He Pou a Rangi
Climate Change Commission

Advice on Agricultural Assistance

Technical Annex I: Risk of Emissions Leakage

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Contents

1 Purpose

This document sets out further information on the assessment by He Pou a Rangi Climate Change Commission (the Commission) of the current evidence on the risk of agricultural emissions leakage.

2 What is emissions leakage?

Emissions leakage risk is created by the uneven implementation of climate policies around the world. Emissions pricing or other policies aimed at reducing emissions may increase costs for emissions intensive businesses and cause them to lose market share to international competitors that do not face similar costs. Depending on whether competitors in these countries are more or less efficient, a shift in production away from Aotearoa New Zealand could result in the total global emissions increasing, reducing or remaining the same.

The Climate Change Response Act (2002) (the Act) section 84C.3c indicates that the level of risk of emissions leakage refers to "increased emissions overseas as a result of emissions reductions in New Zealand, for example, an activity being relocated outside of New Zealand to reduce the emissions-related costs for the activity, based on:

(i) the emissions-related costs and policies in competing jurisdictions; and

(ii) the markets for international trade in the products produced by the activity; and

(iii) the ability of affected eligible persons to pass on increased costs to customers."

In *Ināia tonu nei*, the Commission delineated emissions leakage to situations when total global emissions increase or remain the same.[1]

In this document, we use the term emissions leakage as per the Act.

3 Background

Agriculture is a major part of the emissions profile, economy, and landscape of Aotearoa. Reducing emissions from agriculture will be critical to achieving the target to reduce biogenic methane by at least 10% by 2030 and between 24–47% by 2050. Reducing nitrous oxide from agriculture can also make an important contribution to achieving the 2050 net zero target for all other greenhouse gases.

Emissions from agriculture include biogenic methane from livestock and nitrous oxide from animal excreta and fertiliser use. In this document, we refer to these gases as 'agricultural emissions.'

The dairy and sheep and beef sectors are large export sectors, around 95% of milk,[2] and 85% of meat is exported each year.[3]

The country's meat and dairy products emissions efficiency has increased over time in Aotearoa. There has been an efficiency gain of approximately 33% for sheep meat, 30% for beef and 20% for dairy between 1990 and 2017.[4]

1 (He Pou a Rangi The Climate Change Commission 2021b)
2 (DCANZ 2020)
3 (Meat Industry Association 2020)
4 (Interim Climate Change Committee 2019, page 27)

Most of the markets that producers export into are highly competitive, or subject to distortions due to tariff and non-tariff barriers. Therefore, pricing agricultural emissions in Aotearoa creates a risk that reduced exports would lead to increased production from other countries.

Aotearoa is signatory to different international commitments (for example, the 2015 Paris Agreement, 2030 Agenda for Sustainable Development, United Nations Declaration on the Rights of Indigenous Peoples, and trade agreements) with implications to the food and fibre sectors and across society, the economy, and the environment. Aotearoa does make important contributions to global food security mainly through trade policy, research, and development assistance. The contribution to global food production focuses on the premium value chain and feeding the world's growing middle-class and high-end consumers.[5]

3.1 Rapidly changing international context

The global agricultural supply chain context since the outbreak of the COVID-19 pandemic has shifted and resulted in increasing supply disruptions and increasing freight costs, while producers have benefitted from continued demand for meat, dairy, fruit, and vegetables.[6] The risk of trade becoming less globalised will increase the longer global supply chain disruption persists. Aotearoa may lose important connections, with significant implications for the domestic economy.[7] Moreover, recent and future wars and conflicts would increase these disruptions.[8]

At the same time, consumer preferences are shifting. The joint report from the Organisation for Economic Cooperation and Development (OECD) and the Food and Agriculture Organisation (FAO), *Agricultural Outlook 2020-2029,* noted a gradual decrease in the percentage of consumption of red meat as a source of protein, while an increasing the percentage of poultry consumption. Plant-based dairy substitutes (for example, soya, almond, rice and oat drinks) in the fluid milk sector have increased in various regions, for example, North America, Europe and East Asia.[9]

Disruptions to global production for both meat and dairy due to animal diseases are also expected during the outlook period. Climate change increases the chances of drought, floods, and disease threats, all of which can affect the dairy and meat sectors.

