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Review

Connecting Nature: The Potential of Australian Dairy Initiatives in Collaborative Biodiversity Governance

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Abstract: The dairy industry can be considered a contributor to biodiversity loss in Australia. To address this, many forms of governance can be enlisted, including traditional legislation and regulations, persuasive techniques such as publicly funded subsidy programs or education, and participation in voluntary stewardship programs. This paper explores the benefits of collaborative governance programs, which have international applications to reduce the impact of the dairy industry on biodiversity loss. However, as the Australian sector is unique, the specific opportunities and present challenges are discussed. This paper reports three important objectives that could underpin industry-led initiatives by supporting improved biodiversity conservation on dairy farms: (1) Increase the personal and financial capacities of individual farmers to operate profitable, biodiverse farms; (2) Facilitate market rewards to incentivise pro-conservation behaviours; and (3) Improve the effectiveness of the implementation of biodiversity protection laws and regulatory objectives via collaborative governance arrangements. Existing environmental programs that have been developed by the dairy industry could be suitable for incorporation into more formal co-governance structures sympathetic to biodiversity conservation. However, to be successful in addressing sustainability issues, including biodiversity loss, strengthening the integrity mechanisms around farmers' self-reporting of performance is required to ensure that the industry can credibly refute claims of greenwashing and defend their environmental credentials in the global marketplace.

Keywords: dairy; agriculture; sustainability; biodiversity collaborative governance; collaborative governance; Australia

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1. Introduction

The dairy industry, and more broadly the agriculture sector in general, is considered a major cause of biodiversity loss [1,2]. Commonly noted ecological pressures caused by farming include extensive habitat clearing, exotic disease, weeds, pests and the pollution of waterways [3]. Since European colonization, Australia has recorded the extinction of 90 species [4]. Agriculture is said to impact 57% of Australian taxa, with land clearing and livestock grazing a major threat [4]. As agriculture is more likely to occur in less populated areas where natural biodiversity exists, land clearing in these areas results in fragmented natural habitats. These fragments are also often isolated in ecosystems that are less attractive for agriculture, such as rocky outcrops [3]. The development of infrastructure to support remote areas is also a concern due to the resulting animal mortality from vehicular collisions and inhibited species dispersal [4]. To address issues of farming-related biodiversity loss, including encouraging pro-biodiversity conservation behaviours in farmers, and to govern the conservation mosaic across public and private tenures, there are many forms of governance that might be enlisted. These include:

- Traditional command-and-control approaches that compel farmers by force of law under legislative prescription, such as those applied by standard anti-pollution regulations and anti-clearing laws (e.g., [5,6]). These are reactive to the extent that they punish damaging behaviours that have already occurred, and proactive to the extent that they act as a deterrent to aberrant behaviour;
- Proactive planning regimes that require development proposals, approval and licenses for activities that are calculated to affect the environment (e.g., [7,8]);
- Publicly funded incentive and subsidy programs;
- Persuasion and education programs;
- Voluntary action (e.g., [9]) and participation in voluntary stewardship programs, such as the dairy industry's DairySAT program, discussed in more detail below;
- Responding to market pressures, which can include both consumer preferences and market access. Consumer preference may be facilitated by labelling and certification programs. Market access is already a driver, for example with biofuels (e.g., the EU imposes standards on producers importing into the EU) [10] and domestic sugar (Australia's dominant supermarket chains, Coles and Woolworths, require Bonsucro certification for their private labels) [11,12]. The EU is now considering a ban on importing some types of produce if deforestation occurred in its production [13].

None of these measures alone, or even in concert, have proven entirely successful for environmental protection [14].

On the traditional regulation side, challenges include political obstacles to enacting strong conservation laws, and the practical difficulties of scrutinizing the behaviour of many farmers across large areas. On the market side, problems include the paucity of markets actually willing to pay for environmental values in commercial products, and the disconnection between private profit motives and public interest. On the purely voluntary side, difficulties include recruiting a critical mass of participants, lack of credibility and greenwashing [15].

Over the past three decades, interest in other models that seek to combine or hybridize elements from various governance approaches has increased [14,16–20]. In this paper, these approaches are encompassed under the broad umbrella term, 'collaborative governance', in which private or non-government actors are brought into the governance arena with the Government to help regulate behaviour [21,22]. The classic example of this is the Green Dot program for the management of waste product packaging, which began in response to a German government ordinance in the early 1990s. In this case, the German Government gave German industry two alternatives to dealing with the growing problem of packaging waste: either develop a private industry scheme to deal with the problem or face a regulatory response from government [23].

