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# SUBMISSION IN RESPONSE TO THE ENVIRONMENTAL PROTECTION (GREAT BARRIER REEF PROTECTION MEASURES) AND OTHER LEGISLATION AMENDMENT BILL 2019

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## Executive Summary

This submission provides a response to the Environmental Protection (Great Barrier Reef Protection Measures) and Other Legislation Amendment Bill 2019 ("The Bill") introduced on 27 February 2019. The comments made in this submission largely align with those of our submission to the Consultation Regulation Impact Statement, released September 7, 2017 (the Broadening and Enhancing Reef Protection Regulations). To summarise, we are broadly in favour of the regulatory approach adopted in the Bill and believe it is likely to lead to better water quality results for the GBR (though the timing of those results will be uncertain). In our view, the Bill appears to strike the appropriate balance between landholder's rights, recognising good 'on farm' practices, and improving the quality of water entering the GBR. Any concerns we have are therefore minor, and not necessarily with the standards or policy approach set out in the Bill, but rather, whether the Queensland Government will be adequately investing in the technical and financial resources needed to ensure future compliance with the standards.

The Appendix included in this submission includes a research paper that was recently published in Land Use Policy Journal. That paper includes recommendations associated with a regulatory proposal to address the current problems in the Great Barrier Reef Catchment area attributed to sugar cane industry participants. This proposal recommends the integration of existing Chapter 4A regulations with better incentives for adopting BMPs or BMP-Plus requirements, development of Nutrient Management Plans and enhancement of extension services as currently provided by Cane Productivity Services (see Appendix A). It appears that this is largely what is being achieved through the current Bill and therefore we support its passage.

**Some Further Comments on the Bill**

**THE NEED FOR RIGOUROUS AND INDEPENDENT EVALUATION**

**Our understanding of what changes behaviour in the agricultural community is relatively poor, especially from a social-science perspective. There has been insufficient research in this regard. Rigorous and effective evaluation is therefore essential to a successful long-term approach. We suggest that in introducing new restrictions on farmer behaviour, the government must be prepared to invest appropriately in reviewing and evaluating the changes both of the level of compliance and of the water quality. There is currently a five year period for reviewing the objectives set in policy (section 72) but this should be expanded to review the government's efforts in implementing the policy as well (not just the objectives themselves). If this was intended then it should be made clearer in the Bill. Further thought should also be given to whether this should be a three year period given the urgency of the issues facing the GBR. The evaluation should coincide with a statutory evaluation of the compliance program undertaken by the department, preferably by a third party provider, such as the auditor-general, to ensure full transparency and accountability in regulatory oversight.**

**EXPANDING THE RANGE OF NON-COMPLIANCE OPTIONS**

**The Bill introduces an offence for breaching an agricultural ERA relating to excessive nutrient loading (section 82). The penalty is a fine. There are a broader range of penalty options open to the regulator for other offences under the Environmental Protection Act 1994 (Qld) which may also be relevant. A wider range of sentencing options is considered best practice in achieving restorative justice in criminal law. Consideration therefore should be given to whether those additional orders might apply in substitution of, or in addition to a fine under the Bill. See for example, s 502 of the Environmental Protection Act 1994 (Qld) which allows for a rehabilitation or restoration order; a public benefit order; an education order; a monetary benefit order or a notification order.**

**THE DESIRE FOR EFFECTIVE OFFSET PRACTICES**

**Water quality offsets are introduced in the Bill. It is unclear how well these will work given the uptake of offsets in Queensland has not been strong to date. In any event, non-government organisations and private enterprise should be encouraged through the operation of this policy to help restore degraded wetlands and riverine environments in the GBR catchments. A landscape scale approach should be adopted when considering an offset. In addition, any offset credit methodologies should adhere to best practice standards for transparency associated with measurement, monitoring, reporting and verification (MMRV). Strict standards are therefore necessary to ensure the environmental effectiveness of the new framework is not compromised through offset projects. It should be made clear that offsets are only a matter of last resort, not first resort, in accordance with the paradigm: avoid, mitigate, offset.**

**THE NEED FOR MORE TARGETED FUNDING**

**The plan for the reduction of end-of-catchment dissolved inorganic nitrogen (DIN) and sediment loads will presumably impact on the**

**sustainability of certain industries within the catchments. The additional funding for extension services may alleviate some concerns, however, the management of the funds to ensure extension funding is effectively directed is crucial. Again, effective and transparent evaluation of this element of the approach is necessary, preferably every three years, and through a third party provider.**

**UNCERTAINTY IN THE REGULATORY OUTCOMES**

**The load limits imposed appear to be based on modelling and scientific knowledge that is constantly in development. As such the need for regulatory review is greater, to ensure that the outcomes desired, being improved water quality, are in fact achieved through the load limits imposed. In addition to this, the imposition of restrictions on industry participants may see some exit the catchment area. In this regard it is important to keep in mind that if there is a significant reduction in sugar cane grown in Queensland there is a chance that some of the sugar mills may also have to reconsider their operating strategies, because the throughput of cane is required to maintain mill profit levels.**