New trade agreements and emissions reduction policies would have an impact on exports from Aotearoa. Some countries have started to plan for preventing the risk of leakage, for example the European Union (EU) Carbon Border Adjustment Mechanism in 2023 on specific carbon-intensive EU imports.[10]

The Commission noted in *Ināia tonu nei* that in a low emissions future where red meat and dairy products continue to be consumed, there is good reason to believe that production in Aotearoa would still be globally competitive, and result in less emissions than product from less efficient export competitors.

5 (He Pou a Rangi The Climate Change Commission 2021a, page 15)
6 (Ministry for Primary Industries 2021)
7 (The Treasury 2021)
8 (Simchi-Levi and Haren 2022)
9 (OECD and Food and Agriculture Organization of the United Nations 2020)
10 (European Parliament 2022)

This document updates the literature available after the publication of the Interim Climate Change Committee (ICCC) *Action on Agricultural Emissions*[11] and summarises new available evidence to improve our understanding of leakage risk.

4 Assessing the risk of emissions leakage

In its 2019 *Action on Agricultural Emissions* report,[12] the ICCC assessed the risk of emissions leakage from agriculture and concluded:

> *… the risk of [agricultural] leakage does not appear high in the near term and can be mitigated further by providing allocation strategically. In the longer term, potential changes in consumer demand and the rise of synthetic and plant-based proteins may have more influence on product volumes than domestic climate change policy.*

The ICCC found that dairy output would be unlikely to reduce significantly due to the climate policy assumed in their analysis as it is a highly profitable land use. It suggests that even if dairy exports decreased, competitor countries may not be able to increase production due to policies on their agricultural sectors, and because their governments have generally adopted economy-wide emissions targets.

For sheep and beef, the ICCC found that there is potential for agricultural emissions pricing to make alternative land uses more attractive. Exotic forests are already proving to be an attractive land use without agricultural emissions pricing in place. The expansion of these forests is due in part to the settings of the NZ Emissions Trading Scheme (NZ ETS) and due to low wool output prices, at the time.

The ICCC found that not all competitor countries have economy-wide emissions targets, which could mean that competitors could increase production if Aotearoa reduced output.

The ICCC concluded that a way to mitigate the risk of leakage in the short term is free allocation of emissions units; that is, free NZ ETS units. Any decrease in dairy production would likely be made up by an increase in production in Western Europe or North America. For red meat exports, the situation is less clear given the broader range of competitors. Only some of them are based in countries with economy-wide targets, and some have higher emissions intensity of production (for example, in Latin American countries).

In the long term, other policies and factors such as competition, labour markets, production systems, and food safety requirements and regulations would play a stronger role in defining the pattern of consumption of agricultural products. This pattern refers to how much is consumed, what type of products and where they are consumed, and where these are produced.

In 2021, the Commission's advice *Ināia tonu nei* agreed with these conclusions and stated its confidence that emissions leakage risk can be addressed, so it is not a reason to shy away from reducing emissions. Further, the Commission's Evidence report[13] noted that it would be important to monitor global markets and actions by competitors to ensure that domestic climate policy contributes to global environmental benefits.

[11] (Interim Climate Change Committee 2019)
[12] (Interim Climate Change Committee 2019)
[13] (He Pou a Rangi The Climate Change Commission 2021a)

4.1 Updated review of emissions leakage post 2019 Interim Climate Change Committee *Action on Agricultural Emissions* report

A report from the International Monetary Fund concluded that there is no consensus in the theoretical literature about the amount of leakage and where emissions would increase or decrease due to uneven implementation of greenhouse gas emissions reduction policies.[14] The empirical literature on leakage mostly implies that greenhouse gas emissions leakage is limited. For non-agricultural industries, the Intergovernmental Panel on Climate Change (IPCC) and OECD found that forecasts of leakage assessments have overestimated the risk of leakage when compared to evidence after implementation.[15] For example, existing international emissions trading systems such as the EU ETS found no empirical evidence of leakage but found that most sectors received a net subsidy after free allocation.[16] In Aotearoa, analysis of four products which receive free allocation has shown they appear to be over-allocated with New Zealand Units (NZUs).[17]

In terms of agricultural leakage, a 2019 IPCC report noted that an output-based allocation method maybe most suitable for agriculture as a way to reduce the risk of leakage.[18] Based on analysis by the ICCC, the Commission concluded that the risk of leakage for the dairy sector is lower than the risk for emissions leakage from the meat and wool sectors. This is because not all competitor countries are advanced economies with economy-wide emissions reduction targets.[19]

