Title

Principles to improve agricultural practices impacting on water quality: An analysis of regulatory designs from Australia and New Zealand.

Authors

Felicity Deane and Evan Hamman

Keywords

Regulation, Nutrients, Nitrogen, Great Barrier Reef, Lake Taupo, Culture, Trading schemes

Abstract

Many parts of the world rely on nutrients like nitrogen and phosphorus to improve farming production and increase yields. There are significant food security as well as socio-economic issues at stake. But it is also clear that fertilizer loads are particularly damaging to aquatic environments including lakes, rivers, coral reefs and wetlands. This paper explores the regulation of fertilizer use impacting marine environments. Though ‘regulation’ is often associated with legislation and the use of a ‘big stick’, emerging scholarship reveals it can be far more sophisticated, inclusive and ‘responsive’ than this. In this paper, we analyse the approaches from New Zealand’s Lake Taupo and Australia’s Great Barrier Reef to generate insights into efficient regulation and whether either of these systems work to address these kinds of issues.

Introduction

Pollution from agricultural industries associated with fertilizer application and related farming practices is a global problem. One that is likely to increase over time. Nutrients are essential for improving farming production and increasing yields. However, it is well known that fertilizer loads are particularly damaging to aquatic environments including lakes, rivers, coral reefs and wetlands. This paper explores the regulation of fertilizer practices that impact upon marine environments. Though ‘regulation’ is often associated with legislation and the use of a ‘big stick’, emerging scholarship reveals it can be far more sophisticated, inclusive and ‘responsive’
than this implies. In this respect, behavioral change is a crucial component of environmental law and policy. In the recent past, economists theorized we make decisions based on rational choices and in pursuit of our own (financial) self-interest. Rational choice theory provides that where it is more cost-effective to choose one path over another, we are likely to take that path. Other more recent theories such as ‘bounded rationality’ challenge the assumptions on which rational choice theory exists by arguing there are very real ‘computational and informational’ limits to our decisions, and therefore we rarely, if ever, act as rational beings.¹

Economics has had a profound effect on the way we approach modern governance questions. In environmental governance, incentives and market-driven measures like cap and trade schemes have been applied to encourage behavioral change for a variety of ‘wicked’ policy problems from water allocations,² to greenhouse gas emissions,³ to nutrient run-off.⁴ Regulation – in the narrow sense of the word, has taken a back seat. As Braithwaite remarks, the pursuit of ‘market imperatives’ has increasingly been seen as a far more potent source of change than ‘state regulatory imperatives’.⁵ Likewise, as Cashore discusses, many non-state actors are working to create ‘non–state market–driven (NSMD) governance systems’ which ‘eschew’ state authority by focusing on supply chains “to create incentives and force companies to comply.”⁶ As a result, governance has become increasingly decentralized⁷ and states are far less conspicuous actors, leading to circumstances which Braithwaite and Levi-Faur have described as ‘regulatory capitalism’.⁸

¹ http://journals.sagepub.com/doi/abs/10.1177/1056492601103010 p 268
⁷ For a discussion of decentralized regulatory arrangements, see for instance, Colin Scott’s piece.
In this paper, we are fundamentally concerned with how best to achieve behavioral change in farming communities. The difficult policy question we take up is run-off nutrients affecting marine environments; an issue which increasingly impacts many of the world’s coral reefs, lakes, wetlands and river systems. As Smith and others have pointed out, the restriction of nutrient loading on farms has become ‘the essential cornerstone of aquatic eutrophication control.’\(^9\) It is an issue which affects the United States,\(^10\) Japan,\(^11\) China\(^12\) and many other parts of the world. To explore the issue in greater depth we draw on examples from New Zealand (Lake Taupo) and Australia (Great Barrier Reef) both of which have grappled with the nutrient run-off in recent times. New Zealand has adopted a nutrient trading scheme which has had some successes but inadvertently caused many farmers to leave the area.\(^13\) Australia has also shunned state-driven regulation in favor of industry-led best management practices (BMPs) though reportedly with limited success.\(^14\)

As Gunningham observes, the considerable achievements of command and control regulation are often ‘too easily dismissed’ by scholars and policy-makers.\(^15\) And as we argue in this paper, in the context of nutrient run-off, there are advantages in having a central and coordinating role for the state in regulatory control, not the least because of the public confidence and legitimacy it can provide. A central role is also advantageous so governments can better coordinate the interrelated (and increasingly international) suite of very public responsibilities over which they often preside (health, education, energy, currency, trade barriers, crime etc.). Non-state market initiatives, therefore, might be coupled with or supplanted by some form of regulation, lurking in the background, like a ‘regulatory gorilla in the closet’.\(^16\) Moreover, there is empirical evidence

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to suggest a mixture of approaches, including regulation, delivers the best results. As Gunningham, Grabosky and Sinclair write:

“even in the case of one of the most successful schemes of self-regulation ever documented, it was the presence of the regulatory gorilla in the closet, that secured its ultimate success.”

In the end, we argue that some form of state-based regulation is ultimately desirable, however it should be built alongside NSMD incentives. In certain instances, trading schemes may provide such an incentive, but we argue that the use of these schemes should be limited to specific circumstances. We also argue that any state-based regulation needs to include support for a culturally-sensitive approach that takes account of the way regional and rural communities operate, and have done for decades. Such an approach necessitates a recognition of the unpredictable and volatile circumstances which agricultural communities face. In addition, because of the long-term relationship that most farmers have within their industry, any historically significant issues cannot be ignored.

The paper is structured in three parts. The first part considers the legal and economic literature regarding the control of activities that have a negative environmental impact. Within this part we present principles that we suggest should underpin further regulatory design. In the second part of this paper we analyse two governance frameworks that have been implemented to address water quality in the southern hemisphere: (1) Lake Taupo in New Zealand and; (2) the Great Barrier Reef in Australia. We demonstrate that neither of the means adopted necessarily present an ideal for the addressing this problem. Lake Taupo has caused some unintended results, and the Great Barrier Reef measures lack compliance and a sense of urgency. In the final part of this paper we briefly consider the best means to control nutrient pollution in a way that will avoid problems such as ‘regulatory capture’. In this section we conclude that a multidimensional approach is required, but in all instances it must be accompanied by some form of regulation including the tastes of standard setting; monitoring and enforcement. 

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PART 1: EFFICIENT AND EFFECTIVE REGULATION

What is Regulation?

