Foot off the gas:

How a gas-led recovery will impact Australian farmers

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1. Introduction

Evidence-based planning for state-significant developments such as gas mines should balance the trade-offs between short-term economic gains and the long-term solutions for food security and ecosystem services that agriculture provides.

The Federal Government announced late in September 2020 that Australia's strategy to deal with the economic impacts of COVID-19 would be a 'gas-led recovery'.

This strategy asserts that increasing gas production (by opening new basins and building more gas-burning power stations) and creating a transparent market will make Australian energy cheaper and more readily available. It is hoped this will aid in economic recovery at both the primary (e.g. use in manufacturing and industry) and secondary levels by driving gas prices down for consumers.

The National Farmers' Federation (NFF) has pushed back on this plan, noting that farmers need to be in control of their land to in order to be effective stewards, and highlighting the critical importance of groundwater security (Murphy, 2020). Recent Australian Farm Institute research on land use conflict has found that, beyond the direct competition for land and water assets, many farmers experience additional negative impacts from coal seam gas (CSG) activities including aquifer depletion, water contamination and severe personal stress. Queensland farmers have voiced concerns that the measured and predicted drawdown on water bores as a result of existing coal seam gas drilling will have a disastrous impact on that state's agricultural sector, community wellbeing and the environment. The Queensland Office of Groundwater Impact Assessment has noted 222 effective Immediately Affected Area (IAA) bores in the Surat Basin as of 2019, with a potential 571 bores identified in long-term affected areas (OGIA, 2019). In addition, research has demonstrated a clear link between CSG extraction activities and negative pressure on farmers' mental health (Morgan et al., 2016).

However, farming communities are often divided on the benefits of gas production. Research on the economic impacts of early unconventional gas mining in NSW found that regions with CSG activity had 7% higher family income than regions without (Marcos-Martinez et al., 2019), and many landowners and land managers report minimal disruption from gas exploration.

Evidence-based planning for state-significant developments such as gas mines should balance the trade-offs between short-term economic gains and the long-term solutions for food security and ecosystems services that agriculture provides (Hilson, 2002; Lechner, et al., 2016). However, the extent of continuing conflict between the mining and farming sectors indicates that planning outcomes to deliver this tenuous balance are not being achieved.

At a time when the Australian farming sector has committed to an aspirational economy-wide target of net carbon zero by 2050 (NFF, 2020), concerns have been expressed that accelerating gas production might undermine these goals by increasing greenhouse gas emissions. While the Federal Government's strategy is intended to deliver a net climate benefit by replacing more emissions-intensive energy sources such as coal, in August a group of leading Australian scientists sent an open letter to Australia's Chief Scientist warning that prioritising gas production "is not consistent with a safe climate … [and] there is no role for an expansion of the gas industry" (Hepburn, 2020).

What impact might a gas-led recovery have on the protection of productive agricultural land, the social capital of farming communities, and our long-term food and water security?

Gas mining and agriculture co-exist in many parts of the country – some more successfully than others. One region which has demonstrated particularly fraught interactions between farming and gas production is the Gunnedah Basin, near Narrabri in north-west New South Wales, where a major development by Santos in a productive agricultural area has drawn national attention.

The Independent Planning Commission (IPC) of NSW extensively reviewed the Narrabri Gas Project (NGP) and approved the development subject to stringent conditions, many of which directly related to agricultural impact. The IPC Statement of determination has been used as a guide for this briefing paper on areas of primary concern, due to the relevance of the reasonings and the credibility of the IPC. Although the issues and concerns raised as part of the planning process are specific to Narrabri, many are relevant to the broader context of Australian agriculture.

The concerns raised by the IPC focused largely on the Commission's confidence in the applicant's groundwater impact modelling and estimation of greenhouse gas (GHG) emission levels. Public comments on the proposal regarding agriculture highlighted concerns on groundwater supply impacts affecting capacity to supply stock and irrigation water, insurance and liability concerns for farmers hosting CSG wells, potential reduction of agricultural investment creating uncertainty for the sector's viability in the region, and leakage of labour to the project. The local Council shared many of these concerns, particularly those relating to depletion of aquifers and contamination of groundwater reserves (Table 1). NSW Farmers strongly objected to the NGP, stating that the project poses "an unacceptable risk" to water resources, soil and air quality, food and fibre production and rural communities in the region (NSW Farmers, 2020).

In addition, the project applicant Santos was criticised in public comments for a lack of community consultation, and for disregarding the degree to which the project has fractured the social cohesion of Narrabri. The IPC was urged in public submissions to consider the balance between social benefits and costs in the context of public interest. The local council supported the proposal on its social merits, and the applicant committed to preparing a Social Impact Management Plan. Santos maintains that the project will be of net benefit to the region and submitted a comprehensive Agricultural Impact Statement outlining possible effects on the district's farmers and proposed remediation strategies (GHD, 2016).

This briefing paper has categorised the potential impacts of gas production on agriculture (as highlighted by the Narrabri Gas Project) into sections on natural capital (including environmental and sustainability issues), economic (e.g., the financial opportunities and risks to farmers and associated regional communities) and social impacts (such as community fragmentation or cohesion and mental health). These categories are addressed at a national level. This paper also provides maps of petroleum exploration licence (PEL) areas in Australia overlaid on the Great Artesian Basin and on the country's primary agricultural activities (grazing, cropping and irrigated agriculture), highlighting regions where these intersect (see Section 3.5).

Table 1: Summary of key concerns raised in NGP assessment

Public submissions	Impacts on groundwater – including reduced access and contamination – could threaten the integrity and capacity of agricultural production.
	Insurability concerns for producers hosting CSG wells.
	Leakage of labour to alternate enterprise (the project).
	Reduction of external and internal investment in agriculture could undermine long-term viability of the sector in the region.
Key points in applicant's Environmental Impact Statement (EIS)	28% of proposed project land is on agricultural land – mainly grazing with some seasonal dryland cropping, no irrigated agriculture.
	Direct impacts = removal of land for construction and required infrastructure.
	Indirect impacts = disruptions to agricultural production resulting in reduced landholder profitability.
	Proposal to treat water from extraction and make available for irrigated agriculture.
IPC concerns	Low level of confidence in groundwater impact modelling completed by applicant.
	Underestimation of GHG emissions by applicant in EIS and lack of transparency in reporting emissions.

