operational data in Table 3 as well. Admittedly, the disparity could also be due to the reliability of data provided to the CSIRO study: doubts were voiced during the 2003 interviews over the accuracy of farm records, and the politics of data management to allay public sensitivity to socio-environmental degradation. Incidentally, even though PF appears to perform relatively well under the profit and cost criteria, PF farmers were under pressure to move to other generic categories as their produce was not sufficiently differentiated to command a compensating price.

Therefore there is a need to re-evaluate the practice of assessing performance by relying solely on economic measures. It should be replaced with more holistic representations of performance that will encourage reflectivity in community-based decision-making by recognising the uncertainty and ambiguity over the meaning and implications of the sustainability agenda whilst recognising the multiple aspects of the impact of human activity. This is the aim of our risk management feedback, which builds on contemporary social accounting literature.

Social accounting literature acknowledges the need to move away from rigid, one-dimensional representations of performance to feedback that encourage dialogue: the latter are referred to as discursive methods of accountability (Macintosh and Baker, 2002). Power (2004) encourages diagrammatic representation of risk as a way of engaging with the challenges of developing sustainably. Here, the radar plot is put forward as a means of granting all performance measures equal priority to create space for critically considering alternative ways of representing performance attributes. It becomes the means by which stakeholders in a networked group may legitimately engage with each other to (collectively) arrive at priorities and strategies in their search for sustainable land and water management practices. There are 2 radar plots: one for the introduced crop such as citrus, and another for native vegetation such as wattle.



3(a) Citrus tree **3(b) Native vegetation**

Figure 3: Framework for risk management and accountability (Source: Saravanamuthu, 2007).

The radar plot Figure 3(a) could portray measurements from any one horticultural method. The individual spokes of the radar plot represent different aspects of performance of the introduced crop such as citrus: it includes the entomological, atmospheric, soil and hydrological impacts of cultivating citrus under any one horticultural method. MESH (Movement for Ecologically Sustainable Horticulture, 2003) has documented a set of procedures that farmers could monitor: measurements of these procedures could be represented holistically through the radar plot. The radar plot grants equal weight to each of the measures by juxtaposing the measures against each other (as spokes of the radar plot), thus minimising the spatio-temporal fragmentation inherent in conventional (accounting's) representation of performance. Each of these measurements is a proxy for an aspect of performance, and it is based on a different unit of measurement. The measures have to be translated to a comparable unit of measurement: here it is converted (with varying degrees of subjectivity) into a graduated scale of risk. Here, risk is defined in terms of its impact on the social, environmental and financial well-being respectively. We refer to it as "social risk" to distinguish it from conventional representations of risk as technical, scientific and economic aspects of risk. Social risk reveals the subjectivity inherent in all formulations of risk (including the supposedly objective, techno-scientific and economic representations). Social risk reflects the psychological and sociological genesis of the concept of risk because it shows how social norms, beliefs and values interact with accumulated knowledge about dangers (such as global warming) to shape the construction of risk knowledge. The radar plot representation grants equal representation to known horticultural consequences, whilst striving to engage with the unknown threats. It highlights the relative risk of these consequences because a situation is only as sustainable as its greatest risk hazard.

Figure 3(b) contrasts the consequences of cultivating citrus against that of native vegetation. Native vegetation provides a local benchmark of a "least-impact" plant. Gap analysis against native vegetation is not an attempt to return to a preconceived "pristine" state of nature but is merely an evolving means of setting direction in the unending journey into the unknown.

5.2 Applying the risk management framework using Howie's farm data and estimates

Howie is a fourth generation horticulturalist from Renmark in South Australia: his family owns and manages 24 hectares of mixed citrus plantings. In 1994, he began to gradually convert his family-owned farms from conventional to organic horticultural practices: one half of the acreage now produces organic citrus under the NASAA label. The Howie family also operate a small packing facility and market fruit under the "Fat Goose Fruit" logo.

Howie (and MESH) had participated in the earlier-mentioned CSIRO study that compared four types of citrus management systems ranging from hi-tech (capital intensive), conventional, pesticide free and certified organic. By 2003, MESH had successfully used a bottom-up approach to Environmental Management Systems (EMS) to develop its own manual of best practices and auditable procedures (to ensure compliance among its membership as well as to contribute towards the creation of its eco-label). Its aim has been to identify horticultural techniques that have the least possible detrimental impact on the environment, consumers and growers themselves. The manual (and its auditable processes) may be adapted to other agricultural sectors: this is one way in which the lived experiences of MESH, as a networked community experimenting with the sustainability ethos, could permeate out to neighbouring communities.

Despite the effort that had been invested in formulating the MESH manual, the initial momentum behind MESH has waned. It is due in part to the lack of funds to develop its EMS programme into an eco-label. The marketing connection increases the likelihood that MESH's socio-environmental priorities would be self-financing because the prices fetched in an informed market would better reflect the cost of depleting/stressing natural resources (that is, water, eco-system, and the atmosphere): conventional costing dismisses these consequences as externalities. The higher returns should free MESH farmers from the corporate stranglehold on upstream and downstream activities, and facilitate their participation in long-term search for responsible resource-management strategies. It also satisfies consumer demands for greater transparency and accountability about how food is produced and delivered to the retail market. For instance, TESCO (UK's largest retailer) has announced plans to disclose the carbon footprint of each of its 70,000 products (Guardian Unlimited, 2007).

It is envisaged that these strategies, as part of the search for sustainable horticultural ethos, may result in more socio-environmentally friendly horticulture such as that advocated by the permaculture (or polyculture) ethos: the permaculture ethos strives to implement the logic of responsibility for the whole by securing an economic livelihood within the spatio-temporal frames of the eco-system and society (Holmgren, 2004). Fragmentation of time and space is minimised by using ecological and social frames as a point of reference in earning a living. Howie is experimenting with polyculture/permaculture approach to commercial cultivation as illustrated in Appendix J: note that the emphasis is not just on citrus fruit yield. The areas above ground as well as the subterranean levels are actively managed to minimise the fragmentation of time and space:

- Trees are planted alongside the commercial citrus crop to filter out the strong afternoon sun (whilst not obstructing the milder morning sun rays) and to provide habitat for the local bird-life (which contributes to biological control of the insect population);
- Native limes are planted along side the commercial Navel oranges in contrast to the artificial nature of conventional monoculture;
- Lucerne and other grasses are planted between the rows – the CSIRO study (Colloff *et al*., 2003) has revealed the beneficial effects of providing such a habitat for predatory insects that control citrus thrips;
- Poly-vegetation (as per the bullet points above) provides a matrix of interlocking root systems that tap into different levels of the soil strata. The interlocking root systems manage the subterranean ecosystem and minimise (excess) water seepage into the water table;
- Domestic and native geese reared on the property contribute towards a healthier eco-system, whilst becoming another source of organic meat revenue;
- The horticulturalist uses less heavy equipment to move around, thus reducing soil compaction;
- The net effect of this holistic approach is that Howie hopes to use only 5 Mega litres of water per hectare, which is 50% of water consumed under conventional horticulture.

How does one go about experimenting with the ethos of operating within socio-ecological frames whilst earning a living? In other words, how do we transform the MESH manual of best practices from auditable horticultural procedures and outcomes (that are used to ensure compliance among its membership) into a vehicle for instilling a culture of experimentation and learning in the interest of sustainability? We argue that the transformation may be facilitated by providing networked members (in a local catchment area) access to multi-dimensional risk-danger data which could be presented in the form of radar plots: ideally there should be aggregate community-based data for each performance indicator (to reflect cumulative risk) as well as individual data for each participating member. MESH has endeavoured to establish a database to store operational data of all participating MESH horticulturalists: the database is important for advancing its EMS programme and disseminating its ethos of experimentation. Its auditable processes and measurements could also become the foundation for its eco-label. However, the database stage of project has been stalled for want of funding.

Here radar plot representations of risk-danger (Figures 3 a and b) have been constructed using Howie's actual and estimated data from his family-owned farms in lieu of this database of performance measurements. The radar plots will be used to firstly compare the environmental impact of native vegetation (namely, Mallee scrub) with conventional and organic methods of cultivating citrus: see Appendices C and D for data that has been applied in constructing environmental risk-dangers radar plot representations in Appendices E (i) to (iii). Appendix F (Table 6) provides a commentary that compares the environmental impacts of conventional and organic horticultural techniques: the comparison is carried out spoke by spoke, or for each of the indicators used to signify performance. A few caveats apply here: firstly, the spectrum indicators chosen here were identified based on accumulated knowledge to-date about the impact of horticulture on the environment. As time goes on, more appropriate measures will be added (or existing ones replaced): it is a dynamic process that reflects the learning and experimentation inherent in the search for sustainable practices. The evolution of measures should also reflect advances in understanding the meaning and implications of sustainability. Secondly, the degree of risk associated with each indicator is subjectively constructed based on actual data about performance and where actual data is not available, it has been based on estimates. Thirdly, this is a comparison of data, observations and estimates from Howie's property to illustrate how the radar plot representation may be used to legitimise socio-environmental concerns (beyond the narrower economic focus) and thus engage holistically with the concerns of the local community in diagnosing problems and prescribing strategies for reform. It is not meant to be a universal comparison of organic versus conventional methods.

The exercise above is repeated for the radar plot representation of socio-economic risk-dangers. Appendix G (Tables 7 and 8) provides data applied in constructing socio-economic risk-danger radar plot representations in Appendices H (i) to (ii). Here the term "social" indicates proxy measures for community involvement as well as its health and well-being. Appendix I provides a comparison by each of the indicators used to represent socio-economic impacts.