**Biographies**

**Dr Felicity Deane** is a Senior Lecturer at the Faculty of Law, Queensland University of Technology (QUT), Brisbane, Australia. Felicity completed a Bachelor of Law and a Bachelor of Commerce at the University of Queensland in 1999. Immediately following graduation Felicity commenced work and study in the United States in the disciplines of accounting and law. She commenced PhD studies in December 2009 at Queensland University of Technology. Her PhD entitled, '*The Clean Energy Package and WTO Law: An Analysis of Compliance Issues'* was subsequently completed in August 2013. In January 2014 Felicity commenced her time as a lecturer within the QUT law school on the early career academic program. She has published several articles on the topic of emissions trading, market based mechanisms and the WTO Law. Her book '*Emissions Trading and WTO Law: A Global Analysis'* was published internationally in March 2015. It has been published in several languages. Felicity has

published extensively in areas where economics and the law intersect, in particular regarding emissions trading and other forms of market based mechanisms. Most recently she led a multidisciplinary project which analysed the Regulation of sugar cane farming practices in Queensland, and has particularly reviewed the option of using a cap and trade model for this regulation.[1]

**Dr Evan Hamman** is a lecturer in law at QUT. He has past experience as a solicitor in private practice as well as working for NGOs and the Queensland Environment Department. Dr Hamman's research focuses on implementation of effective governance, especially the design and application of laws relating to biodiversity conservation in wetlands, coral reefs and near the coast.

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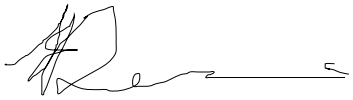

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[1] This research was funded by the Queensland University of Technology: Catapult program and led to extensive consultation with industry stakeholders.

# Appendix A – Article Published in Land Use Policy Journal (2018)

## Sugarcane farming and the Great Barrier Reef: The role of a principled approach to change

Dr Felicity Deane; Professor Clevo Wilson; Dr David Rowlings QUT; Dr Jeremy Webb QUT; Ms Elaine Mitchell QUT; Dr Evan Hamman QUT; Ms Eva Sheppard QUT.

**ABSTRACT**

Nutrient run-off from sugarcane farming practices has been identified as a significant threat to the Great Barrier Reef World Heritage Area (GBRWHA). The load of dissolved inorganic nitrogen (DIN) has increased dramatically in the last decades. This increase has been connected to poor water quality and outbreaks of Crown of Thorns starfish. It is suggested that the current level of the water quality is a failure that can be reversed by a focused regulatory response which meets the timeframe set by government. Considering the historical issues of regulatory capture, we argue that in devising effective regulation the culture of the sugar industry is of critical importance.

Even though in theory it is possible for nutrient trading measures to achieve water quality targets, in the context of the regulation of DIN outfall produced by the sugarcane industry in the GBR catchment area, there are scientific and social barriers that work against such outcomes. We propose a combined instrument approach that involves both incentives and ultimately penalties to meet the timeframes considered necessary to

protect the GBRWHA. Importantly such a strategy can be implemented without significant legislative changes.

**Keywords**

Nitrogen, sugar, Great Barrier Reef, cap and trade, trading, regulation

## 1. Introduction

Coral reefs are now one of the most endangered ecosystems globally due to a variety of threats including climate change, coastal development and terrestrial runoff (Pandolfi et al., 2003; Spalding and Brown, 2015). While climate change is considered the most serious risk, agricultural pollution threatens approximately 25% of the total global reef area with further increases in sediment and nutrient fluxes projected over the next 50 years (Kroon et al., 2014). Immediate management of anthropogenic pressures to coral reef ecosystems are therefore being prioritised.

The Great Barrier Reef (GBR) is the largest living structure on Earth with an economic and social asset value of AUD56B[2] (Deloitte Access Economics, 2017). The 2013 Scientific Consensus Statement on the Great Barrier Reef (GBR) concluded that 'the greatest water quality risks to the Great Barrier Reef are from nitrogen discharge, associated with crown-of-thorns starfish outbreaks and their destructive effects on coral reefs' (Waterhouse et al., 2016). A large proportion of the nitrogen runoff is derived from sugarcane fertiliser loss (Waterhouse et al., 2012; Bell et al., 2016), contributing to an estimated 56% of dissolved inorganic nitrogen (DIN) loads in the GBRWHA (Bell et al., 2016), despite only occupying around 1.3% of its area. Although it is well recognised that agricultural production results in negative externalities (Athukorala,

[2] For value of beach recreation for locals in the Great Barrier Reef Marine Park see Prayaga (2017).

2015), the proximity of the reef to the sugarcane farming areas in Queensland exacerbate the seriousness of this problem.