This paper focuses on a specific instance of collaborative biodiversity governance in the Australian context: the incorporation of non-government, voluntary and industry stewardship programs into the regulatory regime of biodiversity protection. The paper concentrates on the Australian dairy industry and its potential contributions to collaborative biodiversity governance.

This study is important for stakeholders concerned with biodiversity protection and the dairy industry seeking to maintain profitable enterprises as well as consumer and regulator confidence. One of the rationales for collaborative governance is to attempt to capture the best of the constituent governance modes—industry and government—to allow environmental performance to come within the purview of a wider range of public and private scrutineers as 'surrogate regulators'. The key objectives are to increase the protection of the environment and reduce the opportunities for firms to profit from greenwashing and fraud, by holding them accountable for their environmental claims [24].

The dairy sector has historically been vulnerable to negative consumer and government perceptions of industry fraud, as exemplified in the aftermath of the powdered milk scandal in China in 2008. In that incident, an estimated 300,000 babies in China were poisoned following the consumption of milk powder laced with melamine [25]. Melamine is a

toxic, industrial compound that was added to the powder to boost the apparent protein content. This scandal was further intensified by the revelation that all Chinese-produced dairy products, such as milk and yoghurt, also contained melamine [25] and that the responsible company had known about the problem for many months before taking action [26].

The globalised nature of the powdered milk trade meant that the dairy sector's reputation was tarnished, and consumer and regulator confidence was lost on a global scale. Nonetheless, Australian dairy producers were able to capitalise on the 'clean-and-green' perception of Australian produce in the face of the powdered milk scandal [27]. However, the clean-and-green image is a double-edged sword for a sector. On the one hand, it provides an enviable opportunity to profit in situations where competitors are unable to retain consumer and regulator confidence. Conversely, the clean-and-green image can be a risk if it is not underpinned by credibility and integrity and can be challenged and contested by other competitors.

Competitors could originate from other countries where laws and private sector governance measures are stronger and better incentivize credible claims around environmental performance. Similarly, they could originate from competitor sectors—for example, plant-based alternatives to dairy such as oat and soy—that stake a claim for 'superior' ethical performance on a range of parameters, including its environment footprint and animal welfare. If such claims are misconceived, or if the dairy sector's environmental footprint is seriously challenged in the marketplace or legislature, then the sector ideally must be able to call on credible evidence from processes and programs that clearly demonstrate its environmental credentials. If they cannot, this 'greenwashing' will usually have large reputational and legal consequences.

Collaborative governance arrangements can have some political appeal for governments. The Australian dairy sector is a late bloomer in this regard, with other sectors such as cotton, sugarcane and horticulture being more experienced in adapting to political pressure for increased accountability; this is discussed further below.

The objective of the study is to qualitatively evaluate the potential for Australian dairy-industry-driven initiatives to contribute positively to biodiversity conservation. The study uses a collaborative governance perspective, since it implicates the use of private sector governance instruments in the pursuit of public law objectives, including Australia's international legal obligations under the Convention on Biological Diversity (CBD) (for an expanded discussion, see [28]). The key question considered in this paper is: What initiatives is the Australian dairy industry developing as an industry (rather than relying on discrete, uncoordinated actions of individual dairy farmers) that could contribute to a system of collaborative biodiversity governance?

The scope of this study is limited to an exploration of those dairy initiatives at international and national levels that could potentially integrate with regulatory objectives to improve the management of environmental impacts and protect the biodiversity of Australian dairy farms. This paper will briefly touch on similar initiatives in other agricultural industries, including sugarcane, cotton, and horticulture.

2. Collaborative Governance

Though there has been a proliferation of hybrid governance arrangements in a wide range of regulatory fields, there remain risks [15]. Some ex ante economic modelling tends to favour market alternatives to traditional command-and-control for environmental protection, but there has been insufficient ex poste empirical evaluations of their effectiveness [29]. Nonetheless, governments, industry groups, other stakeholders in the market and NGO sectors continue to pursue hybrid governance arrangements, including the incorporation of industry initiatives into governance arrangements. Of all the Australian States and Territories, the State of Queensland appears to be the most willing to experiment with this model of agri-environmental governance.