5.3 Diagnosis and prescriptions based on holistic analysis of conventional versus citrus

The risk-dangers analyses presented here are extremely rough but hopefully thought provoking illustrations from the Howie property. The radar plot provides a visual representation of the complexities that should be considered when ascertaining the risk and long-term viability of farming systems. All of the variables used in the radar plot representations in Appendices E and H are regarded as being equally important indicators of sustainability, with the proviso that more objective indicators should be ascertained through a more rigorous exercise of monitoring and analysis: Howie (and MESH) have been unable to undertake this exercise without additional expertise, time and funds.

It appears from a risk analysis of most of the indicators selected (for the radar plots) that Howie's organic techniques have less risk compared to his conventional ones. In other words, the organic approach displays less detrimental consequences for the environment, finances and society than the conventional one. Furthermore, the organic system is more easily transformed into <u>poly-cultural</u> farming techniques that minimise the fragmentation of time and space (in opposition to mono-cultural methods): see Appendix J. Hence, the Howies are working to integrate more native and introduced species of vegetation within the citrus orchard because poly-culture enhances efficiency in producing biomass; moderates the effect of wind; provides shade and habitat; controls pests; enhances aesthetic value; and provides leguminous input.

The analyses produced in Appendices C to I are intended to replicate a (hypothetical) discursive dialogue between members of a networked community: the information it provides is intended to generate competing yet interdependent discourses. Ideally, these radar plots should have been constructed from aggregate data representing the local catchment-based community, and individual-specific data for each participating horticulturalist. The data would have been analysed as follows:

- A comparison of the aggregate catchment radar plots and individual horticulturalists' ones to enable each farmer to locate his/her holistic performance relative to the catchment performance;
- A comparison of the aggregate catchment radar plots and the Mallee (or native vegetation) ones to identify the extent to which the community's activities are contributing to the impeding danger of (at least) environmental degradation;

- A comparison of the analyses listed under the first two bullet points above to provide competing perspectives for an informed dialogue among networked members.

Such discursive dialogue may serve several purposes. It could become a vehicle whereby individual members provide accounts to other networked stakeholders; a means of identifying catchment and farm-based priorities; a process of teasing out better techniques (in terms of least risk impact) that should be adopted (for the time being) as the more sustainable ones.

At this juncture, we contrast our risk-danger analyses against PIRSA's recommended strategies of (i) increasing scale of operations, and (ii) providing two choices to horticultarists, namely that of opting for either the organic or hi-tech methods of horticulture. Our summation is based on a deductive-inductive logic as MESH does not possess the required database that could provide more universal conclusions. Although we agree that PIRSA has correctly identified the need for greater transparency over the interconnected relationships between various players in the citrus industry, we also depart from PIRSA's analysis at this point. We advocate transparency in the interest of developing a sustainable industry (in opposition to PIRSA's aim to stamp out opportunistic behaviour in keeping with its transaction cost frame). There needs to be greater transparency of operational data to ensure that:

(i) Operations are sustainable in the long-term;
(ii) There is an expanding wealth of knowledge that enables networked members to reflectively refine the meaning and implications of sustainability;
(iii) The transparency is established as part of auditable processes to be reflected in an eco-label, which in turn differentiates the produce in the retail market.

We argue for the development of differentiated citrus market even though PRISA does not expect low cost citrus producers to pose a threat in the medium term because we believe that PIRSA's strategy has been guided by a one-dimensional economic analysis that fails to engage with the ecological and social frames of reference. Therefore, we follow Beck's (1993) theorisation of risk society in urging the citrus industry to engage with social and environmental risks and dangers in formulating its business case for the 21st century. It will involve developing a niche market for its produce (with an accompanying eco-label) by socialising the process of managing social, ecological, environmental and economic risks. This process explicitly incorporates the soft factors of trust and reputation into the culture of reflective learning and experimentation. Hence, public policy should not encourage the development of an inflexible oligopoly in the citrus industry. Instead it should take a long-term view of enabling the local communities to establish a research base for experimenting with the sustainability ethos, and an eco-logo that conveys that spirit of responsibility to the market.

6. Stewardship reporting

Under market economics, participant actors have been encouraged to think in the interest of themselves only. However the sustainability framework requires actors to also consider the interests of the other in making (private) decisions. It is proposed that the radar plot analysis could be used as a vehicle for making decisions in stakeholder discourses: it enables actors to transcend private interests and consider the health of the local catchment (and thus contribute to global consequences of warming) by focussing on the common ground between all stakeholders. The common ground is represented by the shaded area from the origin in the radar plot (see Appendices E and H). By interconnecting the spokes of the radar plot (representing horticultural activities) the common ground also represents the least possible fragmentation of time and space in the local catchment, given the community's current norms, beliefs and values as well as accumulated knowledge about global warming.

The transparency of assumptions and norms used to construct the radar plot feedback should inform dialogue in risk society and empower citizens to scrutinise the appropriateness of these norms. The Venn diagram in Figure 4 provides the methodology for demonstrating stewardship of critical resources.

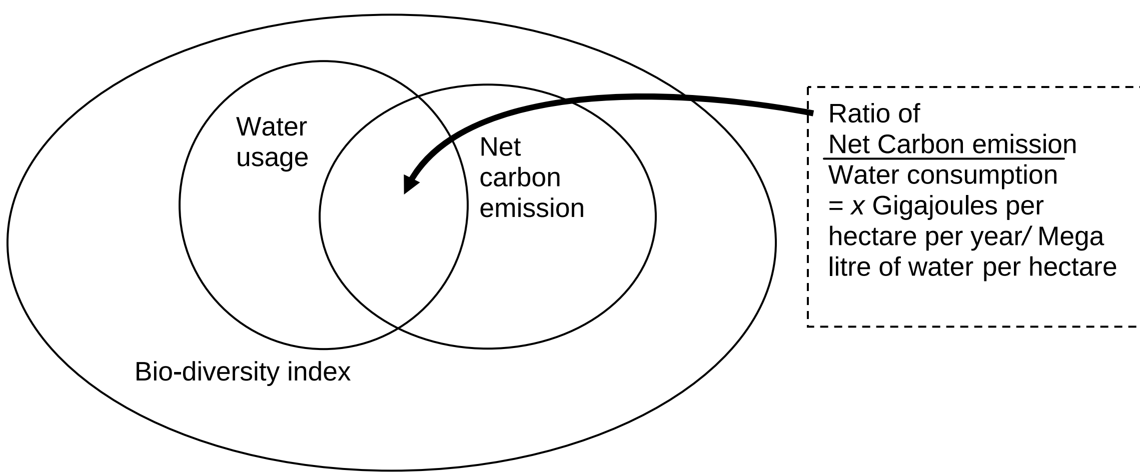


Figure 4 Methodology for computing local-global benchmark of sustainability (Source: Saravanamuthu, Howie, Baker and Donohoe, 2006)

Figure 4: firstly the performance indicator located in the centre between the two intersecting circles reflects societal concerns with (i) greenhouse gas emissions and (ii) appropriate utilization of water. This quotient expresses net carbon absorbed/emitted as a percentage of water consumed. Traditional measures either emphasise crop yield, or cost efficiency with little regard for big picture concerns. More recently, the shortage of fresh water in Australia has given rise to measures of value added (in dollar terms) per Mega litre of water per hectare. Even though this measure is an improvement over the more traditional indicators, sole reliance on value added measurements (without due consideration for the impact of these introduced crops on Australia's arid ecology and biodiversity) would merely favour thirsty and nutrient-demanding crops such as cotton and rice, that are ill-suited for the arid, infertile Australian conditions. Consequently, the quotient proposed here is balanced against the ecological health of the environment, which is represented by an index of native biodiversity. Just as the presence of frogs is a litmus test of the health of a stream, a native biodiversity index could signify the net impact of horticultural practices on the larger environment. These cap indicators would be calculated for each orchard and horticultural method (to be compared against the current state of the catchment).

7. Conclusion

We began this paper with quotations from citrus horticulturalists dissatisfied and disenfranchised by PIRSA's diagnoses and prescriptions. In its place we have contextualised the citrus crisis using the vocabulary of risk society before arguing for research to understand the nature of the problem. Our stance echoes North's (2005) – who was awarded the Nobel prize in 1993 - cautionary observation directed at his fellow economists:

> "Attempting to understand economic, political, and social change (and one cannot grasp change in only one without the others) requires a fundamental recasting of the way we think…We cannot usefully model economic change until we understand the process. A good model entails a prior comprehension of the complex factors making up that process and then a deliberate simplifying to the crucial elements. Understanding is a necessary prerequisite missing in the economist's rush to model economic growth and change. We are a long way from completely understanding the process. Until we do, we have very little success in deliberately improving economic performance" (North, 2005, pp. vii, ix).

The evidence we have presented is case study-based and is unique to the circumstances in the Mallee region. We believe that our introduction to socialised risk management should prompt further in-depth research that should be located in working farms: it should involve accumulating data on all aspects of farm performance so as to better appreciate the meaning and implications of the term sustainability. There is a whole interdisciplinary science waiting to be opened up: it would involve experimenting in different compatibilities of plant and animal species, thus complimenting, protecting and buffering farming systems in an uncertain environment. The conventional scientific community has often labelled organic growers as Luddites for not keeping up with technological advances. We argue that the reluctance on the part of horticulturalists is related to the direction of agricultural research instead of technological advances per se because they seek to engage with nature instead of controlling it (by disengaging with social and ecological spatial frames and temporal cycles). Now more than ever before, there is a need for scientists, economists and politicians to engage with the dynamics of more interactive, diverse, poly-cultural farming systems. Permaculture is an example of one such method that is at the cutting edge socio-environmentally sensitive technology, but it would benefit from further research. Whilst we have some major challenges ahead of us, particularly in regard to climate change, we believe that the way forward begins with keeping people connected through greater transparency in the dissemination of scientific knowledge and evaluative techniques.