Two reports explore the risk of agricultural emissions leakage for Aotearoa. An exploratory study from the OECD[20] found that an emissions price of US$100/t CO_2e applied to agricultural emissions in Australia and Aotearoa resulted in global emissions reductions due to a combination of emissions reduction technologies and reductions in output. The study uses the term 'leakage rate' defined as the sum of the increases in agricultural emissions in countries without emissions pricing policies, divided by the sum of the reductions in agricultural emissions in countries that implement emissions reduction policies. This rate is of 55% or a net reduction in global GHG emissions by 2050 of 45 $MtCO_2e$.

The OECD study found that emissions prices decrease global net emissions as long as agricultural producers have access to emission reduction technologies. The study also found that increasing the emissions price from US$100/t CO_2e to US$200/t CO_2e or taking away the emission reduction technologies increases the risk of leakage, but global emissions still reduce. One of the study limitations is that it overestimates emissions intensities in Aotearoa and it uses US Environmental Protection Agency emissions reduction cost estimates.

Analysis commissioned by the He Waka Eke Noa partnership[21] explored the potential for agricultural leakage. The study uses emissions intensity estimates from life-cycle assessments for beef and sheep meat and dairy and assumes production loss in Aotearoa.

[14] Theoretical assessments referred here use forecasts on the effects of potential policies to reduce greenhouse gas emissions (Wingender and Misch 2021)
[15] (Arvanitopoulos et al 2021; Hurlbert et al 2019)
[16] (Naegele and Zaklan 2019)
[17] (Resource Economics 2021)
[18] (Hurlbert et al 2019)
[19] (He Pou a Rangi The Climate Change Commission 2021b)
[20] (Henderson and Verma 2021)
[21] (Denne 2022)

The report illustrates three scenarios:

a. increases in agriculture emissions are not offset by reductions in other sectors

b. 50% of the increase in agricultural emissions is offset by reductions other sectors

c. all of the increase in agricultural emissions is offset by reductions in other sectors.

The report suggests that global emissions would increase in both the no offset and 50% offset scenarios. In this study, the 50% offset assumption is arbitrary (as acknowledged by the author) and is not an indication of a more likely outcome. The increase in global emissions is driven by the assumption that the competitor countries' agricultural sectors are more emissions intensive than the production from Aotearoa it is displacing. This also implies that other sectors might not reducing their emissions to compensate for the rise in agriculture emissions. Global emissions would stay the same if all the increase in agricultural emission is offset by reductions in other sectors.

The results of the report depend on a series of underlying assumptions and show a range of possible outcomes. For example, in the 50% offset example results in every tonne of emissions reduced from the beef sector from reductions in output, being expected to rise elsewhere by 1.15 tCO_2e. These increases are about 1.07 tCO_2e for sheep meat and 1.30 tCO_2e for milk solids. For both beef and sheep meat, the report found potential for a total increase of global emissions.

The report stresses that the rate of leakage is highly uncertain due to a number of factors and varies by agricultural activity. The report recommends incentivising emissions reductions through efficiency improvements and mitigation technologies, rather than reducing production.

Overall, this report provides some illustrative scenarios, the conclusion that global emissions would increase if Aotearoa priced agricultural emissions is entirely dependent on the assumptions chosen. The report has limitations as it does not account for complex trade dynamics or the potential for changes in demand responses, including product substitution, due to changing prices and consumer preferences.

4.2 Policies and targets of competitor countries that would have an impact on leakage

Any unilateral pricing of emissions could lead to the risk that emissions increase in other countries. Globally, many countries protect their agriculture sectors by providing direct subsidies and non-tariff barriers. Hence, a review of specific policies from competitor countries is required to better understand the potential impact of these policies on agricultural emissions leakage.

Current regulations or future commitments in other countries that produce the same agricultural products may mean that there are limits to their ability to increase production were Aotearoa to reduce its production. Several competitor countries for Aotearoa have established climate targets, either under the Paris agreement, or outside the agreement (Box 1). Monitoring how these commitments change is important, for example, national EU Member State's targets under National Common Agricultural Policy Strategic Plans from 2023 to 2027 are being decided at the time of writing (due for completion around September/October 2022), and could be more stringent than targets in the announced EU Common Agricultural Policy.

