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TOWARDS A TAXONOMY OF AGRI-ENVIRONMENTAL REGULATIONS

A LITERATURE REVIEW

OECD FOOD, AGRICULTURE AND FISHERIES
PAPER
April 2023 **n°194**

OECD
BETTER POLICIES FOR BETTER LIVES

OECD TRADE AND AGRICULTURE DIRECTORATE

Towards a Taxonomy of Agri-Environmental Regulations: A Literature Review

Roger Martini

Regulations are an important part of the policy toolkit governments can use to address climate and environmental objectives in agriculture. This report reviews existing literature on the characteristics and assessment of environmental regulations in agriculture. It finds that direct evidence on the outcomes and cost-effectiveness of agri-environmental regulations is generally limited and situation-specific. However, a taxonomy that classifies and organises information on regulations can give a sense of their number, the environmental domains covered, and the scope and depth of their application. This is potentially useful with respect to measuring progress on international commitments for action on climate change mitigation and other analysis.

Keywords: Agriculture, environment, climate change

JEL codes: K230, Q280, Q180, Q580

Acknowledgements

This paper has benefitted from the advice and assistance of many colleagues who have shared their time generously. I would like to recognise especially the contributions of Jesús Anton, Guillaume Gruère, Ben Henderson, Marion Jansen, Jerome Mounsey, Julia Nielson, Hugo Valin, and Martin Von Lampe. The invaluable contributions of the participants in the Joint Working Party on Agriculture and the Environment is also gratefully acknowledged. A final thanks to Martina Abderrahmane and Michèle Patterson for their help shaping the document in its final form.

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Key messages

- Regulations are an important part of the policy toolkit governments can use to address climate and environmental objectives in agriculture. There are multiple regulatory instruments of different types, the mechanisms and effects of which vary widely. Improved understanding of agri-environmental regulations is needed to guide policy making in this area and will give a better picture of overall agri-environmental policy packages.
- Existing approaches such as regulatory impact assessment provide some coverage of the costs and effects of a specific environmental regulation, but there has been limited application of these instruments in the case of agriculture. Moreover, in-depth assessments of a single regulation are useful, but results are not generalizable and do not provide a systematic assessment of the regulatory environment.
- One way forward is to put together selected information on existing agri-environmental regulations. A taxonomy that classifies and organises information on regulations can give a sense of their number, the environmental domains covered, and the scope and depth of their application. An agri-environmental taxonomy could cover a broad scope of regulations, ranging from voluntary approaches to command-and-control and include details on their environmental domain, affected population and implementation features. A well-designed taxonomy can subsequently contribute to the analysis of the impacts of regulation.
- Examples such as from The Policy Instruments for the Environment (PINE) database provide helpful indications regarding methods of data collection and presentation. OECD work on best practices for regulations also provides useful indications for future work on features related to regulatory design.

Executive Summary

Countries need information about alternative policy approaches to help reach their agri-environmental objectives and commitments effectively and efficiently. While the OECD has for a long time categorised, monitored and evaluated budgetary agricultural policies, the same level of attention has not been paid to non-budgetary policies in agriculture. Yet regulatory policies are part of the overall package of policies that governments use in pursuit of new climate change and environmental objectives in agriculture. Whether they are traditional command-and-control instruments or take other forms, regulations are an important part of the policy toolkit for managing externalities and public goods connected with agriculture.

This report reviews existing literature on the characteristics and assessment of environmental regulations in agriculture, as well as more general OECD work on best practices for regulations and other evidence with respect to the cost-effectiveness of regulations. The aim is to improve the understanding of the type of agri-environmental regulations in use, their number and domain to promote understanding of the scope, scale and depth of use of agri-environmental regulation as a policy tool. Several relevant approaches to assessing and classifying regulations are identified in the review along with several important lessons for the path forward.

One lesson is that while regulatory assessment has become commonplace, the kind of information generated by Regulatory Impact Assessments (RIAs) or the Standard Cost Model (SCM) are generally poorly suited to analysis beyond that for which they were developed. RIAs are used by governments to increase the efficiency and cost-effectiveness of regulations by evaluating the costs and benefits of regulations as part of their design process. One weakness of RIA is that it does not always quantify or monetize those costs and benefits. SCM is a related method to evaluate the administrative cost of regulations that has been widely applied in the European Union.

A second lesson is that evidence on the direct costs to farmers and the effects of regulations on environmental outcomes is limited, heterogenous and hard to generalise. Measuring administrative burden is also challenging, but there are some examples of where this has been done successfully. While difficult, working towards some accounting of the effects of agri-environmental regulations can increase the value of a taxonomy considerably.

A third lesson is that it is important to distil the plethora of existing regulations in place into a practical framework that shows the set of regulations relevant to environmental performance. A country may have hundreds of specific rules governing farm activities and associated licensing, permitting and inspection systems. At the same time, the number of significant regulatory initiatives dealing with climate change and the environment may be relatively small. The literature review suggests that establishing a common frame of reference with respect to major themes can help organise this information and provide some clarity on the agri-environmental regulations profile in a given country.

Taking these lessons together helps shape the contours of the way forward towards a taxonomy of agri-environmental regulations. Once established, such a taxonomy can support further analysis. The first step would likely be to use the taxonomy to inform on the scope and depth of policy presences in different environmental domains (aspects of GHG emissions and sequestration, biodiversity, nutrients, etc.). This can improve overall understanding of agri-environmental policy packages.

Some aspects of the taxonomy may be tackled in the near term, while others will take longer to develop and implement. The most important first step in the process is building an inventory and developing the core classification aspects. Such an inventory and classification can already support analysis and contribute to the broader OECD work in agri-environmental policy.

A taxonomy should identify and include a wide range of regulatory forms, building on existing databases. It should identify the environmental domain of the regulation (emissions reductions, biodiversity, nutrient management, etc.), the population that is covered by the regulation, and other basic information similar to that collected in the OECD Policy Instruments for the Environment (PINE) database. The taxonomy should also be developed keeping in mind future opportunities to integrate work done elsewhere on regulatory design, administrative costs and burden and other features connected to the cost-effectiveness of agri-environmental regulation.

1. The role of regulation in agri-environmental and climate policy

The OECD has a long history of tracking agriculture policy effort via the Producer Support Estimate (PSE) (OECD, 2022[1]) and has produced a taxonomy to characterise and measure progress for budgetary agri-environmental policies (Guerrero, 2021[2]) A focus on budgetary agri-environmental policies alone risks missing other important components of policy effort and therefore paints an incomplete picture of progress. Regulatory policy can play an important role in achieving environmental objectives, and evidence suggests that regulations are among the more effective tools for adoption of better practices (DeBoe, 2020[3]). Keeping track of the current scope and scale of agri-environmental regulations will improve the overall quality and completeness of OECD monitoring of agricultural policy and provide a clearer picture of progress being made towards climate ambitions.

The term "regulation" covers a spectrum of instruments. Most of these fall on a continuum of solutions ranging from completely free to fully closed markets (Table 1.1). This review takes a broad view of regulations, including most instruments other than budgetary, tax or market-based policies. The intention is to be broad enough in scope to include most relevant policies, while avoiding those that are already covered elsewhere or which would require a substantially different frame of analysis.

The OECD report *Regulatory Policies in OECD Countries: From Interventionism to Regulatory Governance* (OECD, 2002[4]) provides a useful list of regulatory forms based on how they are designed and implemented. While not a final list at this stage, it provides a good starting point to consider what types of policies may be considered to be agri-environmental regulations included in a taxonomy.[1]

- *Mandatory information disclosure*. These approaches address information asymmetries to ensure full information is available to both consumers and producers to aid in making choices that match their preferences. This includes eco-labelling schemes or similar.
- *Guidelines*. The promulgation of quasi-regulatory guidelines or best management practices by a regulatory authority setting out processes or providing interpretations to aid understanding of government objectives by business and citizens. They may be designed to accompany existing regulations, particularly those written in performance-based terms, or as an alternative to stricter regulatory forms.
- *Private sector voluntary regulation*. Voluntary approaches are arrangements initiated and undertaken by industry and firms, sometimes formally sanctioned or endorsed by government, in which self-imposed requirements which go beyond or complement the prevailing regulatory requirements. They include voluntary initiatives, voluntary codes, voluntary agreements, and self-regulation. For example, organic farming is considered by some to be a form of voluntary regulation.
- *Co-regulation*. Under co-regulation the regulatory role is shared between government and industry, usually through legislative reference or endorsement of a code of practice. Typically, the industry or a large proportion of industry participants formulate a code of practice in consultation with government, with breaches of the code usually enforceable via sanctions imposed by industry or professional organisations rather than the government directly.
- *Process regulation*. These regulations require businesses to develop processes that ensure a systematic approach to controlling and minimising risks. They are based on the idea that, when specific performance standards for firms are difficult to identify, producers are likely to prove more effective in identifying hazards and developing lowest-cost solutions than is a central regulatory authority. They are particularly useful where there are multiple and complex sources of risk. Mandatory nutrient budgets or farm environmental planning are examples.

[1] Other approaches to taxonomies in the literature review take different approaches such as focussing on Economic or Social domains. An implementation-based approach has the advantage of aligning with the similar approach taken in the classification of the OECD Policy Support Estimate (PSE) database.

- *Performance-Based Regulations*. Performance-based regulation specifies required outcomes or objectives, rather than how they must be achieved. Farmers can choose the process by which they will comply with the law. This allows them to identify processes that are more efficient and lower cost in relation to their circumstances, and promotes innovation and the adoption of new technology on a broader scale. The focus of regulation is shifted to results or outputs, rather than inputs, and the degree of government intervention in markets is effectively reduced.
- *Command-and-control regulation*. This refers to environmental policy that specifies what is mandatory or prohibited to those affected (permission, prohibition, standard setting and enforcement) as opposed to financial incentives, that is, economic instruments of cost internalisation. Technology standards are an example.