There are three elements to our broad conception of regulation as we use it in this paper: (1) standard setting; (2) monitoring; and (3) enforcement. These elements come from commentators such as Scott and Levi-Faur who have written extensively about the issue. For further clarification, standard setting is discussed by Scott who describes it as the process of creating ‘norms, goals, objectives, or rules’ around which the regime is organised. Monitoring refers to, generally, ‘the checking, collecting and analysis of information about [the standards] whilst enforcement refers to ‘taking actions that perforce violators to mend their ways and that provide visible examples to encourage others … to avoid a similar fate. Each of these elements must be robust, and underpinned by sound principles if the regulation is to achieve the desired outcomes without excessive negative impacts.

Within this paper we argue that regulation at the hands of the government can and should be used to influence farmer behaviour, but that these should not be introduced in isolation from other incentives. Legal and economic theories of regulation require the correction of market failures and environmental restoration while at the same time ensuring that the development of the economy is not unnecessarily hindered. Although seemingly simple, these requirements can create complexity in regulatory design and requires careful consideration of the requirements of the regulation alongside the entities whose behaviour is regulated. This complexity is demonstrated in the literature identifying ‘regulatory capture’ which we consider hereunder.

Avoiding Regulatory Failure

20 Citizen Participation and Democratic Governance, in Our Hands
By Mohini Kak at p 175
Government regulators have traditionally been viewed as ‘benevolent maximizers of social welfare’. That view has been underpinned in part by Chicago School economists in emphasizing the efficiency of the market mechanism. In this regard, actors’ imperfect information was often blamed for market failure. A more substantial theory used to explain the increasingly evident market failures and imperfections was propounded by a number of economists who collectively developed a theory of regulation at the centre of which lay the role of asymmetries of information (Becker, 1976; Peltzman, 1976). This theory centred on the observation that while consumers are numerous they typically lack the organisational capacity to accumulate, process and apply countervailing influence. This weakness, as Becker (1976) argued, could be sourced to the relatively modest rewards to be gained by individual consumers. In contrast, industry socio-economic regimes while comparatively small, will, in per capita terms, have far more at stake. They therefore tend to be highly focused on achieving particular outcomes. Peltzman (1976), observing the rising power of environmental groups expanded the theory to incorporate a situation where there were a number of competing interest groups between which regulators arbitrated. Laffont also added to the theory noting that regulators have their own agendas and levels of influence and outcomes are therefore sensitive to asymmetries of information held by actors involved in regulation (Laffont and Tirole, 1991). These theorists pointed to a number of ways in which asymmetries of influence are exercised by interest groups which, they note, is more often than not exercised on elected vote sensitive officials who oversee regulators and may represent the areas which the regulations will affect.

Goldbach (2015) in his study of international banking regulation identifies systemic regulatory capture and failure, which characterised the industry both before and after the global financial crisis. The causes are identified in the form of a symbiosis of national and industry interests. Regulators are under intense pressure to cooperate across governments, in order to supervise globally active banks (in the absence of an international organization). But as Goldbach notes: “Politicians fail to enforce the protection against systemic failure; they rather focus on selectively pushing their constituents’ specific interests at the expense of regulatory stringency”.

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22 Ref?
To summarise, the phenomenon of regulatory capture will often result in the watering down of standards, and consequently the desired outcomes aren’t achieved over the target period. It is important to recognise this phenomenon in this instance, because any new proposals must remain outcome-focused, rather than process-driven. It is this recognition which leads well into the explanation of the principles we suggest should underpin the development of any regulatory regime.

**Towards principles of regulatory design**

Though forms of principled-based regulation (PBR) have not always been embraced in recent years, for instance following the global financial crisis, in this paper we support a principled approach to regulation of fertiliser applications in order to achieve efficient behavioural change. We suggest it is vital to recognize, as we said at the start, that real environmental outcomes can only be achieved through behavioural change and it is only through an understanding of the industry participants that behavioural change can be achieved in a way that is considered fair and robust. In terms of identifying what these principles are, there is considerable discussion already in the literature to draw from.

In 1983, Colin Diver wrote what others have today labelled the ‘classic analysis of administrative rules’. Focusing mainly on the creation of rules (i.e. our first element of regulation), Diver argued that there are three ‘dimensions’ critical for a rule’s success: (1) transparency, (2) accessibility, and (3) congruence. Transparency refers to the requisite that a rule should be comprehensible to its audience, using words with ‘well-defined and universally accepted meanings’. Accessibility refers to the ease of application of a rule to its intended circumstances and congruence to the relationship between the rule and the underlying policy objective.

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23 http://eprints.lse.ac.uk/32892/1/WPS2010-17_Black.pdf
Diver’s dimensions are an effective starting point for building principles of regulation to control fertilizer applications resulting in,. They are relevant, not only in the creation of rules (i.e. the first element of regulation), but in the follow-up activities often performed by the state but increasingly non-state actors: monitoring and enforcement. In other words, whilst a rule must be transparent and accessible so too should the information associated with the practices of monitoring and enforcement.

That said, Diver’s principles of effective regulation offer only part of what makes the framework likely to work well in today’s world. There are other helpful contributions to draw on. Black and Baldwin, for instance, provide an alternative analysis of how to undertake ‘risk based’ regulation which includes responding to five different elements of ‘regulatory design’: (1) the regulatees behavior, attitude, and culture; (2) their institutional environment; (3) the interactions between different regulatory controls; (4) regulatory performance; and (5) change. Drawing on Black and Baldwin’s thinking we consider the importance of a regulatee’s culture and the current institutional environment to be crucial to the determination of sound regulatory approach. Thus the principles that Diver had suggested about the appropriateness of a regulatory rule might also be extended to ensure that all regulatory activities (including monitoring and enforcement) are (6) ‘culturally appropriate’ and, (7) ‘fair and equitable’ in the circumstances. We turn now to consider each of these principles in further detail.