Source: (O'Connor et al., 2020)

2. Energy and climate policies

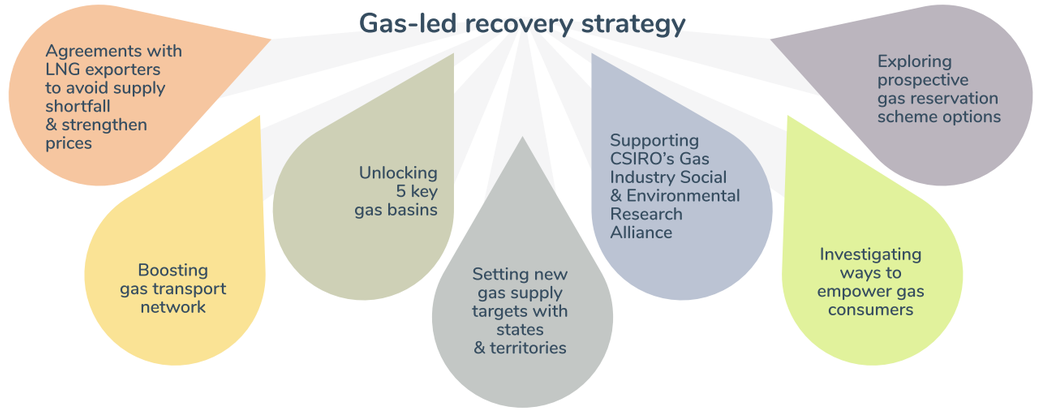


Figure 1: Components to the Federal Government's gas-led recovery strategy

Source: Compiled by authors from (Prime Minister of Australia, 2020)

2.1 Government climate policies

In September 2020, the Federal Government announced a strategy to invest in Australia's gas industry to assist with the economic recovery from COVID (Prime Minister of Australia, 2020). The strategy will involve several actions to increase gas production in Australia, with the aim that this will boost jobs and the economic recovery of the nation while also securing energy supply into the future (Figure 1). Although there is little detail currently available regarding the specifics of each of these strategy points, the announcement was met with mixed reactions.

While the gas-led strategy is intended to result in a net benefit to emissions targets, concerns include the impacts of the strategy on meeting renewable energy and net-zero emissions targets. The disruption to business-as-usual brought about by the global pandemic proffers a rare opportunity for Australian policy-makers to enable a restructuring of the energy sector towards sustainability, which has to date proven politically unpalatable. While a gas-led recovery moves energy production away from potentially 'dirtier' methods such as coal, it also directs resources away from renewables. More than a decade ago, the Garnaut Review warned that the impacts of climate change would have a significant effect on Australia's GDP (Garnaut, 2008), yet successive governments have avoided policies which could mitigate these impacts.

In this time of crisis, consumers and businesses are more accepting of 'brave' decisions – this could be a pivotal moment in political history to harmonise environmental and economic priorities (McKinsey, 2020), as recognised by several organisations.

The Climate Council has proposed a Clean Jobs Plan comprising 12 policy opportunities to kick-start economic recovery, which collectively could represent 76,000 new Australian jobs over three years (AlphaBeta, 2020). The plan will require less than 0.5% of GDP in public funding (compared to current COVID stimulus funding at around 3.5%) and is mooted to attract $1.10 in private investment for every public dollar spent. Farmers for Climate Action is similarly pushing for a regionally-led recovery with renewable energy as one of its primary pillars. The group's briefing paper claims strategic clean energy investment in the post-COVID recovery period could inject $50 billion into the Australian economy (Farmers for Climate Action, 2020). A report by ClimateWorks Australia (2020) identified investment opportunities for Government which make material progress towards net zero emissions as well as meeting objectives of productivity growth and job creation.

> *This could be a pivotal moment in political history to harmonise environmental and economic priorities.*

Are these proposals realistic? Global consulting company McKinsey thinks so, noting that investment into renewables and other mitigation measures would have the dual benefits of climate change impact reduction and the restoration of economic health. McKinsey's analysis holds that a low-carbon recovery would stimulate more economic growth and create more jobs than a high-carbon recovery. This concords with studies investigating the cost/benefit of 'green' stimulus programs implemented in the wake of the 2008-09 global financial crisis. At a time when most countries saw GDP decline by 3-5%, the macroeconomic benefit of these programs ranged between 0.1-0.5% of GDP for around two years (Mundaca & Luth Richter, 2015; Varro, 2020).

While political focus in 2020 has naturally been on the immediate impacts of COVID on public health and business viability, the threat posed by climate change – not least to food security – has not gone away. With natural capital under ever-increasing pressure, protecting our agroecological systems has never been more important (Cresswell & Murphy, 2017). A healthy economy depends on a healthy environment and, notwithstanding the Australian government's hesitation, industry players (even conservative carbon mainstays like BHP and AGL) are now embracing sustainable investment goals (Hartcher, 2020; KPMG, 2019).

> *A healthy economy depends on a healthy environment.*

Although there is no national renewable energy or net zero emissions target backed by the Federal Government, all State and Territory Governments have renewable energy targets (all at least 50% or greater by 2030) to achieve net zero emissions by 2050 (Table 1). Federal, State and Territory policies and strategies should complement one another and work together to achieve desired outcomes for all Australians.

2.2 Ag sector sustainability commitments

While fossil fuels are still an important energy source for many farming enterprises, environmental stewardship and sustainability are major issues and areas of concern for the Australian agricultural sector. Many agricultural organisations have implemented strategies, certification schemes and commitments to reduce contributions to climate change and become more adaptive to climate impacts. Some key examples of these strategies and programs include:

Red Meat CN2030

The Australian red meat sector is working towards carbon neutrality by 2030. Modelling by the CSIRO indicates it is possible for the sector to achieve this goal without decreasing livestock numbers below the 10-year rolling average (MLA, 2020a). Methods to achieve this goal include incorporating supplements into livestock diets to decrease enteric methane emissions, utilising vegetation management strategies and maintaining active dung beetle populations to increase soil carbon sequestration (MLA, 2020b).

Greenhouse gas (GHG) emissions from the sector have fallen by 57% since 2005 (MLA, 2020a) and several red meat businesses have already achieved carbon neutrality, including Flinders + Co, Fiver Founders and Arcadian Organic and Natural Meat Company (Eckard, 2020; Flinders + Co, 2020).

Dairy Sustainability Strategy

The Australian dairy sector developed a framework for reporting on sustainability metrics in 2012 with goals and baseline levels measured in 2013. Progress against the 2020 goals has been reported annually with new goals set for 2030. The commitments underpinning the framework and reporting include:

- Enhancing economic viability and livelihoods
- Improving wellbeing of people
- Providing best care for all our animals
- Reducing environmental impact

The adaptive framework now covers all aspects of the industry with a specific focus on farming and manufacturing activities and aligns with the United Nations Sustainability Development Goals (SDGs) and contains elements which adhere to the Global Reporting Initiative (GRI). For example, the 2018 Progress report noted that waste from dairy companies going to landfill reduced by 51% from 2010-11 levels and 95% of farmers are no longer using routine calving induction (Dairy Australia, 2018).