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Appendix A: Table 2

Table 2: Relationship in 1999 between nutrient cycling and (conventional) profitability of generic horticultural categories. (Source: Colloff, Fokstuen and Boland, 2003, p. 34.)

Generic horticultural categories (2 blockies per category)/ acreage in ha	Input costs (1: lowest)	Yield (1: highest)	Price (1: highest)	Dollar input/output ratio (1: highest)	Dollar profit per hectare (1: highest)
HT1 / 81ha	4	7	8	6	7
HT2 / 2.8ha	8	1	1	4	1
C1 / 28.7ha	6	3	7	7	6
C2 / 24ha	1	8	3	3	8
PF1 / 83ha	3	2	3	2	2
PF2 / 0.5ha	2	6	2	1	3
O1 / 15ha	7	3	5	8	5
O2 / 5.4ha	5	5	6	5	4

The rankings are as follows: 1 represents lowest cost. 1 represents highest yield, price, dollar input/output ratio and, dollar profit per hectare.

Appendix B: Table 3

Energy value of inputs and outputs for 1999 in Gigajoules per hectare per year. (Source: Colloff, Fokstuen and Boland, 2003, p. 30.)

	HT1	HT2	C1	C2	PF1	PF2	O1	O2	Average
Size of orchard (ha)	81	2.8	28.7	24	83	0.5	15	5.4	30
Total labour (hrs/ha/yr)	224	349	189	38	184	76	362	159	198
Total fuel, machinery 7 transport (GJ/ha/yr)	19.12	21.48	31.91	9.97	15.86	12.58	9.45	8.17	16.07
Total fertilisers (GJ/ha/yr)	8.09	6.29	198.31	3.76	26.59	18.05	0	0.28	25.22
Total pesticides (GJ/ha/yr)	45.74	17.26	16.96	0.86	0.54	2.33	0.43	0	10.5
Total energy inputs (GJ/ha/yr)	72.95	45.03	247.18	14.59	42.99	32.95	9.88	8.45	51.81
Output: (i) Fruit yield: tonnes/ha/yr	30	49	35	10	37.8	32.6	35	34.2	33
(ii) Energy outputs in fruit yield (MJ/ha/yr)	50.7	82.81	59.15	16.9	63.88	55.09	59.15	57.8	55.69
Input/output ratios:									
(i) Energy: GJ output/GJ input	0.7	1.84	0.24	1.16	1.49	1.67	5.99	6.84	1.08
(ii) GJ output per ha/labour hr	0.23	0.24	0.31	0.45	0.35	0.73	0.16	0.36	0.28
(iii) Labour hr per tonne of fruit	7.5	7.1	5.4	3.8	4.9	2.3	10.3	4.6	6.0

Appendix C: Table 4

Soil organic matter from Howie's property (sample taken from top 15cm and expressed as percentage of dry weight).

Area code (Horticultural method)	2004	2003	2002	2001	2000	Average
LRL (Conventional)	1.1					
VS07 (Conventional)	1.0	1.2		1.1	0.8	1.1
Home block (Organic)	1.4	2.1	1.8		1.2	1.8
LSO (Organic)	1.5		3.1	1.8		2.1
LNB/WNB (Organic)	1.2	1.3	1.8	1.3	0.8	1.4
					1.7	1.7

Average soil organic matter for organically managed areas = 1.7% (13 readings).

Average soil organic matter for conventionally managed areas = 1.1% (5 readings).

Calculation of total weight of organic matter in top 15cm per hectare assuming soil bulk density of 1.5

Total mass of soil in top 15cm in one hectare = 10,000 sq m x 15 litres x 1.5 (bulk density) = 2, 250 tonnes.

<u>Organic areas</u>:

Total weight of organic matter per hectare = 2,250 x 1.7% = **38.25** tonnes (figure used in Table 5).

<u>Conventional areas:</u>

Total weight of organic matter per hectare = 2,250 x 1.1% = **24.75** tonnes (figure used in Table 5).

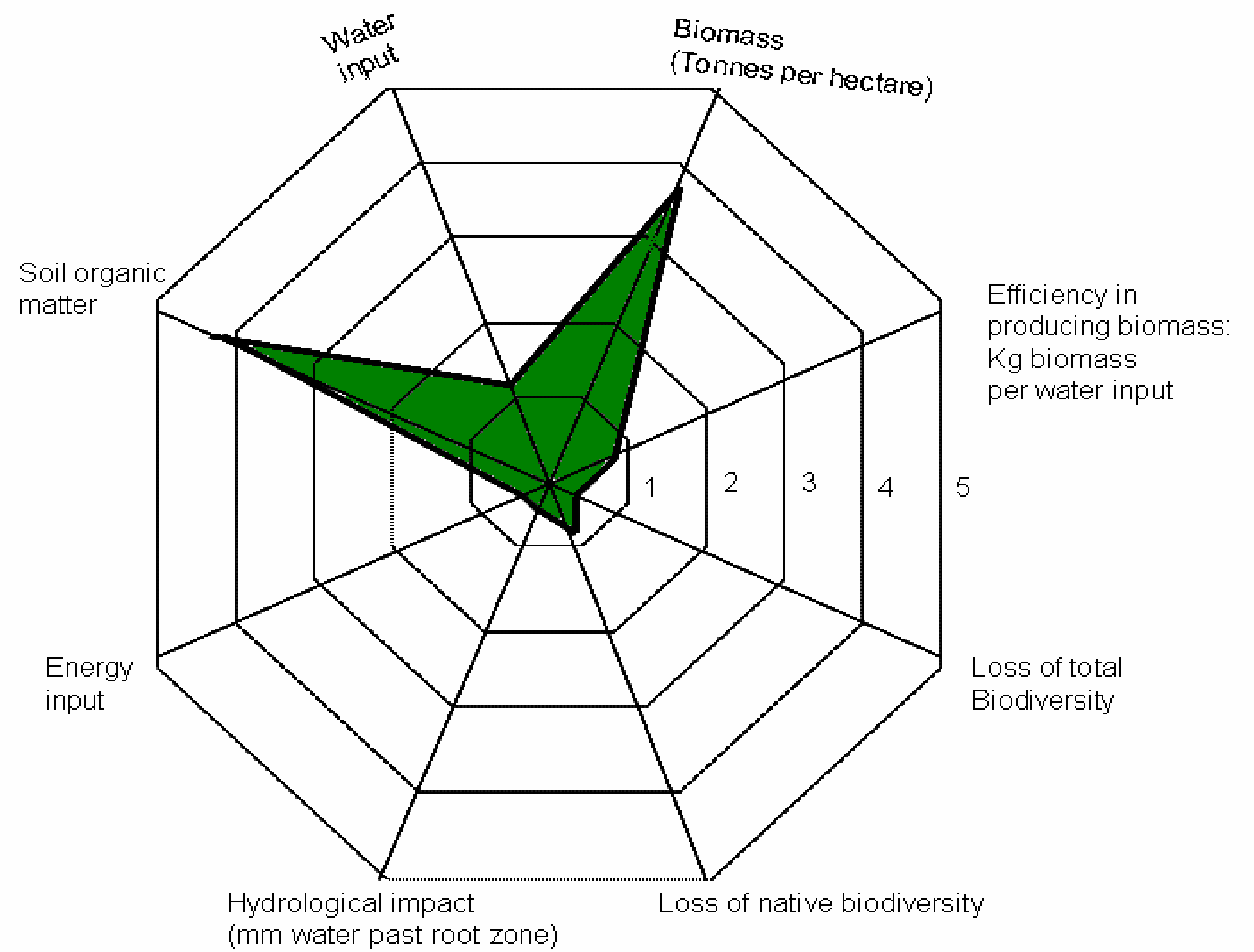
Appendix D: Table 5

Data for radarplots in Appendices E (i) to (iii)