The first proposed principle of the regulations is transparency. It is widely accepted that environmental governance should entail public access to information, public participation, and access to justice. These are considered the ‘three pillars’ of good governance and are generally accepted as such under environmental governance both domestically and internationally. The concept of transparency may be further considered through the requirements associated with international climate change governance, being measuring, monitoring, reporting, and verification (MMRV). Takacs provides a straightforward explanation of each of these terms in the context of the climate change policy issue:

You can *measure* anything quantifiable (and if it’s not inherently quantifiable, you can invent scales and gradients to make it so) … *to monitor* is to assess the changes in carbon or any other variable over time … *to report* is to go public with what you have measured and monitored and thus permit others to see what you are doing and how you are doing it … *to verify* is to ascertain independently that the information measured, monitored, and reported is accurate.²⁹

In regards to agricultural practices which are at times considered to be intimate and private to those who engage in them, it may be that any transparency requirement, associated with public access to information may not only be inflammatory to the industry in question, but also may not be necessary to achieve the desired outcome. Nevertheless, in order for any regulatory measures to be robust these principles must form part of the commitments associated with nutrient reductions. It adds to the public’s view of the system as a legitimate, open and authoritative approach which is also important. It follows that any transparency requirements for farmers applying fertiliser loads, could be modelled on the MMRV requirements (under the climate regime) but with the disclaimer that not all persons will have access to all information, and nor would each intricate detail necessarily form part of those reporting procedures.

With transparency as the first and foremost principle of any regulatory measure we turn now to the other principles that one could suggest may be a requirement of any regulatory framework. These principles include (2) accountability, (3) accessibility, (4) congruence, (5) change (6) culture, (7) equity and (8) innovation. These principles although separate are interrelated and need not require complex nor sophisticated frameworks to promote them. We explain what is meant by each of these briefly below.

In order for the practice of regulation to bring about behavioural change there must be an incentive to adhere to the requirements or the outcomes associated with it. In this sense there need not necessarily be a strict enforcement requirement (i.e. strict liability regime) but there must be some form of accountability with the standards that have been set for regulatees. When we consider the definition provided of regulation above it is apparent that accountability need not

be to a regulator or a perceived enforcer. In fact, this approach may be counter productive and inefficient to the desired outcomes. Accountability may be to others within the industry,\textsuperscript{30} to a third party auditor or verifier (e.g an industry watchdog or professional body),\textsuperscript{31} or in some instances it is enough to be accountable to the community of actors within which one operates. Of course in order to be accountable there must be a means of accountability such as through the accurate measurement of outcomes.

The third principle, of congruence, which is particularly important in addressing the subject matter of this paper, is that the rule that has been set must be linked, in a broad but well thought through way, to the objective that policy makers wish to achieve. There is no point in having rules which are irrelevant to achieve policy purposes. For example, when regulating the practices associated with nitrogen run-off into the Great Barrier Reef (discussed below) the rules must be designed in such a way as to lead to improved water quality within the target area. They must also capture the types and forms of substances that are causing the problem (e.g. phosphour and nitrogen). There is a crucial role for science in this regard, to ensure that the activities captured by the rule are the ones that are most in need of change.

Regulatory frameworks never operate within a social vacuum.\textsuperscript{32} The desired outcomes may be the reason for the regulation but it is the steps to achieve those desired outcomes that are quite often overlooked. As such we argue that where the object and purpose of a regulatory framework is to modify individual behaviour of participants who collectively operate in the same industry, the promotion of a healthy industry culture should be a central principle of any such regulation. As noted by Thaler and Sunstein, social influences can affect beliefs, which will in turn impact on behaviour.\textsuperscript{33} In the instance that the culture of an industry is to be addressed through regulatory measures this principle becomes all the more important and at the same time

\textsuperscript{30} There might be something in the nudge book about this.
\textsuperscript{31} MMRV principles require what form of accountability? Draw on the above discussion.
increasingly complex. Importantly for any such framework to be successful it is important that there is extensive and broad industry consultation, the regulators are immersed in the history and culture of the industry, and there is an empathetic understanding of the existing industry practices. Without this level of consideration any regulation is operating blindly in its aspirations to achieve a positive outcome, whatever that outcome may be. In addition it is important to consider the predominate structure of the operations that will be the subject of regulations. In this regard, a crucial distinction to make, and one that is made by Gunningham is between small and large enterprises. Their activities, supply chains, pressures, and behaviours are entirely different. As Gunningham notes: ‘The key, at least for [smaller enterprises] with less than 50 employees, is to focus on simple, accessible improvements in management practices, rather than the introduction of formalised, administratively complex [systems of compliance].’

To extend on the premise of the previous paragraph, equity and fairness in regulation are important in order to ensure that the healthy industry culture can be promoted. Although equity and fairness are terms that can be defined, the analysis of any regulatory framework using these principles will often return a subjective response. Symes et al suggest that equity appears to have two main components. First *proportionality*, that a person receives that which they deserve, and second *egalitarianism*, requiring that all persons are treated equally. Clearly there can be some difficulty in not only achieving these objectives, but in achieving them in a way that satisfies those whose behaviour is impacted by the regulatory framework. We suggest that this may be particularly problematic in addressing the water quality caused by agriculture because certain locations will have a far more significant problem than others, however those locations will remain important both economically and socially. This principle although difficult to satisfy, cannot be ignored.

The final principle of the regulatory framework is the promotion of innovation. Although a command and control approach to legislation appears to achieve required environmental

outcomes, of course these environmental outcomes may be short lived, or indeed outweighed by the costs of any such method of change. As such, innovation as a principle receives overwhelming support in designing environmental law and policy. Again, to promote this principle requires an intimate understanding of the industry that one seeks to regulate. This is because it is important to understand the current practices, the current trends and the dynamics of the past and present innovative catalysts within that industry. In the instance of promoting innovation within farming practices it is important to have awareness for economic risks associated with any practice change. Therefore innovation cannot be expected to come about without strong scientific, and sometimes financial support to ensure the perceived risks are minimized.

PART 3: ANALYSIS OF EXISTING REGULATORY MEASURES

REGULATION AND VOLUNTARY PROGRAMS: THE GREAT BARRIER REEF (AUSTRALIA)

Nitrogen is a naturally occurring element and the key component of a number of industrial fertilisers. The impacts of nitrogen on the marine environment, chiefly as run-off from fertilizer use, have been reported for decades. In the 1970s, nitrogen was found to be a ‘critical limiting factor to algal growth and eutrophication in coastal marine waters.’ The impacts have been gradually and better understood through the 1980s, 1990s and 2000s. Its impacts on the

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39 Nitrogen, Phosphorus, and Eutrophication in the Coastal Marine Environment By John H. Ryther, William M. Dunstan Science12 Mar 1971 : 1008-1013
Great Barrier Reef, for instance, the world’s largest coral reef ecosystem have been increasingly studied since the 1990s, and a renewed focus, as a result of recent coral bleaching events has led to the question as to how to best tackle the problem of external loads. The ‘external load’ of nitrogen into the marine environment is essentially an accumulation of ‘a wide variety of sources, including groundwater, fluvial, and atmospheric inputs.’