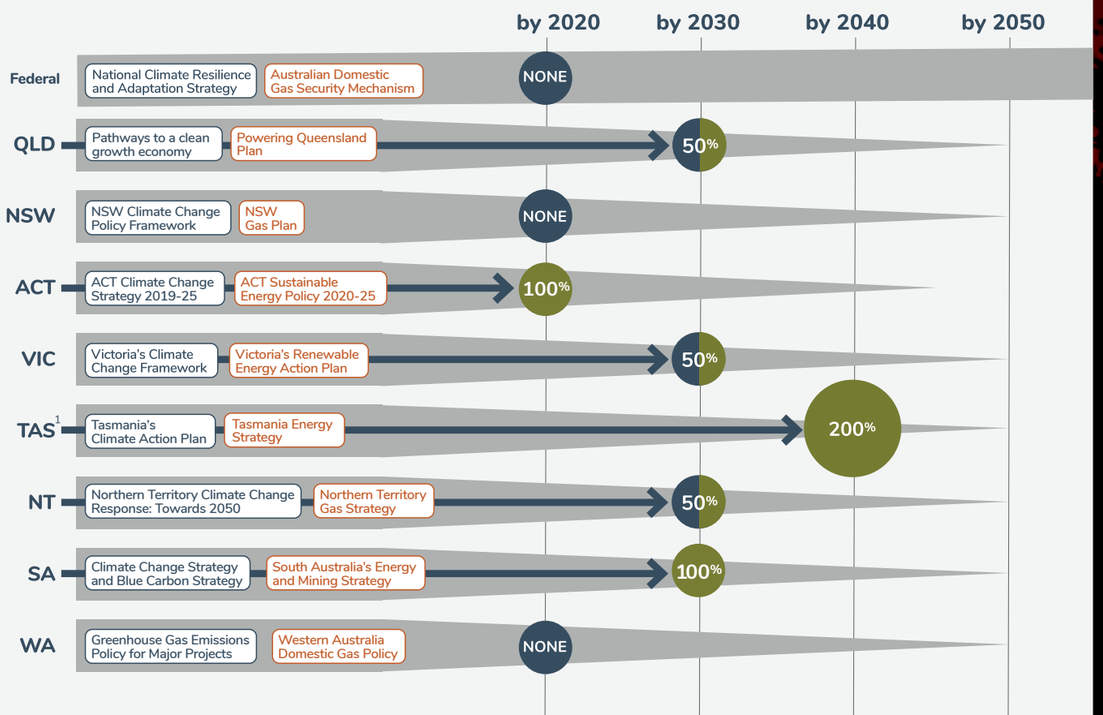
Climate Change Policy, NFF

In August 2020, the NFF released a policy statement supporting an economy-wide aspiration of net zero emissions by 2050. The statement notes that this target is only achievable if both State and Commonwealth legislation does not provide unnecessary regulatory impediments. Several recommendations are also made in the statement regarding elements of Government policy which will help facilitate this transition for the sector. Some of these include recognising that Australian agriculture is an export-dominated industry and must remain globally competitive, and allowing pathways for compensation for areas unable to be used for production due to vegetation management legislation (National Farmers' Federation, 2020).

Behind Australian Grain

The Australian grains sector has developed a sustainability framework to ensure the sector can continue to meet the expectations of consumers, society, government bodies and investors into the future. The three pillars of the framework are: responsible stewardship, building capacity and wellbeing and consumer confidence. Each pillar has a set of goals and priorities and the framework is aligned to the UN SDGs (Behind Australian Grain, 2020).

Table 2: Key climate/energy policies and strategies



Renewable energy in agriculture

Farmers across Australia are increasingly looking to renewable energy sources to both decrease their environmental footprint and reduce rising energy costs. In 2018 the AFI estimated the cost of energy to the Australian agriculture sector to be $5.8 billion annually or $4.56 billion when processing is excluded. This equated to 9% of GVP of the sectors analysed in this research.

Solar, wind and bioenergy generation are common renewable energy sources used by farmers in Australia. Initial up-front investment costs of renewable technology are decreasing, allowing for more farmers to implement solutions on farm. However, the renewable energy industry does not receive the same level of government support as fossil fuels (Heath et al. 2018).

A recent study by Briggs et al., (2019) investigated the barriers farmers encounter in adopting solar PV energy onto their farm and grouped them into three categories: technical, economic and information.

Renewable energy investment will be an integral component of the agricultural sector's goal to reach carbon neutrality by 2050.

Case Study

A HIGH PRICE TO PAY

Brigid and Owen Price are not pastoral romanticists. They are pragmatic intergenerational farmers, producing premium organic certified beef, who have co-existed with extractive industries for many years on their Injune properties in Queensland, north of Roma. The Prices do not begrudge anyone choosing to host gas wells on their property, or indeed choosing to mine gas as a business rather than run cattle. However, they have a problem with accountability.

The property has a history of interaction with gas development including the Gladstone gas pipeline as well as a few legacy exploration wells. In recent years, significant gas development has taken place across their properties with negotiations and discussions currently underway regarding future development.

The impacts of gas development on the Prices’ farming enterprise reach much further than simply the cost of the land used by the company and resulting loss of production. As well as the reduced carrying capacity, ‘hidden’ costs such as time burden for monitoring and remediation, loss of market share if organic status is compromised, biosecurity risks posed by vehicles entering property and animal welfare concerns must be considered. Importantly, the loss of control felt by landowners must also be recognised as this can significantly impact mental health when practices undertaken by mining companies would not be tolerated in any other circumstance.

The Prices’ experience highlights the need for Conduct and Compensation Agreements (CCAs) to be absolutely watertight to protect farming enterprises from the risks incumbent in sharing land management with extractive industries.

Currently, the legislation in Queensland does not recognise the landowner as an expert. Brigid and Owen invested a significant amount of time preparing, investigating and seeking expert advice to ensure they had all the information necessary to minimise risks to their established organic beef enterprise from the gas enterprise, and to ensure their agreement with the gas company was sufficiently robust. Despite this due diligence, they feel that little accountability has been displayed with their interactions with the enterprise which shares their land.

After encountering multiple disputes on unauthorised traffic movement on roads, water access and issues of general conduct, Brigid feels that the heart of the matter lies in an almost irreconcilable difference in values. While the Prices see themselves as stewards of a property which they hope will be not only productive but also home to future generations of their family, their corporate ‘partner’ does not share the same sense of responsibility. It’s the Prices’ opinion that the gas mining enterprise is driven by short-term profit to the extent that agreements can be broken or ignored when it’s cost-efficient to do so.

Even when a CCA is specific and detailed, a company might make a deliberate decision to breach an agreement as a calculated cost of business and pay compensation only if it can be argued the matter was a direct breach. Yet in some instances the damage done is greater than the immediate costs of repair, and it’s not a cost the farmers can always wear as the damage has flow-on or compound effects, such as diminished productivity or reduced market share in following seasons.

In the Prices’ experience, the letter of the law (as outlined in legislation and the CCA) is adhered to, but not the spirit. For example, ‘electronic’ monitoring of vehicle movements was agreed in the CCA, yet the company decided an Excel spreadsheet was sufficient to meet the ‘electronic’ criteria rather than the real-time vehicle location monitoring discussed by the parties. More serious examples included contractors for the gas company driving through quarantined paddocks, blocking livestock watering holes, cutting fences to enable vehicle access and damaging premium pastures.

While the company has apologised and sacked contractors who were found to be responsible for breaches they did so only after the project was completed on time and within their budget. No contractor was stood down or sacked at the time of the breaches, the Prices were simply told construction would continue as a necessity. This effectively meant the Prices shared the cost of the project while the gas company profited.

The Prices have not yet seen any meaningful practice change which would repair or instil the trust they feel has been broken. In Brigid’s words, corners get cut, commercial decisions get made at the expense of good or ethical decisions, and the farmers have no right of recourse. The gas company does not appear to be held accountable for their actions and they have now gone to the Land Access Ombudsman for intervention.

Fundamentally, says Brigid, the values and aims of the agricultural and extraction sectors do not align. It will always be a challenging co-existence when a large corporate entity operates on land owned by a farming family whose place of business is also their home. The gas production company acts on a short-term outlook and is purely commercially

driven with the aim to extract the resource and move on, while farming enterprises rely heavily on natural capital to succeed, aiming for long-term profitability through environmental stewardship and sustainability.

