



RESEARCH ARTICLE

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Quantifying an Integral Ecology Framework: A Case Study of the Riverina, Australia

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Special Section:

Resilient Decision-making for a Riskier World

Key Points:

- Summarizes how the integral ecology concept can help rural communities achieve economic, social and environmental sustainability
- Develops a quantitative framework to operationalize the integral ecology concept
- Applies the framework and ranks 77 Murray-Darling Basin community led initiatives to provide guidance on future community investment

Supporting Information:

- Supporting Information S1

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Abstract

Communities in Australia's Murray-Darling Basin face the challenge of trying to achieve social, economic, and environmental sustainability; but experience entrenched conflict about the best way to achieve a sustainable future, especially for small rural communities. Integral ecology is a philosophical concept that seeks to address community, economic, social, and environmental sustainability simultaneously. Its inclusive processes are designed to reduce stakeholder conflict. However, to date the application of the integral ecology concept has been largely qualitative in nature. This study developed a quantitative integral ecology framework, and applied this framework to a case study of the Riverina, in the Murray-Darling Basin. Seventy-seven community-focused initiatives were assessed, ranked, and quantified. The majority of the community-focused ranked initiatives did not exhibit all aspects of integral ecology. Initiatives typically prioritized either (1) economic and community development or (2) environmental health; rarely both together. The integral ecology framework developed here enables recommendations on future community initiatives and may provide a pathway for community leaders and other policy-makers to more readily apply integral ecology objectives. Further research refining the framework's operationalization, application and implementation to a wider-scale may enhance communities' capacity to develop and grow sustainably.

1. Introduction: Rural Communities and Wicked Problems

Rural communities worldwide, particularly those with high reliance on agriculture, face long-standing, complex and interconnected challenges, which pose serious problems when trying to design policies to enable a sustainable future for these communities. Some of these issues include: globalized agricultural competition; declining terms of trade; declining populations; the reality of climate change and reduced water availability; environmental and disease threats; natural disasters; increased mechanization; bigger farming operations and changing employment structures as demographics change, with concern often expressed about the future of family farms and migration of younger people to cities (e.g., Barr, 2009; Pacione, 2004; Wood, 2008). Consequently, many rural areas now suffer various kinds of socioeconomic disadvantage (such as low incomes, under-employment), while also facing entrenched and significant environmental problems within which solutions to other problems must be situated. Many rural communities thus fear falling farm numbers, shrinking local economies, fraying of the social fabric and consequently their community resilience and long-term viability. The decline of many rural communities in Australia is widely recognized in the literature (e.g., Pritchard & McManus, 2000; Rogers & Ryan, 2001).

The Riverina region in Australia's Murray-Darling Basin (MDB) is an example of these concerns: the region includes a range of farming communities and small townships experiencing population decline, as well as larger towns and regional cities experiencing population growth. Substantial concern has been expressed about maintaining communities into the future in the region, which depends heavily on agriculture, and in particular irrigated agriculture, with concern that reductions in irrigated water supply to be made as part of the MDB Plan may, together with other challenges such as severe droughts experienced in recent decades, lead to a decline of communities within the region (e.g., Alston, 2004; Barr, 2009; Golding et al., 2009).

Such issues are often identified as wicked problems because they have multiple, interconnected causes and many possible solution perspectives (Wallis & Ison, 2011). Wicked problems occur in contexts that value

and respect plurality. Syme (2014) emphasized that although governments often hope that improved science will reduce uncertainties associated with long-term regional sustainability issues, it is often the case that uncertainty comes from social, institutional and economic factors rather than ecological or biophysical ones. As such, there can rarely be a single, technical solution to such challenges. Responses to wicked problems must value and include all perspectives in formulating solutions. The interconnected levels of decision-making and scales of operation add a further dimension of complexity (Ferreira et al., 2008). There are obviously challenges that exist at wider scales (such as river basins), while other problems involve local, community focused scales. Solving wicked problems thus requires structures and principles that respond adequately and equitably to complex situations, while also enabling tailoring of responses to the distinct and often differing challenges and issues faced by different communities even within a single region such as the Riverina. Meanwhile, the decision-making process for the solutions should offer principles and methods for addressing risks across different spatial and sociopolitical scales (Grafton et al., 2016).

Solutions to wicked problems have affinities with the concept of integral ecology: both have a mutual emphasis on complexity, multicausality, inclusion of several perspectives and the employment of strategic responses across a range of systemic, political, spatial and organizational domains. Integral ecology is an emerging concept argued to have potential to help address wicked environmental and conservation issues and for responding to climate change (e.g., Esbjörn-Hargens, 2010; Sánchez Sorondo & Ramanathan, 2016). It has become conventional to speak of rural communities seeking to achieve the triple bottom line of economic and social wellbeing, and a healthy environment. While the need to consider them simultaneously has been emphasized, less attention has been given meeting these ends, despite a large body of work examining how to understand and characterize inter-relationships in socioecological systems in order to increase resilience to climate change (e.g., Cote & Nightingale, 2012; Ostrom, 2009; Young et al., 2006). In particular, little work has focused on assessing community initiatives from the perspective of achieving social, economic and environmental benefits, rather than only one or two of these (see Bark et al., 2014 for a rare example).

This study seeks to investigate whether the concept of integral ecology can be operationalized to provide a means for communities to identify priorities and mechanisms for achieving improved economic, community and environmental outcomes. With integral ecology still an emerging field, there are a lack of consistent methods available for it to be applied to inform decision-making. This is one of the first attempts to operationalize integral ecology by first developing a quantification framework and then applying it at the local level to help identify initiatives that successfully address all elements of rural community development. The purpose of this study is to test whether the quantified integral ecology framework can provide real world guidance for local community development. In doing so, it must be noted that we are only applying the concept of integral ecology at the local level for various communities within the Riverina, even though this regional area coexists within a much bigger river basin scale of the MDB. Needless to say, application and learnings from quantifying integral ecology at a concentrated, local level first will provide the greatest insights before attempting to apply it at a wider spatial scale. The quantified and operationalized framework in this study helps contribute to understanding how to translate from theoretical objectives to practical guidance for rural communities whom are struggling with where to concentrate limited resources on addressing wicked economic, social and environmental problems.

2. Integral Ecology as a New Approach to Community Development

Rural community development or community development is often defined broadly, involves various strategies and can also be described as a method, a process, a program or a movement (Mayo, 1958). When evaluating where to invest resources in communities, although there are the traditional forms of project evaluation that can be applied (e.g., cost-benefit analysis, multicriteria analysis, cost-effective analysis, citizen juries), these different methodologies have been criticized for various shortcomings (e.g., Hajkowicz et al., 2000). Subsequently, a variety of alternative strategies have been explored, albeit needless to say they all have shortcomings as well. For example, Rogers and Ryan (2001) suggested a sustainability focus using a triple bottom line community audit approach by evaluating the wellbeing, environmental impact and economic vitality in the community. Hatton MacDonald et al. (2013) employed grounded theory to elicit community leaders' values of multiple-use landscapes; and Grafton et al. (2016) proposed an adaptive ROAD (Risk and Options Assessment for Decision-making) process to enable decision-makers to make

risk-based responses to food, soil, energy and water threats. In terms of pure environmental strategies, Esbjörn-Hargens (2005) noted that over 100 approaches toward the environment existed, but that none of them capture all of reality. “Integral ecology” has relatively recently been put forward as potentially an all-encompassing concept.

2.1. The Elements of Integral Ecology

Integral ecology began in the 1950s by bringing greater holism to ecological frameworks, expanding their focus to environmental issues, then to social and community problems (Hochachka, 2005). Integral ecology integrates human and environmental wellbeing with spirituality. Human and natural issues are inseparable; economic concerns do not take primacy over ecological ones (Celantano, 2016). Integral ecology also seeks to side-step egoism, abandoning frameworks which reinforce ideology, racism, sexism, or other perspectives which create and/or reinforce individual or collective conflict. It also acknowledges the impact of human frailty and suggests that a better world requires better people (Esbjörn-Hargens, 2005; Hochachka, 2005). The insistence on the unity of creation, the commitment to spiritual growth and the employment of respectful and tolerant processes in problem-solving makes it compatible with mainstream Christian theology, and indeed, many other major religions such as Buddhism, Hinduism, Islam (both Sunni and Shia) and Judaism (Sánchez Sorondo & Ramanathan, 2016). As a recent example, Pope Francis utilized the concept in his Encyclical Letter, “On Care for our Common Home”. It reflects the Pope’s conviction that everything is closely related and the need for a vision capable of taking into account every aspect of the global crisis facing the earth’s future (Bergoglio, 2015).