Within this paper we specifically consider the environmental problem that is attributed to sugarcane farming practices in the Great Barrier Reef catchment area (Robinson et al., 2016). The excessive nitrogen in the reef is a direct result of the ‘mismatched N supply and crop N demand over sugarcane’s long N accumulation phase’ (Robinson et al., 2016). Sugarcane has been a dominant industry in GBR catchments for over 150 years, with some tracing it to the 1830’s (Moore, n.d.). In the 1900s, the State of Queensland released large tracts of land (Crown Leasehold) for agricultural and pastoral purposes, and to open up the State to economic activity. Presently in Australia there are estimated to be 4,400 sugar cane growers (Rural and Affairs References Committee, 2015). The majority of these growers are sole proprietors or family partnerships (Rural and Affairs References Committee, 2015). There are also 24 mills, along with many other stakeholders associated with the ongoing operations of this industry.

The financial viability of this industry hinges on the cooperative action of the growers combined with the work of the mills (Hildebrand, 2002). Sugarcane, in its raw state cannot be sold on either the international or domestic market, and therefore the industry is dependent on the ongoing profitability and operation of the mills (Hildebrand, 2002). As a result, the profit centre of the industry is the mill area or mill region and the farms and the mills must be geographically co-located because of the nature of sugarcane processing (Hildebrand, 2002). Sugarcane is a ‘giant sweet grass that once it has been cut it must be treated within 16 hours otherwise its commercial value deteriorates’ (Mackintosh, 2000) If this is not done the harvested cane will the cane will return a lower Commercial Cane Sugar (CCS) which in turn will result in less revenue for the grower (CANEGROWERS, 2010). This means that the farm must be located near a mill,

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and if a mill shuts down then potentially all the farming operations within that area will also do the same.

Just as the growers are dependent on the mills the mills are also dependent on volume of production, and therefore crop yields. Mills have relatively high operating costs, that includes a combination of a large equipment base and a number of salaried employees (Hildebrand, 2002). Because the costs of operating a sugar mill are significant the profits associated with a particular throughput are necessary, without which a mill would cease to be an ongoing financial concern, which is problematic for those who have a proprietary ownership structure. As a result, in the conceptualization of regulations associated with grower behaviour it is crucial that those regulations do not have a proportionate impact on yield and that nitrogen use efficiency is improved.

Ambitious targets to reduce N loads from key catchments have been set by the Australian and Queensland Governments. The first attempt in 2003, the Reef Water Quality Protection Plan (the Reef Plan) was the Australian and Queensland Government’s first approach at addressing the issue. The Reef Plan was amended in 2009, and again in 2013. The Reef 2050 Long-Term Sustainability Plan target is that by 2018 there is at least a 50% reduction in anthropogenic end-of-catchment DIN loads in priority areas, and up to an 80% reduction in loads targeted by 2025 (Commonwealth of Australia 2015, p38). Current approaches based on subsidizing the voluntary implementation of BMPs are predicted to only achieve approximately one quarter of the target reductions within the timeframe (Griffith report). The Taskforce identified that transformational change is needed over the next 5 to 10 years if targets are to have any chance of being achieved and that a fundamental shift is required in the way that land is managed. This requires the establishment of standards, and the proper monitoring and enforcing of those standards – in short it requires effective and efficient regulation, which has yet to be introduced for this problem as the existing regulatory measures demonstrate.

In 2009, amendments to the Environmental Protection Act 1994 (Qld) were introduced under Chapter 4A, which were designed to ‘reduce the impact of agricultural activities on the quality of water entering the reef’. The regulations required that growers in ‘high risk reef catchments’ limit fertilizer application and maintain records to ensure nitrogen and phosphorous application
could be monitored and verified (Queensland Audit Office, 2015)\textsuperscript{44}. In addition, the regulations included a requirement to undertake and record soil test data. The EPA further includes provisions for audits to ensure the required records are kept. The enforcement provisions carry a fine of up to $34,155 which, if they had been strictly enforced, would have provided strong incentive for growers to meet required reductions in fertilizer application.

In addition to the record keeping requirements, farms greater than 70 hectares were required to have an Environmental Resource Management Plan (ERMP), and to report yearly on its implementation.\textsuperscript{45} The ERMP must ‘identify any hazards of the property that may cause the release of contaminants into water entering the reef’ (\textit{Environmental Protection Act 1994} (Qld) Ch4A s105(2)) and which includes ‘the application of fertilizer or agricultural chemicals’ (\textit{Environmental Protection Act 1994} (Qld) Ch4A s94(b)). Other elements of the ERMP includes performance indicators for improving water quality of discharged water, management plans for the application of nutrients to the soil of the property and any other matters which would reduce the quality of water entering the reef\textsuperscript{46}. The combination of these requirements has presented challenges for growers given, prior to the commitments being introduced, there had been no restrictions or associated reporting requirements. There was also a notable lack of industry consultation and consideration of the culture itself was minimal.

Following the development of the SMARTCANE BMPs the Queensland government elected against enforcing Chapter 4A (Queensland Audit Office, 2015). While this was attributed to the change in government, the regulations were also widely unpopular with industry stakeholders. The phenomenon of \textit{regulatory capture} is relevant here (Becker, 1976; Peltzman, 1976), as it appeared that the decision to avoid strict enforcement provisions may have been a direct result of industry sentiment and resulting pressure. The decision to elect against the enforcement of

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\textsuperscript{44} In particular section 78 outlines the fertilizer application requirements and creates an offence for applying more than ‘the optimum amount’ of nitrogen and phosphorus to soil on the property (\textit{Environmental Protection Act 1994} (Qld) Ch4A, s78,80). Further the Act specifies that fertilizer containing nitrogen or phosphorus cannot be applied if it would cause more than this optimum amount to be applied to the soil (\textit{Environmental Protection Act 1994} (Qld) Ch4A s82).
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\textsuperscript{45} In accordance with the current provisions of the act, any failure to provide a report without reasonable excuse results in a maximum penalty of 100 penalty units (\textit{Environmental Protection Act 1994} (Qld) Ch4A s94(a)).
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\textsuperscript{46} \textit{Environmental Protection Act 1994} (Qld) Ch4A s94(c)(d).
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Chapter 4A removes any accountability in relation to the industry, thus rendering it toothless in this regard.