The drive for practice change and technological intervention therefore recognises that past intervention has been inadequate (Bell, 2015). Such past failures highlight not only the political barriers to change but also that effective regulation of water quality should not be solely focused on environmental issues but also consider the economic and social setting in which sugarcane farmers operate. In short, it should be based on sustainable development but achieved through a specialised principled approach to regulation and governance. These principles consider both the impacts of the regulations and those being regulated. They include:

- transparency (both regulation itself and the resulting impacts);
- accountability of the regulators and the regulatees;
- congruence - to the maximum extent possible - of the regulation to measurable targets;
- promotion of a positive industry culture to achieve the regulatory targets;
- equity and fairness from the regulated parties' perspectives; and,
- promotion of innovation in a practical and real sense.

The unique character of the sugar industry in Queensland means that the necessary reduction of GBRWHA indirect costs requires a unique and highly specialised solution (Shortle and Horan, 2016). A critical element is a trade-off which relates to the need to preserve the sugarcane industry's sustainability recognising the need to maintain grower/mill interdependency. Therefore, first a regulatory regime is proposed in which the issue of DIN measurement complexity is accommodated through the development of individual farm management/measurement plans that are comprehensively applied and monitored. Second, the consequences of reductions or increases in DIN outflows

are subject to a staged application of rewards and enforced penalties. In saying this, measurement of N losses at a farm scale is technically difficult and costly, meaning that regulations and enforcement of them must take this into consideration. As such, reporting and clear adherence to nutrient management plans becomes all the more important.

The third element proposed – the application of penalties, must be sufficient in magnitude to effect appropriate changes to farmer's practices. Underlying this approach is the existing regime based on the adoption of Best Management Practice (BMP) plans by farmers but with the introduction of quasi-market mechanisms which reward efficient farmers (in terms of reducing indirect costs) and penalise inefficient farmers. In such an environment over time efficient farms (in terms of their direct and indirect costs) can be expected to expand their operations with a subsequent contraction in the number of inefficient farmers. We acknowledge that this proposal could potentially lead to an exit of smaller farms, as the costs associated with farming and regulatory compliance generally exceed those relative to the larger scale farming operations.

This paper has a two-part structure. Part one describes the sugarcane farming industry in Queensland, and the problems associated with current practices and existing measures. Part two examines proposed measures associated with nutrient trading. In the second limb of Part two we propose an approach, the elements of which are designed to create a responsive and principled regime incorporating both combined instruments and extension services.

## 2. Sugarcane farming in Queensland

Sugarcane has been a dominant industry in GBR catchments for over 150 years (Moore, 1974). There are an estimated 4,400 sugarcane growers in Australia (Rural and Regional Affairs and Transport References Committee, 2015) most of whom are sole proprietors or family partnerships (Rural and Regional Affairs and Transport References Committee., 2015). The financial viability of this industry hinges on the cooperative action of the growers and the 24 sugar processing mills (Hildebrand, 2002). The interrelationship between growers and millers is based on raw Sugarcane's rapid quality deterioration if not milled within 16 hours of harvest (Mackintosh, 2000). In its raw state, it therefore cannot be sold on either the international or domestic market.

The industry is consequently dependent on the ongoing profitability and operation of the both growers and mills which need to be co-located within a defined area (Hildebrand, 2002). Mills are dependent on a minimum volume of production, and therefore crop yields. In the conceptualization of regulations associated with grower behaviour it is crucial that those regulations do not have a disproportionate impact on yield, but rather nitrogen use efficiency is improved upon.

*2.1 The current Australian legal framework*

In 2009, amendments to the *Environmental Protection Act 1994* (Qld) (EPA) were introduced and designed to 'reduce the impact of agricultural activities on the quality of water entering the reef'. Prior to 2009 there had been minimal regulation of agricultural practices in the region and the current state of urgency is perhaps demonstrative of this. The 2009 regulations required that growers in 'high risk reef catchments' limit fertiliser application and maintain records to ensure nitrogen and phosphorous application could be monitored and verified (Queensland Audit Office, 2015). 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 AUD34,155 which, if they had been strictly enforced, would have provided strong incentive for growers to meet required reductions in fertiliser 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. The ERMP must 'identify any hazards of the property that may cause the release of contaminants into water entering the reef' which includes 'the application of fertilizer or agricultural chemicals'. Other elements of the ERMP includes performance indicators for improving 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. 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.

Following the development of the Smartcane BMPs (2015), the Queensland government elected against enforcing the regulations under the EPA (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 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 the resulting pressure. Although this may have appeared a reasonable compromise, the failure of BMPs in terms of grower uptake could have been predicted had the culture of the industry been sufficiently understood and considered.

*2.2 The Smartcane BMPs*

BMPs were introduced as an alternative measure to the formal approach taken in the EPA. They covered 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 Association, 2010). Within each of the modules, farmers must attempt to reach or exceed the outlined industry standards. They include under the Soil Health and Nutrient Management module, adherence to the Six Easy Steps (6ES) methodology (Schroeder et al. 2010). The methodology is promoted and facilitated by Sugar Research Australia (SRA), an industry-owned company, funded by a statutory levy paid by sugar growers and associated milling businesses. SRA is also directly supported by the Commonwealth Government with matching funds as well as grants from the Queensland State Government. The 6ES methodology has been amended over time, and arguably in its current state there is limited flexibility that appreciates farm and seasonal differences from a grower perspective.