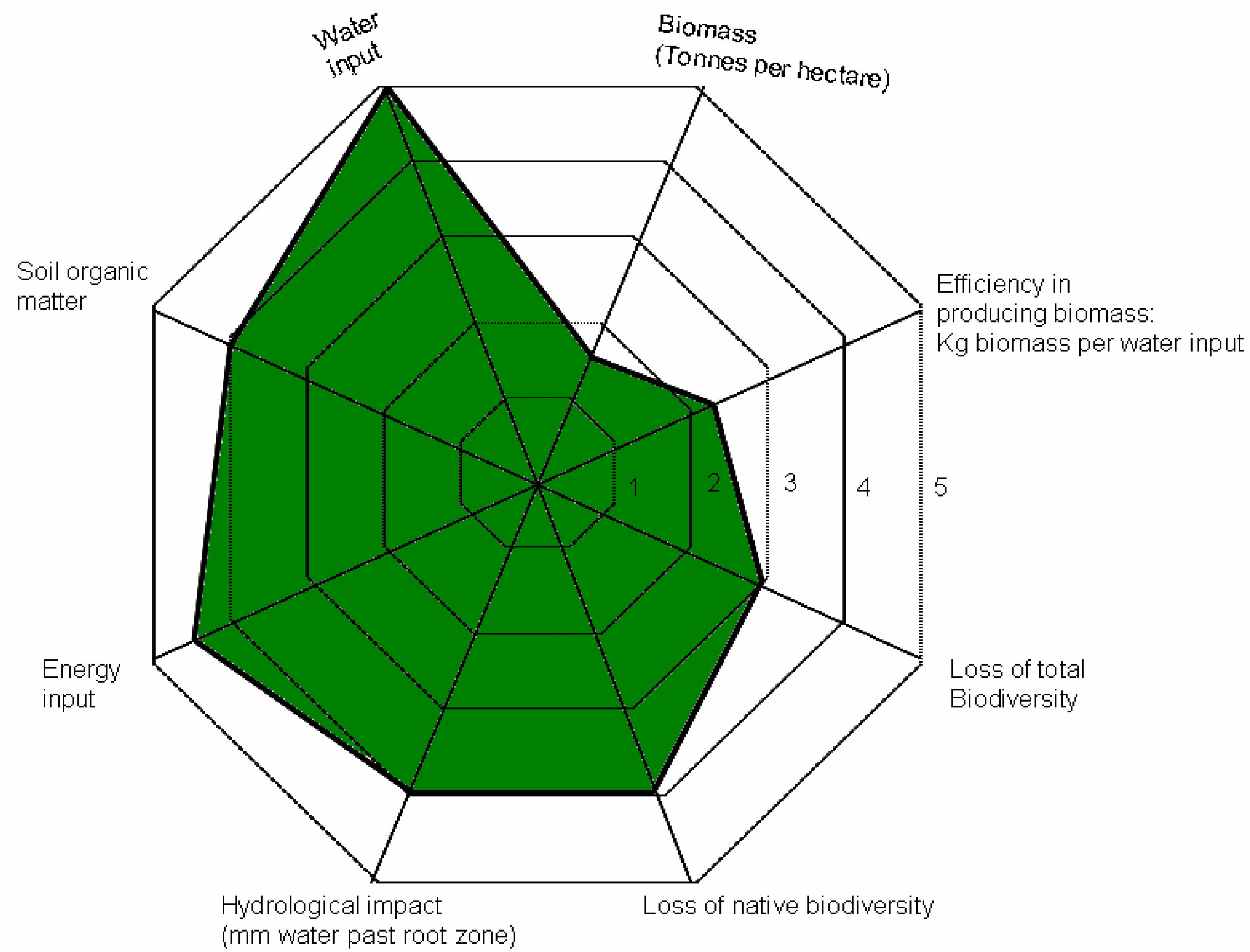
Key: "a" for actual data, and "e" for estimate

Variables	Cross-reference to spokes in radar plots 1a to 1c	Mallee	Organic	Conventional	Comments
Water use (rainfall)		250mm a	250mm a	250mm a	
Irrigation		0 a	800mm a	1000mm a	
Total water use	Water input	**250mm a**	**1150mm a**	**1250mm a**	
Organic matter (% dry matter 15cm depth)	Soil organic matter	0.5 e	1.7 e	1.1 e	Ave data for organic and conventional from Table 4
Organic matter (tonnes per hectare 15 cm depth)		11.25 e	38.25 e	24.75 e	Calculated from data in row immediately above
Organic matter (tonnes per hectare of ground cover)		0.1 e	0.3 e	0.2 e	Calculated from estimated plant dry weight
Organic matter (tonnes dry weight of trees/shrubs per hectare)		10 e	40 e	40 e	Estimated based on pruning observations
Average fruit yields (tonnes per hectare dry weight)		0 a	5 a	8 a	Based on 6 year yield average at 15% dry weight
Total Biomass (tonnes per hectare)	Biomass (Tonnes per hectare)	**21.35**	**83**	**73**	Figures are sum of actual data and estimates as specified in 4 immediate rows above
Biomass (kg dry weight per mm of water)	Resilience via reduction in kg biomass per water input	**84**	**72**	**58**	

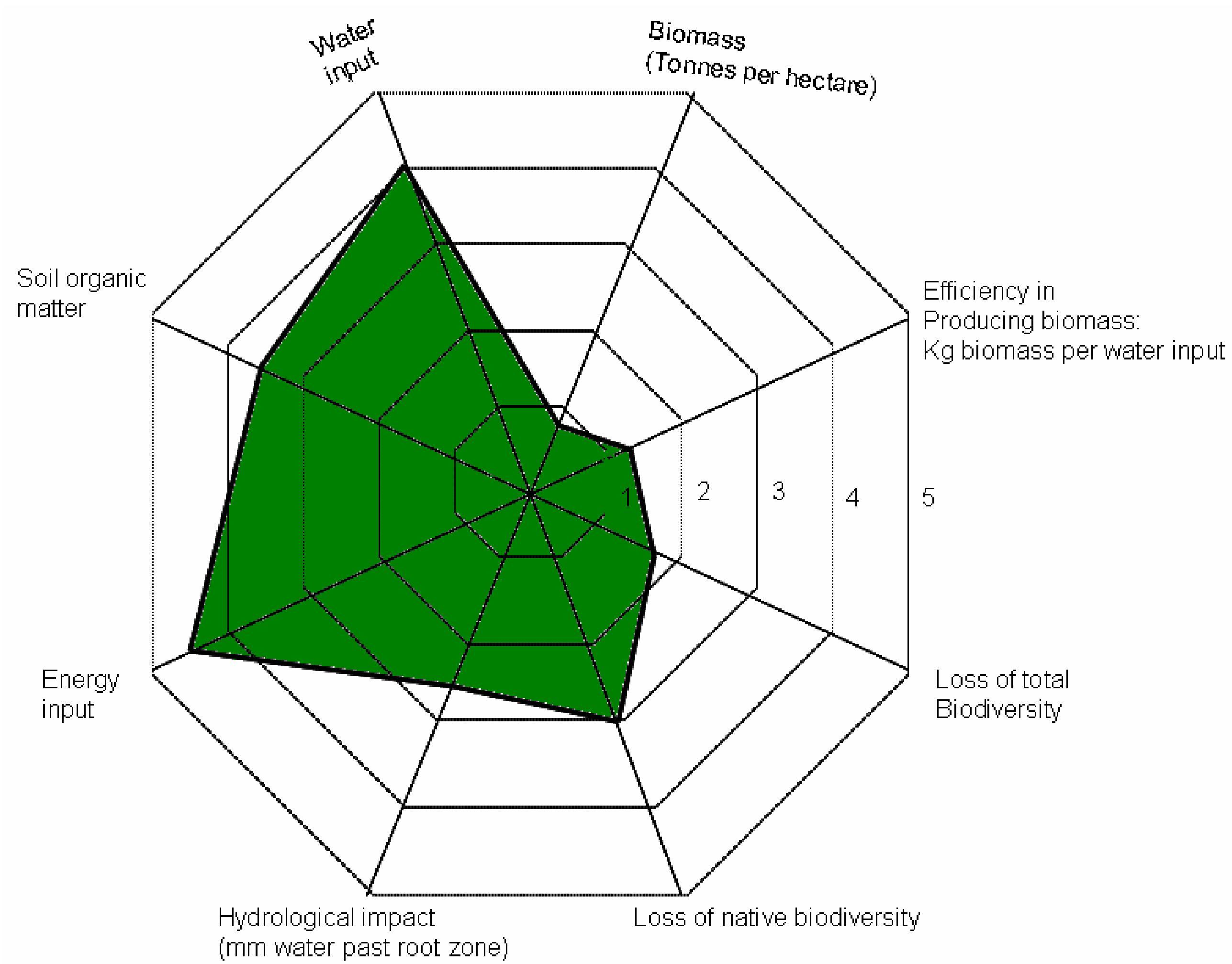
Table 5: Continued					
Variables	**Cross-reference to radar plots 1a to 1c**	**Mallee**	**Organic**	**Conventional**	**Comments**
Fossil fuel energy input (ie use of fertilisers, tractors, chemicals etc)	Energy input	**0** e	**High** e	**High** e	Need scientific input to calculate this figure properly
Number of different plant species as % of Mallee total		100 e	100 e	50 e	Figures estimated based on little observation
Number of different insect species as % of Mallee total		100 e	70 e	50 e	Figures estimated based on little observation
Number of birds/animals as % of Mallee total		100 e	50 e	30 e	Figures estimated based on little observation
Total Biodiversity as % Mallee total	Loss of total Biodiversity	**100** e	**70** e	**40** e	Average of 3 rows immediately above – rounded off.
Number of different native plant species as % of Mallee total		90 e	30 e	10 e	Partly due to NASAA 5% min native vegetation policy
Number of different native insect species as % of Mallee total		90 e	50 e	30 e	Figures estimated based on little observation
Number of native birds/animals as % of Mallee total		90 e	40 e	20 e	Figures estimated based on little observation
Total Native Biodiversity as % of Mallee total	Loss of native Biodiversity	90 e	40 e	20 e	Average of 3 rows immediately above – rounded off.
Hydrological risk (mm water passes root zone)	Hydrological impact (mm water past root zone)	**0.001** (ie no loss of water) e	**80** (irrigation) e	**120** (irrigation) e	Estimate based on 85% irrigation efficiency and possible spaciality of roots in organic system.



Appendix E (i): Environmental risk-danger of Mallee vegetation



Appendix E (ii): Environmental risk-danger of conventional citrus orchard



Appendix E (iii): Environmental risk-danger of organic citrus orchard

Appendix F: Table 6 - Explaining environmental risk-danger profiles of horticulture in Appendices E(i, ii, iii).