The Smartcane BMPs were introduced as an alternative measure to the strict regulatory approach taken in Chapter 4A. The BMPs cover all areas of farming practices from soil, nutrients, irrigation, drainage, weeds, pests, disease, crop production, harvesting, farm business, natural systems, workplace health and safety, managing people and the environment (CANEGROWERS, n.d). Within each of the modules there are numerous aspects of the practice in which the farm must attempt to reach the outlined industry standard or above it. For example, ‘Calculating optimum nutrient rate’ under the ‘Soil Health and Nutrient Management’ module requires soil tests and adherence to the ’Six Easy Steps’ methodology (CANEGROWERS, n.d). This methodology is not outlined in the module itself causing some complications, however it is promoted and facilitated by Sugar Research Australia (Sugar Research Australia, n.d.).

In accordance with the latest data, 170 farms have been accredited under the Smartcane BMPs (CANEGROWERS Association, n.d). The process for accreditation under the Smartcane BMP includes a self-assessment by the grower in relation to the industry standard, module training (including the provision of evidence of diary records, management practices) for certification of meeting/exceeding standards and auditing by local area Smartcane BMP facilitator (CANEGROWERS Association, n.d.). In order to obtain a final certification and become Smartcane BMP accredited an audit will be conducted by a BMP facilitator from another district (CANEGROWERS Association, n.d.). For instance, if a grower has carried out a BMP self-assessment, then the regulatory agency – the Queensland Department of Environment and Heritage Protection (EHP) will give them a year to complete the BMP accreditation (although if they are falling short of the standard for accreditation then they have to have a year of records to be able to become accredited). According to EHP, 60% of the land in the area has been through the self-assessment process but only 5% have been accredited. Of course without any threat of enforcement of Chapter 4A and without the requisite industry culture of accountability, there is little surprise that the good intentions underpinning the BMPs, including innovative practices, are presently unfulfilled.
It may have been possible to predict this failure when one considers the principles as articulated in this paper. Neither Chapter 4A nor the BMP regime demonstrate a framework that aligns with those principles in any meaningful manner. For instance, when we examine the culture and history of the sugar cane industry it is apparent that in Australia it includes a large number of small farms (Figure 1). There are around 4000 farms, averaging approximately 100 hectares in size (CANEGROWERS, 2010). The bottom 2% in size average 36 ha while the top 25% average 216 ha. It is estimated that 70% of farms are less than 125 hectares, and account for 30% production. A particular problem for the sugarcane farming industry is the low level of profitability associated with the small farms. Rates of return on capital (excluding capital gains) for the smallest 25% of farms is around negative 9% (SRA Performance Report, 2015, 2016). Moreover, small area sugarcane growers typically derive a large proportion of their income off farm. As the SRA survey notes, farm businesses with less than 50 hectares planted to sugarcane have had cash operating margins close to zero with income from other sources - crops, beef cattle and contracting – providing a small positive average farm cash income of $14 900 per business. Under these circumstances, it is not surprising that small scale cane growers whose operations are only marginally profitable are highly reluctant to spend the time and effort adopting BMPs.

This indicates that in all probability some 30% or more of cane growers do not have the ready resources to devote to following BMP procedures. Moreover, given the low return they derive from this activity in comparison to their off-farm activities they have little incentive to do so even if resources were available. That is, given the required outlay in time and resources, the adoption of BMPs may not greatly increase their overall income. These elements lead to important implications for the way in which a regulatory regime is designed to reduce DIN outfalls in the GBR catchment area. Firstly, the lack of voluntary uptake of BMPs by small growers indicates that persuasion alone has not been successful for this group of growers. This may be because growers don’t readily accept that BMP’s in their totality will provide a worthwhile increase in revenue. Thus, given the overall lack of profitability of smallholder cane farming and the entrenched longstanding farming habit traditions amongst some growers, there appears to be good reason why persuasion has been less than successful. That failure can equally be attributed to the lack of active and consistent intervention in support of BMP uptake by third parties, although some regions have responded better than others which may be attributed to
superior extension models. Economic theories of *path dependence* and *lock in* may also explain why this uptake has been less than optimal particularly as the regulatory threat of Chapter 4A waiting as the ‘gorilla in the closet’ was temporarily disabled (Gunningham and Sinclair, 1998).

In addition to the phenomena of path dependence and lock in, a problem for the sugarcane farming industry is the low level of profitability associated with the small farms. Rates of return on capital (excluding capital gains) for the smallest 25% of farms is around negative 9% (SRA Performance Report, 2015, 2016). Moreover, small area sugarcane growers typically derive a large proportion of their income off farm. As the SRA survey notes, farm businesses with less than 50 hectares planted to sugarcane have had cash operating margins close to zero with income from other sources - crops, beef cattle and contracting – providing a small positive average farm cash income of $14,900 per business. Under these circumstances, it is not surprising that small scale cane growers whose operations are only marginally profitable are highly reluctant to spend the time and effort in adopting BMPs.

Although the current measures will not achieve the desired environmental outcomes, this research has found that a total replacement of them is unnecessary. As noted previously, there is evidence that BMPs as an approach for mitigating agricultural externalities is sound in principle, although the introduction needs to be complemented by other measures in the form of incentives or ‘nudges’. Arguments for this need are supported by the current poor uptake of BMPs in the sugarcane industry. This may be explained in part both by the complicated nature of these standards, the costs associated with any transition to them and the economic arguments associated with lock in theory noted above. One of the key findings of this study is that, without proportionate incentives, any voluntary program is unlikely alone to deliver the scale of change required to improve water quality in the GBR catchment area in the time frame required (Van Greiken et al., 2013).

**Nutrient Trading: Lake Taupo (New Zealand)**

Nutrient trading is a modified spin-off of an emissions trading framework commonly introduced in the form of a cap and trade mechanism (carbon trading) which is advocated as a flexible
mechanism in the Kyoto Protocol (United Nations, 1998). Emissions trading schemes generally require a target reduction to be applied to the source of greenhouse gases (standard setting), with permits either issued or auctioned. The emissions of each regulated entity is reported and the appropriate number of allowances or permits must be surrendered (monitoring and enforcement). Whether these entities will buy emissions permits rather than mitigate greenhouse gas emissions, in theory depends on the price of the allowances on the emissions trading market and whether this price is less than the cost of emissions reductions. Such emissions trading models have been promoted as a means of making environmental law more administratively flexible (Bogojevic, 2013) and economically efficient. That is, the trading system is used to ensure that the price mechanism of the trades produces an efficient outcome.