To date, 170 farms have been accredited under the Smartcane BMP program (Canegrowers Association, 2013b). Accreditation initially involves a grower self-assessment as to what extent industry standards are met, module training (including the provision of evidence of diary records, management practices), the certification of meeting/exceeding standards and auditing by a local area Smartcane BMP facilitator. Final certification follows an audit conducted by a BMP facilitator from another district (Canegrowers Association, 2013a)[3]. According to the Department of Environment and Heritage Protection (DEHP) 60% of cane land in Queensland has been through the self-

[3] If a grower has carried out a BMP self-assessment the department 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).

assessment process but only 5% have been accredited. As such it is fair to conclude that the BMP approach has represented something of a failure that now must be reconsidered if real environmental outcomes are to be achieved.

*2.3 Theoretical explanations: path dependence, lock-in, the Kuznets curve*

Economic theories of path dependence and lock in can be used to explain why this uptake has been less than optimal despite the regulatory threat (Gunningham and Sinclair, 1998; Briggs et al., 2015). Given path dependent growth is driven primarily by positive feedback mechanisms (Arthur, 2009), once catalysed the end product is typically market failure whose hallmark is a less than efficient allocation of resources by the market[4].

Cowan and Gunby (1996) apply lock-in theory in an environmental context to explain how the overuse of pesticides can occur even when there are lower costs and less environmentally damaging alternatives. In reality they noted that the value of adopting a particular pesticide rose with the rate of adoption. People habitually will not adopt a technology without the knowledge that many others were equally willing or had already done so (Farrell and Saloner, 1986). Moreover, the rate of uptake can be critically affected by first allowing improvements to a technology by learning and research, which may leave an ultimately efficient technology or practice in a less efficient undeveloped state.

[4] That is the market does not achieve 'Pareto efficiency' – defined as an economic state where resources are allocated in the most *efficient* manner, and it is obtained when a distribution strategy exists where one party's situation cannot be improved without making another party's situation worse.

Such findings have relevance to the application of nitrogen fertilisers in sugarcane cultivation. An alternative technology or crop – in this case the more efficient use of fertiliser through a careful analysis of its effect in different seasons/soil types etc. – might well be more cost effective. Growers have in the past been participants in a path dependent growth in the use of fertilisers given uncertainties about lesser use and the positive feedbacks created over time by their collective over-use. In this way, growers are unwilling to adopt an alternative technology (or crop) which, in less complex environments, would have been resolved by simple market forces.

These issues become more complex where indirect environmental costs can cause a substantive form of market failure not in evidence when considering direct costs. Moreover, given the indirect cost may not be directly born or felt by the parties directly involved (i.e. farmers and millers), poses particular problems in devising regulatory solutions which take into account the real and perceived equity for stakeholders.

While BMPs can be seen as a sound approach (Brodie et al., 2013) there has been limited uptake from growers which can be explained both by the above economic theories but also the striking lack of a financial incentive for growers to transition to lower fertiliser use via BMPs.

International trends indicate growers who have completed an environmental stewardship program such as Smartcane BMP may derive a premium for sugarcane similar to the application of the Bonsucro standards that apply to the mills which choose to be certified accordingly, which require sugar to be produced sustainably and to comply with certain human rights requirements (Bonsucro, 2014). However, the number of entities currently applying such environmental standards are small.

The important role of path dependence and lock-in is underlined by the apparent absence of progressively lower environmental degradation as would have been predicted by the environmental Kuznets curve. This theory suggests that while environmental degradation will increase early in a country's economic development a turning point is reached as per capita income rises after which degradation falls with heightened awareness and greater resources are available for mitigation (Sugiawan et al.,2017). The trend of any given environmental Kuznets curve reportedly reflects differently depending on the environmental degradation studied (Miyama and Managi, 2015). The expected U-shape curve has not been demonstrated in this study given that DIN emissions have steadily increased notwithstanding greater awareness and resources for mitigation.

## 3. Frameworks for regulation of the sugarcane Industry

There are a number of options for the regulation of sugarcane farming practices, outlined in the literature both in Australia and abroad (Flatt et al., 2014; Smart et al., 2016). In particular, a nutrient trading scheme has been identified as one solution with the potential for 'transformational change' (Smart et al.,2016) in which a regional cap is applied and permits are either issued or sold to the growers in that region, with an option to trade.

### 3.1 *Nutrient trading framework*

Nutrient trading generally requires a target reduction to be applied to the source of greenhouse gases, with permits either issued or auctioned. Whether the entity regulated

will buy nutrient emission permits rather than use mitigation, in theory depends on the price of the allowances on the emissions trading market and whether this price is less than the cost of emission reduction. Such a system is used on the basis it allows greater administrative flexibility (Bogojevic, 2013) and, through the price mechanism, produces an economically efficient outcome.