Given these principles, integral ecology uses integration of expert and lay knowledge, emphasizes collaboration, respectful and inclusive participation, and the use of conflict resolution procedures as part of its aim of working toward developing shared goals, visions and norms for conduct. Integral ecology applies developmental psychology to self (subjectivity), culture (intersubjectivity), and nature (objectivity). Therefore, any issue requires attention to its objective, subjective, and inter-subjective dimensions. Integral ecology unites the knower and the object of knowledge by asking: What is known? Who knows it? And how is it known? This “who, what and how” nexus becomes the guiding maxim in problem identification and resolution. The integral ecology concept suggests that the “what” consists of *four ecologies* and *12 niches*; the “who” consists of *eight ecological selves*; and the “how” consists of *eight ecological modes*. Accordingly, the aim is to recognize all niches of environmental concern, all selves of environmental worldviews, and all modes of environmental inquiry through four ecologies:

1. *Experience*: This is the internal, subjective reality of an individual; for example-somebody enjoying a walk by a river or an irrigator facing reduced water allocation. This ecology includes religious and spiritual beliefs, along with individuals’ cognitive, emotional and moral capacities.
2. *Culture*: This is the shared values, world-views, meanings and mutual resonances among a group of people (includes language, shared norms, customs, symbolism, and communication forms). Culture includes collective interpretations of the environment, and attends to stigma and to collective perceptions of inequities related to class, gender, ethnicity or age. Tools for cultural transformation may include: dialog and community development; inclusiveness and consensus-based strategic planning and trust-building exercises.
3. *Behavior*: This is the measurable behavior at all levels of the system and concerns the actions and movements of human and nonhuman members of the natural world; for example, the pH of a river, or the number of people who recycle. The tools for transforming behavior range from actions promoting wellbeing, adoption, regulation and education.
4. *Systems*: This focuses on functional interaction of human and nonhuman components of the natural world, for example: economic and community impacts, migration patterns and food chains. It encompasses the visible aspects of social structure and a society’s economic, political, social, technological, educational, and informational dimensions. From a public governance point of view, it is the institutions upon which society operates. Climate change, environmental restoration, sustainable use of natural resources and food chains are included in this domain. Systems’ transformational tools include systems thinking; institutional change; capacity building; organizational change; regulation; pricing; education; and subsidies (Esbjörn-Hargens, 2005; Esbjörn-Hargens & Brown, 2004).

Table 1.
Integral Ecology Four Ecologies and Quadrant

	Interior	Exterior
Individual	I Experience—individual realities	It Behavior—the visible behavior of any part of the system.
Collective	We Culture—the shared views of groups of people.	Its Systems—the health of the system and the range of socioeconomic forces that influence its health.

Source: Adapted from Esbjörn-Hargens (2005) and Preist (2008).

These four ecologies give rise to four quadrants which encompass and express multiple ways that an issue may be conceptualized, with both subjective and objective aspects of a problem and its individual and collective dimensions (Esbjörn-Hargens, 2005; Wilber, 2000). Table 1 outlines the way the four ecologies align with subjective and objective, individual and collective, as well as the internal and external dimensions of a system. For example, both the *behavior* and *systems* ecologies represent the exterior part of the world; while *systems* represents the collective exterior part, which includes society's institutions and property rights. Institutions help create/implement mechanisms and tools to change behavior (which represents the actual action/outcome of an individual (or collection of individuals)) of interest. The classic figure that has been used to depict these four quadrants is the four views of a frog shown on the cover of Esbjörn-Hargens and Zimmerman (2011).

Each of the four ecologies has various levels of complexity associated with them. Implicitly it is possible to undertake decision-making on the basis of risk, by considering all the possible hazards and impacts within each of the four quadrants, and doing a causal risk assessment within each area (similar to Grafton et al. (2016)). One extension of the integral ecology literature is the concern with knowledge perception and generation. Integral ecology utilizes knowledges that examine the visible and nonvisible aspects of systems (natural and social), individuals and communities. It respects and includes local, "folk," Indigenous and expert knowledge. Qualitative and quantitative methods ensure that visible and invisible dimensions are addressed. For integral ecology to be completely applied, it requires coordinated input from many disciplines and stakeholders. Needless to say, in practice transaction costs will usually impede such inclusiveness, but to date the integral ecology concept has been applied by over 35 professions (Celantano, 2016).

Integral ecology also includes concepts and attributes from the resilience literature, and in particular systems ecology encompasses community resilience. Resilience is recognized in the literature as the capacity to withstand and recover from shocks and stressors. From a variety of disciplines and perspectives, three main commonalities among the resilience literature are summarized as: absorptive, adaptive and restorative capacity (Bond et al., 2017). Integral ecology has been increasingly suggested to be a crucial concept to solve wicked environmental and conservation issues and for responding to climate change (e.g., Owens, 2005; Riddell, 2005). Accordingly, some have suggested using integral ecology as a comprehensive and holistic concept for community development (Hochachka, 2005; Preist, 2008; Tavanti et al., 2017; Tissot, 2005) and place-making/planning (Wight, 2005).

We believe that the concept of integral ecology is one that deserves greater focus and implementation. However, in order for it to be further applied and implemented, there is a need to quantify the concept and to create a framework upon which its indicators can be directly applied. Table 2 is our attempt to first provide a summary framework of the integral ecology literature, by breaking it down into various quadrants, issues and then indicators that reflect the overall issue and quadrant.

These critical indicators in Table 2 are then correspondingly broken down into various questions and ranked in Table 4 to allow application to actual community initiatives in our case study. To our best knowledge, this is the first time the concept of integral ecology has been quantified as a framework and applied directly. Developing a quantitative integral ecology framework may allow a more systematic application of ranking key criteria in community projects to guide improved rural community development and wellbeing. The following case study investigates this further.

Table 2.
Integral Ecology Quadrants, Issues and Criteria

Quadrant	Issue	Indicators
Experience	Identify beliefs, values, worldviews and so on that impact on the issue	Widespread consultation Leadership All stakeholders engaged Respect all points of view and sources of knowledge
	Align attitudes, values, beliefs, worldviews and so on to achieve project aims	Effective group processes <ul style="list-style-type: none"> • Conflict resolution/trust building • Develop commitment/motivation • Improve communication/collaboration Address education, physical and mental health needs
Culture	Identify interpretations/symbolism related to natural world	Widespread consultation Leadership, all stakeholders engaged All points of view and sources of knowledge are respected
	Identify interpretations and norms around the local community	Space for dialog/communication Develop fora for communication Develop norms for group processes and inclusiveness
	Identify salient relationships and address inequities	Inclusive strategic planning and community development Skills building, support groups Provide necessary resources Organizational learning
	Effective group function	Leadership, participation, cooperation and collaboration Consensus on vision, goals and strategies. Develop a shared view of the problem
	Improved community function	More cohesive, resilient and inclusive More outward looking and engaged Greater tolerance of diversity, equity and care
Behavior	Identify behaviors impacting issue and identify scale at which it can be addressed	Political structures (federal, state, local) Organizations (local, regional, national, global) Develop a clear plan with goals, timelines and which specifies roles and responsibilities
	Access to relevant infrastructure and technology	Networks, alliances, coalitions Skills, marketing and capacity development Access to specialized knowledge New food chains, energy and water-saving technology
	Measuring behavioral outcomes	Tourism, population, business numbers and behaviors Improved infrastructure and/or technology Responses to policy, legislation, regulation Increased community wealth and other indicator improvement Resource management projects Job creation/new businesses Labor and corporate regulation to support issue Improved ecology, habitat, biodiversity; environmental restoration Organizational/social learning/change
Systems	Are solutions sustainable in the short or long-term?	Do they value-add or diversify the local economy? Do they develop local organizational, social and human capital? Do they prioritize community development over individual activity? Do they provide technical fixes or socially sustainable solutions? Are benefits distributed equitably? Do they promote ecosystem health as a whole? Are all possible environmental problems addressed?