Gas companies are held responsible by their shareholders, while the Prices are held accountable by the next generation of their family enterprise. Issues are bound to arise when these differences are so stark. With little reason to trust that the company will abide by the agreement, the Prices are spending increasing amounts of time ‘policing’ their own property, particularly as previous impacts have concerned animal welfare.

> *“People talk about competing land uses co-existing with one another, but no one wants to just exist, we want to flourish and to thrive.”*

Despite these issues, Brigid notes that for some farming businesses, gas development is a good enterprise mix and can benefit the agricultural enterprise by investing the compensation funds into other areas of the business. However, she cautions that navigating gas development on a farming enterprise requires carefully weighing up the risks and benefits to make a well-informed decision. The Prices believe that if the risks outweigh the benefits and the values of the two enterprises don’t appear to align, farmers should have the right to say no.

Brigid says that as an industry, agriculture needs to get better at considering the actual costs and benefits posed by co-existence with gas development. Too many farmers take a stand on one side or another, pro or con, and not enough are open to rationally discussing the real risks and opportunities. Some farmers can benefit from a business relationship, provided they are not just prepared for the flow-on impacts but also are legally protected when interacting with gas mining. However, for the Prices’ organic enterprise, the relationship with gas production has been far from romantic.

3. Intersections between gas and farming

3.1 Overview

This paper does not aim to determine or comment on the merits of increased gas production as an energy strategy, but rather to highlight some of the potential impacts of a gas-led economic recovery strategy on Australian agriculture.

The authors also emphasise that this is a briefing paper, not a comprehensive investigation of the impacts of gas development on agriculture. It is intended to provide a high-level discussion of some issues which should be considered by the Australian agriculture sector and enable the sector to plan accordingly for appropriate strategies and policies to minimise the risks and costs of increased gas exploration and maximise any benefits.

The following discussion on the potential impacts to agriculture from a gas-led recovery strategy has been categorised into areas of natural capital, economic and social capital impacts; however, these impacts do not operate in isolation and are often interrelated (Figure 2). For example, the economic viability of farming operations is closely intertwined with both the prosperity of natural and social capital.

Assessing cumulative impacts on a proposed development is a key role of the state-significant planning process.[2]

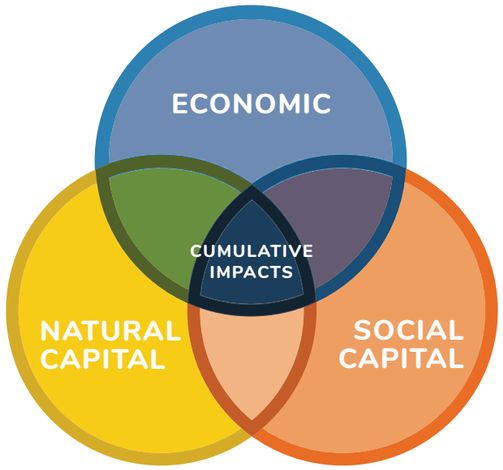


Figure 2: Impacts on agriculture cannot be separated

3.2 Natural capital impacts

Agriculture is reliant on access to natural capital to a greater degree than almost any other sector of the economy (McRobert et al., 2019). Soil health, water quality and availability are vital to the ongoing success of farming operations.

> *The economic viability of farming operations is closely intertwined with both the prosperity of natural and social capital.*

CSIRO's Gas Industry Social and Environmental Research Alliance (GISERA) has undertaken significant research into the environmental impacts of gas development. However, further research is still needed given the large number of unknowns and differences in geology across Australia. The level of knowledge of the environmental impacts of gas production remains highly contentious and poorly documented, despite the fast growth of the industry (Drinkwater et al., 2014).

In areas where gas development is proposed, the usual intent is that once the project has reached the end of its life the land will return to its original use

Although rehabilitation of land is often a component of the project life, reversing detrimental impacts on soil health is a lengthy and costly exercise. GISERA research by Antille et al. (2014) modelled impacts on soil from CSG development and found compaction in lease areas was approximately 10% higher compared to fields without gas development. This has negative impacts on productivity and rainfall use efficiency. The research also notes that on one testing site with high levels of sodium present in the soil profile, the soil structural damage from gas development compaction was exacerbated.

Implications on water quality and supply are of major concern when regarding the impacts of gas developments on agriculture. Hays & Shonkoff (2016), found that 69% of studies into water quality contained findings "that indicate potential, positive association, or actual incidence of water contamination".

Research has assessed – and is continuing to assess – the impacts of gas extraction on groundwater; however, there are still many unknowns on this topic. A multitude of factors influence the robustness of models which predict groundwater impacts which often leads to assumptions where data is unavailable. Sometimes the use of a single model may not be able to represent the complexity of the scenario environment, with multiple approaches and models needed to test assumptions and increase confidence in findings (Coffey Geotechnics, 2014).

In a report on the Surat Basin, the Queensland Government noted that new knowledge regarding aquifer connectivity and improvements in modelling have led to predicted impacts on groundwater varying from their previous reports (Office of Groundwater Impact Assessment, 2019). This example highlights the need for continued research into the impacts of gas mining on water impact, to ensure planning decisions are underpinned by robust science.

The IPC decisions regarding the Narrabri Gas Project noted that groundwater impacts were the most significant concerns voiced in public submissions and council comments (O'Connor et al., 2020). The Commission noted the importance of the concerns but accepted the Water Expert Panels (WEP)[3] finding that impacts are likely to be more local rather than regional.

However, several stringent conditions were imposed on the Narrabri Gas Project, including improving and updating modelling on groundwater impacts to a higher level of confidence. If the modelling shows impacts greater than those documented in the EIS, Santos will be unable to commence the second phase of the project. These conditions demonstrate that the IPC appears to understand the importance of concerns surrounding groundwater security but highlight the lack of confidence in current models.

> *A transition away from fossil fuel energy generation to renewable energy sources could decrease climate impacts on agriculture.*

Santos' own report outlining the impact of the proposed Narrabri gas development on agriculture states "the extent of damage to farm infrastructure and consequent impact on production cannot be accurately quantified due to the evolving nature of the gas field development" (GHD, 2016). Although the applicant and IPC both conclude that many of the impacts on agriculture and the environment can be mitigated or minimised with appropriate management practices, it is concerning that the evidence on which these decisions are made does not have the IPC's full confidence, given the impact and scale of potential consequences.

One notable claim of the Government's gas-led recovery strategy is that gas is less emissions-intensive than coal and thus will play a fundamental role in transitioning Australia to renewable energy. However, it has been argued that gas is just as 'dirty' as coal.

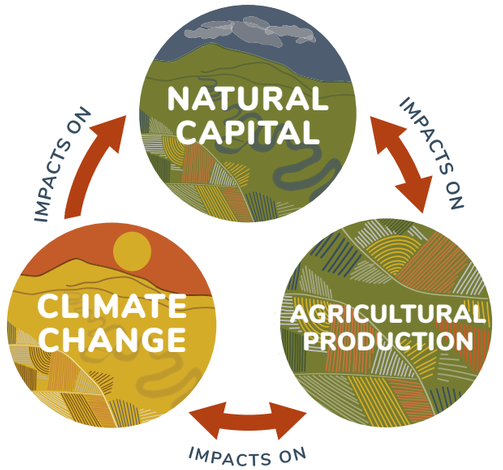


Figure 3: The intersection between agriculture, natural capital and climate change

Source: (Admassu et al., 2019)

Yet like coal, gas is a finite energy source which releases GHG emissions. As it is not within the scope of this paper to comment on the emissions-intensity of various energy sources, the authors have noted the general impacts of GHG emissions on agriculture.