For example, a variation of the model was trialled by the Queensland Government in the mid-2000s. The Government signed a memorandum of understanding with the

state's peak farming body, the Queensland Farmers' Federation [30], and prepared a policy framework [31] to the effect that, where a farm management system (FMS) developed by a farm sector and a statutory process virtually duplicated each other, the Government would consider recognizing the FMS as equivalent in law to the statutory process. Since 2005, however, it appears the only farm sector to have taken up the opportunity was the cotton industry, although a recognition process for FMSs was a feature of more recent regulations for the protection of the Great Barrier Reef (GBR) [32]. The cotton industry's peak body, Cotton Australia, developed a stewardship program for cotton farmers called Cotton Best Management Practices (Cotton BMP), now called 'myBMP' [33,34]. It was accorded equivalency to a statutory planning process—the development of a 'land and water management plan'—which the Water Act 2002 (Qld) requires from farmers applying for an irrigation licence. Under the more recent GBR regulations, participants in accredited farm industry stewardship schemes 'are considered a lower priority for compliance inspections' in relation to regulatory restrictions on farming in the catchments adjacent to the GBR [12]. BMPs for sugarcane and horticulture are also accredited under this arrangement [35].

There are some obvious shortcomings purely with self-assessment approaches in industry stewardship schemes for farmers. Self-assessment can be a useful as internal business improvement process but suffers some weaknesses when pushed beyond that role into an outward-facing guarantee of performance. Self-assessment is notoriously open to fraud and greenwashing. It may be insufficient for satisfying the expectations of key influential stakeholders, including environmental NGOs and government agencies at state and federal levels, for rigorous assurance. Hamman and Deane [36] conclude that a mixed arrangement combining regulatory and non-regulatory approaches would likely be required to improve the condition of the Great Barrier Reef. The weak application of existing regulations means that there is no effective regulatory 'back-up' (the 'shadow of the law') [14,37], and no opportunity for equivalency or regulatory concession to act as drivers for participation in the BMPs.

However, the rudimentary elements of a more effective mixed approach appear to exist. Hamman and Deane [36] suggest existing regulatory provisions at state [38] and federal levels [8,39] are likely adequate but currently under-utilized. The BMPs themselves have been designed with the potential for a more rigorous assurance if required, and BMPs in sectors such as cotton, sugarcane and horticulture require third-party audits for full certification, though there is often an entry level for participation which starts with self-assessment. The recent changes to the GBR regulations may provide the impetus for a better integration of regulatory and non-regulatory approaches.

3. Opportunities and Challenges for the Australian Dairy Sector

This part of the paper explores international and national environmental initiatives of the dairy sector. The GBR experience outlined above is relevant to the Australian dairy sector for two reasons. Firstly, there are dairy farms in the GBR catchments, and the changes to GBR regulations may bring dairy farming more fully into the reef regulatory regime. In this case, the dairy sector could work to position its stewardship programs as 'an alternative pathway for meeting regulatory requirements' [40]. Secondly, should the proposed approach for the GBR prove effective or politically attractive for general agri-environmental governance, then it may be applied in other locations where dairy farming occurs.

Dairy is the fourth largest rural industry in Australia generating AUD 4.4 billion in farmgate value in 2018–2019 [41]. There are approximately 5000 dairy farms, 120 factories and 46,200 people employed directly by the dairy industry in Australia [41,42]. The country's dairy herd of 1.37 million cows produced 8.9 billion litres of milk in the 2020–2021 season, with this figure projected to rise by 1.1% in 2021–2022 [43]. The Australian dairy industry consists of small- to medium-sized enterprises, which are typically owner-operated businesses [44]. Australian dairy farms are predominately low-cost, pasture-based enterprises, mainly located in the southeast of the country where the climate is suited to this type

of farming. The majority of milk production occurs in Victoria (67%), followed by New South Wales (11%), Tasmania (8%), Queensland (7%), South Australia (4%) and Western Australia (3%) [42]. On a global scale, Australia accounts for less than 2% of total milk production [45]. The majority of milk (59%) produced in Australia is consumed by the domestic market as either liquid milk or manufactured products (e.g., cheese, yoghurt, butter) [42]. In 2019–2020, the total value of Australian exports was approximately AUD 3.4 billion [45]. China is the biggest exporter of Australian dairy, accounting for 32% of exports by volume [43,45].