Table 2.
continued

Quadrant	Issue	Indicators
	Changes required in system to address issue	Capacity building, networks, alliances and coalitions Institutional development, organizational learning/change Implementation of policies, legislation, regulation Appropriate mix of local, regional and up-stream strategies

3. Case Study

3.1. Case Study Area: The Riverina in Australia's MDB

The Riverina sits within the MDB, which is Australia's most important agricultural production region, providing about one third of the nation's food supply. The MDB is also an area of great ecological, cultural and recreational significance (Wheeler, 2014). The Riverina is an inland agricultural area within the southern reaches of New South Wales (NSW). It includes both irrigation and dryland agricultural areas; the irrigation areas are part of a larger inter-connected major irrigation area extending into the bordering regions of the Murray region of NSW and Goulburn Murray in Victoria, all highly reliant on irrigated agriculture produced from water delivered through the MDB system. The Riverina region (and surrounding regions) are defined in varying ways by different government agencies and community development organizations (Figure 1), using definitions such as "Regional Development Area" (RDA), "Local Land Services" (LLS) area, and biophysical catchments (surface water sustainable diversion limit, or SWSDL, area). In this study, we focused on the parts of the Riverina dependent on irrigated agriculture, and also examined irrigated agricultural regions near the Riverina, including those in the "Murrumbidgee" catchment which overlap with parts of the Murray region to the south and, where appropriate, other irrigated agricultural areas nearby.

The Riverina provides a representative case study of the interrelated and wicked problems of rural development. From the inception of non-Indigenous settlement in the MDB, farming practices, including irrigation, created a variety of environmental problems (e.g., saline soils and water, degraded biodiversity) (McKenzie et al., 2004). Until the late 20th century, there were almost no limits on water diversions, leading to over-allocation. The "Millennium drought" of the 2000s (2001/2002–2009/2010) was associated with significant hardship for many communities, with water allocations at their lowest levels since the inception of irrigation schemes. Growing water scarcity and quality issues prompted wide-scale government reform of water management in the MDB, moving from localized governance to greater federal management, creation of new water institutions and responsibilities, the introduction of a water market and the development of a MDB wide plan (implemented in 2012; e.g., Wheeler, 2014). The MDB Plan's main focus was on achieving the environmental health of the Basin, but the Murray-Darling Basin Authority was also required to consider economic and social issues and hence the development of other water policy heavily considered the viability of irrigation businesses and communities. Nevertheless, the Plan was criticized by many irrigators and irrigation-dependent communities in the Basin who were concerned about whether it adequately balanced the goal of restoring water for environmental health with maintaining social and economic wellbeing. In particular it generated extreme hostility in parts of the Riverina that depend on irrigated agriculture (Quiggin, 2012). Conflict between stakeholders remains an enduring feature of Basin management, and multiple calls have been made to increase collaborative, respectful and ethical discussions about how best to ensure the social, economic, and environmental future of Basin communities (e.g., Abel et al., 2016; Schirmer, 2017; Tan & Auty, 2017).

One of the main reasons for this ongoing conflict over environmental sustainability versus irrigation sustainability is that many areas within the Riverina, similar to many others across Australia, face serious socioeconomic challenges, which are considered by many to be exacerbated by water reform processes. On the other hand, equally water reform processes could improve community sustainability in the long-term (Wheeler et al., 2017). As shown in Table 3, many local government areas in the region, particularly those with smaller populations, experienced population decline during much of 1996–2016, particularly during the years coinciding with the Millennium drought. It should be noted that rural population decline

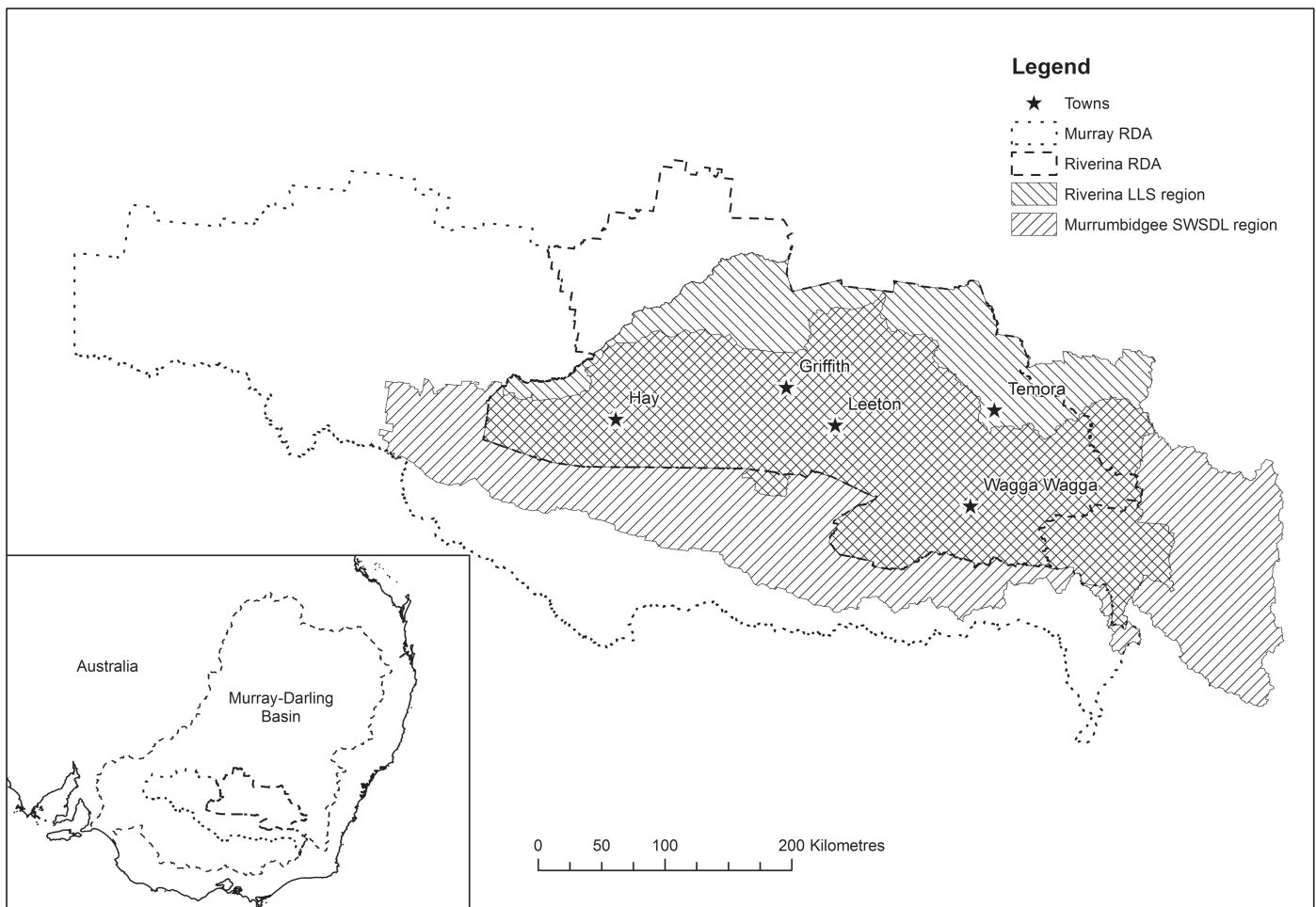


Figure 1. Location of the Riverina region using different definitions.

over time is an ongoing reality for the Riverina, and any decline in the period studied here needs to be considered in this context. Nevertheless, several communities in the region are ranked among the 30% most disadvantaged communities in Australia, and very few rank among the less disadvantaged. Almost one in four households had low household income in 2016, rising to more than 30% in some of the more disadvantaged areas. A key factor that is evident in Table 3 is the variation in outcomes: some communities are doing better than others, even after taking into account overall population size as a driver of change. For example, in the four Riverina communities with the smallest populations—Carrathool, Hay, Murrumbidgee and Lockhart—two experienced strong population growth during 2011–2016, one population decline, and one more moderate population growth. Two ranked among the lowest fifth of communities across Australia in terms of socioeconomic disadvantage, while the other two ranked among the “less disadvantaged” 50% of communities. A range of influences (e.g., soil and water quality; institutional support; health and education services; proximity to regional centers) will drive these differences in disadvantage. One of these influences that we are most interested in studying in this article is the types of community development initiatives enacted in communities over time, and how well they support sustainable development and initiative.