Public submissions regarding the Narrabri Gas Project, were concerned that the applicant had severely underestimated the proposed emissions from the development. The IPC investigated all relevant material and data and decided to impose a condition on the development, that if the applicant emits more than the limits set in their EIS, they must purchase credits to offset these emissions (O'Connor et al., 2020).

It is not within the scope of this paper to comment on the emissions intensity of various methods of energy generation. However, increasing GHG and other harmful emissions will lead to the exacerbation of climate change, which has detrimental impacts on agriculture due to the sector's reliance on natural capital and increased frequency and strength of severe weather events. A transition away from fossil fuel energy generation to renewable energy sources could decrease climate impacts on agriculture and positively contribute to achieving carbon neutrality goals.

KEY TAKEAWAY: The impacts of gas development on the natural capital which underpins agriculture remain relatively unknown. Decisions with such a significant potential risk impact must be based on robust evidence.

[2] A recent example of this process in action is the Narrabri Gas Project application by Santos.

[3] The Water Expert Panel (WEP) is an independent panel established by the Department of Agriculture to obtain advice regarding water impacts of the proposed Narrabri development. Findings of the WEP are relied upon by the Commission in making recommendations.

3.3 Economic impacts

Under growing climate pressures, agriculture must feed more people with fewer resources and increasingly compete with other land uses for these resources (e.g., residential/industrial development, mining and energy generation). Losing productive agricultural land to other land uses will have an impact on food security strategies as the farming sector seeks to meet the challenge of sustainably providing for the growing global population.

The largest economic losses for farmers interacting with gas development are usually from land taken out of production for access tracks and lease areas. Research by Marinoni & Navarro Garcia (2016) at CSIRO, modelled and calculated the revenue losses from a standard CSG well was between $7,500 and $16,000 per standard well for cropping and $1,400 and $3,000 per well for grazing. However, it should be noted that the work does not suggest that landholders are not adequately compensated for this loss of productive land area.

Compensation payments to farmers with gas development on their property differ depending on the stage of gas development. The compensation amount is generally calculated based on the land value (using landholder's rates notice) with farmers also receiving a share of royalty payments (GHD, 2016; Santos, 2018). Although this compensation can be viewed as a stable source of drought-proof income for landholders and allows them the opportunity to invest into other areas of their enterprise, it is important to note that compensation calculations often do not include or cover non-economic impacts, such as those on natural or social capital. For many farmers, their business goals are not just about being drought-proof but being sustainable into the future to ensure the next generation can continue to farm successfully.

Earlier in 2020, some insurance companies in Australia announced they would not provide public liability insurance products to customers with CSG or shale gas operational activities or infrastructure on their property. However, a joint media statement4 from industry bodies in June 2020 notes there are still insurance options available to farmers and collaborative work is being done to ensure there is common understanding amongst the farming community (QFF, 2020). Although it appears that this is not a widespread issue, inability to access public liability insurance will leave farmers exposed to significant risk. This situation should continue to be monitored by industry bodies.

Concerns regarding inability to access public liability insurance is not an issue solely for gas infrastructure. Anecdotal evidence from soon-to-be released research conducted by the Australian Farm Institute into land use conflict found similar concerns were apparent with farming enterprises neighbouring proposed solar operations. Therefore, this issue appears to be applicable more broadly with conflicting land uses to agriculture rather than solely gas developments.

> *Investment into the renewable energy sector can also generate significant employment opportunities*

Farming operations in Australia are increasingly pursuing value-adding business strategies and many rely heavily on branding as 'clean and green'. Perceptions by farmers of the coexistence between agriculture and CSG development investigated by Huth et al. (2019) found this issue created significant apprehension. The research also noted this concern was not balanced by other perceived local benefits CSG operations would bring to the area.

The IPC report determined that the Narrabri Gas Project would deliver a net economic benefit for the local and broader communities. This is mainly through the creation of local employment opportunities (1,300 jobs during the construction phase and 200 jobs during operations) and funding to the local council of $14.5 million for infrastructure and community events. Broader economic impacts such as the generation of royalties for the state of NSW was also considered in the IPC's determination.

A key aim of the Federal Government's gas-led recovery strategy is to create jobs and boost the Australian economy. The estimation of the examples used in the Narrabri Gas Project shows that gas development can achieve this aim. However, research shows investment into the renewable energy sector can also generate significant employment opportunities. Garrett-Peltier (2017) presents a model using input-output tables to calculate the number of jobs created from investment in fossil fuel sector compared to the renewables sector. The research finds that from $1 million in spending, 2.65 full-time equivalent (FTE) jobs are created in fossil fuels which the same spending in renewables or energy efficiency would create 7.72 FTE jobs.

KEY TAKEAWAY: Economic compensation for use of agriculture land may provide benefits for some farming enterprises but for others it fails to account for the broader impacts of gas development.

[4] The joint media release includes the Insurance Council of Australia, the Australian Petroleum Production and Exploration Association, National Farmers' Federation, Queensland Farmers' Federation, AgForce Queensland and Cotton Australia.

3.4 Social capital impacts

Social capital is an integral component of rural communities, degradation of which can lead to a decline of regional populations and viability of rural towns. Agriculture as an industry has close ties with rural Australia and is highly dependent on strong local economies. When gas development impacts (either positively or negatively) on the social capital of a community, it is likely to create a subsequent impact on the agricultural sector. Likewise, when a development impacts on the social capital of agricultural enterprise in a region, this will impact on the community.

Studies show that gas development activity (such as CSG) in a region can result in higher family incomes. Marcos-Martinez et al. (2019) and Fleming & Measham (2015) both found increases in family income in areas which had CSG activity compared to those which did not. However, research has also shown that mining activities in regional areas can contribute to income inequality. Reeson et al. (2012) noted that personal income has a significant but non-linear relationship with mining employment. The associated risk of increased income inequality is the subsequent danger of community fragmentation. Income inequality has also been identified in other research as contributing to the perceptions of gas development's producing low economic benefits (Huth et al. 2019).

Table 3: Key potential societal NGP benefits and risks from IPC report

BENEFITS	RISKS
- Employment opportunities	- Increased traffic and subsequent accidents
- Skills training opportunities for Aboriginal workers	- Reduction in availability and affordability of housing in Narrabri
- Local industry and jobs diversification	- Increase in male population of Narrabri during construction
- Local procurement increased	- Potential loss of jobs from agriculture to the project
- Small increase of Narrabri population	- Continuation of social conflict/division around Narrabri
- Landholders being compensated for the duration of the project	- Increased demand on social infrastructure and services in Narrabri
- Community Benefit Fund grants	- Potential increase in the cost of living
- Voluntary Planning Agreement with council	- Potential decline in mental health indicators from perceived CSG impacts
- Catalyst for Inland Port Employment Precinct	

Sources: (O'Connor et al., 2020)

Displacing agricultural workers

Fleming & Measham (2015) investigated the relationship between CSG development and employment by analysing census data for regions with and without CSG development. They calculated that around 1.8 jobs were lost in the agriculture sector for every job gained in the gas sector. The often higher wages paid by mining companies are a primary factor contributing to the labour leakage attracting workers away from agriculture and into the extraction sector.