Nutrient trading is a similar concept, but with a number of additional complications to the emissions trading model. Nutrient trading initially came about in the United States between point source pollution, and non-point source pollution in waterways. The schemes were devised as a way to improve water quality where some parties, the point source polluters, were subject to regulatory guidelines, but other parties, the non-point source, were also contributing to the problem. The cap and trade model was considered a way to enable parties to reduce their impacts in a way that could be economically beneficial. This scheme model was the basis for the development of the first non-point source trading scheme in the world, which was introduced in the Lake Taupo region of New Zealand to address water quality problems that resulted from agricultural practices, predominately pastoral farming (Shortle, 2012). Similar to the issues that face regulators in regards to the GBR catchment area, Lake Taupo, supports a thriving tourism industry and is an ecological icon in the southern hemisphere.

The Lake Taupo nitrogen reduction scheme was devised in relatively simple circumstances in that there was one body of water, and one main source of pollution. There are three significant components of the scheme being:

- A cap on the nitrogen losses
- A nitrogen trading system
- A protection trust to fund the initiative

Analysis of this scheme notes that public funds were used to achieve the required 20% nitrogen
reduction by buying back the allocated nitrogen discharge allowances. The trust was also designed to achieve cuts through purchasing whole farms, and converting them to uses that leach lower levels of nitrogen such as forestry, and then on-selling them. This latter component was employed not long after the introduction of the scheme, and although the 20% reduction was achieved there were mixed emotions about this method for achieving the target (Kerr et al., 2015).

In reviewing nutrient trading schemes introduced in different jurisdictions such as in the United States and New Zealand, a number of practical requirements are shown to be important. While a cap and trade scheme has a regulatory aspect which is the cap, there is also the voluntary aspect in terms of the trade of any permits or allowances (depending on the legal structure of the scheme). For this reason, in most cases for a scheme to be successful in a political context, any proposed market needs to have the support of the entities who will be participants in it (Fisher Vanden and Olmstead, 2013). The voluntary aspect of the scheme therefore requires buy in from stakeholders (Bayon et al., 2009) and trades to have low transaction costs. To facilitate this the trades must be simple and provide commercial certainty. In this respect the literature indicates that transaction costs fall over time as participants learn by doing (Woodward, 2003).

Research indicates that the number of trades in both the United States schemes and in the Taupo scheme have not been substantial (Flatt et al., 2014). The Taupo scheme for example has created 32 trades over 3 years, and the majority of these have been transacted by the centrally funded trust as opposed to farmer to farmer (Kerr et al., 2015). This is not to say that the scheme is inefficient but rather, that the structure of the scheme is yet to demonstrate its primacy over other possible methods of reduction, such as a traditional type of regulation, or simply an ad hoc buy out arrangement. When we consider our principles for regulation there are a number of aspects that raise metaphorical red flags, particularly when regulating smaller growers and other agricultural stakeholders. For instance, these schemes may be viewed as both a form of taxation and additional administration. The inclusion of farmer to farmer negotiations may not always be a welcome addition and there are some concerns that such a scheme will stifle momentum to innovate in farming practices simply because of complexities associated with the additional administration required for each participant in these schemes.
Even if these schemes are considered desirable by the entities themselves, there are other elements that must be present for a cap and trade mechanism to be appropriate. One that may be considered vital and aligns with the need for transparency (MMRV requirements) as noted in the first part of this paper, is that the externality must be capable of accurate measurement so the associated cap can be applied fairly, and reductions measurable (Fisher-Vanden and Olmstead, 2013). This element is often crucial to gain the support of participants as noted in the previous paragraph. Indeed, the ability and costs required to measure externalities can be critical to the efficiency of the scheme. In this respect water quality testing is highlighted as one of the essential criteria for nutrient trading by the Environmental Protection Agency in the United States (Flatt et al., 2014). The quantitative aspect of the scheme implemented in the Lake Taupo region was not set through actual measured data of the diffuse emissions. Rather a modelling program OVERSEER was required (Wheeler and Read, 2016) because of the ‘highly stochastic and unobservable nature of the emissions that were subject to the cap’ (Kerr et al., 2015).

A reliance of models, rather than direct measurements, to assess improvements in water quality outcomes is likely to be met with scepticism, with questions of fairness and accuracy of any cap that is set. Further research on the effect of farm management practices on N run-off and/ or leachate will help to further parameterize paddock scale models helping to extrapolate findings across larger spatial scales, which may increase confidence in the application of modelling. Further, the development of new monitoring technology may lower the cost of providing measurement at a paddock scale. However, at present the ability to monitor farm level N losses in an accurate and cost-effective manner remains a significant barrier to the adoption of a strict cap regulation of N run-off.

For nutrient trading schemes to be effective, reductions in the nutrient must be able to come from anywhere within the capped location, and generally at any time within a prescribed period. The argument hinges on the premise that regardless where the reductions are initiated, the favourable environmental outcome will be achieved. In terms of water quality trading this is difficult to achieve, as the location of the source of the pollution will generally change an environmental impact (Fisher-Vanden & Olmstead, 2013). As a result, a number of current water trading

47 As noted above, a cap and trade framework can be inefficient in terms of the resources needed for its establishment, but the arguments for its use generally surrounds the efficiency in reducing the pollution, as these reductions can come from the place that will cost the least.
programs have introduced location-based trading ratios (Fisher-Vanden & Olmstead, 2013). However, where reductions need to be specific to a time or place, the environmental effectiveness of the scheme will be questionable or, alternatively, the transaction costs associated with trades will be higher and will carry an increased likelihood of inefficiency. This will in turn result in less trades, and render the framework unnecessary or even counterproductive to the environmental objective. Further complexities arise where a cap needs to be reassessed on a yearly or sub yearly basis as a result of weather events, financial circumstances or industry movements.

Finally, if a scheme is designed to ensure the ongoing economic viability of an industry it is important that the framework encourages rather than stifles innovation through other supporting arrangements as opposed to encouraging either reduced acreage or industry exit (Driesen, 2003). For example, a framework should encourage nitrogen use efficiency (matching N supply to potential crop demand), which may change with technology such as genetic improvements, rather than simply limiting, or capping, nitrogen use. The need for flexibility and innovation in improving nitrogen use efficiency supports the development of paddock-scale nutrient management plans, with reporting requirements closely linked to measurable outcomes.