The above discussion highlights many of the wicked problems facing regional development in general. Some areas (especially large urban areas) in a region may fare considerably better than others, while smaller, more rural areas often experience rapid decline over time. Often it is these smaller, rural areas that also face more issues associated with environmental health (such as water quantity and quality in the MDB), particularly as they often have very high reliance on agriculture, which in turn is highly sensitive to

Table 3.
Sociodemographic Characteristics of Riverina Communities, Compared to the MDB Average

Type of region	Region	Total population, 2016	Population change, 1996–2006 (%)	Population change, 2006–2011 (%)	Population change, 2011–2016 (%)	SEIFA index of relative socioeconomic disadvantage, 2011 ^a	Households with low income, 2016 (%)
Major region	MDB	2,216,117	5.2	4.5	5.8	N/A	22.7
Region	Riverina	184,380	0.7	1.0	3.5	N/A	23.8
Region	Murray	102,707	8.1	1.4	5.4	N/A	25.8
LGA ^b	Wagga Wagga	62,383	2.7	4.3	4.9	Decile 7	24.6
LGA	Albury	51,080	10.7	3.3	6.8	Decile 6	30.4
LGA	Griffith	25,635	10.2	2.4	5.2	Decile 5	29.3
LGA	Hilltops	18,497	3.9	2.0	1.5	Decile 3 (est.)	25.8
LGA	Snowy Valleys	14,398	−1.6	−0.3	0.7	Decile 4	27.7
LGA	Federation	12,279	n.d.	−0.6	1.0	Decile 5 (est.)	24.1
LGA	Murray River	11,682	5.1	1.3	7.0	Decile 6 (est.)	22.3
LGA	Leeton	11,167	0.7	−0.6	1.2	Decile 4	26.8
LGA	Cootamundra-Gundagai	11,144	−1.5	−0.1	1.3	Decile 4 (est.)	28.3
LGA	Greater Hume Shire	10,357	n.d.	0.9	5.5	Decile 7	20.4
LGA	Edward River	8847	−2.9	−4.9	2.2	Decile 4 (est.)	27.1
LGA	Berrigan	8462	−2.1	0.9	4.9	Decile 4	26.5
LGA	Junee	6295	0.4	1.8	7.1	Decile 3	23.5
LGA	Temora	6110	−1.0	−1.4	5.8	Decile 4	20.1
LGA	Bland	5958	−8.7	−3.9	1.6	Decile 5	23.3
LGA	Narrandera	5853	−15.8	−1.8	−0.8	Decile 2	26.7
LGA	Coolamon	4313	4.8	1.7	5.2	Decile 5	27.4
LGA	Murrumbidgee	3838	−4.7	−9.4	2.2	Decile 2	30.3
LGA	Lockhart	3121	−8.7	−5.8	4.2	Decile 7	27.1
LGA	Hay	2945	−11.6	−12.5	−0.4	Decile 2	29.1
LGA	Carrathool	2723	−11.0	−8.2	5.3	Decile 5	24.5

Sources: Australian Bureau of Statistics (1997, 2008, 2012, 2017).

^aRegions in lower deciles are more disadvantaged, those in higher deciles are less disadvantaged. Estimates indicate that an estimate has been made of the ranking due to the LGA boundary changing between 2011 and 2016.

^bLGA, local government area.

^cn.d., no data, due to changes in geographic boundaries of this region over time.

^dDefined as household income of less than AUD\$650 weekly.

changes in environmental health. Both state and federal governments have attempted to address these rural inequities by a variety of programs, and especially in the MDB, there has been a significant amount of government expenditure budgeted for such purposes. For example, the *Water for the Future* policy is an AUD\$13 billion+ strategy, primarily marked for irrigation on- and off-farm infrastructure investment, which is intended to better balance the water needs of communities, farmers and the environment (Wheeler, 2014). However, questions remain as to how local, regional and national bodies can identify how best to invest funding where it is most effective at addressing rural inequity from an integrated social, economic and environmental perspective. Developing and applying the concept of integral ecology as a guiding framework for making these difficult decisions may help communities shift beyond traditional decision-making processes that often focus on limited dimensions or criteria rather than an integrated perspective.

3.2. Case Study Methodology

There were two different methodologies employed in this case study. The first methodology was a survey of Riverina residents on what improved their wellbeing and way of life. The second methodology was an attempt to operationalize and quantify the concept of integral ecology by (1) developing a quantitative framework of the four quadrants of integral ecology; and (2) operationalizing the framework by applying it to a wide range of Riverina community initiatives. The two methodologies complement each other. The insights from the community survey provides context for the integral ecology framework as well as informing the results of the ranking of the community initiatives. This then allows a greater and deeper discussion about what areas (quadrants) are underrepresented if communities wish to follow the integral ecology concept to improve economic, social and environmental sustainability. It also provides possible targets for intervention/capacity building.

3.2.1. Identifying Rural Community Drivers of Wellbeing from a Riverina Residents Survey

Riverina community members' views about the strengths, weaknesses and likely future of their communities are essential to understanding which initiatives may contribute best to improving social, economic and environmental wellbeing. This information was assessed by analyzing qualitative comments made by residents living in six Riverina local government areas with moderate to high dependence on irrigated agriculture (Griffith, Leeton, Murrumbidgee, Hay, Carrathool, and Wagga Wagga) in the 2016 *Regional Wellbeing Survey*. This survey began in 2013, with just over 9000 participants, increasing to 13,000 participants by 2016. It asks a range of questions about community wellbeing, quality of life, and people's experiences (Schirmer et al. (2015)). The responses included 336 nonfarmers and 99 farmers (51 were irrigators). Answers to these three open-ended questions were analyzed:

1. At the moment, what things are having a POSITIVE effect on the wellbeing or quality of life of people in your community?
2. At the moment, what things are having a NEGATIVE effect on the wellbeing or quality of life of people in your community?
3. What is most needed to improve quality of life in your local community?

Respondents' answers were first analyzed using NVivo to generate simple word clouds and hence common themes; and second by categorizing each respondents' answers into these common themes to quantify the frequency of common answers (reported in this article).

3.2.2. Identifying, Operationalizing and Ranking the Concept of Integral Ecology for Local Riverina Initiatives

To operationalize the concept of integral ecology and create a framework for the case study, we used the summary from Table 2 which provided a series of statements to capture the essence of each integral ecology quadrant (e.g., experience, culture, behavior, and systems) in relation to environmental and/or community development to create indicators for each statement. For example, the *Experience quadrant* focused on stakeholder input and respectful process; the *Culture quadrant* focused on community development and community function; the *Behavior quadrant* focused on economic and environmental impact; and the *Systems quadrant* focused on economic and environmental sustainability. Finally, a score was given to how much an initiative fit the integral ecology concept.

These indicators were formulated and each assigned a quantitative score, as Table 4 demonstrates. Overall, a 0 was given to an indicator where there was no evidence of achievement, 1 for some level of achievement, 2 for more achievement and 3 for high levels of achievement. For consistency purposes, one member of our team ranked all community initiatives, with other team members checking/clarifying rankings afterwards. The somewhat subjective nature of this ranking process must be noted, hence why it was important to have one person undertake all the rankings.