Table 1.1. The spectrum of regulatory and non-regulatory policy instruments

		Regulatory form	Indications for use
Competition	Market-driven solutions	Free market governed only by general competition policy	Effective competition possible but requires intervention only to create appropriate frameworks or supports
		Mandatory information disclosure (to enhance consumer choice)	Efficient markets hampered only by information asymmetry. Disclosure requirement minimizes cost of correction
		Guidelines (specification of best management practices)	Best practices offer profitable solutions and aid regulatory compliance, but barriers to adoption exist.
		Market-based instruments established by government	An essentially efficient market exists, so intervention is aimed at correcting externalities
		Private sector voluntary regulation (voluntary agreements, private standards)	A high level of good practice exists among market participants or enforcement is difficult, so consent issues are critical
		Co-regulation	Public and private interests are aligned, sector organizations strong and effective
		Process Regulation (requiring firms to assess risks and take most cost-effective action)	When performance standards are difficult to specify, this response emphasises the benefits of systemic thinking and disclosure
		Performance regulation (standard objectives set by government	Specific standards are easily identified, but many tech. solutions possible, tech, change is rapid
		Command-and-control regulation	Few acceptable options exist, high level of government control needed as important values or substantial risks concerned
	Government-driven solutions	Regulated private monopoly	High degree of natural monopoly, but performance standards can be specified and monitored adequately
Monopoly		Contracting out of monopoly to the private sector	Some aspects of provision can be competitive, but government control of overall process desired.
		Corporatised public monopoly	Strong national monopoly character plus difficulty in regulating outputs due to multiple objectives. Fundamental values involved.
		Public monopoly	
		Government ban on activity	
No formal activity			

Note: Shaded area are regulatory forms proposed for consideration in this work.
Source: Based on OECD (2002[4]), *Regulatory Policies in OECD Countries From Interventionism to Regulatory Governance*, https://doi.org/10.1787/9789264177437-en.

Regulations are often considered a less desirable policy alternative to market-based instruments (MBIs) because of their inferior cost-efficiency. Different policy types will be best suited to different circumstances and objectives, as Weitzman (1974[5]) pointed out regarding the conditions under which price-based or quantity-based policies are superior. In short, quantity-based approaches are preferred when the social benefits function is sharply curved around the optimal level, and regulators have poor information on firms' abatement costs. When firm's costs are unknown, the quantity of abatement resulting from a tax on pollution is uncertain. When the benefits curve is sharply curved, the penalty for getting the quantity wrong is high.

Market-based instruments have been applied most successfully to the management of industrial point-source pollution issues. In these cases, emissions have generally proven to be reasonably easy to measure and have had sufficiently direct relationships with their environmental impacts. In contrast, the diffuse-source environmental problems commonly encountered in agricultural contexts have been less amenable to market-based solutions (Henderson, 2010[6]). This is changing in some areas, such as GHG carbon markets, where new protocols and technologies for the measurement, reporting and verification (MRV), are improving measurement accuracy and cost (OECD, 2019[7]; Henderson et al., 2022[8]). Depending on your perspective, MBIs can be seen as a variation in how regulations are applied or a different type of policy instrument altogether (Box 1.1).

Box 1.1. Market Based Instruments vs. Regulations

MBIs like cap-and-trade have long been the preferred policy instrument of economists to reduce GHG emissions. MBIs can provide the most cost-efficient solution for a given target for or level of environmental benefit. This efficiency property primarily stems from their capacity to decentralise decision making to producers regarding selecting the most cost-effective technologies and practices available to them. This cost efficiency outcome of MBIs is achieved and reflected by equalising the marginal costs of abatement among producers. In principle, these instruments can be very effective, however, in practice political economy concerns can place limits on the emission price and therefore on the strength of the abatement signal.

A cap-and-trade instrument without the trading part is just a command-and-control regulation that specifies total emissions. Other MBIs like baseline-and-offset or voluntary offset schemes do not have the same hard regulatory “cap”. Demand for trades in these systems comes from other sources like regulation applied elsewhere or to respond to consumer demand. While MBIs may share some features with regulations, the ability of firms to trade among themselves fundamentally changes the nature of MBIs and in practice these bear little resemblance to quantitative regulations.

An OECD inventory of agri-environmental regulatory policy will help improve understanding of this policy tool and contribute to the policy monitoring and evaluation mission of the OECD. Regulatory measures have interactions with the price and budgetary support already measured in the Producer Support Estimate (PSE) and reported and analysed in the annual Agricultural Policy Monitoring and Evaluation report (OECD, 2022[1]). Generally speaking, the overall effects of agricultural policies will be better understood when more types of policy measures are included.

At the same time, several OECD-wide initiatives have been put in place to help facilitate an evidence-based multilateral exchange of information about the different efforts around the world to reach net zero emissions. The International Programme for Action on Climate (IPAC) provides regular monitoring, policy evaluation and feedback on results and good practices to help countries strengthen and co-ordinate their climate action. The Inclusive Forum on Carbon Mitigation Approaches (IFCMA) is designed to help secure a globally more coherent and better coordinated approach to carbon mitigation that is informed and facilitated by technical and objective analysis.

The objective for this report is to explore a possible structured inventory (taxonomy) of environmental regulations in agriculture as a tool to assist in monitoring and evaluating their impact and performance. The main method is the review of existing taxonomies and evidence and experience on assessing environmental regulations in agriculture, with a particular emphasis on climate change mitigation.

This review also considers what information elements such a taxonomy may practically contain, as this can influence what the best structure would be. It investigates OECD work on regulatory best practices that can potentially provide a conceptual framework, reference points and other valuable information to guide the inventorying and assessment of regulations affecting environmental outcomes in the agricultural sector.

Specifically, the report carries out a literature review of relevant work within and outside the OECD with a view to identifying:

- Existing applications of taxonomies, databases and policy indices (Section 2).
- OECD analysis regarding best practices of regulatory policy design and governance (Section 3).
- The evidence on the costs of regulations, in terms of direct compliance cost and administrative costs, including enforcement (Section 4).
- The evidence on the impact of regulation in terms of changes in emissions or other environmental outcomes (Section 5).

2. Taxonomies and policy indices

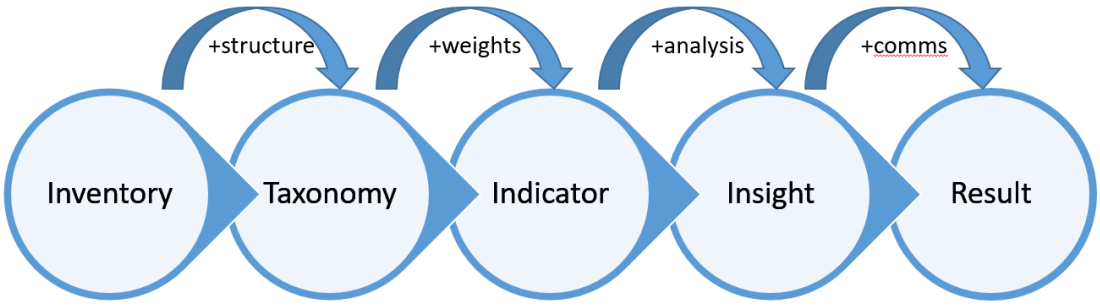
A good taxonomy can make understanding and communicating about agri-environmental regulations easier. Past lessons provide a wealth of information on how to design a taxonomy suited for this purpose

A taxonomy is a system of organisation to define, describe and classify related concepts. In this section, examples of existing taxonomies and related indicators and indices are reviewed with a view to understanding how a taxonomy may be designed and applied that is useful in the context of GHG emissions and other agri-environmental topics.

An indicator is a means to describe a situation or a trend. An index is a type of indicator that is ordered in some fashion (say from largest to smallest), though these terms are often used interchangeably in the examples that follow.

A taxonomic approach to regulation can provide a consistent and meaningful scope of inquiry regarding the key aspects of the regulatory landscape. A taxonomy can also facilitate the creation of indicators when its structure is conducive to aggregation into summary measures. That is, the way that information is initially organised can affect how it is analysed and used at later stages, and this fact should influence taxonomy design. Once a taxonomy with a useful structure is established, its components may be weighted to produce a composite indicator. That indicator could contribute to analysis leading to insights that can be communicated to policy makers to achieve the desired result (Figure 2.1).

Figure 2.1. How a taxonomy supports further analysis



While much remains to be developed, the regulatory features identified in a taxonomy include primarily the form, and environmental domain of the regulation. Evidence shows that the form a regulation takes, combined with the context in which it operates, matters a great deal for its prospects for successfully achieving desired social outcomes, making a taxonomy a useful tool for policy analysis (Balla et al., 2018[9]).