Although the Lake Taupo scheme has been used as an example of the feasibility of a nutrient trading framework, it does not necessarily conform to each of the above noted requirements nor is it necessarily aligned with the principles of efficient environmental regulation noted in the first section of this paper. For instance, there are questions associated with a number of proposed principles such as fairness and equity, innovation, culture and even to an extent, its congruence. Indeed, when considering the positive impacts that the scheme has had in regards to water quality, it is apparent that these have come about through the third element of the scheme, the protection trust. Although this presents evidence of success, arguably it demonstrates that the cap and trade scheme framework was unnecessary and rather the financial incentives of the trust have driven change. Further the cap has reduced farmers’ ability to intensify production, has decreased land values, and has significantly increased administration and compliance costs. These economic costs have led to social costs as significant land-use change has resulted from the policy, with many farmers exiting the regulated area. Reportedly, these changes have negatively affected the social lives of farmers left in the catchment.
If we consider the principles of effective environmental regulation as noted in this report it is apparent that this type of framework would have difficulty in meeting the criteria of a principled approach to regulation. Clearly a cap and trade framework would present greater difficulties and complexities than the Taupo catchment. The GBR represents a much more diverse catchment, with many different land uses, soil types and climate, and the area of land to which it would be applied is far larger. Although no economic analysis has been conducted, judging by the program complexities, the economic and social costs of a cap and trade program would appear to be greater for the GBR catchment stakeholders in comparison to those of Taupo.

As noted previously in this section, for a nutrient trading program to operate efficiently and effectively there must be industry buy-in and acceptance. Without this program pre-requisite, the transaction costs of this framework would be substantial, as there would be a need to promote the scheme through ongoing education, extension and monitoring that may not exist in other regulatory responses. Although these costs may be similar in terms of the proposal that follows in this report, it is suggested that the benefits in the multifaceted proposal would outweigh those of any cap and trade framework. In addition, the complexities associated with making a scheme fair and equitable in terms of the prescribed cap amounts, and the means of measurement for setting the cap and monitoring the actions of the farmers can also present significant complexities. In particular, the prospect of increased monitoring to attribute N run-off to individual farmers is unrealistic on the basis of scientific difficulty, cost and time. In short, this analysis does not present a favourable outcome in terms of the use of this type of framework for the NPS pollution associated with N runoff.

Recently a review of the Taupo scheme was undertaken where environmental benefits were considered against the costs of the scheme:

The introduction of the Lake Taupo Nutrient Trading Scheme has had some environmental gains, but has also had significant social and economic costs. We find that while the introduction of a cap on nitrogen has effectively limited discharges into Lake Taupo, it has also imposed various economic and social costs on those who now face a limitation on the productive capacity and development potential of their land. The reduction of options and additional costs associated with farming under a cap has driven
some landowners to exit the catchment, and may also have reduced the value of capped land compared to land not affected by a cap.\textsuperscript{48}

When these circumstances are considered against the principles for regulators articulated in this paper it appears that certain undesirable outcomes could have been avoided through different measures. However, of course, if the costs of farming in this region were greater than the benefits, then the exit of a number of farmers is a clear indication of market failure correction – however we argue that it is a correction that could have taken place through other more efficient means.

**PART THREE: THE ROLE OF REGULATION IN ACHIEVING BEHAVIOURAL CHANGE IN AGRICULTURE**

Agriculture is, and will continue to be one of the biggest environmental challenges for the planet. Studies vary though there are estimates that it contributes up to 30\% of the World’s Greenhouse gas emissions\textsuperscript{49} and is a major cause of decline in the world’s wetlands - 50\% of which have been lost since the 1900s.\textsuperscript{50} The conversion of land (vegetation and wetland clearing) for intensive agriculture and pastoral purposes has been particularly devastating on biodiversity. The world’s insatiable appetite for more and better meats, cotton, rice, corn, soybean, sugar and other crops places tremendous pressure on ecologically sensitive areas including marine systems. As such, it is increasingly accepted that the world is in environmental crisis. Several centuries of unchecked development, consumption and unsustainable growth have tested the earth’s resilience. Sustainable development was a powerful paradigm in the 1980s and 1990s, but after two decades some are left questioning whether it was premised on misguided footing.

The regulation of activities in agriculture does present a number of very serious conflicting concerns that may not be present in relation to other industries. There are considerable difficulties, philosophically, in arguing for environmental gains in a world where many struggle


\textsuperscript{49} Agriculture and Food Production Contribute Up to 29 Percent of Global Greenhouse Gas Emissions

\textsuperscript{50} http://www.publish.csiro.au/mf/Fulltext/MF14173
to put food on the table, or where there is not enough to go around. Second, is the diffuse nature of many of the environmental problems agriculture creates. In this respect, agriculture often occurs on a large scale, spread over a wide area, with many thousands of smaller operations contributing to environmental issues like run-off, vegetation loss, soil erosion, or carbon emissions. Third, most governments around the world heavily subsidise their agricultural sectors. Food industries are sensitive to global movements in currency and other raw materials (such as oil), and governments are often protective of creating further costs (in the form of regulation) for their industries. Adding to these complications are the issues associated with regulatory capture, path dependence and lock in.

Therefore, from the outset it is clear that finding a regulatory solution to agricultural pollution and waste is a challenging task. Any such solution will need to achieve acceptable environmental, economic and social outcomes for the numerous stakeholders associated with those agricultural practices. What complicates matters is that there are a vast number of options for the regulation of farming practices. For instance, there are the command and control options, where growers could be specifically directed to change behaviour with defined N rates of application. As noted there are also tradeable permit schemes such as those from the United States and New Zealand. Indeed, nutrient trading ‘has been identified as one potential transformational change’ (Smart et al., n.d). However, our research suggests that a nutrient trading platform should be considered an accessory contained within a regulatory toolbox in the form of incentive, and it should be implemented alongside other measures such as the aforementioned command and control options.

Alternatively, rather than drafting and enforcing strict standards there are voluntary measures, such as the introduction and suggested adoption of the BMPs. Although we have not seen a great deal of success with this type of measure within the sugar cane community in Australia, this could in part be attributed to its method of implementation. The notable omission of other instruments to further encourage compliance may explain the reluctant response. The analysis above has lead us to conclude that regardless of the formal design of the framework that it must adhere to the principles as noted previously in this report. Those principles are, transparency, accountability, congruence, promotion of industry culture, equity and fairness and innovation.
Each of these principles presents a challenge in and of itself, and their application involves a delicate balance and long term commitment to the regulatory goals.