Next, information on all current MDB community initiatives (primarily in the Riverina) was collected to rank against our integral ecology framework. Although the Riverina was our main area of focus, information on other MDB initiatives was also collected and assessed for comparison purposes where it was believed they may rank highly on integral ecology criteria.

Table 4.
Integral Ecology Case Study Scoring Key

Criteria	Quadrant	Indicator	Score
Stakeholder input (SI)	Experience	No intersectoral or community involvement	0
		One or two sectors involved; marginal/no community involvement	1
		Several sectors from diverse domains included, as well as community input	2
		Many diverse sectors and widespread community involvement	3
Respectful process (RP)		No consultation or negotiation	0
		Consultation only; no negotiation undertaken	1
		If consultation not specifically mentioned, but outcome achieved	2
		If consultation and negotiation mentioned to achieve outcome	3
Community development (CD)	Culture	Commercial enterprise only; no impact on community development	0
		'Official' agencies only involved; minimal impact on community development	1
		Widespread involvement and widespread community benefit	2
		Widespread involvement and funds or profits diverted back to community	3
Community function (CF)		No/negative impact on community function	0
		Minimal impact improvement	1
		Involves large number of diverse groups and volunteers	2
		Large number groups involved, including marginal groups/individuals	3
Economic impact (ECI)	Behavior	No/negative direct impact	0
		Limited local wealth and employment generation	1
		Wealth and employment generation involving several community sectors	2
		Activity/event designed for community benefit	3
Environmental impact (ENI)		No/negative environmental impact	0
		Localized impact improvement	1
		Regional impact improvement	2
		Generalized or potentially generalized impact improvement	3
Economic sustainability (ECS)	Systems	No/negative impact on economic sustainability	0
		Limited impact improvement (by time or confined)	1
		Wider community and/or ongoing benefits	2
		Widespread, permanent economic benefits for the community	3
Environmental sustainability (ENS)		No/negative impact on environmental sustainability	0
		Limited impact (a particular species or location) improvement	1
		Wider, ongoing environmental sustainability improvement	2
		Permanent, widespread improvement to environmental sustainability	3
Integral ecology (IE)		Focus on either economic/community OR environmental betterment	0
		Focus on economic/community AND environmental betterment for commercial enterprise	1
		Focus on economic/community AND environmental betterment for community benefit	2

To collect information on current regional initiatives, the following methods were utilized: (1) a literature review of all gray and academic sources; (2) interviews of key economic development officers in the Riverina area; (3) online search of websites and reports produced by local governments in the Riverina; (4) online search of local media, community organizations and MDB initiatives; and (5) analysis of qualitative comments made by Riverina respondents in the University of Canberra's *Regional Wellbeing Survey* in 2016. It should be noted that it cannot be guaranteed that all community initiatives in the Riverina have been identified (given, e.g., many hospitals, schools, and other organizations such as churches may have individual focuses that were not public); but we are reasonably confident that the bulk (and most significant) initiatives were identified.

As keeping with the focus on local scale and regional communities, the overall criteria in identifying a regional initiative to rank stipulated that it must contribute in some way to local community development and/or to environmental sustainability, but avoid “technological fixes” or “individual initiatives.” In total, information on 77 MDB community/development initiatives was collected and assessed, 67 of which were from the wider Riverina region. Each initiative was ranked according to criteria in Table 4, and all four quadrants plus the integral ecology quadrant were scored, which was summed to provide a total with a maximum of 26 (the online appendix describes all initiatives and rankings).

It needs to be noted that the adequacy and comprehensiveness of the information that was available for initiatives can vary depending on the information sources available. This may be reflected in the ranking scores and may result in, for example, overemphasizing some aspects of the initiative and not mentioning others when initiatives are designed to meet current standard funding rounds. Other issues could involve political or resource based factors determining initiatives. This could explain why there was a lack of initiatives scoring highly in all quadrants.

4. Results

4.1. Regional Wellbeing Survey Findings

When asked what things were having a positive effect (Table 5) on wellbeing and quality of life in their community, answers given by Riverina residents predominantly fell into six themes: (1) local events (26%); (2) good weather, water availability and farming season (20%); (3) improved local infrastructure, facilities and services (18%); (4) rural life and community support (16%); (5) lower unemployment levels and economic growth (8%); and (6) other (e.g., improved (mental) health services) (10%). Responses were similar for both farmers and nonfarmers.

Local events included festivals, farmers' markets, arts and sporting events, and multicultural events. People's contribution to the community was identified as important, with many contributions such as volunteering, developing new initiatives and strong support in difficult times valued, but some respondents also identified that these contributions needed additional support to ensure their continuation. Local government input to the community was particularly valued in relation to helping establish new health services and/or supporting new community events.

When asked about factors that were having a negative impacts on quality of life and community wellbeing (Table 6), seven key themes emerged: (1) crime (e.g., break-ins, domestic violence) and drug use (mainly methamphetamine) (18%); (2) weather (spring flooding in 2016, hot weather, flies/mosquitos) (13%); (3) lack of facilities/activities and poor local governance (e.g., corruption, not listening to people) (11%); (4) poor economic outlook (e.g., lack of tourists, housing, jobs, businesses, and opportunities for young people) (10%); (5) lack of transport/road infrastructure (also living in an isolated area) (8%); (6) poor local health support (e.g., outdated facilities, lack of elderly, and specialist services) (7%); (7) water reforms (e.g., Basin Plan, water buy-back) (7%); and (8) other (28%). Responses of farmers and nonfarmers were reasonably similar, with two key exceptions: irrigators were more likely to mention both weather-related issues (34%) and water reforms (20%).

The “other” category include a diversity of issues, including some that related to specific events occurring in 2016 and some related to longer term issues: for example, some respondents referred to antisocial behavior (e.g., disrespectful, disengaged and dishonest people) (3%); reduced commodity prices/increased general costs of farming/volatility of markets (2%); and lack of education (e.g., access, funding) (2%).

Table 5.
Community Resident Responses to what has a Positive Effect on the Wellbeing/Quality of Life in the Riverina in 2016
(n = 435)

Topic	Responses (%)	Examples
Local events	26	<p>"School musicals/production were good, health expo in the park was good too"</p> <p>"There are a lot of community events being held and this is boosting the moral of the area"</p> <p>"Local events e.g., agricultural field Days, shows and so on, local Sikh games days"</p> <p>"Community based projects which bring people together for a given cause like men's health, the bike ride and follow up carnival, breast cancer support groups, cultural events such as the Country Bands Weekend, Chamber of Commerce happenings which promote the town"</p>
Good weather, water availability and farming season factors	20	<p>"Recent good rainfall"</p> <p>"The good weather for livestock producers, the crops are ripening well even though there were floods recently, landscape is doing well"</p> <p>"Water availability and price on temporary market, employment opportunities, good prices for commodities, sunny spring weather conditions"</p> <p>"Good weather is keeping farmers happy at harvest time"</p>
Improved local infrastructure, facilities and services	18	<p>"Local gardeners and council go to battle over who can grow the best gardens in town making our home a beautiful sight to behold"</p> <p>"Active local council maintaining walking track, improving facilities, developing exercise area close to new children's play area. Sporting facilities well maintained"</p> <p>"Improved telecommunications, medical availability (but not for all conditions) in main town"</p>
Rural life and community support	16	<p>"Strong community values, I love walking down the street and people wave to you and stop and have a chat, there's always someone who will lend a helping hand when needed"</p> <p>"I live in a caring sharing community, where we know many of the local people and can say hi to people in the street and at local events"</p> <p>"Sense of community"</p>
Lower unemployment levels and economic growth	8	<p>"The growth of the cotton industry in our area providing extra employment"</p> <p>"High employment rate"</p>
Other	10	<p>"New, younger council members willing to listen to what people want."</p>

Note. More than one answer could be provided and % are calculated on total responses.