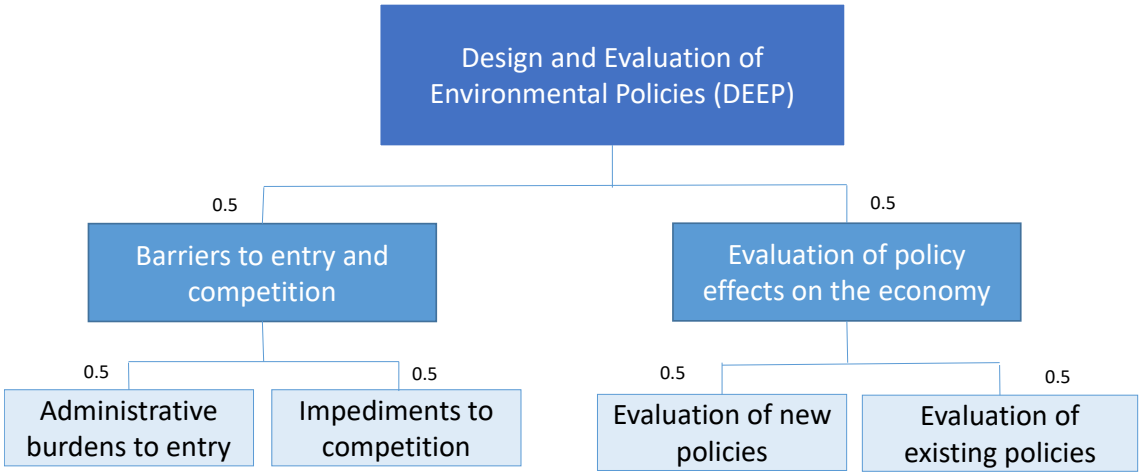
2.1. General environmental policy indices or taxonomies

2.1.1. OECD Indicator of Design and Evaluation of Environmental Policies (DEEP)

To measure the extent to which public policies promote or inhibit competition in markets, the OECD quantifies and compares anticompetitive product market regulation (PMR). However, the PMR indicators do not include information on environmental policies, permitting and licensing. Using a survey method similar to the PMR, the Indicator of Design and Evaluation of Environmental Policies (DEEP) was developed to put a focus on the efficiency of environmental policy design (Berestycki and Dechezleprêtre, 2020[10]).

The DEEP is an indicator built upon an inventory of measures organised into a taxonomy, so would fall under the third bubble of Figure 2.1 above. The purpose of the indicator is to measures potential market burdens generated by environmental policies and the extent to which environmental policy evaluations take those into account (Figure 2.2). The indicator measures the administrative costs associated with environmental policies and the extent to which environmental policies directly inhibit competition. It also investigates the quality of *ex ante* and *ex post* environmental policy evaluation.

Figure 2.2. Structure of the DEEP indicator



Note: Aggregation uses equal weights of subcomponents. The 2018 DEEP indicator has the same structure as the 2013 BEEP indicator.
Source: Berestycki and Dechezleprêtre (2020[10]) "Assessing the efficiency of environmental policy design and evaluation: Results from a 2018 cross-country survey", https://doi.org/10.1787/482f8fbe-en.

The four components of DEEP are as follows:

- *Administrative burdens* associated with permitting/licensing procedures – this component groups questions attempting to capture the administrative complexity related to permitting, which is faced by entrepreneurs when opening a plant or a company. Includes the legal limit on the administrative response to a request for a permit/license, ease of access to all necessary information, forms to be filled-in, etc.
- *Direct impediments to competition* – this component captures the aspects of environmental policies that can directly discriminate against new entrants. New entrants may face stricter environmental norms than incumbent firms. Tax and subsidy incentives can be more beneficial for incumbents than for young firms, for instance by being based on past performance or if young firms tend not to have profits.
- *Evaluation of new policies* – this component summarises information on the process of environmental policy making. The focus is on requirements to conduct ex ante analysis of various economic consequences of new policy proposals and the choice of tools to achieve environmental goals.

- *Evaluation of existing policies* – this component attempts to capture the degree to which economic considerations are present in reviews of the entire setup of existing policies, regarding *ex post* evaluations of policies and policy setups, transparency and the responsiveness to stakeholders.

Question responses are scored on a scale from zero to one, zero reflecting policies or dispositions most friendly to competition, and one is the worst possible score.[2] Questions are then aggregated into the relevant sub-indicators and rescaled from zero to six where zero is the best score. Aggregating the four sub-indicators with equal weights yields the final indicator. DEEP demonstrates that it is possible to collect useful information on administrative burden through a questionnaire approach. This information has been quantified and used in analysis to investigate the relationship between burden and stringency (see EPS below).

DEEP, like the Burden on the Economy due to Environmental Policies (BEEP) indicator upon which it is based (Kozluk, 2014[11]), emphasises effects of regulation on competition and barriers to entry. It is less concerned with the direct costs of compliance and regulatory efficiency. It applies a useful method to evaluate and compare the components of administrative cost. The DEEP uses a tree structure to organise the separate elements of the index. Each element is assigned a score and these scores are aggregated into an indicator by weighting the different branches of the tree. The DEEP is therefore a taxonomy that structures elements of an inventory of regulatory features and an indicator built by scoring and weighing those features.

2.1.2. OECD Environmental Policy Stringency (EPS) Indicator

The EPS indicator is a proxy for environmental policy stringency measured as the implicit or explicit cost of environmentally harmful behaviour (Botta and Kozluk, 2014[12]). It is based on an inventory of individual indicators of policy stringency organised into a taxonomy, so it falls into the third bubble of Figure 2.1. The individual indicators are combined by a weighting system to arrive at a composite indicator. It is not exclusively about regulations, as it also includes tax and budgetary support policies, but is a good example of a practical indicator built from a taxonomy of policies using available information. Like the DEEP, it uses a tree structure to build the indicator (Figure 2.3).

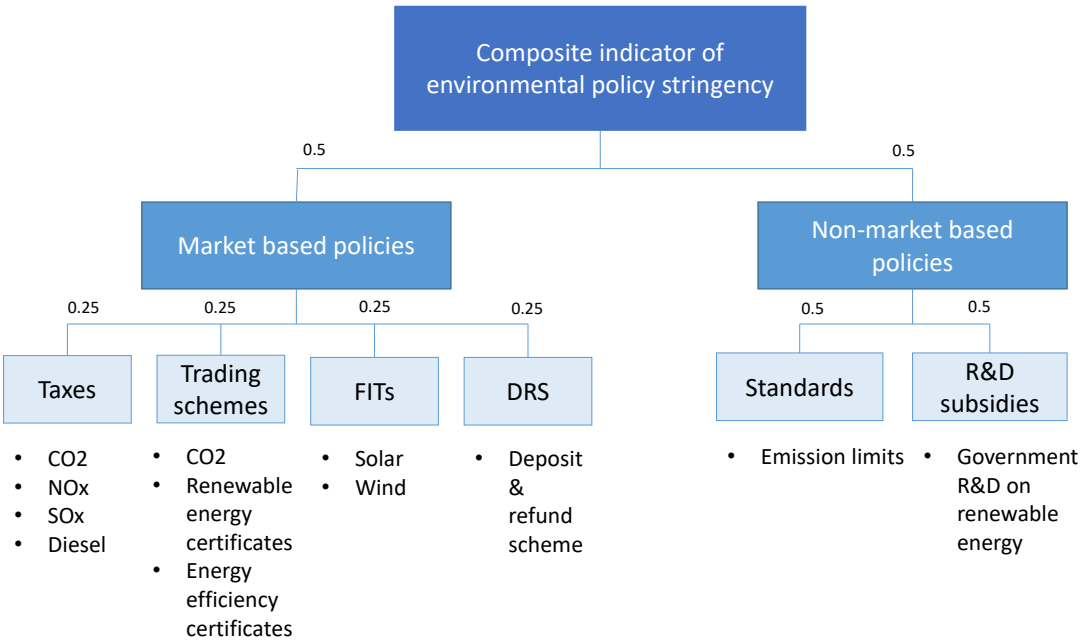
The EPS work identified many challenges driven by the heterogeneous nature of environmental issues and the various instruments that address them. Most relevant is the problem of multi-dimensionality, when a single regulation has many related impacts. For example, the EU Nitrate Directive is aimed at reducing surplus nitrogen, but it has important climate change effects related both to methane and nitrous oxide emissions. Such regulations are hard to fit into a single policy category.

A correlation between DEEP and EPS was used to evaluate the relationship between burden and stringency of regulations. A low correlation was observed, indicating that stringent environmental policies need not be associated with more burdens on the economy, and that some of these burdens apply specifically to the environmental domain. A similar indicator and analysis were applied to understand how aquaculture sector growth was affected by administrative burdens (Innes, Martini and Leroy, 2017[13]).

While DEEP uses a scoring method for qualitative information and the EPS uses quantitative parameters such as tax rates, both rely on a hierarchical structure and weights to produce a composite indicator. The Climate Actions and Policies Measurement Framework (CAPMF) discussed below also uses this approach, and contains a mix of quantitative and qualitative information, showing the flexibility of this method.

[2] For example, a question asks regarding the existence of a single contact point for a firm to obtain permits. Single contact points imply lower administrative burden as the farmer would therefore have to spend less time and effort obtaining required authorisations. The responses available are “There is such a single contact point and it is the same contact point as for other necessary registration/start-up procedures” (score zero), “There is such a single contact point, but it is not the same contact point as for other necessary registration/start-up procedures” (score 0.5), “There is no single contact point for environmental procedures and firms must contact more than one entity” (score one).

Figure 2.3. OECD Environmental Policy Stringency Indicator



Note: Numbers denote weights for each category. FIT=Feed in Tariff.
Source: https://www.oecd.org/economy/greeneco/how-stringent-are-environmental-policies.htm.

2.1.3. OECD Database on Policy Instruments for the Environment (PINE)

The OECD Database on Policy Instruments for the Environment (PINE) is primarily an inventory of policies and falls into the first bubble of Figure 2.1. While it does not contain a taxonomy, its database structure allows users to use queries to organise and present the data according to their interest.