Nutrient trading was first introduced in the United States where some parties, the point source polluters, were subject to regulatory guidelines, but other parties (the non-point source) were also contributing to the water quality problem. This scheme model was the basis for the development of the first non-point source trading scheme in the world – in the Lake Taupo region of New Zealand, to address water quality problems that resulted from agricultural practices, predominately pastoral farming (Shortle, 2012). As is the case for the GBRWHA, Lake Taupo supports a thriving tourism industry and is an ecological icon in the southern hemisphere.

The Lake Taupo nitrogen reduction scheme has three significant components:

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

Public funds were used to achieve the required 20% nitrogen reduction by buying back the allocated nitrogen discharge allowances. As well, cuts were achieved through the purchase of whole farms, and converting them to low nitrogen forms of agriculture. While a 20% reduction was achieved there were mixed emotions about this method for achieving the target (Kerr et al., 2015).

Past experience in countries such as the US indicate that for a cap and trade scheme to be successful in a political context, it needs to have the support of participating entities (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, 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. While more research is needed to respond adequately to this criterion, preliminary investigations suggest that a cap and trade scheme is not considered necessary nor useful by participants of the sugarcane industry in Queensland. It is possible that these schemes could be viewed as both a form of taxation and additional administration. Further, 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 the current momentum of the industry to innovate in farming practices.

Another element that generally must be present for a cap and trade mechanism to be appropriate 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; Meub et al., 2015). This element is often crucial to gain the support of participants as noted in the previous paragraph, as has been shown in US cap and trade schemes (Flatt, 2014).

In the Lake Taupo scheme emissions were calculated through a simulation modelling program (Wheeler and Read, 2016) because of the stochastic and uncertain nature of the emissions that were subject to the cap (Kerr et al., 2015)[5]. Given the expense and difficulty of measuring nitrogen losses at a farm-level, a similar modelling approach to water quality testing would have to be implemented in the GBRWHA if such a framework were adopted. Currently, the Paddock to Reef Program assesses water quality targets based on paddock scale measurement and uses models to extrapolate results across spatial locations and over long timeframes. However, reliance of simulation models, rather than direct measurements, to assess improvements in water quality outcomes is likely to be met with scepticism from cane growers, with questions of fairness and accuracy of any cap that is set.

Of course these issues can be addressed over time. For instance, further research on the effect of farm management practices on N runoff and/or leachate will help to further parameterise paddock scale models helping to extrapolate findings across larger spatial scales, which may increase confidence in the application of modelling. Furthermore, the development of new monitoring technology may lower the cost of providing measurement at a paddock scale. There are however, additional concerns that accompany these schemes that may pose barriers to their introduction.

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

[5] 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.

of the pollution will generally change an environmental impact (Fisher-Vanden and Olmstead, 2013). A number of current water trading programs have introduced location-based trading ratios (Fisher-Vanden and Olmstead, 2013). 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. Certain weather events can also have significant impacts on harvesting and on any subsequent ratoon crops. Over a period of years from the initial plant cane crop to ratoon growth, different amounts of nitrogen fertiliser will be required in order to achieve the desired seasonal potential of the crop. A yearly cap will need to be regularly reviewed, particularly if accurate measurement of the fertiliser loss is unavailable.

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 and does not encourage reduced acreage (Driesen, 2003). Equally however, as discussed below sustainability and viability of the Australian sugarcane industry should by no means exclude and indeed support the exit of small and or marginal cane farmers and thereby increase the size and profitability of farms which are better able to innovate and mitigate.

The basis for a regulatory framework should entail encouragement of improved 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. There are also questions associated with a number of proposed principles such as fairness and equity, innovation, culture and even to an extent, its congruence. The Taupo scheme thus arguably demonstrates that the financial incentives of the trust have driven change as opposed to the market created by the cap and trade framework. 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. Despite noting this, it is important to recognise that in some instances such reductions are of course necessary where external costs outweigh farming benefits.

Although one may be able to make positive arguments for the framework developed in the Taupo region, clearly a cap and trade framework would present greater difficulties and complexities if it was to be used as a regulatory tool in the GBRWHA. The GBR represents more diverse catchments, with many different land uses, soil types and climate, and the area of land to which it would be applied is far larger.

Although buy-in and acceptance costs may be similar in terms of the cap and trade scheme and the proposal that follows in this paper, it is suggested that the benefits in the multifaceted proposal would outweigh those of any cap and trade framework. In particular, the prospect of increased monitoring to attribute nitrogen runoff to individual farmers is unrealistic on the basis of scientific difficulty, cost and time. Our research

did not find support for the use of this type of scheme for sugarcane farming practices in the GBR catchment area at present.