Box 1: Agricultural emissions policies and targets in competitor countries

Examples of emissions policies and targets in Aotearoa dairy and meat and wool competitor countries:

- Economy-wide net zero emissions targets are in place for Australia, Chile, EU Member States; the US, and the UK by 2050, and in China by 2060.
- In the EU, policies include the EU Climate and Energy Framework, and the European Green Deal policy, including the Farm to Fork strategy and Biodiversity strategy.
- Outside of the Paris agreements some countries have government targets or strategies for emissions reductions for agriculture, such as the Irish government's 'Ag Climatise policy' or the UK's 'agricultural Transition Plan 2021-2024'. These strategies outline broad areas of action in terms of change of agricultural systems and investment into technologies and farmer support, but do not highlight policy restrictions for agricultural emissions or practices.
- These transition plans for agriculture are in a framework of increasing carbon storage, agricultural productivity, and low emissions manure management. This implies an intention to either maintain levels of production or even increase production.
- The cessation of fertiliser-use and a shift to widespread organic methods of farming are also cited in many countries' agricultural plans for emissions reductions.
- A few national-level industry bodies have stated targets for their sectors, for example, the Meat & Livestock Australia company aiming to reach carbon neutrality in the red meat sector by 2030; the National Farmer's Union of England and Wales aiming for carbon neutrality in agriculture by 2040; and the Netherland's dairy industry aiming for a 20%reduction in dairy emissions by 2020. These targets are not legally binding.

Source: (Guenther, Saunders, and Driver 2022)

4.3 Modelling of the potential risk of agricultural emissions leakage for Aotearoa

There is limited evidence available on agricultural emissions leakage. Aotearoa would be the first country to price agricultural emissions in the world. Understanding international trading relationships and competitors for our agricultural products is key to understanding the potential risk of emissions leakage. We commissioned modelling by the Agribusiness and Economics Research Unit (AERU) at Lincoln University to better understand specific policies from competitor countries and the potential impact of these policies on agricultural emissions leakage under different levels of assistance.

Understanding international trading relationships and competitors for our agricultural products is key to understanding the potential risk of emissions leakage. Analysis of emissions leakage using the Lincoln Trade and Environment model (LTEM)[22] found that under the assumptions made (on emissions price, levels of assistance and levels of international action on agricultural emissions), introducing a price for agricultural emissions in Aotearoa would be expected to reduce emissions domestically and to reduce net global emissions for the studied commodities (Box 2).

[22] The Lincoln Trade and Environment model (LTEM) is a multi-market, multi-commodity partial equilibrium trade model, which maps global production and trade of 26 agricultural commodities.

Box 2: modelling emissions leakage for Aotearoa

We commissioned specific modelling on agricultural emissions leakage, using a trade model, to assess a range of scenarios for six commodities within the meat and dairy sectors over the period 2021-2050. The commodities are beef, sheep meat, butter, cheese, whole milk powder, and skim milk powder. While these scenarios help to better understand the uncertainty around agricultural emissions leakage, they do not show likely policy outcomes since agricultural emissions pricing policy details are yet to be determined.

The modelling used some key assumptions including emissions factors (the amount of greenhouse gas emissions per unit of mass), price elasticities, and emissions prices. Average emissions factors are taken from the FAO.[23] Price elasticities are based on historical movements in prices and mimic how quickly countries would be expected to change their output in response to higher or lower commodity prices. The emissions prices used across all scenarios were illustrative and were not set to achieve a specific emissions reduction target.

While no decision has been made about whether assistance would be provided and which assistance method might be used, the goal of this modelling exercise is to understand how domestic emissions and global emissions would change under a set of assumptions. The results are not policy forecasts and insights are to be drawn by examining the differences between scenarios.

The scenarios have different settings for the degree to which competitor countries take action on the agricultural emission targets they have set and the level of financial assistance provided to domestic participants. These scenarios were compared against a baseline where domestic agricultural emissions are not priced and competitor countries do not fulfil their agricultural emissions targets (Table 1).