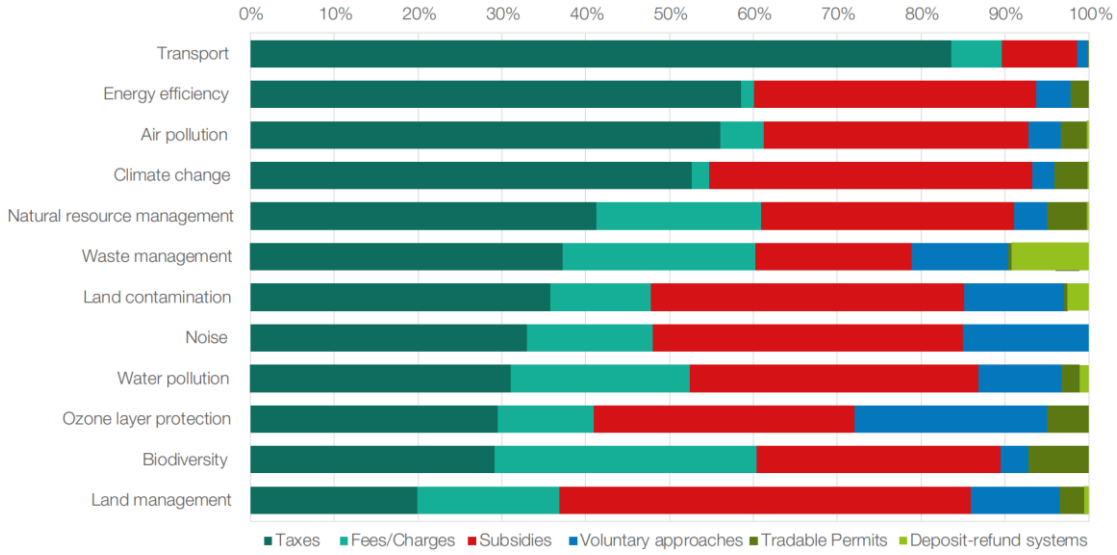
PINE gathers information on six policy types – fees/charges, taxes, subsidies, voluntary approaches, tradable permits and deposit-refund schemes (Figure 2.4).[3] It contains quantitative and qualitative information on 3 200 instruments relevant to natural resources and the environment in 90 countries. PINE is a relational database; rather than containing its own taxonomic structure it can be interrogated via structured queries (SQL).

The data fields collected differ for each policy type reflecting their specific characteristics (for example, entries for deposit-refund schemes have information on the refund amount). Minimum common descriptive information for each policy instrument is when it was introduced; what it applies to; the geographical coverage; the environmental domains it aims to address; the industries concerned; revenues, costs or rates; and exemptions. Links can be drawn between different policies in the database to facilitate analysis of instrument mixes used for environmental policy.

The PINE database is built on the contributions of a network of 200 country experts (including government agencies, research institutes and international organisations). Experts update the database in collaboration with the OECD each year through a dedicated portal that allows for adding, deleting, modifying, or validating policy information. The way data is collected and shared in PINE is a useful model for this work.

[3] https://www.oecd.org/environment/indicators-modelling-outlooks/policy-instrument-database/.

Figure 2.4. Environmental policy instruments in PINE by type

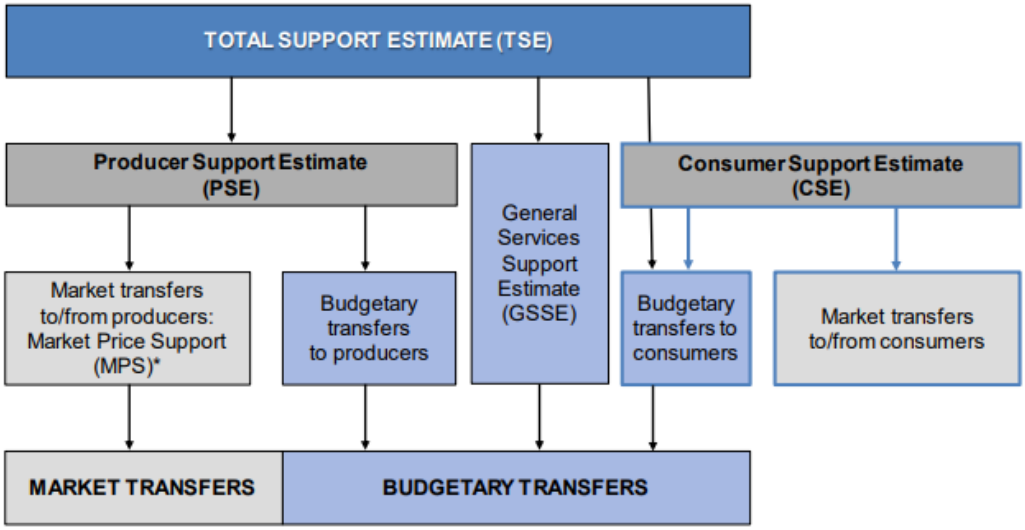


Source: https://www.oecd.org/environment/indicators-modelling-outlooks/policy-instrument-database/.

2.1.4. OECD Producer Support Estimate (PSE)

The OECD Producer Support Estimate (PSE) database is a taxonomy of agricultural policies. It falls into the second bubble of Figure 2.1. It contains categories and sub-categories of support defined according to how a policy is implemented (e.g. distinguishing between direct payments to producers and payments based on the use of variable inputs) (Figure 2.5). These categories are not in a hierarchy, and there is no single indicator derived from the PSE, though several indicators may be created from the quantity information in each category. For example, the categorisation uses economically relevant distinctions to identify, *inter alia*, those support types that are more or less likely to distort production and trade of agricultural products (OECD, 2022[1]).

Figure 2.5. Structure of the OECD PSE



Note: Each of the light blue boxes contain many sub-categories.
Source: OECD (2022[1]), *Agricultural Policy Monitoring and Evaluation 2022: Reforming Agricultural Policies for Climate Change Mitigation*, https://doi.org/10.1787/7f4542bf-en.

The PSE contains information on main agricultural policies, including agri-environmental schemes. A complementary taxonomy of agri-environmental regulation can provide a better picture of agricultural environmental policy effort by providing a more complete view of overall policy packages, rather than budgetary or regulatory policies in isolation.

2.1.5. George Washington University Taxonomy of Regulatory Forms

The George Washington University Regulatory Studies Center, as part of a cooperative agreement with the US Department of Agriculture (USDA), developed a taxonomy of regulatory forms (GW taxonomy) based on design elements informed by economic theory. The goal of the taxonomy is to estimate the impacts of regulation on agricultural industries, but the taxonomy itself is comprehensive and includes many regulatory forms not commonly seen in agriculture (Xie and Pérez, 2018[14]). There is no single indicator produced from the GW taxonomy, and it falls into the second bubble of Figure 2.1.

The authors of this taxonomy wished to improve on past research that mostly focused on a narrow set of instruments (such as market-based vs. command-and-control regulations) in specific policy fields. A well-defined, widely applicable catalogue of different forms of regulation provides greater opportunity to inform research on the relative effectiveness of different regulatory forms in addressing market and social problems.

Xie and Pérez's classification system identifies regulations by form in three tiers. The first tier has four broad categories: economic regulation, social regulation, transfers, and administrative regulation. The second tier breaks down each broad category. For example, social regulation includes command-and-control, market-based, and information-based regulation. The third-tier classification is more specific, including a total of 36 categories such as performance standards, means-based regulation, pre-market approval, and permitting (Table 2.1).

Table 2.1. The GW taxonomy of regulatory forms

First-tier form	Second-tier form	Third-tier form
Economic	Price	Benchmarking, Price ceiling/floor, rate of return, revenue cap
	Quantity	Obligation to serve, portfolio standards, rationing and quotas
	Entry and exit	Certification of need, licensing, exclusive permits, certification
	Service quality	Product identity or grades, quality levels
Social	Command and Control	Monitoring and reporting, performance standards, means-based standards, technology standards, permitting, pre-market notice, prohibitions
	Market-based	Bonds, marketable permits, subsidies, taxes and fees
	Information-based	Hazard warning, labeling, user fees, contingency planning
Transfer		Monetary transfer, tech transfer, user fees, knowledge transfer
Administrative		Definitions, government actions, organisational

Source: Xie and Pérez (2018[14]), "A Taxonomy of Regulatory Forms", https://regulatorystudies.columbian.gwu.edu/taxonomy-regulatory-forms.

The taxonomy has been used to examine the prevalence of different forms of regulation related to agricultural industries in a given year as well as regulatory changes over time. The authors expressed the intention to use the taxonomy and resulting dataset with other measures of regulation to empirically examine the impacts of different regulatory forms on agricultural productivity at the industry level.

The authors examine more than 700 examples of US regulations in the form of Code of Federal Regulation (CFR) parts.[4] They find that the most common USDA regulatory forms have to do with monetary transfers, monitoring and reporting (especially for pesticide use) and user fees and subsidies. Environmental Protection Agency (EPA) regulations that apply to agriculture are most commonly performance standards (again related to pesticide use), monitoring and reporting, permitting and other disclosure requirements.

[4] The CFR is organised as a hierarchy of which parts are the lowest level: Title->Volume->Chapter->Part. For example, Chapter I of Title 7 on Agriculture is associated with the Agricultural Marketing Service (part of the USDA).

The GW taxonomy embraces a broader definition of regulation than taken in this review. It includes subsidies, transfers, taxes, fees and market measures. It also allows for refined distinctions between regulatory elements that are relevant down to the level of specific rules. This reflects its objective of providing a comprehensive taxonomy that can decompose a large sample of legislative elements but is likely both too broad and too detailed for cross-country agri-environmental analysis.

2.1.6. Other policy taxonomies

In *Regulatory Policies in OECD Countries From Interventionism to Regulatory Governance*, the OECD sets out a categorisation of traditional and alternative regulations (Table 2.2, see also Table 1.1) (OECD, 2002[4]). This listing covers a relatively broad set of alternatives, notably voluntary measures. Voluntary approaches to climate change mitigation are growing in importance for sector-level commitments to emissions reductions. For example, Norway's government signed a voluntary agreement in 2019 with its two main agricultural organisations to reduce emissions and enhance removals by a total of 5 million tonnes of CO_2-eq over 2021–30 (OECD, 2022[15]). The US dairy sector has established a Net Zero Initiative to be climate neutral by 2050.[5] Farmers may also be involved with selling voluntary carbon offsets, for example connected with activities that store carbon in soils (carbon farming). Sector organisations may opt for voluntary measures, either self-enforced or in partnership with the government to pre-empt other regulatory alternatives or as part of social corporate responsibility strategies.