The dairy industry faces several environmental issues, which the sector seeks to address through a series of international and national frameworks. Climate change, nutrient run-off, effluent management, and water consumption are just some of the issues faced by the sector. The Australian dairy industry is estimated to account for approximately 2% of national emissions [46] and contributes to climate change five times more than the chicken and pig meat industries [47]. The industry is also a known contributor to declining soil health, causing soil acidification and ground cover loss [48]. Dairy production in Australia is predominantly pasture-based. As such, although some challenges faced by the Australian industry are common to other countries, the extensive nature of the industry also presents its own unique challenges, for example, waste management in barn-based dairy systems where waste can be confined and more easily managed compared to pasture-based systems [49,50]. Nevertheless, the examination of governance programs targeted towards different dairy systems is valuable to ensure a holistic review. In this paper, an analysis of the dairy industry's response to environmental problems at an international and national level shows some promising initiatives and some gaps.

4. International Initiatives

4.1. The Dairy Declaration

A partnership between the International Dairy Federation (IDF) and the Food and Agriculture Organisation of the United Nations (FAO), the Dairy Declaration (Declaration) was signed at the IDF World Dairy Summit on Wednesday 19 October 2016 in Rotterdam, Netherlands [51]. The declaration, on behalf of the one billion people who make up the global dairy community, states that the dairy industry is 'committed to the sustainable development of the dairy sector to generate widespread benefits for people and the planet' [51]. Since the Declaration's launch, there have been 22 signatories, including Australia, New Zealand, the United States of America and the United Kingdom [52].

The Australian Dairy Industry Council (ADIC) endorsed the Declaration in September 2017. Ian Halliday, Managing Director of Dairy Australia at the time (Australia's peak dairy industry body) also endorsed ADIC and the wider dairy industry's commitment to the goals of the Declaration. Chair of the ADIC, Terry Richardson said:

> *"The Australian dairy industry is committed to finding innovative solutions and building capacity to develop the sustainable food systems and resilient agricultural practices envisaged by the goals"* [53]

4.2. The Dairy Sustainability Framework

The Dairy Sustainability Framework (DSF) was developed as a program of the Global Dairy Agenda of Action to address the sustainability issues of the industry in a holistic and comprehensive manner [54]. Dairy Australia is a governing organization and aggregating member, meaning that they can report on behalf of smaller industry groups in Australia. Implementing members of the framework must endorse the 11 global sustainability criteria and satisfy the strategic intents outlined below:

- *"Undertaking a prioritization of sustainability issues at a more local level (the prioritization process will support your key areas of focus locally);*
- *Implementing initiatives to address the priorities;*
- *Delivery of the Plan, Do, Check and Adjust actions on existing programs to ensure they are continually evolving and addressing the key areas of interest; and*

- *Provision of annual reporting and updating of shared initiatives with the DSF"* [54].

In the 2020 DSF report, greenhouse gas emissions and animal care were considered the top priorities for members [55]. Biodiversity prioritization also saw a large increase, with an additional 1.9% of farms implementing a biodiversity plan between 2019 and 2020. An additional 40,000 farms also reported a prioritization of soil nutrients between 2019 and 2020, although the proportion of farms implementing nutrient management plans fell by 0.6%. Areas with a lower level of prioritization by members included water availability and quality both on-farm and at processing, and waste management on-farm and at processing.

5. National Initiatives

5.1. The Australian Dairy Industry Council Sustainability Framework

In 2016, the ADIC released the 'Australian Dairy Industry Sustainability Report' (Sustainability Report), with the aim of reducing environmental impact, enhancing economic viability and livelihoods, improving the wellbeing of people and providing the best care for animals by 2020 [56]. Since then, the goals have been refined, and the current 2030 goals are aligned to the United Nations (UN) Sustainable Development Goals (SDGs) in "recognition of dairy's role in the global effort to address the world's sustainability issues" [57].

The ADIC's Sustainability Report is based on the global 'Dairy Sustainability Framework' (DSF) [58]. The DSF:

> *" . . . has been developed to provide overarching goals and alignment of the sector's actions globally on the path to sustainability. The DSF will enable the dairy sector to take a holistic approach to sustainability through a common language, alignment of international sustainability activity and through this generate a common sustainability commitment that can be expressed at a global level, but also regional, national and organizational levels"* [56]

Through the Sustainability Report the Australian dairy industry is committed to developing a more sustainable dairy industry, both at home and on a global scale. Although the SDGs are not legally binding in Australia, it is expected that each country will work towards establishing frameworks and policies that will lead to the achievement of each of the 17 goals.