When asked what could be done to improve their community (results in Table 7), Riverina respondents nominated a range of actions: (1) improving local facilities (e.g., parks, cycle path), activities (especially for the youth) and government services/governance (20%); (2) improving economic outlook (e.g., more/better job opportunities, more incentives for businesses, attract more tourists) (20%); (3) reducing crime rate and drug abuse (13%); (4) improving access to critical health services (especially mental health, midwifery, specialist and aged care services) (10%); (5) increased community cohesion (e.g., a common community goal, better communication/support among people, acceptance of diversity) (8%); (6) improved public transport and roads (7%); and (7) other (23%). While local leadership was acknowledged, enhancing their capacity was regarded as important. Support for facilities that are tailored to young people was a major topic. The "other" category included a diverse range of suggestions from improving education facilities (e.g., remote learning center/more education on multiculturalism/health/antibullying, pathway programs for youth) (4%); to more social events/cultural activities (3%).

It should be noted that water and water reform does not feature heavily in respondents' comments in 2016. This is due to the fact that it was a relatively good year for water allocations, and that local community

Table 6.
Community Resident Responses to what has a Negative Effect on the Wellbeing/Quality of Life in the Riverina in 2016
(n = 435)

Topic	Responses (%)	Examples
Crime rate and drug use	18	<p>"Drugs, alcohol"</p> <p>"A spate of crimes, concerns within the community about illegal drug use"</p> <p>"Anti-social behavior"</p> <p>"Crime—break and enter—stealing cars—drugs—domestic violence."</p> <p>"There are heightened levels of theft, property damage and law breaking behavior Also, drug related behaviors are negative"</p>
Weather (flooding)	13 (34 of irrigators)	<p>"We are currently suffering flooding from the Lachlan River, which is severely affecting local farmers, livestock and a local increase in diseases from the dirty water and mosquitoes"</p> <p>"A lot of local s are still having problems after the 2012 floods and we still are very worried about if it"</p> <p>"A really wet winter. This has caused flooding, crop losses. Crops unable to be planted and in the grape industry work delayed which will make the rest of the year very challenging both time-wise and for disease control"</p>
Lack of facilities, activities and access to necessities (e.g., shops)	11	<p>"Lack of communication technology. Lack of direction from government as to funding of community infrastructure and the improvement of them"</p> <p>"Limited access to services"</p> <p>"Very poor postal service, no council rubbish pick up, lack of road maintenance, no proper phone service, shop closures"</p>
Poor economic outlook	10	<p>"Low commodity prices"</p> <p>"Limited employment opportunities"</p> <p>"A downturn in employment opportunities in our local community"</p>
Lack of transport, roads	8	<p>"Local farm roads are atrocious—funds (local) appear to be spent only in town —not any on rural infrastructure"</p> <p>"More people could get jobs out of town if we had good public transport"</p> <p>"Not enough affordable public transport to and from capital cities (train) and what there is time table does not suit the traveling public"</p>
Lack of access to local health support	7	<p>"Lack of quality services for mental health and general health"</p> <p>"The downturn in our local hospital which used to be an excellent training hospital and gradually the services have been hacked so much that now we only have the bare bones of a multipurpose center with a severe shortage of nurses and extreme lack of security"</p> <p>"Lack of support for people with depression/medical specialists"</p>
Water policies and management (e.g., Basin Plan)	7 (20 among irrigators)	<p>"Water removal because of MDB Plan"</p> <p>"The impact of the MDB Plan and the associated loss of water for irrigation and subsequent economic consequences."</p> <p>"The continuing farce with the MDBA which is gutting communities, killing the environment with 'kindness'"</p> <p>"The increasing uncertainty of the MDB Plan."</p>
Other	28	<p>"Depression and bullying are the main negatives in the community"</p>

Note. More than one answer could be provided and % are calculated on total responses.

members (e.g., nonfarmers, who made up the majority of those surveyed) are usually not as directly influenced by water reallocation as farmers (and irrigators per se). It also highlights the multifaceted issues of regional development that concerns focus on many different ways communities can improve. It is also notable that concerns re water policies was most reflected in the question on what has a "negative" effect on wellbeing and quality of life in the Riverina.

Table 7.
Community Resident Responses to What is Needed to Improve the Wellbeing/Quality of Life in 2016 (n = 435)

Topic	Responses (%)	Examples
Improve local facilities/services	20	<p>"More shop in the main street to have tenants as there are a lot of vacant shops"</p> <p>"More community infrastructure, multipurpose community center, youth performance space"</p> <p>"More variety in shops, theaters, entertainment"</p>
Improve economic outlook	20	<p>"More job opportunities and something for youth"</p> <p>"Better/more communication facilities i.e. remote learning center, remote meeting rooms. Things that make it easier for big business to encourage their people to move out here"</p> <p>"Employment for young people and for older people"</p> <p>"More business coming to the area and employing local people"</p>
Reduce crime rate and drug use	13	<p>"Reduced crime, vandalism. More education, help for those caught in a cycle of drug abuse, alcohol abuse, dole budging"</p> <p>"More police, crack down on ice and violence"</p> <p>"More police patrols and have them on duty 24 h. As it stands now, in an emergency, our phone call to the police could be answered 60 km away"</p>
Access to appropriate health services	10	<p>"Access to appropriate and regular health services."</p> <p>"Maybe easier access to medical treatments like specialists where we now have to travel one and a half hours"</p>
Better community cohesion	8	<p>"A more inclusive council setting the agenda"</p> <p>"More inclusive community groups and events"</p> <p>"Better acceptance of people from all backgrounds"</p>
Improve public transport and roads	7	<p>"Better transport links"</p> <p>"Better road access to the local urban center"</p>
Other	23	<p>"More women in significant leadership role, e.g. local government."</p> <p>"Politicians who will work for the country, not themselves"</p>

Note. More than one answer could be provided and % are calculated on total responses.

4.2. Regional Initiative Findings

Of the 77 initiatives identified that conformed to some key elements of integral ecology, many dovetailed with respondents' opinions about their communities. The initiatives reviewed were diverse, and included some with a strong focus on individuals or technical advances, which met criteria for inclusion as they have objectives consistent with integral ecology criteria such as reducing environmental impacts or supporting regional economies or communities. These initiatives were scored based on our integral ecology framework, and available information. Very few initiatives ranked similarly on both the socioeconomic and environmental axes, and most scored well below the maximum possible (26), with the highest scored initiative (located outside the Riverina) being 23. The top ranked Riverina initiative scored 14, while 8 was the average ranking. Figures 2 and 3 depict the ranking (score of the integral ecology [IE] index) for the Riverina and non-Riverina initiatives from highest to lowest ranked. Figure 2 shows the overall outcome of the ranking and Figure 3 shows the breakdown of the scores for each quadrant in a radar chart for the top scoring initiatives (e.g., those who had rankings from 10 to 23).

Figure 3 reveals the extent to which each initiative encapsulated integral ecology's four quadrants/ecologies and their overall conformity with integral ecology principles. Only one initiative—a community initiated and run wind farm (no. 76)—included all four quadrants and a score for embodying integral ecology principles of combining socioeconomic and environmental emphases (the score for integral ecology was added to the systems quadrant). When considering the input from each quadrant for the top-ranking