Table 2.2. A broad classification of regulatory alternatives from the OECD Reviews of Regulatory Reform

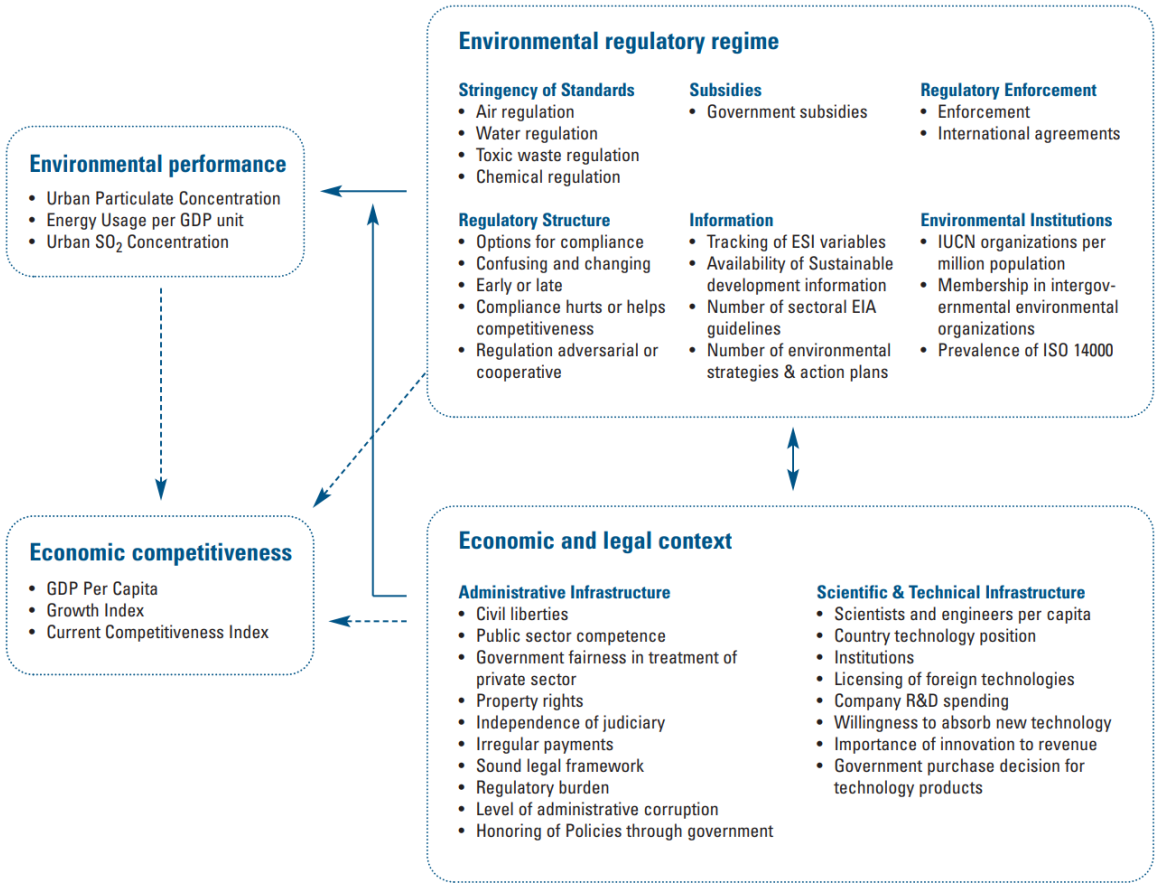
Regulatory type	Example	Notes
Performance-based regulation	Phosphorus Control to Prevent Eutrophication of Lake Okeechobee, Florida, United States (Goldstein and Ritter, 1993[16])	Performance-based regulation specifies required outcomes or objectives, rather than how they must be achieved. This form of regulation is thought to encourage innovation by virtue of the flexibility it gives to firms (Coglianese, 2017[17])
Process-based regulations	US FDA's Hazard Analysis at Critical Control Points (HAACP)	These require businesses to develop processes that ensure a systematic approach to controlling and minimising production risks. They are based on the idea that, given the right incentives, producers are likely to prove more effective in identifying hazards and developing lowest-cost solutions than is a central regulatory authority. Also called "management-based" regulations
Co-regulation	Sampling of Containerised Hay and straw in Australia	The regulatory role is shared between government and industry, usually through legislative reference or endorsement of a code of practice.
Economic instruments	Dutch Phosphate trading rights	These tools – taxes, subsidies, tradable permits, vouchers and the like – operate directly through the market, thus harnessing market incentives and avoiding the substantial potential for distorting market incentives inherent in most forms of regulation.
Guidelines	Best practice guidelines for reducing greenhouse gas emissions from livestock	Guidelines by a regulatory authority, set out processes or providing interpretations to aid understanding of government objectives by business and citizens. They may be designed to accompanying existing regulations.
Voluntary approaches	Voluntary agriculture carbon markets	Arrangements initiated and undertaken by industry and firms, sometimes formally sanctioned or endorsed by government, where participants take on self-imposed requirements which go beyond or complement the prevailing regulatory requirements.

Note: HAACP: https://www.fda.gov/food/guidance-regulation-food-and-dietary-supplements/hazard-analysis-critical-control-point-haccp. Co-regulation: https://www.agriculture.gov.au/biosecurity-trade/export/controlled-goods/plants-plant-products/ian/02/11. Economic instruments: https://www.cbs.nl/en-gb/news/2019/07/phosphate-output-from-livestock-manure-down-again/phosphate-rights-trading-system. Guidelines: https://www.europarl.europa.eu/RegData/etudes/note/join/2014/513997/IPOL-AGRI_NT(2014)513997_EN.pdf. Voluntary approaches: https://extension.psu.edu/carbon-markets-voluntary-versus-mandatory
Source: OECD (2002[4]), *Regulatory Policies in OECD Countries from Interventionism to Regulatory Governance*, https://doi.org/10.1787/9789264177437-en.

[5] https://www.nmpf.org/issues/sustainability/climate-policy/#:~:text=U.S.%20dairy%20has%20set%20a,of%20all%20sizes%20and%20regions.

Esty and Porter (2002[18]) produced an early, widely used index of environmental performance based on institutional and quality criteria. The objective was to explain differences in national environmental outcomes based on environmental regulation as well as intuitional structure and rank countries according to their performance. The component of their analysis having to do with the overall environmental regulatory regime was termed the Environmental Regulatory Regime Index (ERRI) which contained representations of six different elements, including stringency of standards, use of subsidies, enforcement, regulatory structure, information collection, and institutions. The ERRI in turn is a component of their Environmental Performance Index (EPI) that also contains some outcome, macroeconomic and contextual indicators (Figure 2.6).

Figure 2.6. Determinants of environmental performance in the Environmental Performance Index



Source: Esty and Porter (2002[18]), "Ranking National Environmental Regulation and Performance: A Leading Indicator of Future Competitiveness?", https://www.hbs.edu/ris/Publication%20Files/GCR_20012002_Environment_5d282a24-bb10-4a9a-88bd-6ee05e8c6678.pdf.

Esty and Porter found considerable variation in the environmental regulatory regimes in different countries. Though these results are now out of date, it was one of the first environmental performance indicators of its kind whose values could be analysed with respect to measurable outcomes such as emissions levels and GDP.

Dasgupta et al. (2010[19]) constructed an index of environmental regulations in the agricultural sector, based on country reports prepared for the United Nations Conference on Environment and Development on the existing environmental regulations facing the agricultural sector. Each country report is based on survey questions prepared under UNCED guidelines, making a cross-country comparison possible. The reports provide information about the state of the environmental regulatory framework, focusing on existing environmental policies, legislation, control mechanisms, and enforcement. Using the information gathered, a quantitative index was developed for a set of 31 countries by assigning the answers on each of

25 questions for five sectors a score from 0 to 2. Each question posed was answered with regard to water pollution, air pollution, land use, and biodiversity, and the scores were added to yield an index with a maximum of 250.

The World Economic Forum (WEF) produces an annual index of environmental regulatory stringency. It is produced via a survey of business leaders, who are asked: "How would you assess the stringency of your countries' environmental policy? (scale: 1=very lax − 7=among the world's most stringent)." This is part of their World Executive Opinion Survey. This indicator is available for more than 100 countries on a yearly basis since 2004. This is solely a perception index and does not have an empirical component.

Observing that the field of regulation lacks a clear and widely accepted conceptual taxonomy of regulatory design, Coglianese (2017[17]) proposes a taxonomical scheme for distinguishing between performance-based instruments. Performance-based regulations specify a required outcome but leave the means of achieving that outcome to the discretion of the regulated entity. These are commonly contrasted with means-based regulations that require a certain set of actions to be undertaken or avoided, though Coglianese notes that the distinctions are more subtle and varied than this simple dichotomy would suggest. This is a relatively novel basis for making a primary distinction between regulatory types; most of the other examples found in this review start with implementation characteristics such as command-and-control vs. market-based measures, or distinguish between policy domains such as economic, social or administrative rules.

Coglianese characterises performance standards according to their specificity (loose or tight), proximity between the legal basis and the regulatory goal (close or distant), how performance is determined (measured vs. predicted), its basis (ideal vs. feasible), the unit of regulation (individual vs. aggregate), and where lies the burden of proof (regulator vs. regulated). The lesson from this study is that there is not a general taxonomy of regulatory types that can serve all analytical purposes. To be useful, a taxonomy of agri-environmental regulation must correspond to the intended use.