Although seemingly less than precise there are some elements which we feel safe in concluding when a regulatory framework for agriculture is conceptualized. First, we advocate for a multidimensional approach to regulation which includes the introduction of a centrally enforceable regime. Alongside this there are a number of other measures that should accompany the penalty provisions. Although the other regulatory elements must be specific to the industry and the problem to be addressed, we argue that two categories should always form part of the mix. To ensure the uptake of standards there must be incentives, and to achieve the desired outcomes most efficiently for all stakeholders there must strongly supported extension programs. We discuss both of these important elements in more detail below.

**Incentives**

When we speak of incentives we are not limiting this to any specific category of incentive. Incentives can come in many forms, such as in penalties, in trading schemes and in direct financial assistance. Regardless of the form they many take, in the context of agriculture the use of rewards to drive compliance introduces a new set of issues. As Braithwaite notes this type of incentive carries with it problems associated with verification, free-riding and gaming of the system (Braithwaite, 2011). As noted, verification is a particularly difficult issue given the challenges involved in accurately measuring environmental impacts and potential improvements.

While Braithwaite’s claims that rewards are less useful in regulation than markets, in sequencing regulatory actions his recommendation treads too lightly on political imperatives. This is a real concern particularly in the agricultural context, where neither governments for electoral reasons nor the industry for economic reasons, would find a move to directly apply harsh punitive measures acceptable. For these reasons the provision of financial incentives to farmers tied to adoption and implementation of BMPs or other relevant standards, would seem appropriate under certain conditions. Such assistance could of course be on sliding scale with a lesser amount provided for larger farms where more resources are available and which stand to make relatively greater cost savings through the adoption of BMPs.
However, Braithwaite’s concerns about the downsides of a rewards based regulatory regime are real and need to be addressed. It is important that economic viability does not become dependent on any potential rewards if indeed the direct financial incentive is the path that is chosen. As such it is important that rewards be offered over a fixed timeframe beyond which non-adoption and compliance with BMPs would attract penalties. Such a progressive form of regulation would help to avoid free-riding.

Despite noting the importance of incentives to aid in the transition to BMPs, comply with standards or transition to more innovative practices, there remain other difficulties associated with their adoption not the least the learning curve barrier that some farmers may find difficult to overcome. Therefore, there are good reasons why a clear focus on appropriate extension programs is called for.

Extension Programs

Extension programs and government support for them is one of the key aspects of both voluntary and involuntary practice change in the agricultural sector. Building strong extension programs necessarily involves a long-term commitment from all industry stakeholders the benefits of which may only be realised over an extended period (Hunt et al., 2014). Such a commitment would need to be appropriately directed in terms of funding, training and perhaps most importantly, ‘peer-to-peer’ learning (Barrier Reef Water Science Taskforce and Office of the Great Barrier Reef, 2016). Appropriate personnel with the ability to build trust in the relevant industry would also be a critical element (Barrier Reef Water Science Taskforce and Office of the Great Barrier Reef, 2016).

Currently in Australia for example, State departments of agriculture provide limited extension services and many such services have been shifted to private enterprises (Zhang-Yue Zhou, 2013). This is indeed the case in the Australian sugar industry with SRA predominately responsible for research and development, and with extension provided by Cane Productivity Services (CPS). However, research indicates that a completely deregulated research development and extension (RD&E) competitive framework should be avoided (Hunt et al., 2014). This is a
risk if regulation is adopted without prioritising extension to ensure efficient innovation, improved culture and potentially, accountability.

Therefore we argue that extension services must not be considered as add-ons, but be fully integrated into the process and delivery of research, be active in providing feedback from industry stakeholders as well as in identifying farmer innovations (Hunt et al., 2014). These services should therefore be integrated as part of an industry solution to any agricultural issue where changes to farming practices, culture or reporting is required. In many sectors there already exists an extension model, however in Australia at least the funding provided to these services is more of an after thought as opposed to a core feature. This means that any service offering does not necessarily need to be reinvented, but, rather, promoted and properly funded to reflect the significant role it needs to play in resolving the environmental issues faced by the agricultural sector.

**PART 4: CONCLUSIONS AND FURTHER WORK**

The regulation of fertilizer run-off is a difficult challenge globally. The problems with feeding a growing population have led to food security problems on one hand that must be balanced against the problem of cumulative environmental impacts resulting in water quality issues, land clearing and climate change exacerbation. In this paper we analysed two different regulatory frameworks for the reduction of nutrients in waterways in two prominent locations, Lake Taupo and Australia’s Great Barrier Reef catchment. To analyse these frameworks we first presented principles that we suggest must underpin regulation in this sector. Those principles are, transparency, accountability, congruence, promotion of industry culture, equity and fairness and innovation.

The analysis of the two frameworks considered in this paper demonstrate that these principles were not clearly considered, which in the case of the regulation of sugar cane farming practices in Australia has rendered the scheme ineffective to date. The Taupo trading program has been somewhat more successful in nutrient reduction, however this has come at a cost to the industry culture, and arguably could have been achieved through more efficient means with greater outcome certainty.
This analysis has led to the conclusion that agricultural regulation, particularly for nutrient pollution, should necessarily include a multifaceted approach. We suggest that this should always include a regulatory gorilla (whether in the closet or otherwise), an appropriate incentive and dedicated extension programs designed to promote and support any innovation, change or reporting requirements. Of course any measures must not only be specific to the industry where behavioural change is necessary, but it should also have been conceptualized with a full environmental, economic and social view as opposed to considering only the specific circumstances of the problem.\(^{51}\)

In a sense there is a degree of urgency, simply because some of the benefits from the proposed measures here may not be realised for some time, such as the improvements in extension programs and incentives to adopt practice change and encourage innovation. Further, as cultural change is something that usually takes place over many years, there is a particular need to focus resources to accelerate this process. In doing it is important to recognise that solutions to the issues which are localised and specific to the agricultural sector can best be solved as far as possible within the industry, rather than strictly imposed externally. However, to conclude we suggest that the external impositions need to sit alongside the internal solutions, even if sit is indeed the only thing that they do.

\(^{51}\) Reference Christine Parker work.