However, positive spillover effects from mining booms were estimated in other areas of the local economies, such as boosts to accommodation and food services. The authors note that the transition to more mechanised agriculture practices and increases in farm productivity requiring less workers could also contribute to the reduction in agriculture workers over the time period investigated (2001-11).

> *When a development impacts on the social capital of agricultural enterprise in a region, this will impact on the community.*

The IPC report on the Narrabri Gas Project decided that the project is unlikely to be the source of significant physical health impacts on the local community. The Commission also determined that although there were community concerns regarding risks and costs to society through the project, the conditions put in place by the applicant would adequately manage these risks. The Commission's determination of the key benefits and risks to society (Table 4) are also relevant in the broader context of gas development in Australia.

Although studies show gas development can increase job opportunities within the local area, there is evidence that gas development can decrease the availability of farm employment (see story on Displacing agricultural workers on left).

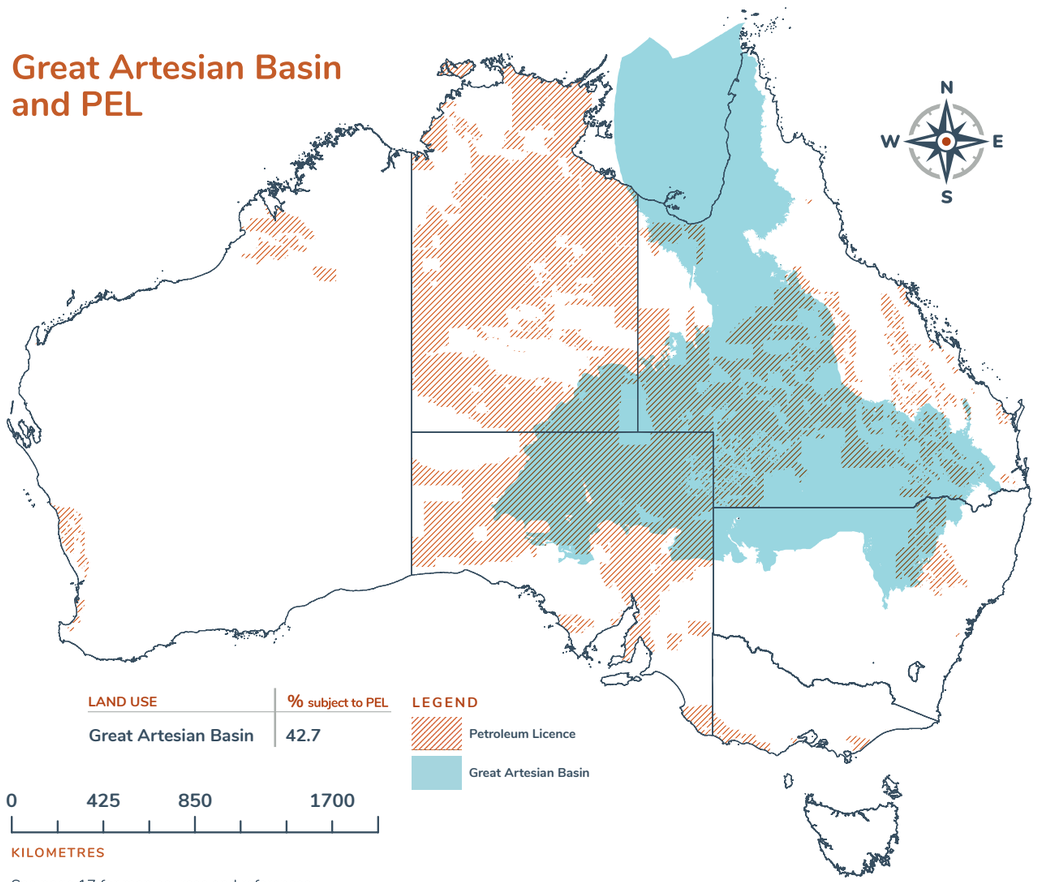
Mental health impacts on farmers, particularly those who are neighbouring developments and in direct conflict, are another significant consideration. Soon-to-be released research conducted by the Australian Farm Institute into land use conflict highlighted that detrimental impacts on the mental health of farmers was one of the most severe costs of conflict.

Morgan et al. (2016) investigated the contribution of CSG extraction to the stress burden and mental health of Australian farmers. Stressors caused by CSG development could be categorised as off-farm (community, environmental and health) and on-farm (profitability, operations and personal privacy). Although inference from the data on the direction of causation cannot occur, the research appears to show that active interactions with CSG activities (either positive or negative) contributed to their stress levels. Farmers allocated to the CSG-stress profile as part of the study were found to have "exhibited clinically significant levels of psychological morbidity".

KEY TAKEAWAY: The net social benefit of gas activity in a region depends on the specifics of the development and local area; however, mental health impacts on farmers from interaction with gas companies are likely to be severe regardless of the net benefit.

3.5 Maps: gas exploration and agricultural areas

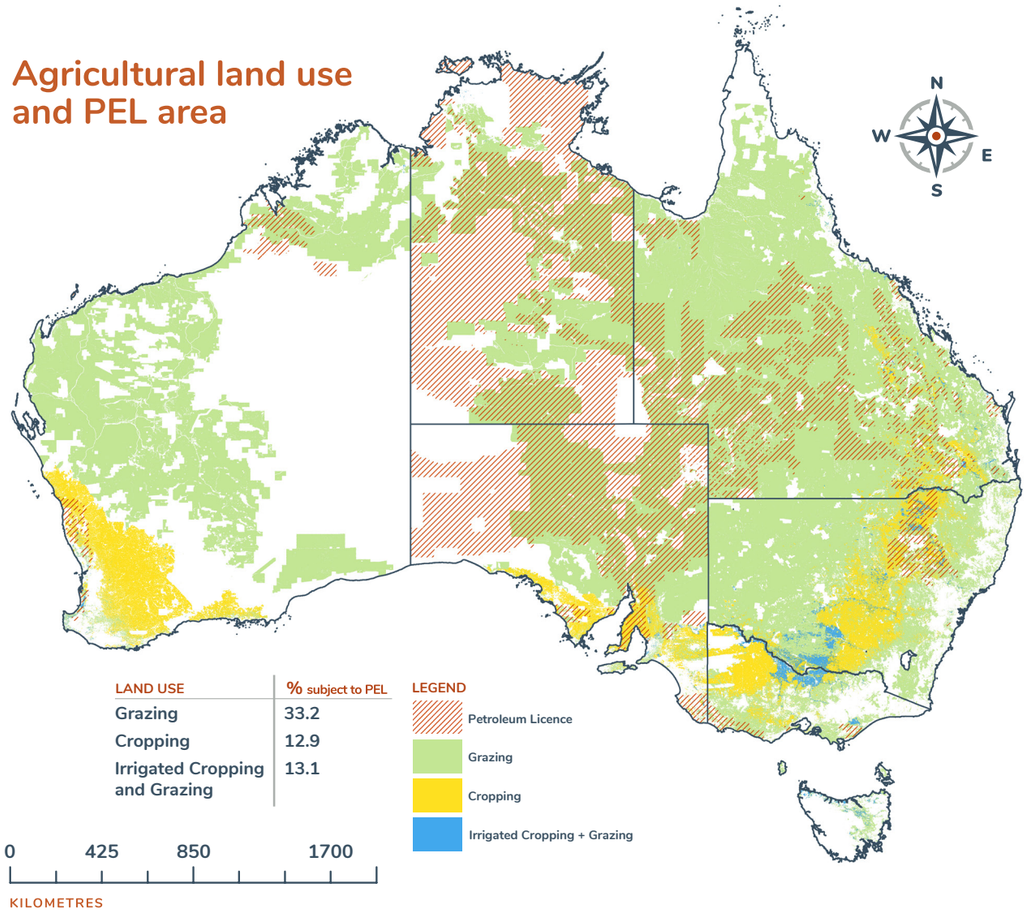
The following section includes several maps depicting the location of petroleum exploration licences (PELs), agricultural land uses and groundwater. These maps were created by aggregating data on land uses and PELs across the different states and territories. While some of this data is collated differently across the jurisdictions, every effort has been made to present the data consistently. More detailed maps completed for this exercise and additional information on the collection of data are available on the Australian Farm Institute website, www.farminstitiute.org.au.