Spoke of radar-plot	**Inter radar-plot comparison: implications for risk-danger management**		
	Mallee	**Conventional**	**Organic**
Water input	Lowest risk of all because the native vegetation has adapted to arid conditions and is able to sustain itself even in times severe droughts linked to global climate change.	Highest risk because it is most reliant on irrigated water: hence greatest input, highest degree of intervention and highest risk	Less risky than conventional but still a far cry from the Mallee.
Biomass (tonnes per hectare): this is an odd measure because it is an absolute amount. If the logic of high input implies high intervention and hence high risk is applied blindly, this measure would show that it is "high risk" when there is a lot of biomass per hectare. However, recognising that the native state of the Mallee land has been changed forever by human settlement, high biomass content reduces evaporation of water added to plant, reduces amount of artificial nutrients added, and provides a habitat for soil biodiversity: hence, it will be treated as low risk here.	High risk based on modified logic (to high intervention implies high risk – see column one in this row) because there is little biomass (in absolute terms) in the arid Mallee environment. Nevertheless as the Mallee has evolved over time to the poor soil conditions in the area, this spoke is not relevant for Mallee.	Lower than organic in terms of absolute biomass content. Again there is a problem with using this absolute measure as an indicator of risk because the lower amounts of organic content imply that this method would resort to artificial additives (fertilisers and chemicals) that would be washed off to contaminate the waterways. Hence, this measure is modified in measuring resilience in terms of reduction in biomass per unit input of water (next row).	Highest in terms of absolute biomass content (and lower than conventional in terms of modified risk logic) because of the organic ethos of relying heavily on mulching to supply nutrients to the plants.
Efficiency in producing biomass per unit input of water: this is a better indicator of risk (using logic outlined of relating it to human intervention) than row above ie absolute amount of biomass	Low risk as the Mallee is an efficient biomass producer in a low rainfall environment.	Higher risk than both Mallee and organic because with each additional unit of water, the corresponding increase in biomass is lower.	Lower risk than conventional because of greater biomass production per unit of water due to greater diversity of plant and animal species.

Spoke of radar-plot	**Inter radar-plot comparison: implications for risk-danger management**		
	Mallee	**Conventional**	**Organic**
Loss of total biodiversity	Very low risk as it has evolved with native flora and fauna.	Higher risk than organic because it is governed by the logic of controlling more "variables" than organic.	Lower risk than conventional because of ethos of working in harmony within the ecosphere.
Loss of native biodiversity	As above	As above	As above
Hydrological impact	Minimal risk as there is no irrigation.	Higher risk than organic because of greater reliance on irrigation, less reliance on natural mulching that retains water and less spatiality of root system.	See conventional column.
Energy input	Minimal risk due to reliance on nature's forces	Similar level of risk to organic but made up primarily on energy inputs into artificially manufactured chemical farm products as well as farm machinery.	Similar level to conventional but reflects the labour intensive nature of operations as say, weeds are slashed instead of killed off by chemical herbicides that leave a contaminating residue in the ground.
Soil organic matter (expressed as a percentage of dry matter)	High risk based on modified logic (to high intervention implies high risk: see column one under "Biomass - tonnes per hectare"). Nevertheless as the Mallee has evolved over time to the poor soil conditions in the area, this spoke is not relevant for Mallee	Risk level higher than organic – but same reverse logic as Mallee in interpreting this. Also effect of using percentage to compute feedback	

Appendix G

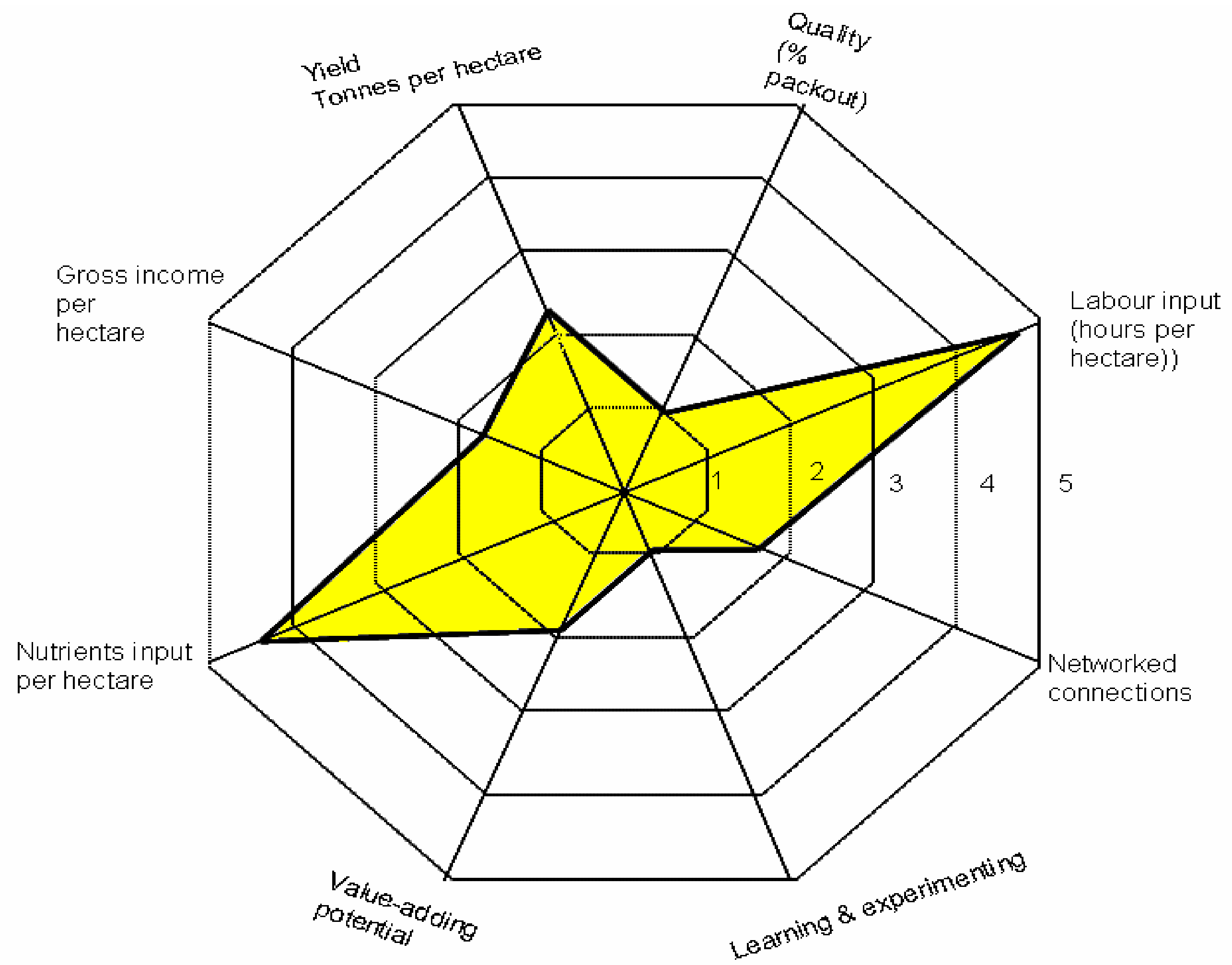
Table 6: Data for radarplots in Appendices H (i) to (ii)