In the 2020 progress snapshot report, key progresses towards the 2030 sustainability goals are listed [57]. Of the four commitment areas: enhancing economic viability, improving the wellbeing of people, providing the best care for animals and reducing environmental impacts, progress was mostly evident in the first two areas. Comparatively, less progress was evident regarding the best care of animals and the reduction in environmental impacts. Notable improvements for the latter included the reduction in water consumption by dairy companies, the reduction in greenhouse gas emissions by manufacturers and the reduction in produced landfill. Conversely, one target saw an overall regression in progress, with the number of farms with a water security risk management plan falling by 5% from the baseline. Of note, almost half of the target metrics listed under this focus area had no available data or the target metrics were yet to be finalized. Thus, a clearer understanding of progress towards these areas is expected in future reports.

The Sustainability Framework can form a useful 'umbrella' for organizing a range of sustainability measures for actors in the dairy sector, including farmers and processors. Significant developments include Dairy Australia's DairySAT program (discussed in detail below), and more recently, a carbon calculator tool, part of the dairy sector's response to climate change [59,60].

5.2. DairySAT—The Dairy Self-Assessment Tool

DairySAT was launched in 2005 by Dairy Australia through its Natural Resource Management Program 'Dairying for Tomorrow'. It is currently being upgraded, with the new version due for release in 2022.

It is a comprehensive tool for dairy farmers to assess and demonstrate dairy farm sustainability and can also be used to meet processors' or retailers' reporting or risk assessment requirements where necessary [61].

DairySAT consists of self-assessment modules containing questions on ten components of environmental sustainability on a dairy farm. Upon the completion of the self-assessment DairySAT creates an action plan for the farm based on the identified risks. The program is intended for use by dairy farmers but is accessible to anyone through the program website.

The ten self-assessment modules ask a total of 101 very comprehensive questions (between five and 22 per module) about the on-farm condition and management of soils, fertilisers, effluent management, irrigation, greenhouse gas emissions, biodiversity, energy and water, pests and weeds, chemicals, and farm wastes. The options for each question include a description of 'Below Good Practice' and 'Good Practice'. Many questions also include an 'Innovative Practice' option, which is presented as a means of further improvement.

The Biodiversity module consists of questions covering the use of an integrated whole-farm plan, sound riparian and wetland management, the protection of remnants of native vegetation and other habitats, revegetation and habitat connectivity practices, and the awareness and management of local threatened species or their habitats on the property.

The action plan compiled after completion of the self-assessment contains a list of sources of information about the identified environmental risks so farmers can educate themselves to improve the environmental sustainability of their properties. It does not contain prescriptive instructions or management advice. The links are generally to organizations such as regional natural resource management (NRM) bodies, Landcare, Greening Australia (an Australian NGO focused on regeneration, revegetation and restoration of Australian native vegetation), state government agencies, or industry programs such as Fert$mart (for nutrient management) and Dairying for Tomorrow (for the management of soils, waterway health, biodiversity and climate impacts).

In general, risk-based sustainability programs have the advantage of being flexible and adaptable to different circumstances. However, they have been criticized for their lack of performance standards and for their sole reliance on continual improvement without a requirement for monitoring [62,63]. DairySAT does not require ongoing monitoring or reporting but does record the initial management for each issue and maps ongoing progress. For each module, 'Good Practice' is the option for which no further action is required, and therefore functions as the performance standard. A higher level cannot be attained for those who implement 'Innovative Practices'.

DairySAT relies on farmers' and participants' self-reporting results and improvements. This can be useful for internal enterprise learning and improvement but may not be sufficient to convince external stakeholders of actual outcomes. It is not clear from the DairySAT website whether there is a facility for a regular review or upgrading after the ten modules are successfully completed and 'Good Practices' are implemented. This could be developed further to demonstrate ongoing sustainable practice to consumers, processors or retailers.