See page 17 for map sources and references

Figure 4: Great Artesian Basin and PEL areas at November 2020

Figure 4 shows the Great Artesian Basin (GAB) which is the largest groundwater reserve in Australia, with current petroleum exploration licences mapped over the top. The Basin is an integral component of the country's water supply providing vital resources for 120 towns, 7,600 businesses and 180,000 people. It covers more than one-fifth of the continent and has a storage capacity of 64,900 million megalitres (Department of Agriculture, 2020). Approximately 43% of the GAB has exploration licences on the land above it, with these licences present across multiple states and territories - Queensland, New South Wales, Northern Territory and South Australia. This map highlights the vast scale of the area which is applicable to concerns regarding gas development impacts on groundwater (discussed in section 3.2). While not all land in these licence areas will host active gas development, this map shows the potential for impacts in one small area of the Basin to be felt across the entirety due to the often-underestimated scale of the GAB.



See below for map sources and references

Figure 5: Agricultural land use and PEL areas at November 2020

Figure 5 depicts areas of agricultural land uses (grazing, dryland cropping and irrigated grazing/cropping) in relation to current PEL data. From a national context, grazing is subject to the greater proportion of licenced area (with 33% of Australia's grazing land subject to PELs), with irrigated regions and dryland cropping roughly equal at 13.1% and 12.9% respectively. (NB: Due to the much smaller land area of irrigated cropping and grazing, these 'blue' areas can be difficult to see on the national map. Maps of each state are available at www.farminstitute.org.au)

MAPS DATA SOURCES

NSW Licences	https://minview.geoscience.nsw.gov.au/
NT Licences	https://dpir.nt.gov.au/mining-and-energy/STRIKE/accessing-nt-datasets/nt-wide-titles-datasets.
SA Licences	https://data.gov.au/dataset/ds-dga-5c718962-0a92-41b2-b6e0-24b09ad6faf9/details
WA Licences	https://catalogue.data.wa.gov.au/dataset/wa-petroleum-titles-dmirs-011
Queensland Licences	https://data.gov.au/dataset/ds-dga-94d516ae-900e-404b-80a4-77d98e420c92/details
Victoria Licences	https://www.data.vic.gov.au/
Great Artesian Basin	ftp://ftp.bom.gov.au/anon/home/geofabric/version2/
Land Use	https://www.agriculture.gov.au/abares/aclump/land-use/catchment-scale-land-use-of-australia-update-december-2018

LAND USE

Cropping	Dryland cropping & horticulture
Grazing	Grazing (native vegetation) & dryland modified pastures
Irrigated cropping and grazing	Irrigated cropping & horticulture / irrigated modified pastures

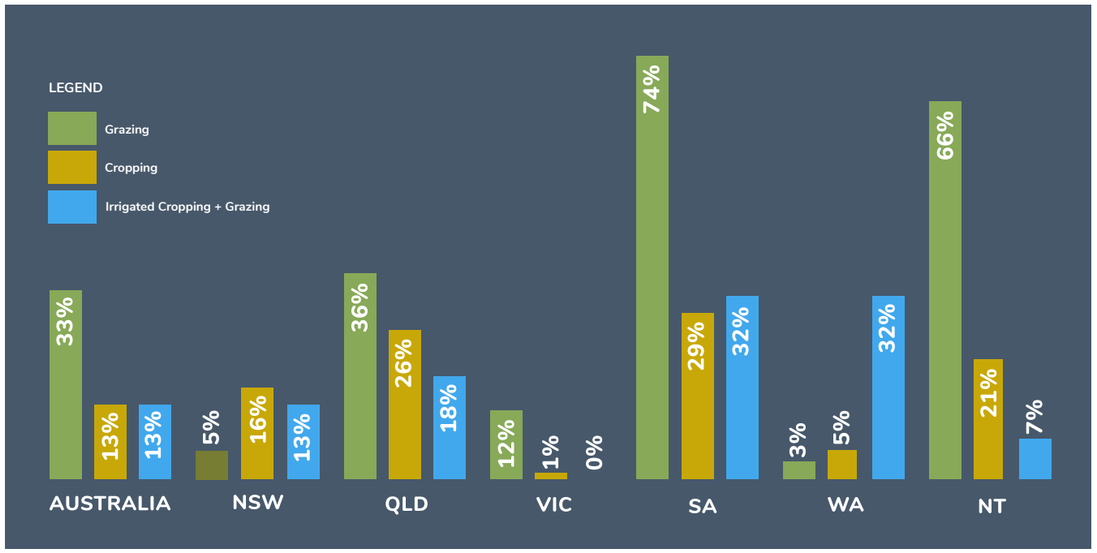


Figure 6: Percentage of agricultural land use in Australia covered by PELs (November 2020)

Figure 6 graphs the percentage of each agricultural land use category subject to PELs. The Northern Territory, Queensland and South Australia have the highest percentages of agricultural land subject to exploration licences. The highest level of agricultural land covered by licences is grazing in South Australia and Northern Territory, with 74% and 66% of grazing land covered by PELs. A significant proportion of the small irrigated cropping area in Western Australia is covered by licences, most of which are centred on the Margaret River region.

These maps illustrate the significance of the concerns raised in Section 3 regarding the impacts of gas development on natural capital, the economy and society and how they relate to agriculture. They provide a visual representation of the breadth of area which can experience these potential impacts.

It should be kept in mind that these maps use current PEL data and a fundamental aspect of the Federal Government's gas-led recovery strategy is to invest in opening new areas for gas exploration activity. Therefore, the percentage of area under the GAB and agricultural land use is likely to change as more licences are issued. However, these maps should not be read as displaying areas of impact – rather they highlight areas of concern. For example, the above-ground impact of gas development is limited compared to the size of the exploration area as not all area inside the mapped licence perimeters will have active gas development.