<u>Key</u>: "a" for actual data, and "e" for estimate

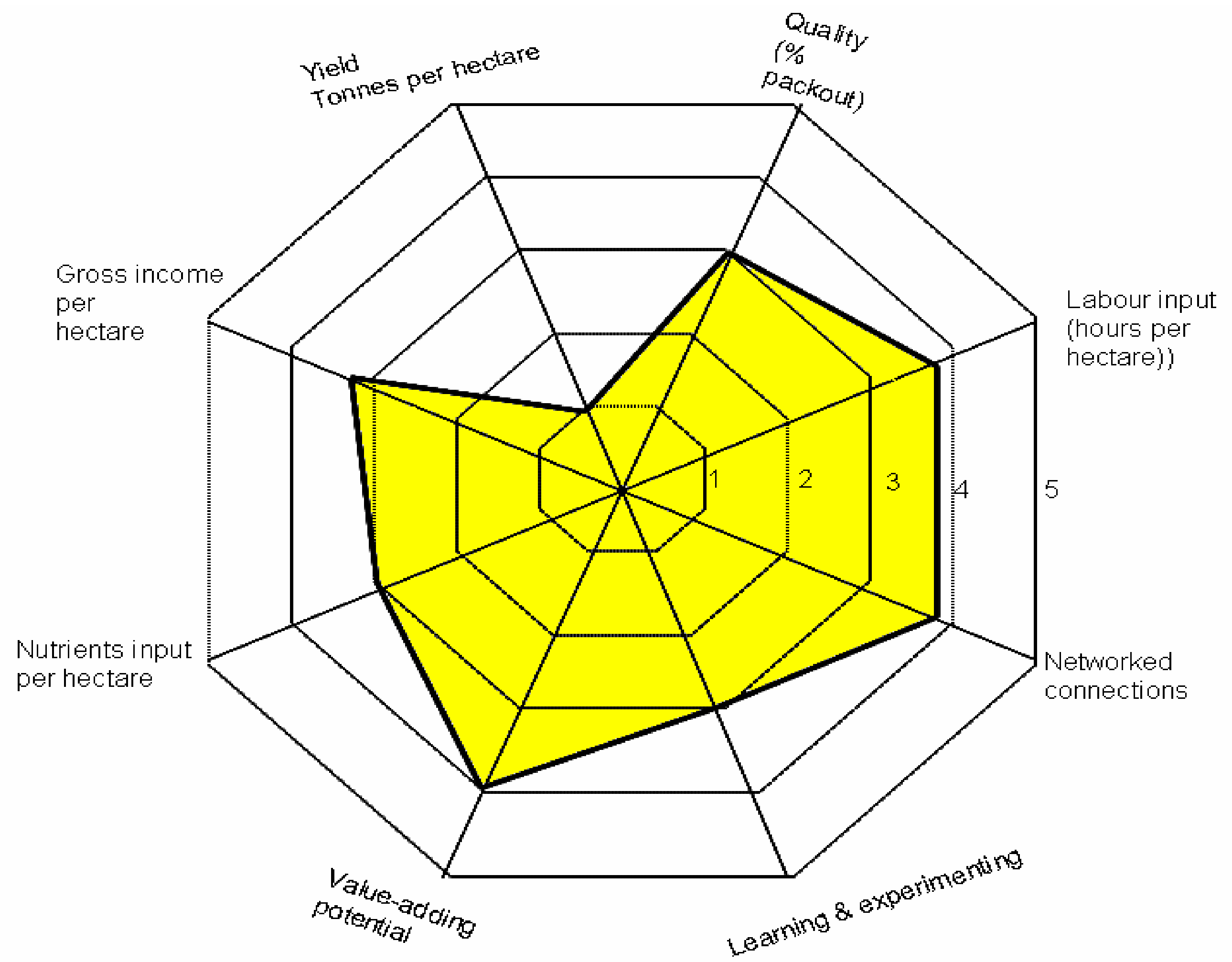
Variables	Organic	Conventional	Comments
Fruit yield (Tonnes per hectare)	29 a	42 a	Based on 4 years data on 2 landholdings (1 Navel orange, 1 Valencia orange)
Quality (as % of fruit packed as fresh)	80 a	40 a	Pack-outs are always higher with Navels than with Valencias.
Labour input (hours per hectare: see table 7 below)	280 a	230 a	Weed control much greater in organic
Gross income ($ per hectare ex-farm gate)	20,000 a	11,000 a	Based on 2004/5 returns
Nutrient input per hectare eg via compost versus chemicals ($ per hectare)	900 a	600 a	Nutrient inputs higher for organic because rely on compost, whereas nutrient input from chemical additives are lower.
Network (social)	95 (in 2005) a	40 (in 1996) a	1996 represents period when only engaged in conventional horticulture. By 2005, had converted some holdings to organic. Network measured using number of telephone numbers on record in respective periods.
Experimentation, learning and scientific involvement	High e	Low e	Organic property has been used by various groups for trial-work and visits.
Potential for value adding	High e	Low e	Possibilities include participation in farmers' markets, processing and eco-tourism.

Table 7: Calculation of labour input (hours per hectare)

Activity	Organic horticulture	Conventional horticulture
Harvest	130	160
Slashing	8	6
Mowing	10	0
Whipper-snipping	60	0
Spraying weeds	0	5
Thinning	0	10
Pruning	20	20
Irrigation	15	11
Spraying	6	10
Fertilising	3	2
Spreading compost etc	8	0
Maintenance	8	7
Goose husbandry	12	0
TOTAL	**280**	**230**



Appendix H (i): Socio-economic risk-danger of organic citrus orchard



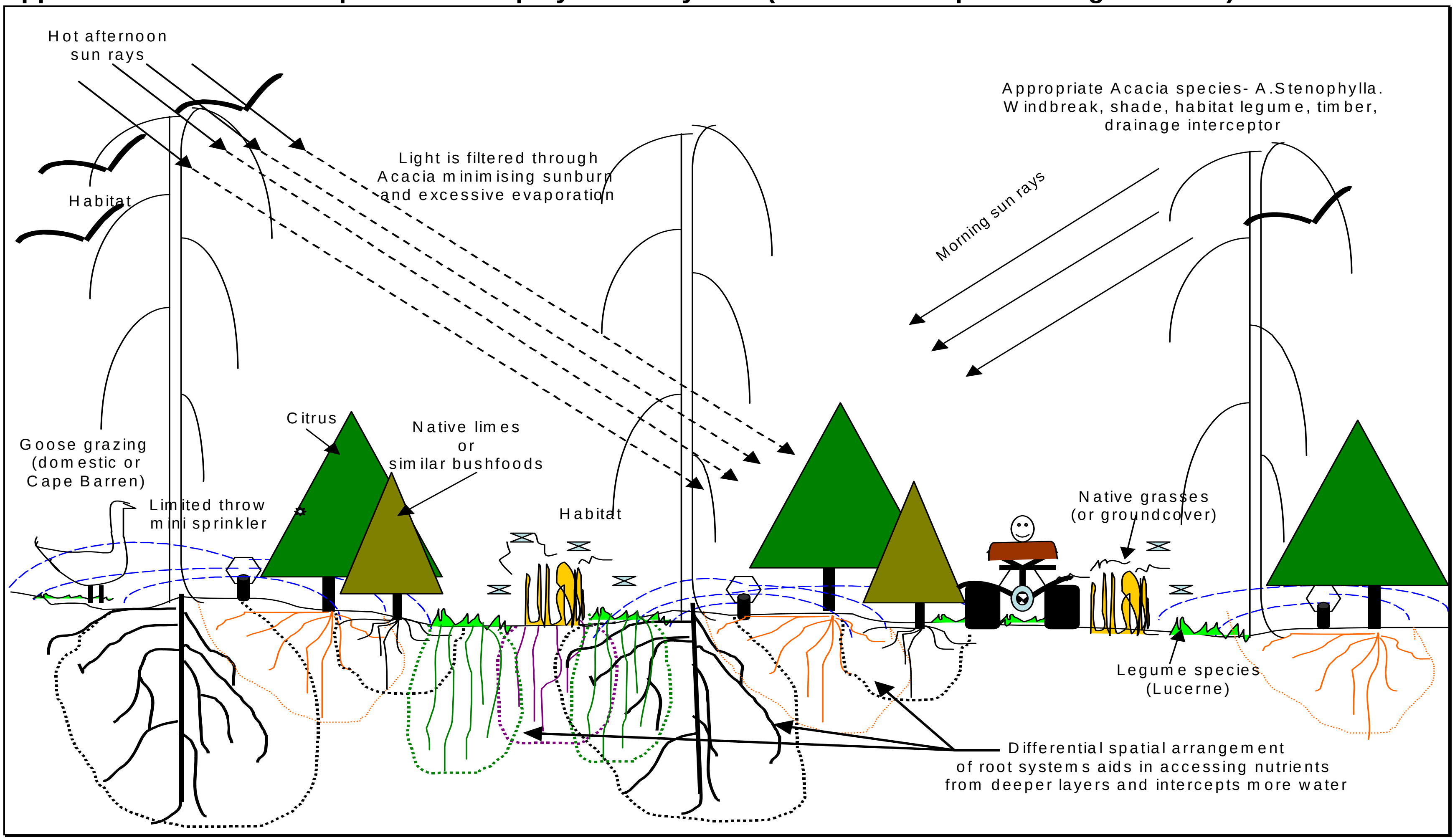
Appendix H (ii): Socio-economic risk-danger of conventional citrus orchard

Appendix I: Table 8 – Explaining socio-economic risk-danger profiles of horticulture in Appendices H (i) and (ii).

Spoke of radar-plot	**Inter radar-plot comparison: implications for risk-danger management** (The same logic is applied here, namely, the lower the level of intervention regarding inputs the lower the risk: the logic is reversed for outputs with caveats with regard to sustainability implications)	
	Organic	**Conventional**
Yield	Lower yield than conventional because lower intensive application of chemical inputs. Caveat: although conventional has higher yield (therefore it follows it has lower risk), it has a higher risk profile with regards to inputs of chemical fertilisers, herbicides and water usage.	See organic
Quality	Lower risk because most of the fruit harvested is sold: this is partly due to the fact that the organic market is much more informed about what to expect, and slightly blemished fruit is more likely to still satisfy an organic consumer compared to a conventional one (whose perception of quality is shaped by advertising promotions of the perfectly shaped and coloured fruit).	Higher wastage of produce, which has ironically been produced by more intensive use of additives to increase yield.
Labour input	Higher labour input therefore higher risk because less reliance on chemicals to control weeds, pests etc	See organic
Networked connections	Organic farming depends on integrated marketing as well as exchange of knowledge. Also increasingly informed consumers keen to learn more. The more networked, the more differentiated the produce and hence less risk.	Less networked because of greater reliance of corporatised upstream suppliers and downstream distributors. Farmer disconnected from consumer.
Learning and experimenting	As intimated above, the organic ethos is about continually learning to find newer ways of having less and less impact on socio-environmental surrounds while earning a sustainable level of income. Higher learning and experimentation, therefore lower risk.	As explained in the Canadian National Farmers Union (2003) report, the farmers here are more likely to be captive to purchasing product innovations that promote the interests of the corporate seller, and the farmer is a price taker rather than experimenter.