Table 1: Scenarios examined

No.	Scenario name	Global action	Rate of assistance	Emissions price
1	Baseline	None	N/A	None
2	High assistance and global action	High*	95% decreasing 1% yearly	\$0 in 2020, \$85/tCO_2e in 2025 and \$138/tCO_2e from 2030 to 2050**
3	Medium assistance and global action	High	60% decreasing 1% yearly	As above
4	No assistance but global action	High	None	As above
5	High assistance but no global action	None	95% decreasing 1% yearly	As above
6	Medium assistance but no global action	None	60% decreasing 1% yearly	As above
7	No assistance and no global action	None	None	As above

*High global action = countries achieve 100% of their targets. **Assumed NZU Price ($/tCO2e)

The modelling allows us to understand what might happen to domestic and global emissions if Aotearoa priced agricultural emissions. Figure 1 shows the change in Aotearoa and the rest of the world's livestock emissions in 2030 if emissions pricing is introduced with either high assistance (95%), medium assistance (60%), or no assistance to participants. Lower levels of assistance are expected to drive greater emissions reductions as the sectors are more exposed to the full emissions price. In all these scenarios the emissions price is the same, and the level of financial

[23] Food and Agriculture Organization of the United Nations (FAOSTAT 2022)

assistance varies (Figure 1). This figure does not apply constraints to the rest of the world agricultural emissions for the studied commodities.

As expected, as assistance levels fall across scenarios so too do domestic emissions in 2030. Livestock production and emissions reductions in Aotearoa are offset to some extent by greater output and emissions from other countries. However, the increase in emissions in the rest of the world is smaller than the reductions in Aotearoa, resulting in lower overall livestock emissions. The modelling predicts that the majority of the offsetting increase in livestock emissions would occur in countries which have taken all of economy targets and are parties to the Paris Agreement. As a result, any increase in livestock emissions in these countries would need to be offset by equal or greater emissions reductions in other sectors.

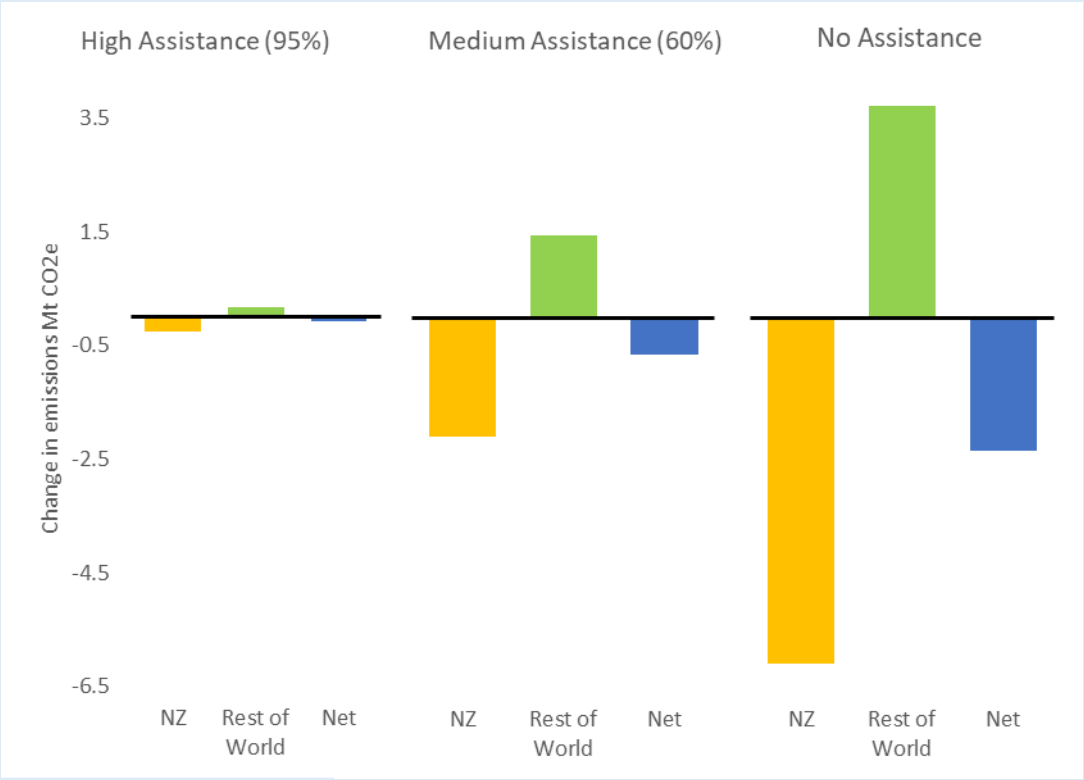

Figure 1: Change in livestock emissions (MtCO2e) in 2030 in Aotearoa and the rest of the world if Aotearoa prices livestock emissions with high (95%), medium (60%) or no assistance provided. While production and emissions would increase in the rest of the world, overall livestock emissions are lower in all scenarios

The total emissions reductions out to 2050 will depend on the level of assistance provided. Higher levels of assistance would result in lower emission reductions (12.3-16.2 $MtCO_2e$) compared with medium assistance (57.9-62.4 $MtCO_2e$), or no assistance (139.1-144.6 $MtCO_2e$).