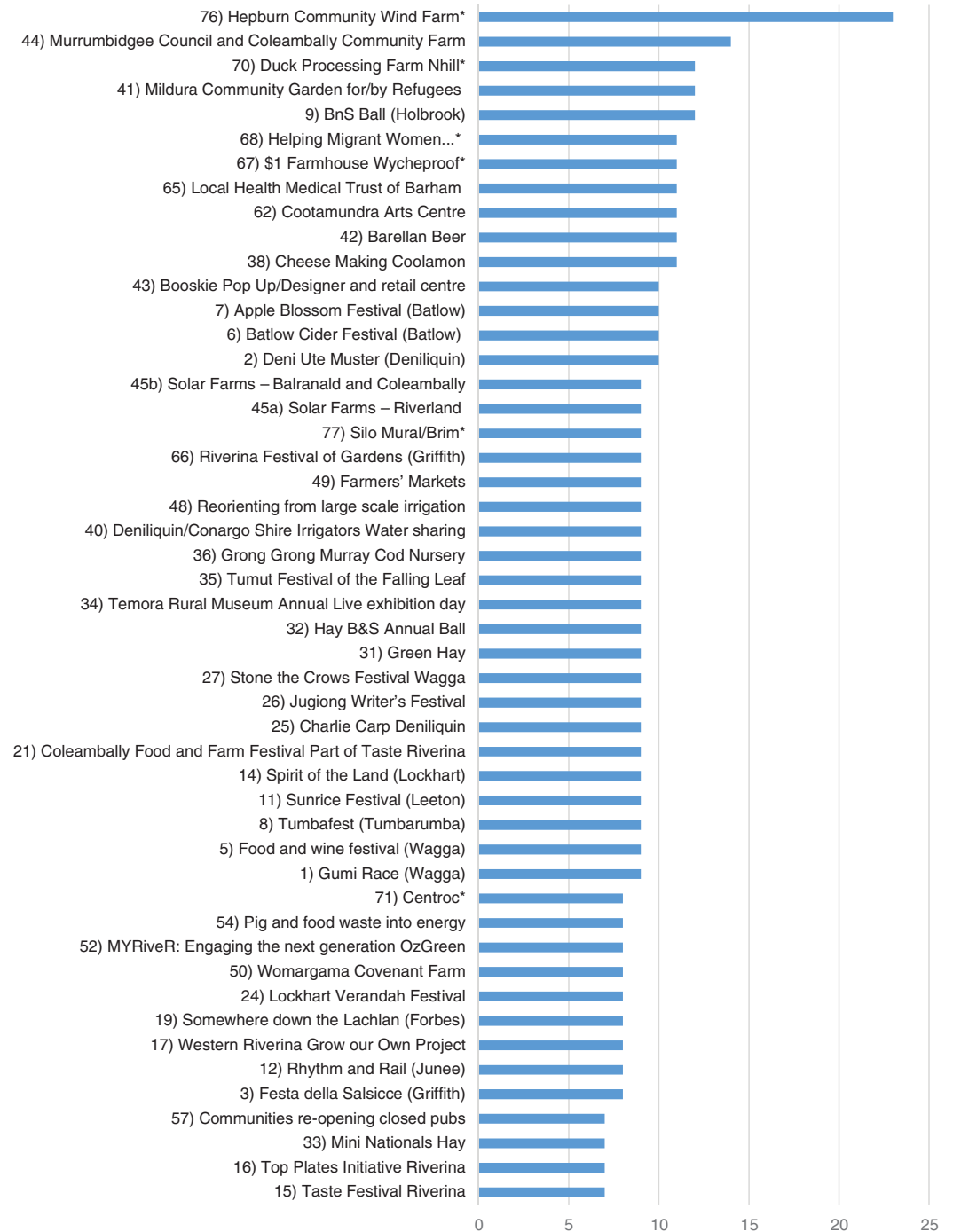


Figure 2. IE ranking index (displaying initiatives with 7–23 total scores). *Denotes non-Riverina initiatives.

initiatives, the scores are overwhelmingly derived from the experience and culture quadrants. Less activity was evident in the behavior quadrant and even less in the systems quadrant (Figure 3).

4.3. Classifying Initiatives

As mentioned previously, few initiatives united a focus on economic development, social wellbeing and promotion of environmental health, even though many initiatives closely reflected the opinions and aspirations of residents. The remainder of this section discusses the four main orientations of regional initiatives, from



Figure 3. Quadrant radar chart for top-scoring initiatives. *Denotes non-Riverina initiatives.

predominantly private economic enterprises with some community benefits, to the initiatives focused on environmental and public good benefits.

4.3.1. Private Economic Initiatives which may Benefit Community Function

Some initiatives were driven primarily by individual enterprise and were motivated by economic development. They did not involve the community in their formulation and implementation, but they did have potential community benefits beyond the instrumental benefits of employment and wealth creation. Initiatives generate social interaction, provide potential help for community groups or become focal points of community activity. For example, a pop-up shop (no. 43) was established to showcase the work and designs of 12 local makers. The founder recruited two designers and hired a shop front to prepare for a local festival. The business is still operating and provides sewing classes, which are usually fully booked. In response to empty shop-fronts in Leeton, the Chamber of Commerce offered 6-month leases with a 30-day cancellation notice, allowing potential businesses to “test the water” without committing to a full lease. The leases are available to any business or to community groups (no. 30). Initiative 42 saw a local crowd-funded establishment of a microbrewery. The microbrewery is now established as a not-for-profit business and is staffed by local volunteers.

4.3.2. Boosting Community Function with Potentially Beneficial Economic Impacts

Some initiatives are concerned primarily with boosting community function by integrating people, promoting inclusivity and cohesion; there may also be economic spin offs for the community. The town of Wycheproof, facing declining population and fraying social fabric, established the AUD\$1 per week farmhouse (in which residents only paid \$1 per week in rent) to attract new residents. Local individuals and businesses offered various kinds of support. New shopfronts have been established and new families have taken residence in the district (no. 67). Initiative 68 aided migrant women to source materials, price items and develop networks that allowed marketing of their traditional art and craft products. The project also teaches small business management skills and provides an environment to improve conversational English. A duck-processing factory has created workforce and community participation opportunities for Karen

migrants. This has brought economic and cultural benefits to the community. Locals aided the settlement of the migrant community through a range of mentoring activities and the Karen presence has improved the town's economy through increased employment and expanded business opportunities in town (no. 70).

4.3.3. Improving Community Function with Community Benefits

Some initiatives (e.g., no. 41) are primarily aimed at improving community functions thereby strengthening cohesion and resilience. The Burundian community garden was established in Mildura in September 2016 and this helped increase social integration and sense of belonging for an ethnic minority. A local farmer helped adapt African maize to Australian conditions and reported that it brought the community together, allowing two-way knowledge transfer. Local groups contributed land, time, and other resources. It has brought psychosocial benefits to the Burundian refugees. A community farm (no. 44) began in 1996 so that community groups could engage in agricultural activity for experiment, demonstration or fund-raising. Many individuals and businesses donated time, money, machinery, merchandise, and services to develop the farm. Important agricultural research has occurred at the farm and, since 1996/1997, \$AUD1 million has been generated, which has been donated to service clubs, football clubs, and schools. This has strengthened the community by uniting people to pursue a shared goal and by distributing financial resources to community groups.

Initiative 62 concerns volunteer activity to restore an old building, transforming it into a community arts center. This is a valuable resource and has strengthened relationships between stakeholder groups. It is managed by the Cootamundra Creative Arts and Cultural Committee, which is a community-based board. It includes a theater for live performance, a cinema, an exhibition space, a visual arts workshop and spaces for conferences and seminars. The establishment and maintenance of this facility is primarily due to local volunteers, with support from council and some government grants. It is a "by the community, for the community enterprise". It will stage events targeting "at-risk" youth and encourage them to use the facilities.

Health, services, and local wellbeing are consistently named as important to regional wellbeing, and indeed, is a critical function of the integral ecology behavior quadrant. One highly ranked initiative (no. 65) exemplifies a community working together to provide a community service that will also yield economic benefits. Nine volunteers manage the community owned Barham and District Medical Center. They wanted to improve the health of residents and aid the social and economic function of the town. The retention rate of General Practitioners has increased. They have secured funds to expand the center and they administer the Medical Student Scholarship Scheme.

Events based tourism can also aid community function by uniting diverse stakeholders to work toward a common goal which often has direct economic benefits for local community businesses and makes a significant contribution to community function. Examples of such initiatives include initiatives 2, 3, 15, 32, 33, and 49. But, such events are often only held annually or biannually; hence do not provide ongoing economic benefit. Furthermore, they require a pool of dedicated and skilled volunteers. Unless they can gain adequate and secure sponsorship, such projects remain at risk of not continuing (which was highlighted in our review by a number of events no longer held). This suggests that individual experience and culture may be, by themselves, insufficient resources to effect desired outcomes.