The Biodiversity module contains six descriptions of 'Good Practice' and five of 'Innovative Practice'. The education of farmers regarding the best practice management for biodiversity is a very positive outcome. However, it is not clear from the DairySAT website whether there are measurable outputs (e.g., level of uptake amongst farmers, area or percentage of property being revegetated, percentage of wetlands or waterways fenced from stock). These outputs would make it easier to assess the actual impact of DairySAT on biodiversity. Improvements listed in the Climate Change and Energy and Water modules would also have impacts on biodiversity, and publishing the outputs of these modules would also assist in assessing their effect. There are reports outlining an increase in the number of dairy farmers undertaking general environmental improvements [56,64], but it is not possible to assess the extent to which DairySAT is the vehicle for this progress.

The publication of measurable outputs would also help farmers, dairy associations, environmental NGOs, governments and supply-chain actors to assess DairySAT's potential

to contribute to market-facing biodiversity or sustainability programs. As is the case for many farm sectors, there is a dearth of pathways to recognise for farmers adopting good environmental practices and achieving demonstrable positive environmental outcomes. Such a recognition framework for Australian dairy farmers remains underdeveloped, but DairySAT is a potentially useful foundation from which to progress with this goal.

6. Issues That Shape the Effectiveness, Efficiency and Fairness of the Governance Arrangements of the SDGs in the Dairy Industry

The dairy industry has historically focussed on environmental activities and has made inroads to improving environmental outcomes. However, the industry has not been as successful in addressing social dimensions. Activities that have a positive influence on achieving targets are complex and may address more than one SDG, directly or indirectly. This highlights the challenge faced if there are attempts made to influence one particular target. Additionally, by reaching targets for some economic or social criteria, this may lead to a flow-on effect for environmental concerns due to the increased viability of the business and/or improved human capacity to address issues. For inroads to be made into improving environmental sustainability, investment needs to be increased regarding the research and development in these areas, as does the extension and support for farmers to implement findings [65].

In simplistic terms, improvements could be made to the various dairy industry programs via:

- The requirement for accurate and honest objective reporting regarding progress against targets audited by a third party (as opposed to self-reporting);
- Government/industry incentives as opposed to penalties for practice changes;
- Compliance required under regulatory instruments as opposed to voluntary codes;
- Increased collaboration and connection between key stakeholders throughout the entire dairy value chain at a regional, national, and international scale, in order to address SDG.

7. Discussion

There are potentially at least three important objectives that could underpin industry-led initiatives for supporting improved biodiversity conservation on farms: (1) Increase the personal and financial capacities of individual farmers to operate profitable biodiverse farms; (2) Facilitate market rewards to incentivise pro-conservation behaviours; and (3) Improve the effectiveness of the implementation of biodiversity protection laws and regulatory objectives via collaborative governance arrangements. The essence of the first is inward-facing; it focusses mostly on the internal management practices, expertise, and capacity of farming enterprises. In contrast, the second and third objectives are outward-facing; they involve persuading outsiders, external to the farming enterprise, i.e., customers and regulators, regarding the environmental credentials of the enterprise. The mechanisms needed to drive action in each case, both inward-facing and outward-facing, are different. Initiatives such as DairySAT, at the time of this review, potentially serve the first, inward-facing objective, but not the outward-facing objectives. Pure self-reporting approaches struggle to match the expectations of credibility and integrity demanded by external stakeholders. Other sectors showed more adaptability in this regard, such as cotton, sugarcane, and horticulture, which may enable them to better capture opportunities for 'clean-green' produce and better defend their environmental credentials in a competitive global marketplace. It may also better equip them to remain participants in the development of law and policy in the face of pressure from governments and civil society stakeholders for increased regulation.

This important point about facilitating market rewards must be emphasised: commodity markets, for the most part, simply do not reward farmers on the basis of their efforts to improve biodiversity protection, long-term soil health, and other important environmental parameters in the public interest. Individual farmers, even those that are good environmen-

tal stewards, are mostly price-takers in an unrelenting commercial environment and have little power to alter the pricing of commodities to better incorporate environmental values. The connection between improved biodiversity conservation and an individual farmer's production and profitability is not clear cut. Sometimes conservation supports production; sometimes it is in opposition to it. For some farmers, the 'holy grail' of participating in market-oriented stewardship schemes would be the access to market advantages that incentivise pro-conservation practices. Though such advantages have not emerged in a consistent and persistent manner, they remain a legitimate interest of public policymaking to augment the often-limited availability of public funds [66].