This study focused on the changes in emissions in the six livestock commodities detailed above. It suggests that due to the reduced domestic production there could be implications for the global price of livestock products as a result of pricing agricultural emissions. However, further research would be required to understand how climate action in Aotearoa and other countries around the world has implications for food production and food security.

Example scenarios results

Scenario 4, 'No assistance, but global action', implies the greatest reduction in output in Aotearoa and its competitor countries. In this scenario, China, India, and the US are the main countries supplanting reduced global livestock production. In particular, the US becomes a greater exporter of cheese, skim milk powder, and beef. China increases its production of whole milk powder,

sheep meat, and beef, while India increases butter production, and to a lesser extent sheep meat. These changes, however, do not imply greater global livestock emissions.

In Scenario 2, 'High assistance and global action', dairy prices are higher than those in the baseline scenario because of the significance of Aotearoa in global dairy markets. The balance of higher world prices offsets the low cost of carbon pricing under the high assistance scenario, thus allowing some dairy production in Aotearoa to increase. This implies somewhat higher emissions from the dairy sector. Total Aotearoa emissions still decrease due to reductions in the production of beef and sheep meat, although beef also shows some price gains from global action, albeit to a lesser extent than for dairy.

In Scenario 5, 'High assistance but no global action' producer prices are below the baseline. Essentially global action implies higher world prices for dairy as other countries are constrained. This would have implications for Aotearoa dairy producers and consumers.

Under Scenario 7, 'No assistance and no global action' beef prices decrease by over 50% in 2050, an equivalent of US$10.6 billion lost annually in producer returns. For sheep meat this is a 40% reduction in producer prices, and US$13 billion less than in the baseline annually.

All other scenarios have lower prices for dairy, beef, and sheep meat than seen in the baseline. The most extreme, Scenario 7, implies a 7% decrease in dairy prices by 2050, equivalent to an average annual loss of US$12.4 billion in producer returns.

Source: (Saunders, Guenther, and Driver 2022)

4.4 Conclusions

Globally, there is little evidence that emissions leakage is a material issue in sectors covered by different emissions pricing systems and climate policies. This could be due to the generous free emissions allocations (or assistance) that these sectors have received. Because emissions from agriculture have never been priced anywhere in the world, there is no empirical evidence on the risk of agricultural emissions leakage.

The two published studies that include Aotearoa in their leakage estimations are not directly comparable. The results of their quantitative analysis are dependent on the assumptions each used.

While there will always be a risk of emissions leakage when countries unilaterally price emissions, the ample body of theoretical literature suggests that there is no consensus about the size of emissions leakage or where emissions would increase or decrease due to uneven implementation of greenhouse gas emissions reduction policies. The empirical leakage evidence, although smaller, finds that the leakage could be limited.

In the long run, the risk of agricultural emissions leakage depends not only on the emissions pricing put in place in Aotearoa, but on the actions (both price and non-price) being taken by other countries, other domestic and international climate policy, trade policy, the physical effects of climate change, and changing consumer preferences for food.

Overall, we assess that risk of emissions leakage for agriculture if emissions pricing is introduced in Aotearoa is highly uncertain. The risk would be different for the main subsectors – it would likely be lower for the dairy sector than the sheep and beef meat sector. This risk depends, among other factors, on emissions prices, which in turn can change over time. Changes in consumer preferences and lifestyles, influenced by relative prices, growing health and environmental concerns could play an important role in meat and dairy consumption and influencing policy.

The adoption of emissions pricing to address agricultural emissions from competitor countries would also influence the risk of leakage. Other uncertain determinant factors on the risk of leakage include the point of obligation (farmer or processor), the level of financial assistance, and macroeconomic shocks and disruptions.

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