Spoke of radar-plot	**Inter radar-plot comparison: implications for risk-danger management**	
	Organic	**Conventional**
Value adding potential	Higher potential for value-adding such as producing organic preserves or other novelty items that may be sold at farmers' market (because of low volume). Also Bed-&-Breakfast opportunities as greater interest from public.	Because of higher yield, greater reliance on large scale processors downstream to add value.
Nutrients input per hectare	Organic code requires reliance on compost for supply of nutrients to the plant: use more compost than chemicals therefore based on risk logic, it is reflected as higher risk. However, it is also less likely to be leached out of soil unlike chemical additives.	See organic
Gross income per hectare	Higher net income so lower risk. More significantly, farmer has greater control over upstream and downstream activities	See organic

Appendix J: Illustration of permaculture/polyculture system (water consumption = 5MgL/Hectare)



Appendix K.

PIRSA's diagnoses and prescriptions.

This appendix outlines and critiques PIRSA's analysis of the 2004-5 crisis in the industry.

K.1 The South Australian context

It is asserted that the "environmental and climatic characteristics" make South Australia a "prime" location for producing high quality fresh fruit: quality is defined in terms of colour, sweetness and taste (PIRSA, 2005 a, p.13). The Riverland's higher winter chill factor gives the fruit a competitive advantage in the fresh fruit market. Two types of oranges are cultivated, Valencia and Navel. Orange juice is predominately produced from Valencia oranges, and Navel oranges tend to be sold as fresh fruit (partly because Navels may become bitter when kept for significant length of time after processing or when it is pasteurised: PIRSA, 2005 a, p. 5). The 2 varieties have different bearing seasons: Valencia from Sept to April (and perhaps to July but at the risk of stressing the trees), whilst Navels are in season from May to December. So even though processors prefer to use Valencias for juice, they may use Navels during the seasonal gap. Production in S.Australia is predominately targeted at the fresh fruit market. Fruit that is surplus to requirement, or deemed unsuitable for the fresh market, is sold for juicing: hence, production of citrus for juice production is a secondary activity (PIRSA, 2005a, p. 13).

PIRSA believes that this practice of selling residual fruit for juice has contributed to the citrus crisis because it creates uncertainty in the supply-demand relationship as the growers anticipate the probability of higher returns on the spot market for fresh fruit, or move between packers in seeking a better deal. Contractual arrangements in the region have been restricted to (fruit) packers selling growers' produce for a fee. Some packers engage in juicing activities. Even though packers may have long-standing arrangements with retailers (of fresh fruit) and processors, their arrangements are combinations of formal and verbal contracts, which "rarely specify all aspects of supply" (PIRSA, 2005 a, p. 7): these loose arrangements accentuate uncertainty in the supply relationship.

The supply and demand of oranges is also affected by the extent to which juice processors rely on imported Frozen Concentrate Orange Juice (FCOJ). Even though orange juice produced from 100% fresh fruit commands a 250% premium over juice concentrate, processors use FCOJ to fill seasonal gaps and ensure greater consistency of taste. Riverland horticulturalists are unable to compete with imported FCOJ on a cost basis: imported FCOJ costs 22-25 cents a litre while the Australian cost of producing juice is 60 cents, and $1 per litre for concentrate (PIRSA, 2005 a, p.5).

PIRSA (2005 a, pp. 8-10) draws from the 1989 to 2005 national demand and supply trends of Valencias and Navels (against this backdrop of uncertainty and cost differentials) to assert the following:

- The consumption of orange juice is growing at around 4% pa;
- Consumption of fresh oranges is declining marginally;
- Production of orange juice from Australian fruit is declining at 2% pa;
- The gap between local production and consumption is primarily satisfied with imported FCOJ.

Nevertheless, industry preferences reflect a couple of contradictory trends: firstly, despite the fall in consumption of fresh oranges relative to juice, PIRSA (2005a) notes that growers are moving out of the juicing orange varieties (such as Valencias) in favour of fruit for the fresh market (namely Navels). Consequently, imported FCOJ will penetrate more deeply into the market to fill the "juicing gap" (p. 13). Secondly and relatedly, the imported concentrate based juice is targeted at the lower (value-added) end of the market even though there is an emerging market that demands premium grade fresh juice.

K.2 PIRSA's diagnoses-prescriptions

PIRSA has identified the following factors as having contributed to the citrus crisis:

- Uncertainty that resulted from a combination of uncertainty inherent in predicting citrus yields, and the absence of specific contracts between growers and packers/juice processors, has resulted in opportunistic grower behaviour of speculating on spot prices;
- Higher average cost of production in Australia compared to foreign competitors especially in FCOJ market;
- Absence of objective indicators regarding fruit quality: such feedback could reduce uncertainty in the demand-supply relationship.

Each of these factors is elaborated below:

K.2a Uncertainty

The yields initially forecasted for the 2004-5 citrus season had been pessimistic and growers had held back from selling their (uncontracted) fruit. Fruit had also been left unpicked on the trees to increase its yield and size. Not surprisingly, processors had increased purchases of imported FCOJ. However the actual harvest proved otherwise. The anticipatory actions of the growers-processors served to aggravate the problem of over-supply even through processors like Berri purchased 30% more than its contracted obligations

(PIRSA, 2005 a, p. 16). Furthermore, unlike cooperative packing and export practices in the US and South Africa, Australian packers compete with each other to capture a greater slice of the export market. In contrast, (successful) Californian industry is organised around Sunkist cooperatives which are aimed primarily at controlling quality and minimising opportunistic behaviour (PIRSA, 2005b, p.25).

Describing the industry as "inherently variable and therefore risky industry", PIRSA (2005b) advocates "improved transparency, more collaboration, new entrants and some institutional change" (p.4) because of its implications vis-à-vis Williamson's transaction cost economics (more on this later). PIRSA

> "has formed the view that the current means of handling it – meaning the contracts, the information flows, the institutional arrangements etc found in the industry – fall short of the ideal" (PIRSA, 2005b, p. 5).

PIRSA (2005a) prescribes the following:

- Review current forecasting arrangements (p. 20);
- Acknowledge the "inextricable link" between oranges sold as fresh fruit and those for juice. These 2 parts are to be connected by contractual arrangements (p.21), or link growers and packers in a "more cooperative framework" (p.23) to curb grower behaviour of opportunistically speculating on anticipated supply shortfalls. Develop "long-term horizontal strategic alliances among growers and/or packers" as well as "vertical alliances between growers and packers" because "a simple reliance on the market is not an effective way to manage the complexities of coordinating supply to numerous markets (domestic, export and juice)" (p.23).

K.2b Average cost of production

By extrapolating current supply and demand trends, PIRSA (2005a, p. 17) predicts a shortage of locally grown Valencias and an accompanying increase in imported FCOJ. However because it believes that in the medium term, low-cost citrus producing nations like Brazil and the People's Republic of China would not pose a threat to the Australian industry, it continues to advocate increasing the Riverland supply of Valencias albeit at a lower cost of production. The cost of growing citrus is to be reduced by increasing the size of the orchards through buyouts or cooperative management of common assets.

Its rationale is as follows: the estimated cost of producing Valencias and Navels from long-run average cost curves are about $220 to $250 per tonne respectively (PIRSA, 2005a, pp. 18-20). On the one hand PIRSA concedes that there are no significant economies of scale to be tapped because the operating cost of Valencia production is expected to fall by 17% ($300 to $250) when the orchard size increases from 10 ha to 50 ha. Even at 800ha, the total cost of Valencia production would be $270/tonne. Therefore, PIRSA argues that juice-only production of Valencias is not attractive at the long-term contracted price of $220-250/tonne[4] (PIRSA 2005a, pp. 18-20; 2005b, p.30). On the other hand, PIRSA reinforces the significance of scale to survival by drawing on the 2002 Productivity Commission finding that 30% of growers produce 86% of the citrus output in S.Australia to (PIRSA, 2005a, p.19). Post-citrus crisis, PIRSA's

> "central message is that many small growers can look at options other than get big or get out…Some of the greatest benefits of increased scale can be achieved through collaboration, acting as if the group were one big unit. Collaborating can also spread the costs of deepening links downstream along the production chain…The issue of scale is also important from a social viewpoint. Small growers are more likely to live in the region and hence spend money there and support the local community…Scale is a significant issue….in downstream activities. In general, the further along the chain, the larger is the scale required. Ideally, packers operate on a scale larger than growers; exporters and local retailers operate at a larger scale again" (PIRSA, 2005b, pp. 30-1, emphases original).

A closer examination of the presumptions of its long run average cost curve is warranted because the cost of production appears to drive PIRSA's rationale (which will be critically evaluated in section 3). The following assumptions have been used to construct PIRSA's long-run average cost curve (with the Y-axis representing production costs, and the X-axis representing size of orchard):

- Cost of capital has been incorporated at 8% of total cost of orchard, including land and water rights;
- Analysis has assumed that appropriate technology is utilised, and the choice of technology varies with the size of orchards. Appropriateness is ascertained by extrapolating current technology against size of farms;
- A yield of 40 tonnes/hectare for Navels, and 47 tonnes/hectare for Valencias;
- "A high, professional standard of management expertise" (p. 19),
- Costs and yields have been averaged over a series of seasons.

Furthermore, a breakdown of operating costs of conventional horticulture is used to highlight the significance of labour inputs (at 40-45%, which does not include owner's labour at 10%), and overheads at 8 to 20% (see Table 3.1 in PIRSA, 2005b, p.28, with data drawn from the 2003 Productivity Commission report). The "prevalence" of overheads is used to suggest that

> "citrus might be grown more cheaply in larger orchards. This is consistent with previous work which has claimed that as many as 2/3rds of all Australian orchards are of insufficient size – and South Australian orchards are generally smaller than the national average (Productivity Commission, 2003, p.81)" (PIRSA, 2005b, p.28).