The development of an inward-facing program with a self-learning focus, which would help individual dairy farmers improve their capacity to manage their environmental impacts, is in no way a faulty strategy. Such programs can encourage self-reflection and learning in a safe, low-stakes context. Since all land managers should ideally be good environmental performers, such programs 'meet' participating farmers at whatever level of capacity and performance the participants currently achieve, providing opportunities for good performers to consolidate their capacities and weaker performers to improve. Arguably, this 'learn to walk before you can run' approach is a necessary prerequisite of the whole industry's attempt to improve overall industry performance. To this extent, a self-reporting paradigm is appropriate for a self-learning objective. Additionally, it is noteworthy that some dairy farmers voluntarily participate in DairySAT in the absence of clear-cut rewards. Thus, in short, DairySAT is a good start but not sufficient for expanding the range of benefits that could theoretically materialise with a more outward-facing objective.

Dairy farming's impacts on biodiversity, and its potential contributions to conservation, are both direct and indirect. The management of individual farms can enhance or degrade in situ biodiversity. The leakage of nutrients into waterways potentially affects off-farm biodiversity. Additionally, the issue of climate change hangs heavily over the survival of vulnerable species.

In respect to direct impacts and contributions at the farm level, it seems unlikely in the short-to-medium term that countries such as Australia will be able to create a truly comprehensive, adequate and representative (CAR) reserve system for biodiversity conservation on public land alone. Inevitably, we rely on the engagement with private landholders, including commercial dairy farmers, to effectively conserve biodiversity and achieve the international obligations of the CBD.

The latest Australian Intergenerational Report notes that any reduction in national GDP caused by climate change

> *"is likely to be unevenly distributed across sectors and regions. The agricultural sector is particularly vulnerable to the physical effects of climate change, the resources sector is particularly vulnerable to the transition effects, and the financial sector is vulnerable to both"* [67]

Physical effects include changes to the climate such as decreased rainfall, increased temperatures and increased variability in climate patterns. Transition effects include the legal and policy responses of governments and businesses across the globe in response to climate change. Cattle-based industries such as dairy farming are uniquely vulnerable to both effects.

A recent report from CSIRO (Australia's national science agency) emphasizes the need for Australian agriculture to cultivate international markets looking for high-quality, high-value produce, which Australian farmers grow. However, governments in some of these same markets are sharpening their response to greenhouse gas emissions [68]. Simultaneously, they face concerns from their own farmers about the uneven playing field that might eventuate if their home governments impose stronger domestic requirements to reduce greenhouse gas emissions from agricultural sectors than those required of Australian imports [69]. Again, industries relying on methane-emitting ruminants, such as the dairy and beef sectors, will be firmly in the spotlight and Dairy Australia's leadership and initiatives discussed above will be crucial.

What Broad Conclusions Can We Draw about the Capacities, Opportunities and Challenges for the Australian Dairy Industry to Address Environmental Impacts?

Some foreseeable issues are out of the control of individual farmers, or even the industry as a whole, and may require a greater focus on adaptation and strategic positioning. Since industry deregulation around the turn of the millennium, dairy farmers continued to operate in an unrelenting commercial marketplace that prioritizes low prices and consumer advantage, resulting in consolidation and larger individual enterprises to facilitate the economy of scale [70,71]. Mismatched market signals and the lack of market incentives for good biodiversity protection performance remain frustrating for environmentally focused dairy farmers. There is a dearth of recognition for measures taken by those dairy farmers who are good stewards of biodiversity. It is not easy for shoppers to favour good performers over bad performers, and they should be allowed to capitalize on higher levels of environmental performance. Additionally, the recognition that is available overlooks less obvious types of biodiversity conservation that may be easier for dairy farmers to support, e.g., soil biodiversity. As mentioned above, dairying is vulnerable both to climate change, and to climate change regulations. It is seen by some environmental commentators as a high-carbon, high-water-use food source. How dairying will position itself in the low-carbon economy and how it will manage its climate change risks remain key challenges.

On the other hand, there are a number of positive developments. The industry as a whole is engaging with environmental issues at international and national levels through a cascade of nested frameworks, such as the Dairy Declaration and Industry Sustainability Framework. This demonstrates the industry's seriousness to tackle its environmental impacts on a collective basis. The industry, as well as individual farmers and governments, have invested heavily in voluntary stewardship programs, such as DairySAT. Ideally, industry and farmer input into the development of these types of programs helps ensure a user-friendly and practical process for environmental management. Such programs might be further developed to a stage suitable for the incorporation into more formal co-governance structures sympathetic to biodiversity conservation, such as the reef regulations mentioned above.