*3.2 A responsive and principled approach*

Despite a seemingly difficult problem situated in a sensitive location, there are steps that must be taken by all stakeholders and regulators with a view to improving environmental outcomes as soon as possible. As such, an alternative approach to a cap and trading scheme is proposed which operates within the existing regulatory framework and meets the criteria we have set out for a principled approach.

The GBR Water Science Taskforce has identified a goal of an 80% reduction of DIN by 2025 which, if the current industry trajectory is maintained, would almost certainly be out of reach. This failure indicates both a case of the locking in of a class of cane famers' farming practices and of fundamental regulatory failure and regulatory capture (Barrier Reef Water Science Taskforce and Office of the Great Barrier Reef, 2016).

There is clear evidence that under the current regulatory regime that neither cane growers individually or collectively have sufficient incentive nor behavioural flexibility to achieve the DIN reduction goals. Given the failure of the previous regime it is argued that new mechanisms are needed which encourage a principled approach embracing behavioural change and which should include robust incentives if the objectives are to be achieved. Equally there is need for similarly robust compliance measures which have been all but absent following the Queensland State Government's decision in 2015 not to enforce relevant measures of the Environmental Protection Act (1994). To date there have been minimal site audits and an insufficient focus on appropriate extension staff.

One of the key findings of this study is that, without proportionate incentives (and ultimately necessary penalties) , 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). However, the current incentives have been disproportionate to the costs associated with it for many small-scale farmers

### *3.2.1 Incentives and compliance*

The particular problem associated with the economics of sugarcane farming is linked with uncertainty, productivity and the need to maintain a certain level of output. Therefore, these issues need addressing if farmers are to mitigate the problems associated with DIN outfall. The transition from existing agricultural management practices to those with reduced pollutant exports requires significant upfront capital and transaction costs to plan and execute change (Kroon et al., 2016). This observation is consistent with the environmental Kuznets Curve theory, which suggests that as development reaches a particular level, environmental pollutants associated with economic activities will decrease through technological advances (Miyama and Managi, 2015). The need for incentives alongside any practice changes therefore needs to be explored.

The sugarcane farming industry in Australia is dominated by small farms (Table 1). There are around 4000 farms, averaging approximately 100 hectares in size (Canegrowers Association, 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.

Such small farms typically have a low level of profitability and return on capital. Indeed, excluding capital gains, for the smallest 25% of Australian sugarcane farms profitability is around negative 9% (Sugar Research Australia and Queensland Government, 2015). Moreover, small area sugarcane growers typically derive a large proportion of their income off farm. 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 AUD14,900 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.

The existence of a number of smaller farms can also potentially exacerbate the problem of fertiliser runoff given there is evidence from overseas studies that large scale sugarcane farms on average use less fertiliser than small scale plots per hectare (Ju et al., 2016). Nitrogen fertiliser use on a per-acre basis decreases with the increase of farm size notwithstanding that crop yields were higher in large-scale farms. They explain this finding in terms of cost considerations given the low usage of machinery in smallholder farms which inhibited the application of precise fertilization technologies. Similar to Australian smallholder cane growers, most Chinese smallholders surveyed have a low dependence of income from cropland and greater reliance on off-farm income compared to largescale growers (Ju et al., 2016). Thus, large-scale growers are found to be generally more sensitive to the level of fertiliser use given it was a more important factor in overall income. Such incentives would seem to be replicated in Australia where fertiliser cost is on average the largest non- labour cost in sugarcane farming (Figure 1).

The above indicates that in all probability some 30% or more of cane growers do not have the ready resources to devote to following BMP procedures. Given the low return they derive from farming activities in comparison to their off-farm activities they have had little incentive to do so - even if resources were available. This leads to the conclusion that to promote both sustainability and viability of the Australian sugarcane industry and meet the deadlines set for reductions in DIN, a regime which can encourage rationalisation of small farms into larger enterprises should be encouraged as has been the case for the Australian dairy industry. 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.

In the context of the Australian sugarcane industry the use of rewards to drive compliance introduces a new set of issues. This type of incentive carries with it problems associated with verification, free-riding and gaming of the system (Braithwaite, 2011). Verification is a particularly difficult issue given the challenges involved in accurately sourcing and measuring DIN outflows from individual farms.

In the Australian context, 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 growers tied to adoption and implementation of BMPs, 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.

Provision of government incentives to slow environmental degradation as a result of pollution has been supported in recent case studies of water quality and economic growth in China (Zhang et al., 2017). Indeed, as it is hypothesised that where economic

development has not yet reached the level associated with a positive upward trend in the environmental Kuznets Curve, government incentives can simulate this development level (Zhang et al., 2017). However, rather such a policy direction must be carefully managed and therefore rewards could 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. This proposal is made all the more logical as the threat of a punitive measure for non-compliance already exists in the form of the *Environmental Protection Act 1994* (Qld).

Ultimately if such a mix of incentives and rewards are not considered viable by smallholders, strict compliance measures should assist a useful rationalisation into larger more efficient and sustainable units financially capable of meeting environmental standards in a accelerated manner.