2.2. Climate-specific databases and indices

There is a good deal of interest in measuring policies and progress with respect to climate change objectives. International agreements such as the Paris Agreement are motivated by this shared and common mission to reduce climate change-related emissions. As well, the burdens of any climate policy likely extend beyond national borders, either as part of an international agreement or as a combination of unilateral national programmes. Countries regulate within their own borders but, policies might generate distributional impacts within each country *and* between countries (Fullerton and Muehlegger, 2020[20]).

This section reviews existing work to quantify and compare climate change policies and progress. Existing climate indices take a number of different approaches, making use expert opinion, ratification of international agreements, policy coverage, and climate outcomes. They have been used to track policy progress, to evaluate the effects of climate policies and to describe the scope of approaches taken by governments to combat climate change.

2.2.1. OECD Climate Actions and Policies Measurement Framework (CAPMF)

The CAPMF was developed under the International Programme for Action on Climate (IPAC) (Nachtigall et al., 2022[21]). It is a structured and harmonised climate mitigation policy database. It provides 128 policy variables, grouped into 57 policy instruments and other climate actions covering the 52 IPAC countries from 2000-2020. Sources populating the CAPMF include the OECD Policy Instruments for the Environment (PINE) database, the IEA Policies and Measures database, the ITF Transport Climate Action Directory, the United Nations Statistical Division (UNSD), the United Nations Framework Convention on Climate Change (UNFCCC) and the World Bank.

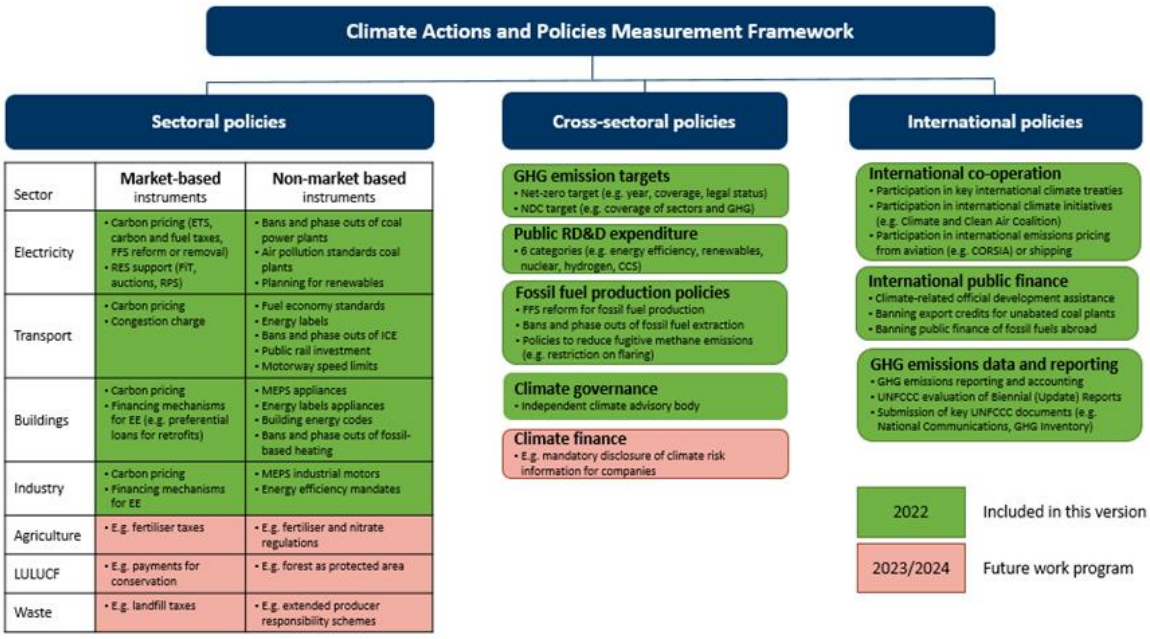
The CAPMF covers both climate policies with an explicit intent of advancing mitigation as well as non-climate policies that have an expected positive effect on mitigation. These include sectoral, cross-sectoral and international policies with market-based instruments such as taxes or subsidies for zero-carbon technologies, non-market-based instruments such as standards or energy labels, and other climate actions such as short-term and long-term emissions targets or climate governance.

The structure of the CAPMF is similar to the EPS index, layered under a top-level structure distinguishing between sectoral policies, cross-sectoral policies and international policies (Figure 2.7). That is, policies are categorised as market-based, non-market-based, or other. The scope of the CAPMF includes market-based instruments in agriculture, but no such policies are currently identified.

The CAPMF normalises each policy variable based on the in-sample distribution across all countries and years. Each policy variable is assigned a stringency level between 0 and 10, defined as the degree to which climate actions and policies incentivise or enable GHG emissions mitigation at home or abroad. For example, if a country has increased its carbon tax, this will be reflected in a higher policy stringency. Policy variables in the same grouping are assigned equal weights to arrive at an aggregate representation.

Like the EPS, the CAPMF focusses on climate change policies and actions which are based on, and embodied in, national and international laws and institutions. The CAPMF does not feature indicators based on direct or indirect outcomes or perceptions (as in the Climate Change Performance Index or WEF's Regulatory Stringency Index). As is the case for the EPS, the CAPMF measures the scope and ambition of policies and actions that countries have adopted to mitigate climate change, but does not take into account their enforcement. Sectoral policies for agriculture and land use change (AFOLU) are not yet included in the CAPMF.

Figure 2.7. CAPMF structure



Note: Modules for future work program are only indicative. Abbreviations: LULUCF: Land use, land-use change and forestry; ETS: Emissions trading system; FFS: Fossil fuel support; FiT: Feed-in-tariff; RPS: Renewable Portfolio Standard; EE: Energy efficiency; ELV: Emission limit value, ICE: Internal combustion engine; MEPS: Minimum energy performance standard
Source: Nachtigall et al. (2022[21]), "The climate actions and policies measurement framework: A structured and harmonised climate policy database to monitor countries' mitigation action", https://doi.org/10.1787/2caa60ce-en.

2.2.2. The Climate Change Performance Index

The Climate Change Performance Index (CCPI) is produced by Germanwatch and updated yearly as an annual report. It is an indicator based on an inventory of policy and other data organised in categories, so falls into the third bubble of Figure 2.1. Climate change performance is measured by four factors: GHG emissions (40%), renewable energy (20%), energy use (20%) and climate policy (20%). Non-policy data is sourced from the International Energy Agency (IEA), PRIMAP, the Food and Agriculture Organization (FAO), and the national GHG inventories submitted to the UNFCCC

Climate policy includes measures of both national and international climate policies, each given a weight of 10% in the calculation of the CCPI as a whole (Burck et al., 2011[22]). While policy has only 20% of the total weighting, it can be important in short-term movements of the index as other elements such as GHG emissions have relatively slower trends.

The Climate Policy element of this index is constructed via surveys of NGOs, academics and think tanks regarding the number of climate change policies in a country and their perceived effectiveness compared to targets and emissions reduction potential. It is not sector specific. This approach suffers from all the usual concerns regarding expert surveys; subjectivity and inconsistency; bias and strategic reporting; limited connection to evidence and small sample size.

2.2.3. The Climate Laws, Institutions and Measures Index

The Climate Laws, Institutions and Measures Index (CLIMI) is produced by the European Bank for Reconstruction and Development (EBRD). CLIMI is an index based on an inventory of policies and measures organised into a taxonomy, so falls into the third bubble of Figure 2.1. CLIMI uses data drawn from National Communications to the UNFCCC, cross-checked against other international databases, national legislation, and expert opinion. Policy instruments are classified according to the structure set out in National Communications: (1) cross-sectoral fiscal or regulatory policies, including carbon trading and emissions taxes; (2) sectoral fiscal or regulatory policies and targets in energy supply/renewables, transport, buildings, agriculture, forestry, and industry; and (3) additional cross-sectoral fiscal or regulatory measures (EBRD 2011: 60).

CLIMI uses information in the National Communications (NCs) made by countries to the UNFCCC to build a policy inventory. This provides a kind of “meta consistency” across countries in that all reporting nations face the same incentives to report, but policies in the NCs are not always clearly described and many are only tangential to climate. As a result, the CLIMI cannot not control for thematic content of policies, their relevance or their impact on climate change, leaving its scope poorly controlled. There is still information in the index, but there is potentially a low signal/noise ratio and the quality of the index can be hard to evaluate.

2.2.4. Other climate indices

Sauter (2014[23]) produces an index of regulations related to CO_2 by searching the ECOLEX database of environmental law for any mentions of CO_2, identifying 379 measures. These are converted to an index for each of 55 countries by simple summation, producing an index of policy presence. This, this is an indicator based on an inventory but without an explicit taxonomy associated with it. This index is compared with measures of national CO_2 emission intensity and efficiency. He finds a correlation between his policy index and these measures of CO_2 intensity and efficiency, with some important caveats.

Surminski and Williamson (2012[24]) sound a note of caution regarding the potential misuse of climate policy indices. They note that comparing the quality, breadth and depth of climate policies, measures, laws and institutions across a wide range of countries is neither simple nor uncontroversial. Also, the potential importance of subnational or public/private initiatives that may be omitted, and uneven coverage between developed and developing countries could bias results. Differences in implementation can make the effects of similar commitments and policies uncertain.

2.3. Conclusions regarding structuring a taxonomy of regulation

This report has reviewed several policy taxonomies and indexes based on different methods of accounting for regulations across countries. Some of these build index numbers from policy counts, with some limited scope for adjustment for policy quality. These attempt to solve a key challenge for economic analysis of regulation – finding a valid measure of the cumulative amount of regulation (Carey, 2016[25]). A simple inventory of the complete set of regulatory policies in each country is not helpful because that encompasses a large number of unique and varied approaches that would defy easy analysis (Compston, 2013[26]). That is, collecting all regulations in an inventory is not the goal – it is to collect a well-defined common set of regulations.