4.3.4. Enhancing Community Function with Environmental Foci

While the initiatives discussed above represent a mix of public and private undertakings and show a variety of ways in which improved community function may dovetail with economic development, none of them have an environmental focus. Some initiatives focusing on ecological activities are included because they dovetail with integral ecology's insistence that the economy and community should not be accorded primacy over environmental and ecological concerns. However, most of these initiatives assessed originate from private interests. For example, initiative no. 47 concerns the Bittern (a bird species) lifecycle which clashes with the rice harvest so local irrigators are attempting to divert the birds to nearby wetlands (or setting aside areas on their own farms) in the hope the bitterns will stay longer for environmental and tourism benefits. Covenants on farms (e.g., no. 50, which is a partnership between farm owners and conservation trusts to aid ecological restoration) are also primarily interested in biodiversity outcomes, but they can result in improved farm financial returns through increased value-adding and productivity. Other initiatives in

this area can include private initiatives designed to boost private income through environmental initiatives. One example included a pig farm (no. 54) that transformed its waste into energy and fertilizer. The farm became carbon neutral and produced more food, while the requirement of a power plant, glasshouse and increased infrastructure expansion generated 30 jobs and injected AUD\$10 million annually into the economy.

Environment, farming, social connectedness/involvement, and economic outputs all seem to be achieved to some extent as part of Riverina's *Part of the Food Next Door* project. The Burundian community garden (no. 41) was established in Mildura in 2016 and connects local migrant and refugee groups to vacant land where "traditional crops" can be grown. The project was facilitated by Sunraysia Local Food Future and was supported by Slow Food Mildura. Another strong initiative example was the Murrumbidgee Council and Coleambally Community Farm (no. 44). This is a not-for-profit, demonstration farm of 379 ha established in 1996, allowing local community groups to engage in agricultural activity for experiment, research, demonstration, or fundraising. Many individuals and businesses have donated much resources to allow the farm to be developed, and the AUD\$1 million+ from cropping proceeds have been utilized within the community.

Finally, the ranking of initiatives also showed that local organizations and council support can be critical in helping develop strong community initiatives. The role of councils is significant because Riverina respondents continuously name councils in helping build and maintain communities. For example, Juneec Council (no. 63) reconsidered the way it disposed of effluent and this resulted in considerable economic, environmental (reduced discharge of pollution, increased fish, water quality, tree-planting, and increased biodiversity) and social (increased ability to irrigate sporting fields) benefits.

5. Discussion

This article has offered some insight into the capacity of integral ecology as a concept to be quantified into a framework to aid rural communities diversify and develop their economies, strengthen their community function, respond positively to environmental challenges, and therefore become more resilient to shocks and stressors. For example, responses from the 2016 *Regional Wellbeing Survey* suggested that community improvements should focus on: (1) improving local facilities (e.g., parks, cycle paths), activities (especially for the youth) and government services/governance; (2) providing job opportunities, incentives for businesses, and affordable housing; (3) reducing crime rates and controlling drug use; (4) improving access to appropriate health services; and (5) improving community cohesion (e.g., setting goals, improving communication/support, promoting diversity). This study has sketched how integral ecology may be quantitatively operationalized at the local level of community development, by providing a framework and guidance on quantified indicators for each of the four quadrants.

While the framework provides a mechanism for evaluating initiatives, it is important to consider our study's limitations. First, it focused only at the local level of community development. Further consideration about how to apply integral ecology to regional/national programs and issues will be needed. Second, conceptualizing integral ecology (at any spatial scale) will require a certain amount of data and information needs. This study shows that it is possible to do this broadly (which would be valuable for many countries that do not have the financial ability to source considerable amounts of data), but individual case studies will need great data evaluation, some of which may not be available. Other issues that will become more important at the wider spatial scale are the issues surrounding measuring benefits and costs, which our integral ecology framework will struggle to meet given its relatively simple scale. Finally, it is important to note that none of the initiatives discussed in this article were originally developed with an integral ecology framework explicitly in mind. Only one initiative (no. 76—the community wind farm) scored in all four quadrants of community function, economic development and promotion of environmental sustainability. This suggests that proponents of community development projects often operate within an "either/or" framework, in which it is considered possible to develop socioeconomic conditions within communities or to promote environmental health, but not both. It is also noteworthy that the top scoring initiatives had scores derived mainly from the Experience and Culture quadrants, with lower scores being generated in the Behavior and Systems quadrants. This may indicate that undertaking activity in these quadrants is more difficult and requires a wider range of skills than activities centered primarily in the experience and culture quadrants.

Further research could try to understand how initiatives who scored well in Behavior and Systems quadrants were different to the others. Capacity building in a range of areas may be needed to enable local decision-makers to adopt approaches such as integral ecology.

We suggest that there are three main ways that integral ecology may help communities in addressing their wicked problems (at least in the context of local community development). First, integral ecology can promote simultaneous development in different domains. Initiatives assessed in this study demonstrated that overwhelmingly rural community development remains fragmented, addressing either economic development, or community function, or environmental sustainability. Perhaps ironically, projects with an environmental focus were typically implemented by private interests, whereas those with an emphasis on economic and/or community development were more likely to be undertaken by community groups or local organizations. The quantified, operationalized framework of integral ecology outlined in this article provides communities with a toolkit they could use to help develop holistic responses to the multifaceted challenges they face.

Second, integral ecology promotes respectful, productive collaboration between individuals and/or sectors that are typically alienated from, or hostile to, each other, and includes groups that are often marginalized. Only collaborating with like-minded groups or individuals is likely to stunt the capacity to develop projects that are broadly based and focus on inclusive participation. Given the predominant disadvantage within many rural communities, such a focus is essential if social cohesion is to be maintained. Furthermore, ensuring widespread participation broadens the knowledge and skills available to community development projects.

Finally, integral ecology can help address the need for skills development among community leaders. Our data suggest that rural communities typically work within two quadrants—typically experience and culture—to design and implement the various projects identified in this article. The relative lack of focus on behavior and systems sometimes means that all aspects of a given issue are not considered and that legislative, regulatory and technological responses are not given due emphasis. It can also mean that wider economic, political, social, and demographic factors are not being optimally identified and addressed in communities projects. This may limit the scope of a project's impact and make it less sustainable over time or pay inadequate attention to individual and community resilience. While it is clear that many rural communities have talented, committed and visionary leaders, using our operationalized integral ecology framework could aid them to develop further skills. Another approach could be to organize initiatives in a region in a way that they interact and complement one another regarding their focus which acknowledges the challenges when aiming to address all principles of integral ecology in one single project. In this case, local governments and other organizing/funding bodies might use the integral ecology framework across multiple projects to ensure a balance of development.

Overall it seems our integral ecology framework may be a useful tool to help make better decisions on community-led projects. In terms of making decisions on significant, long-term and costly regional and national developments it may also provide a useful input and complement other more traditional tools, by highlighting explicitly some of the trade-offs that many traditional forms of decision-making ignores (e.g., quadrants involving experience, culture, and systems), but further work will be required in this space to highlight additional limitations.

6. Conclusions

Rural communities need new paradigms to face challenges in economically, socially, and environmentally sustainable development. It is possible that the integral ecology concept may be such a paradigm, but to date there has been a lack of research conducted in operationalizing and quantifying it. This study has developed an initial integral ecology framework that communities can use to evaluate initiatives. The integral ecology framework was operationalized by applying it to a case study area that has faced considerable change and numerous social, economic, and environmental interlinked challenges over time, namely the Riverina area in the Murray-Darling Basin. Information was collected on a large number of community-focused initiatives (both public and private) which were consequently quantitatively ranked, to provide guidance about where future scarce resources may be directed (whether it be by local organizations, or local, state or national levels of government). However, it is important to note that the data here is

limited because none of the initiatives evaluated were explicitly designed on the principles (and practice) of integral ecology. Designing projects explicitly based on integral ecology and, where necessary, refining the toolkit developed here, especially by considering decision-making under risk more explicitly in the four quadrants, may provide more accurate data on the capacity of integral ecology to aid rural communities. It does seem that our integral ecology framework may further aid and complement social decision-making regarding wicked local community problems. Further refinement of this study's ideas and instruments, for example using different weighting and ranking criteria, and applying the concept to other areas and wider regional scales, will help clarify the contribution of such a quantitative integral ecology framework.

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