The dairy sector has partnered with relevant stakeholders in other innovative environmental governance initiatives. For example, a collaboration managed by Water Stewardship Australia, involved Dairy Australia, the Goulburn Broken Catchment Management Authority (GBCMA), Tatura Milk Industries (TMI), and about 280 dairy farms in the Shepparton Irrigation Region. The collaboration laid important groundwork on the extent to which

> *"a water stewardship system could add value for both the catchment manager in balancing competing demands and the dairy industry in dealing with its compliance costs and stakeholder relations"* [72]

Individual dairy enterprises are also engaging with environmental stewardship programs on a voluntary basis, such as the major dairy processor, Bega Cheese, which has operated an independently verified environmental management system based on ISO 140001 for over 15 years, involving about 50 dairy farms [73].

Potentially, industry stewardship programs such as DairySAT are well-placed to integrate with more ostensibly biodiversity-focused initiatives driven by government and civil society, such as Trust for Nature and the Biodiversity Conservation Trust. Stewardship schemes seem to be proliferating, which potentially adds to the confusion amongst consumers and landholder participants, as well as opportunities for greenwashing. Strategic alliances between on-farm biodiversity programs and industry stewardship schemes could buck that trend by adding credibility and rigor in the demonstration of on-farm biodiversity outcomes.

Some gaps and limitations yet to be resolved include strengthening integrity mechanisms in the dairy stewardship program beyond farmers' self-reporting of performance. Additionally, more robust reporting mechanisms for dairy would be welcomed to account for its biodiversity protection performance (and general environmental performance) at a national, industry-wide scale. This could build on nascent developments already happen-

ing in this regard, such as the Sustainability Report and other more local initiatives. The dairy stewardship scheme lacks a dedicated on-farm biodiversity emphasis (as opposed to the effluent run-off emphasis for off-site water quality) but acknowledges the potentially more limited opportunity for dairies in this regard, as they are often situated as smaller, more intensive operations on mostly cleared land. This contrasts with pasture-based beef enterprises, which are perhaps more likely to have larger tracts of remnant native vegetation and native grasslands that could be managed for biodiversity outcomes. However, in both cases, it may be possible to combine the revegetation and restoration of habitats with shade and shelter for cattle, important in the context of a changing climate with rising temperatures and longer hot spells.

8. Conclusions

Agriculture remains a key player in both the conservation of biodiversity and the causes of its degradation. Agricultural practice continues to impact the condition of species and ecosystems. Farmland comprises important biodiversity sites, and when sympathetically managed, it potentially provides stepping-stones and corridors to facilitate conservation. The international legal instruments, particularly the CBD, impose many obligations on the Australian Government that implicate agriculture in biodiversity conservation. The apparent inability of current laws and regulations to turn around this long-term trend in biodiversity loss has spurred interest in alternative models of behavioural regulation, involving private schemes and instruments such as farm stewardship programs. This paper outlines the possibility that these might help accelerate and pave the way for better biodiversity conservation, but the new governance models carry their own set of risks and challenges, including the generation of an adequate incentive for participation as well as credible accountability and integrity mechanisms.

The key findings of this paper conclude that the Australian dairy industry is engaging in environmental issues at both international and national levels. This demonstrates the understood importance of the industry's role in sustainability, and the commitment to making real change.

Industry-led initiatives that encourage reflection and self-learning, increasing farmers' capacity to manage their environmental impacts, are worthy ventures. This seems to be the point reached by the Australian dairy industry with its DairySAT program. Some dairy farmers are participating in the program without the prospect of immediate market rewards or regulatory concessions, which again attests to the fact that industry actors are engaging with the issues. As such, this is a positive start, but more is needed if the industry is to capture these more ambitious benefits. This will require more attention to integrity measures beyond self-assessment. Existing environmental programs that have been developed by the industry, including DairySAT, may be suitable to incorporate into more formal co-governance structures that are sympathetic to biodiversity conservation. However, strengthening the integrity mechanisms around farmers' self-reporting of performance still requires further consdieration.

Other sectors, such as cotton, sugarcane and horticulture, are grappling with similar issues and appear to have made greater progress by incorporating third-party auditing measures. This may better enable them to develop realistic options for market advantages, fend off calls for increased outside regulations, credibly refute claims of greenwashing and defend their environmental credentials in the global marketplace.

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