A taxonomy adds structure to an inventory by identifying and classifying main distinctions in types of regulation. This review has identified some existing approaches to making these distinctions, such as the EPS' differentiation between market- vs. non-market-based regulations or the GW taxonomy based on economic, social transfer or administrative forms. A taxonomy structured to a specific analytical purpose is likely to add more value than one that is generic in nature. This requires accounting for the experience in measuring regulatory costs and burden, and in linking with outcomes as done in Sections 4 and 5.

Finding a common frame of reference can help make sense of the unique and varied approaches taken by each country to regulatory policy. Such a common frame can be established by defining a subset of policies that could in principle be present in all countries and which can be taken to represent a sufficiently wide range of agri-environmental or climate change regulations. This does not mean that any unique regulations that lie outside this subset are not important, just that this subset provides a good proxy for overall regulatory effort. This set of policies can serve as an indicator of policy scope for the country. However, policy scope alone is an incomplete indicator; it does not track the effectiveness, cost or coverage (in terms of population affected) of the regulatory regime and would likely be a poor measure of progress over time. Additional elements are needed for a taxonomy to cover these relevant dimensions.

An approach that can deal with regulatory complexity and measure progress in policy development while being practical and pragmatic was proposed by Knill et al. (2012[27]). They approach the problem in three stages. First, whether a regulation exists for a specific target or not (such as methane emissions), termed policy presence. The next stage includes the regulatory instruments (such as emission caps, manure storage requirements, or manure application restrictions) in place to achieve the regulatory targets. The third stage has to do with the concrete setting or application of the instruments (such as the specific emission limit or its scope of application)

In addition, to conceptualise the magnitude and direction of policy change, Knill et al. define density and intensity change dimensions. Density change concerns changes in the degree of regulatory penetration and internal differentiation of a policy field. It measures how the numbers of policies or instruments change over time. Intensity change concerns changes in the stringency of the policy instruments, including the levels of regulatory standards, for example, emission limits, and their coverage, such as number of farms. The criteria outlined by Gruère and Shigemitsu (2021[28]) related to policy design, policy implementation capacity and policy results also provide relevant guidance for measuring policy progress.

The approach by Knill et al. (2012[27]) assumes that more targets and more instruments always mean a better outcome. This is unlikely to be true for agri-environmental regulations: a single overall emissions target may provide more flexibility than having a separate target for each GHG and would in principle lead to the same outcome. Also, regulatory simplification where fewer regulations achieve the same objective is generally viewed as a positive outcome. That said, the idea of having different levels of the taxonomy serve different overall functions with respect to setting the scope and describing features is sound, as is the idea of using simple policy counts where possible.

In summary, past experience shows value in creating a taxonomy whose structure can inform regarding the scope of policy activity according to a common frame, and whose contents contain a mix of quantitative and qualitative information to express regulatory depth. The next section investigates how OECD work on regulatory practices could be relevant to qualitative characteristics and to make sure that a taxonomy is useful for subsequent policy analysis.

3. OECD work on regulatory best practices and its relevance for assessing environment-related regulations in Agriculture

OECD work on regulatory design provides a sound basis for investigating and improving the quality of agri-environmental regulation. Past work on administrative burden, assessment and coordination are particularly relevant.

OECD work on regulatory best practices can provide useful insights that serve as a guide to reform and improvement for regulators.[6] The best practice guidelines expressed in the 2012 Council Recommendation and subsequent analysis provide a structured approach to regulatory design that can help inform the development a regulatory taxonomy or index (Deighton-Smith, Erbacci and Kauffmann, 2016[29]; OECD, 2012[30]; OECD, 2021[31]) (Box 3.1). Recent work has investigated the connection between regulations and innovations and how digital technologies can affect regulatory design and implementation. This section briefly reviews the OECD Best Practice Guidelines, and the related Council Recommendation, along with more recent thinking in the latest OECD Regulatory Policy Outlook and the new OECD Recommendation on Agile Regulatory Governance to Harness Innovation.

Box 3.1. The OECD Regulatory Policy Committee and the Steering Group on Measuring Regulatory Performance

The Regulatory Policy Committee (RPC) was created by the OECD Council on 22 October 2009 to assist member and non-member economies in building and strengthening their regulatory reform efforts. It is a platform to help countries adapt regulatory policies, tools and institutions, learning from each other's experience. The Regulatory Policy Committee is supported by staff within the Regulatory Policy Division of the Public Governance and Territorial Development Directorate. More information about OECD work on regulatory policy, including information about how governments can design, apply and enforce better rules can be found at www.oecd.org/regreform.

The Steering Group on Measuring Regulatory Performance advises the Committee on the work of the Measuring Regulatory Performance programme. The Measuring Regulatory Performance programme aims to help OECD countries demonstrate how improvements to regulatory governance deliver actual benefits to business and citizens, and to measure regulatory performance to diagnose success and failures, improve regulatory policies, programmes and tools, and to communicate progress. Further information on the OECD Measuring Regulatory Performance programme is available at https://www.oecd.org/gov/regulatory-policy/measuring-regulatory-performance.htm.

[6] "Quality" itself is a bit of a fraught term. While it can imply assessment, it may be better understood as simply describing certain characteristics of regulations. In particular, it is a counterpoint to "quantitative" aspects of regulations such as costs that are more easily expressed as numbers. To the extent that OECD work has identified some characteristics as being desirable, a normative element to the description of regulations may be introduced.

Ensuring that regulations are “climate change ready”, “digital ready” and “innovation friendly” is an emerging priority that will challenge old approaches. While consideration of digital and innovation in regulations has taken place mainly outside the context of agriculture, many of the same issues are relevant to the sector and many of the insights are transposable to agri-environmental regulation. Taking account of these factors can help ensure this work is forward-looking and can help policy makers meet the challenges of the next decades.

For example, the European Union has developed a Strategic Foresight tool as part of its better regulations toolbox (EC, 2021[32]). This tool encourages regulators to pay attention to megatrends that are likely to have significant long-term influence. One of these identified megatrends is continued climate change and environmental degradation. This tool also advocates for the use of long-term scenarios to stress test policy designs.

3.1. OECD Best Practice Guidelines for Regulations

The existing concept of “better regulation” used by the OECD is grounded in a framework of institutions, tools and processes developed over the last 30 years. This work is codified in the 2012 Recommendation of the Council on Regulatory Policy and Governance and a substantial amount of work after the Recommendation has broadened and updated this to meet current challenges (OECD, 2012[30]; OECD, 2021[31]).

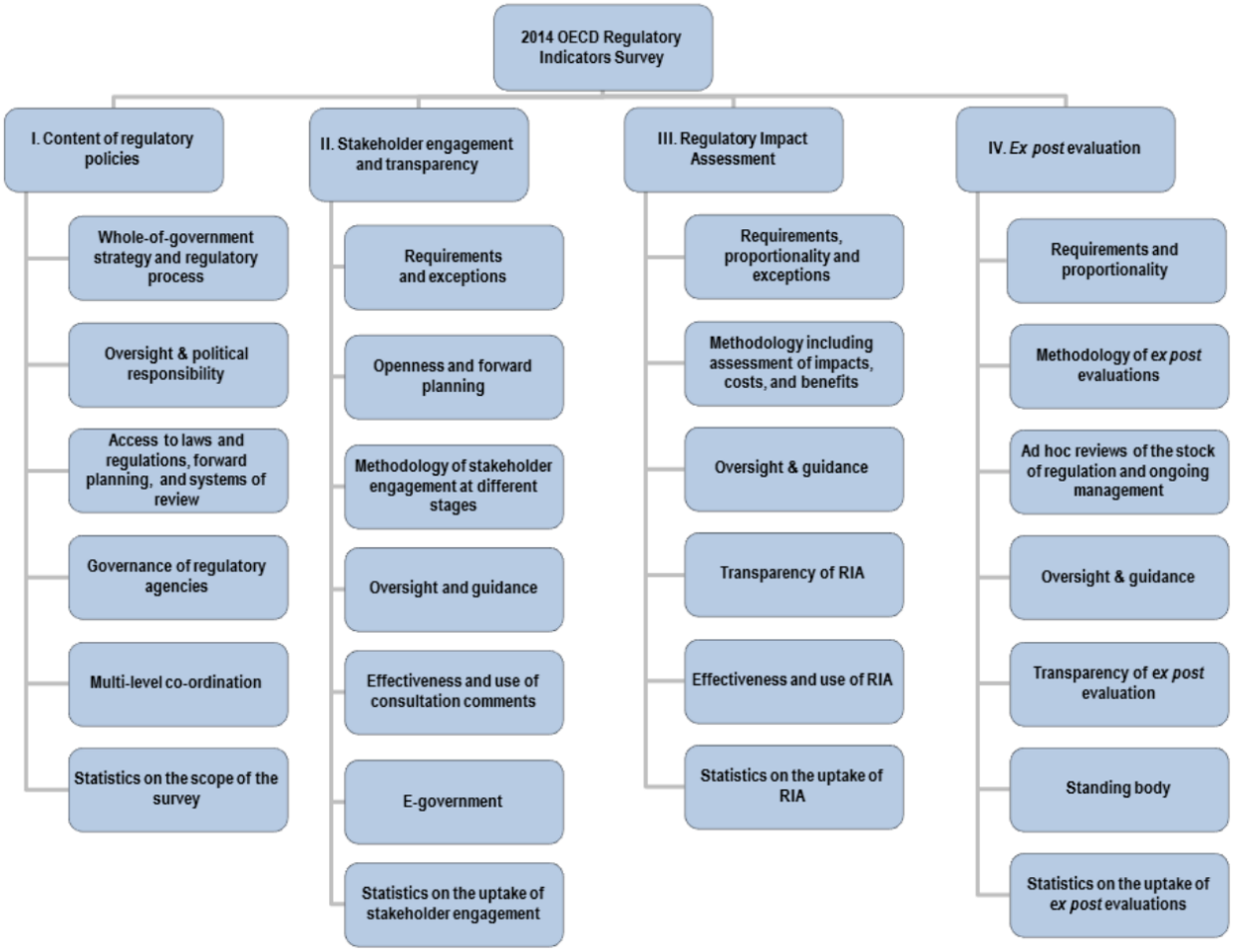
The definition of regulatory quality used by the OECD covers governance, efficiency (regulations do not impose unnecessary costs), coherence (when the total scope of the regulatory regime is considered) and simplicity (the regulation in itself and the rules for its implementation should be clear and easy to understand) (OECD, 2015[33]).