*3.2.2 Extension programs*

Given the now difficult task of meeting the 2025 target a greater focus on appropriate extension programs is clearly necessary to ensure adoption of BMPs - an essential component of both voluntary and involuntary practice change in the sugarcane industry (Hunt et al., 2014). They 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).

Currently in Australia, State departments of agriculture provide limited extension services many of which have been shifted to private enterprises (Zhang-Yue Zhou, 2013). This is 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). In particular, there are concerns over weakening of linkages between research and extension within the sugar industry (Hunt et al., 2012). Current extension services are found to be inadequate to respond to the volume of grower needs.

Extension services must not, it is argued, 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 the water quality issues in the GBRWHA, with greater connections between them and SRA where appropriate. Thus we argue the existing framework does not need to be reinvented but, rather, promoted and properly funded.

### *3.2.3 Nutrient management plans*

As indicated by Thorburn and Wilkenson (2013), improvements in the decision support systems and diagnostics to define the appropriate nitrogen application rate is needed. Under the current approach of the Six Easy Steps program fertiliser nitrogen application rates are determined as an estimate of a target yield, the scale at which that target is set (typically a district comprising thousands of hectares) and the method of setting the target (20% above the best district average yield obtained in the last 20 years). Research continues to indicate consistent over-application of N by most growers in most years (Bell, 2015). Therefore, targets using a finer spatial resolution (sub-district, farm or

block) are needed similar to that being followed in other industries such as the Fert$mart initiative of Dairy Australia.

Thus a farm or block scale specific plan which, while involving considerable extra expense, can be justified in terms of improved environmental outcomes and is likely to be better accepted by growers if their specific circumstances are adequately taken into account. It is proposed that these plans could be designed in accordance with the farm size, grower expertise, crop potential and farm resources in mind. Rather than replacing the BMP methodology, the nutrient management plans that includes a crop's seasonal potential and requirements could be incorporated into the approach. Such plans could be both developed and verified by third parties, such as the CPS, if properly resourced, as a means of freeing up scarce regulatory resources.

The high initial costs of this type of regulatory framework is not overlooked and therefore this is a proposal that requires further research and cost benefit analysis. It does provide an approach that can be implemented over a time, that is consistent with reef targets but will also provide positive outcomes for all sugarcane industry stakeholders, improve industry culture and result in immediate environmental benefits within the GBRWHA.

## 4. Conclusion

This paper analysed the practice of sugarcane farming in Queensland with a focus on designing regulations which address the sociological factors that operate to resist change. The findings of this research promote a staged process in which the primary phase is based on decentralised regulation that incorporates a variety of state and non-

state actors, participating in various roles with varying levels of influence. In theory, these players should be able to 'pull compliance' collaboratively where possible, from those responsible for environmental impacts. This process of responsive regulation is a flexible approach to governance where regulatees form relationships with regulators and collaboratively work together to meet environmental standards through negotiation and mutual interest. Given the strict timeframe imposed on reducing nutrient runoff, a second phase is created in which penalties are proposed where uptake of measures in the first phase are inadequate to meet targets in the required timeframes. This second phase requires that the existing regulatory measures are enforced after there has been extensive industry consultation.

We argue that a cap and trade framework is an inferior scheme for nutrient reduction. Being based on the level of nitrogen applied will produce highly variable outcomes in terms of DIN outfalls and therefore a nutrient trading scheme would be high complex, administratively intensive and likely to produce the result of industry dissatisfaction. These schemes risk being 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 the current momentum of the industry to innovate in farming practices.

We acknowledge that given the complicated nature of non-point agricultural pollution, developed nations have not done enough to reduce pollution where this occurs (Shortle and Horan, 2016). In this paper, we addressed this issue as it affects the sugarcane industry through the development of a specialised and principled approach employing multifaceted regulation. Specifically, we recommend the inclusion of the following elements to reduce any further harm to the GBRWHA:

- Expanded extension programs which employ specialised extension officers to better educate farmers and thereby present BMPs in a less intimidating light.
- Support through incentives for growers to transition to adoption of BMPs. These incentives should be accompanied by regulations that have the strength of enforcement to ensure growers understand the importance of both commencing the adoption process and completing accreditation.
- Enforcement measures should be calibrated to ensure that small marginally profitable farming enterprises are encouraged to exit and thereby promote larger more economically viable units.
- Support of BMPs through a more innovative approach and increasingly specialised programs.
- Block level fertiliser management plans that takes into account a crop's seasonal potential. Such management plans would not only lead to improved nitrogen used efficiency at a block level, but help ensure new technologies are employed where it is beneficial to do so.
- A graduated regulatory regime that builds on the existing requirements under the *Environmental Protection Act 1994* (Qld) with genuine enforcement measures that take not only reporting but fertiliser application into account.