[4] In comparison, Navels are a more attractive proposition as it fetches $400/tonne and generates $3,000/ha profit.

Whilst PIRSA has acknowledged that "further work" could be undertaken "especially regarding the influence of scale", it "expects long-term decline in the small, traditional orchard" (PIRSA, 2005b, p.4).

On the question of preferred method of horticulture, PIRSA (2005b, p.4) has carried out "economic modelling" of 3 horticultural methods (namely, conventional, organic and advanced fertigation or open hydroponic): it reveals that profitability has increased in the same sequence above. PIRSA appears to be impressed with the potential to reduce costs through intensive farming technologies: the intensive method is regarded as symbolic of "appropriate" technology for larger orchards (2005a; also PIRSA 2005b, pp. 49-53 & Appendix 5, for trial comparing the financial implications of Advanced Fertigation Systems and Martinez Open Hydroponic Technology in Farm 8 Yandialla Park):

> "For example, we have received evidence that large-scale orchards using higher-density plantings and the open hydroponic system are currently delivering Valencias to the packing shed door for $110 per tonne, with the potential for further cost reductions, possibly to the order of 30%. We have not investigated this information in detail, but its implications appear to be substantial, all the more so because the benefits of the new technologies appear to be greater at larger scales of operation. Thus, as we have seen in other agricultural sectors, the drive for greater competitiveness requires relentless pursuit of new technology and this, in turn, tends to increase the optimal scale of production" (PIRSA, 2005a, p. 20).

PIRSA anticipates the following changes regardless of which horticultural method growers opt to embrace:

- Growers who shift to advanced fertigation will "share some fixed costs with their neighbours";
- Growers who move to organics will "need information, accreditation and coordinated marketing"; whilst
- Growers who remain in the conventional category remain vulnerable and need to cooperate and collaborate, in particular by developing "contracts and supporting structures" (PIRSA, 2005b, p. 6)

K.2c Objective and measurable quality standards

As the quality of oranges is not evident at the point of sale, quality may be ascertained by "specifying and monitoring the way in which the fruit is grown" (PIRSA, 2005a, p. 24). It is hoped that monitoring these proxies (of quality) would reduce uncertainty because it should identify the proportion of the harvest to be sold as fresh fruit, and hence the residual left for juice. On the one hand, PIRSA notes that there are indications that the industry is already collaborating in developing standardised terms of contract in this regard. On the other hand, it unproblematically extends the implications of this development to economies of scale:

> "One implication of strategic alliance contracting of the desired sort is that the quality systems and other investments required to nurture the relationship tend to be of an up-front nature and this is a factor, additional to those mentioned above, that increases the economies of scale" (PIRSA, 2005a, pp. 24-5).

Perhaps the presumption above may be attributed to the perception that monitoring quality would make it easier to access export markets. However the harsh reality is that world trade is shaped by political priorities and national interests, instead of quality of produce. Nevertheless, the Citrus Board SA has taken the lead in negotiating access to the US market. It provides weekly updates of production estimates to the industry.

K.3 Commentary

A brief introduction to the evolution of economic thought will be used to locate the PIRSA reports.

We begin with neo-classical economics: it relies on restrictive assumptions to explain market efficiency. Its assumptions include the notion of perfect competition and instrumental rationality, which ensures that actors will always make decisions to maximise profits. One of its infamous technical relationships is the long-run average production cost curve which PIRSA has applied in rationalising its prescription of increasing scale of operations (to tap into economies of scale). However, there is a major weakness to this asocial method of theorising economic reality: neo-classical economic analysis is static. It is unable to explain how and why economic development occurs (or fails to occur) over time. Furthermore, it ignores the vagaries of cognitive decision-making by presuming that the process is a rational one. In reality, a person's decisions are influenced by social and cultural factors. Neo-classical economics is also unable to explain how and why individuals make decisions under conditions of uncertainty and ambiguity: conditions which PIRSA (2005b, p. 5) has acknowledged as the dominant traits of the citrus industry.

Williamson's (1985) Transaction Cost economics represents the next stage in economic thinking: he follows Coase (1960), who had linked neo-classical economics to the role of institutions through transaction costs. Williamson connects "transaction costs" to the traditional production costs in explaining why (vertically integrated) firms exist. Nonetheless, he assumes that firms are intent on maximising profit (by minimising costs). In other words, Williamson explains why managers use the hierarchical structure of the firm to make decisions instead of contracting it out to the (presumably more efficient) market: he theorises management behaviour in terms of attempts to minimise production and transaction costs. Similarly, PIRSA's recommendation that favours vertical integration in the citrus industry reflects the aim of Transaction Cost economics, namely, minimising transaction costs.

What are transaction costs? They may be regarded as costs that arise when perfect market conditions fail to materialise. Therefore, transaction costs are the costs of "friction" or "market failures". It could arise for any number of reasons: the absence of perfect knowledge about the options available before making a decision, or imperfect knowledge about the market that results in an actor paying too much. Therefore Williamson's concept of transaction costs relaxes the rigidity of the neo-classical model because he recognises limited rationality in decision-making (following Simon, 1961) and asserts that people act opportunistically "with guile" if circumstances allow them to take advantage of another. PIRSA subsequently categorises speculative grower behaviour as opportunistic and advocates curbing it through contractual/cooperative arrangements.

Williamson uses his logic of minimising transaction costs to explain why the following categories of transactions will be resolved either within the firm or in the open market:

- Transactions that occur frequently are executed within the firm's hierarchical structure rather than in the open market because the transaction costs are lower.
- Transactions that are inherently uncertain are problematic, especially when the uncertainty is compounded by actors' limited rationality and opportunistic behaviour. Transaction costs will be reduced by confining it within the firm as it automatically limits the number of variables that could impact on it.
- Transactions that involve specific assets (in the sense that they are only valuable for a particular use, such as growing oranges for juice only) are more risky. Transaction costs will be reduced by vertical integration.

Even though Transaction Cost economics moderates the neo-classical notion of a frictionless (hence zero transaction cost) efficient market, it is not without its critics because it is still located within the conventional ethos of profit maximisation. Consequently, it does not recognise the social effects of the production relationship, in particular, the manner in which the balance of power between competing-interdependent parties affects the decision outcome. Conversely, it also does not allow for the mitigating effect of soft factors like trust and reputation on opportunistic behaviour. Last, but not least, it is difficult to define and measure the primary variable, transaction cost.

This brings us to a more recent formulation of economic theory that is more in tune with the social dynamics of economic development (or lack of development): North's (1993, 2005) New Institutional Economics, or the Washington approach to Coase's theory. North's conceptualisation of a political economic theory relaxes the notion of instrumental rationality. He also adds the time dimension because conventional economics is not equipped to explain economic performance (or non performance) over time. North introduces 2 terms, institutions and organisations: institutions are socially constructed structures such as formal rules and legislations while informal institutions refer norms, code of conduct and other self-imposed rules. Organisations are a category of players in the market, and are made up of individuals who are bound by a common interest. The role of institutions is irrelevant in circumstances where there are zero transaction costs: this is an unrealistic situation. Institutions play a significant role when the aim is to minimise transaction costs: it is a complicated political exercise as institutions are not designed to be socially efficient. North asserts that institutions are created to "serve the interests of those with bargaining power to create new rules" (North, 1993, p. 3 of 12). The organisational players take advantage of "opportunities provided by the institutional matrix" (North, 1993, p. 3 of 12). However, it cannot be presumed that this would culminate in progressive economic development because (historically) societies have become "stuck" in the institutional matrix: that is, they incur additional transaction costs instead of securing productivity gains. North's caution should be heeded in recommending structural reform for the Riverland citrus industry's formal and informal institutions. The community's responses quoted in the Introduction reflect fears that parallel North's concerns.

North (1993) places more emphasis on understanding how an individual's cognitive process facilitates/hinders the rate of learning, which in turn, influences economic development over time. Arguing that the speed of economic change is a function of rate of learning, he tries to create flexible institutional structures that facilitate continual (long-term) transformation of politico-social and economic relationships. North's incorporation of learning into cognitive decision-making processes places his New Institutional Economics at odds with PIRSA's prescription of vertical integration (or cooperation) because the latter's prescription has already alienated the local community of (family-run) horticulturalists instead of cultivating a culture of experimentation. PIRSA's prescriptions are aimed squarely at countering opportunism and facilitating economies of scale by (incorrectly) assuming that individual actors know what is best and will act to maximise economic returns. This is not always the case especially in circumstances where decisions are being made amidst uncertainty about expected outcomes. Furthermore, PIRSA's prescriptions minimise the competition that North asserts is crucial for stimulating a learning environment. In constrast, vertical integration may retard the rate of learning because it could result in structural rigidity.

Further, PIRSA (2005a, p. 18) relies on the long run average cost curve (with production cost per tonne plotted against size of orchard in hectares) in making its case for economies of scale. This is a technical relationship that has its roots in neo-classical economics: put simply, the average cost is the quotient resulting from dividing dollar cost by a measure of volume (of acreage). This technical ratio does not imply that the average cost also represents the optimal price for farm inputs. Not surprisingly, the Canadian National Farmers Union[5] (2003) challenges the presumption that small farms inefficient. It problematises the taken-for-granted notion that scale of operations is related to profitability by demonstrating that the business of farming has more to do with the politics of corporatisation than economies of scale.

[5] The Union was founded in 1969 and represents thousands of Canadian farm families.