Besides the direct disruption to agricultural grazing and cropping enterprise and the potential impact on groundwater, there are many other factors to consider when analysing the intersections between agriculture and gas development. These include definitions of 'strategic' agricultural land, soil type and topography, access to infrastructure and transport, biosecurity concerns, and access to other water sources such as rivers. Further analysis into these areas would be beneficial to the agricultural industry in understanding the true impacts of gas development.

4. Conclusions

While agricultural enterprises and gas mining can exist together, this co-existence comes at a compromise, particularly for agriculture. Despite efforts to mitigate these impacts via landholder compensation, offset arrangements and community support programs, gas production has the potential to significantly impede the agriculture sector. For some farmers, gas development offers a beneficial business mix. However, if the values and aims of the agricultural and extraction enterprise are not aligned and the risks outweigh the benefits, farmers should have the right to say no.

A gas-led recovery strategy is likely to have a fragmenting impact on the agricultural community, with those located within exploration zones feeling greater impacts from natural capital, economic and social impacts. It should be noted that some of the impacts discussed herein are not solely related to gas but to land uses conflict more generally. However, those concerns which intersect with agriculture and are specific to the gas industry – such as potential compromise of the Great Artesian Basin – are ones of very high significance. Unfortunately, the same is true of this issue as of many facing the agriculture sector today; i.e. there is often insufficient information to make fully informed decisions to protect agricultural enterprise. As such, the authors recommend a precautionary approach should be taken to the proposed strategy. The precautionary principle is not merely an admonishment to be wary when considering potentially damaging activities, but also includes taking preventive action in the face of uncertainty; shifting the burden of proof to the proponents of the activity; exploring alternatives to the proposed actions; and increasing public participation in decision-making (Kriebel et al., 2001; Peterson, 2006).

Under this principle, the Australian agricultural sector should advocate to limit those activities which could cause unknown damage and seek further research on the impacts of gas exploration on natural capital to ensure planning decisions are based on robust evidence. Governments can contribute to addressing information gaps by mapping strategic agricultural land data with petroleum exploration licences.

To assist in the post-COVID economic recovery, the agricultural sector should continue to prioritise R&D on increasing renewable energy generation opportunities for farm businesses and removing barriers to adoption. As a low-carbon recovery could stimulate more economic growth and create more jobs than a high-carbon recovery, this would be a positive move towards achieving sectoral and regional net carbon emissions goals while also decreasing energy costs.

While the direct costs are often considered and accounted for when negotiating agreements and approvals for shared land use, indirect effects, externalities and hidden costs can exacerbate the impacts of the mining enterprise on the farming business, land and social network. Agricultural advocacy bodies in impacted regions should increase investment in education and assistance resources to help farmers understand their rights in negotiating with gas mining companies and ensure they are protected by strong and binding CCAs.

Increasing gas production in Australia creates obstacles to the agriculture sector's economic viability, social cohesion, environmental stewardship and ability to meet sustainability goals. The paper recommends that the Australian agricultural sector should advocate to limit those activities which could cause unknown damage and seek further research on the impacts of gas exploration to ensure future strategies are based on robust evidence.

KEY TAKEAWAYS:

- **Natural Capital** - The impacts of gas development on the natural capital which underpins agriculture remain relatively unknown. Decisions with such a significant potential risk impact must be based on robust evidence.
- **Economic** – Economic compensation for use of agriculture land may provide benefitsfor some farming enterprises but for others it fails to account for the broader impacts of gas development.
- **Social Capital** - The net social benefit of gas activity in a region depends on the specifics of the development and local area; however, mental health impacts on farmers from interaction with gas companies are likely to be severe regardless of the net benefit.

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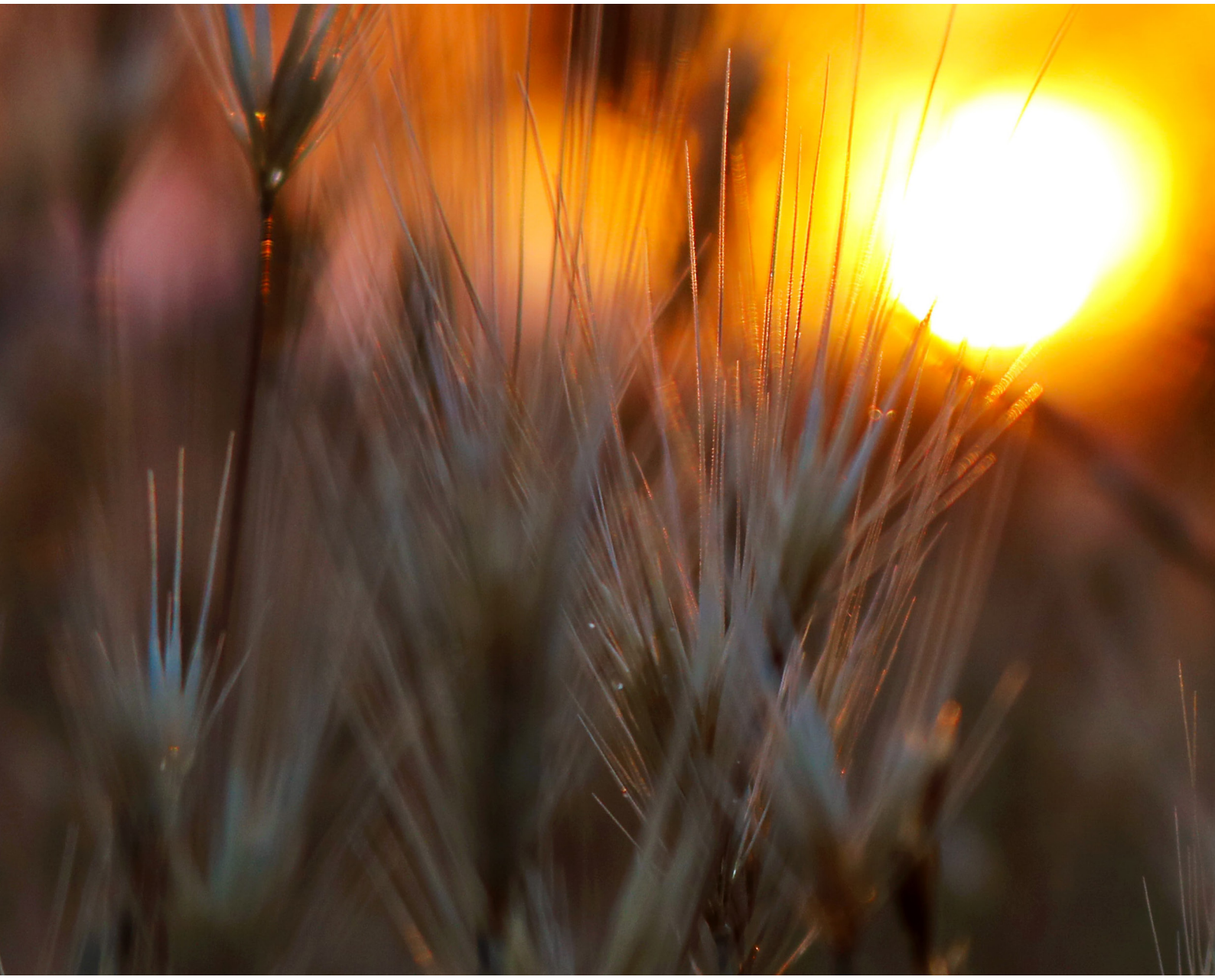

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