We acknowledge that climate change poses the primary threat to the health of the GBRWHA but emphasise that building resistance to other pressures will increase the ability of the reef to respond favourably from any climate change events (Department of Environment and Heritage Protection, 2016). Given the GBR's increasingly fragile health localised impacts should be addressed immediately. It is accepted that 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 in fertiliser application.

We recommended a graduated approach for the regulation of sugarcane industry which is sufficiently robust in its measures to ensure regulators together with the industry stakeholders can meet those self-imposed but all important deadlines and which are currently in danger of being out of reach. As cultural change is something that usually takes place over many years, there is a particular urgency in focusing resources to accelerate this process without further delay. The nature of these measures recognise that solutions to the issues which are localised and specific to the sugarcane industry can best be solved as far as possible within the industry, rather than imposed externally.

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Table 1: Distribution of sugarcane farm businesses, by area planted to sugarcane (2013-14)[6]

[6] Reproduced with permission from ABARES, Australian Sugarcane Farm Business Survey.

| Area planted to sugarcane | Sugarcane farm businesses (No.) | Share of businesses (%) | Share of sugarcane production (%) | Share of sugar production (%) |
|---|---|---|---|---|
| < 50 hectares | 1557 | 44 | 12 | 11 |
| 50 – 125 hectares | 907 | 26 | 18 | 18 |
| 125 – 250 hectares | 656 | 19 | 25 | 24 |
| > 250 hectares | 387 | 11 | 45 | 46 |
| All sugarcane farm businesses | 3508 | 100 | 100 | 100 |

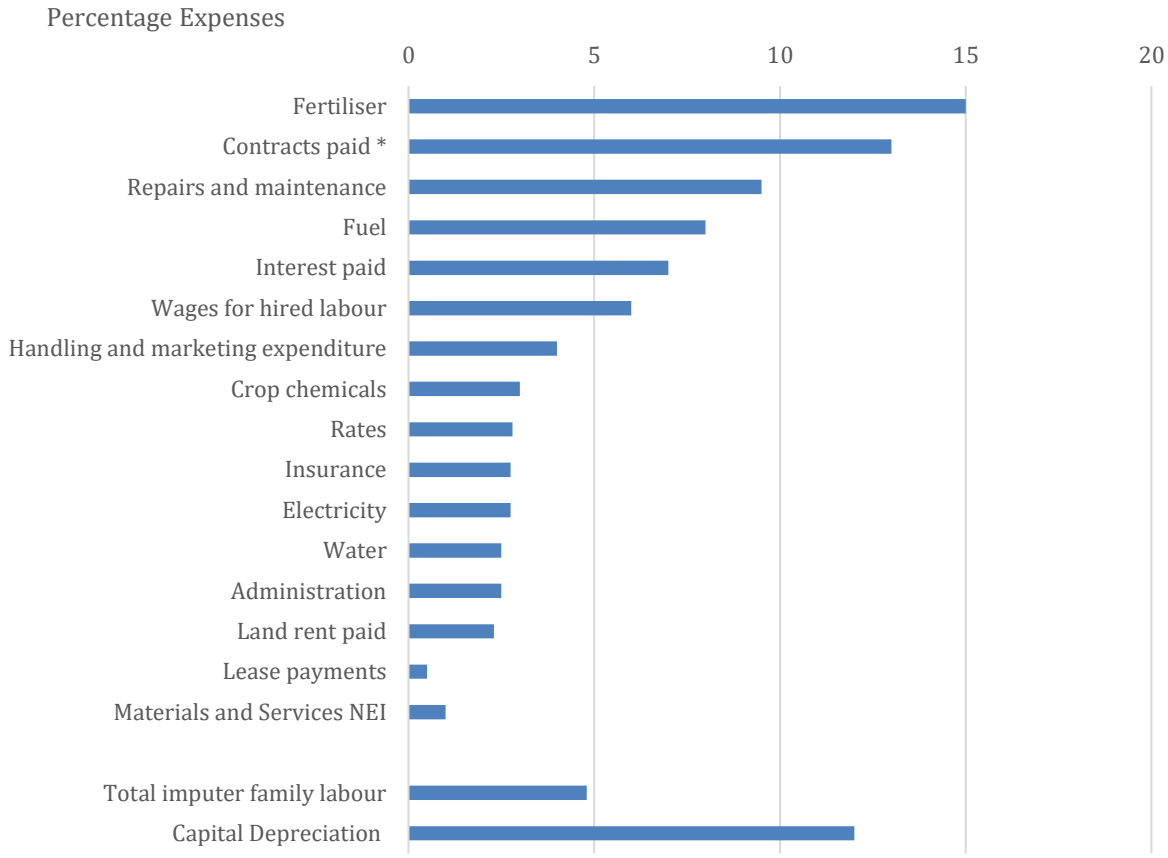


Figure 1. Composition of sugarcane production cost, sugarcane farm business (2013-14)[7]

[7] *Includes contract harvesting, planning, spraying and cultivation. NEI not elsewhere identified. Reproduced with permission from ABARES, Australian Sugarcane Farm Businesses Survey.