The main thrust of the Recommendation is that regulatory design should be guided by a central policy. That policy should have clear objectives with the tools needed to ensure that regulations maximise net social benefits. This includes processes that are transparent and participatory, proper oversight, evaluation and reporting of results. Regulations should be coherent across the whole of government, properly address risks, and follow and support international standards. The Best Practice guidelines elaborate on these points with specific guidance.

The OECD tracks progress towards implementing regulatory best practice, using a survey to produce the Indicators for Regulatory Policy Governance (iREG) that captures the quantifiable elements of the recommendation (Arndt et al., 2015[34]) (Figure 3.1). The latest of these is reported in the *OECD Regulatory Policy Outlook 2021* (OECD, 2021[35]).

The iREG survey and the OECD guidelines take a broad view of regulations that cover the whole of the economy. Not all these elements are required to sufficiently characterise agri-environmental regulation. Identifying those elements that are of use in this context will help ensure that the content of a taxonomy of agri-environmental regulation is practical and contributes to policy improvements.

Figure 3.1. Structure of the OECD Regulatory Indicators Survey



Source: Arndt et al. (2015[34]), "2015 Indicators of Regulatory Policy and Governance: Design, Methodology and Key Results", https://doi.org/10.1787/5jrnwqm3zp43-en.

3.2. Subsequent work on regulations

The OECD Regulatory Policy Outlook 2021 builds upon the 2012 Recommendation with a "regulatory policy 2.0" agenda to create a more agile framework for better regulation. The "Regulatory Policy 2.0" agenda identifies new dimensions of regulatory design to reflect the needs of the modern era. This includes:

- Regulatory coherence, aligning regulatory governance with strategic governmental goals such as the Sustainable Development Goals.
- International regulatory co-operation, to improve the effectiveness of regulatory frameworks. This has become ever more evident with digitalisation that ignores national or jurisdictional boundaries while drastically increasing the intensity of cross-border flows and transactions.[7]
- A whole-of-government approach to regulatory delivery.

[7] The OECD Trade and Agriculture Directorate has also carried out work on International Regulatory co-operation. See for example (von Lampe, Deconinck and Bastien, 2016[82]).

The OECD Recommendation on Agile Regulatory Governance to Harness Innovation was agreed in 2021 (OECD, 2021[31]). It describes how regulations can be designed to encourage innovation as well as cope with a rapidly changing economic landscape. Among other things, it recommends that governments:

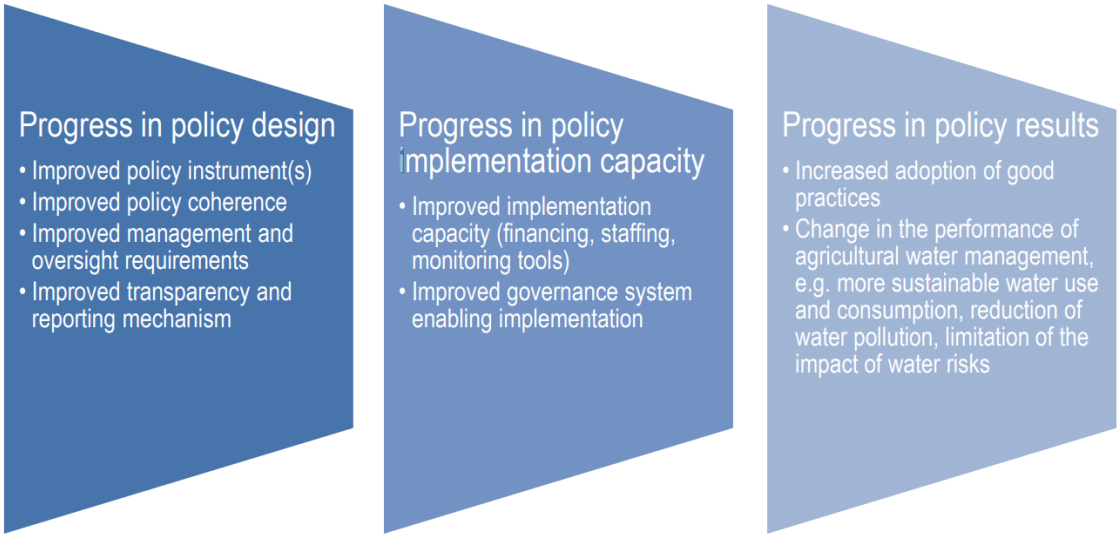
- *Develop more flexible, iterative and adaptive ex ante and ex post assessments*, capitalising on the opportunities provided by digital technologies to improve the quality of evidence. Continuous monitoring of the stock of regulations could help governments assess whether regulation remains fit for purpose, effective and deliver the policy objectives and undertake regulatory revisions when necessary.
- *Foster coherence and joined-up approaches* through effective co-ordination between the supra national, the national and sub-national levels of government to cope with the cross-cutting nature of innovation.
- *Develop forward-looking governance frameworks* and regulatory approaches to help identify opportunities and risks at an early stage and to steer, under the conditions of trust, the sustainable deployment of technology.
- *Extend the traditional regulatory toolbox* by incorporating more agile regulatory approaches such as outcome-based regulations, fixed-term regulatory exemptions (e.g. regulatory sandboxes), co-regulation and non-regulatory approaches such as voluntary codes or standards.
- *Develop new enforcement strategies to promote compliance*: governments should privilege responsive and compliance-promoting approaches to regulatory delivery that are focused on outcomes and based on risk-proportionality rather than focusing primarily on the letter of the rules.
- *Use digital technologies to develop innovative approaches* that allow for more effective and efficient rulemaking, compliance monitoring and enforcement (e.g. data-driven regulation) (OECD, 2021[35]).

OECD work has identified four critical challenges that emerging technologies pose to rulemaking activity. The two of these most relevant for the purposes of this study are the pacing problem and designing “fit for purpose” regulatory frameworks. Digital technologies tend to develop faster than the regulation or social structures governing them. While the ability of regulation to keep up with change is not new, there is a growing consensus that digital technologies are making this situation more acute. Moreover, traditional distinctions between markets, sectors, consumers and producers are becoming blurred.[8]

OECD work in the context of water policy also provides guidance regarding what elements are needed to describe policy progress (Gruère and Shigemitsu, 2021[28]). That work describes how agriculture policy progress can be measured in terms of policy design, implementation capacity, and policy results (Figure 3.2). According to that study, assessing progress in policy design involves reviewing the specific features of policy changes based on clear criteria against a reference text for comparison regarding policy alignment. Progress in policy implementation capacity is through efforts to fill technical, financial and human capacity gaps, or to address governance weaknesses that may constrain policy implementation. Progress in policy results requires evaluating how a policy change leads to changes in agricultural management practices or environmental outcomes.

[8] This blurring of lines between markets, sectors, consumers and producers can be seen in the agriculture context in the importance of food systems approach to address the “triple challenge” of food security, resilience and sustainability (OECD, 2021[81]). Where environmental problems related to agriculture have in the past been considered an issue to be addressed mainly through agri-environmental policies, a food systems approach opens the possibility to use other instruments such as promoting changes in consumer behaviour or promoting voluntary standards among firms.

Figure 3.2. Three types of policy progress



Source: Gruère and Shigemitsu (2021[28]), "Measuring Progress in Agricultural Water Management: Challenges and Practical Options", https://dx.doi.org/10.1787/52b4db7e-en.

3.3. Conclusions regarding regulatory design

OECD regulatory advice is mainly focussed on governance and economy-wide regulations, not all of which are relevant to a sector-specific investigation of regulations with a specific aim (climate change, environment). The purpose here is not to apply the guidelines specifically to the agriculture sector, but to identify what information elements may be useful to collect. This also helps ensure that the work carried out here is coherent with and supportive of other OECD work outputs.

Existing OECD guidelines and recommendations identify design elements of regulations that may be applicable. Below is a notional list. The literature on quantitative elements such as costs and connection with outcomes is reviewed in Sections 4 and 5.

- *Administrative burdens associated with permitting/licensing procedures*, including delays, cost and number of administrative bodies.
- *Administrative burdens associated with compliance*, including book-keeping, reporting, and information collection, number of regulations and duplication.
- *Existence, quality control and features of Regulatory Impact Assessments*. This includes scope of RIA, identification of quantitative costs and benefits, assessment of compliance mechanisms, use of written guidance, independence of assessment body.
- *Methods of ex post evaluation*, including assessment of costs, conformity with international rules and norms.
- Existence of mechanisms for public and stakeholder engagement in the regulatory process, including citizens and innovative small and medium-sized enterprises (SMEs) throughout the policy cycle.
- *Degree of co-operation across policy-making departments* and regulatory agencies as well as between national and sub-national levels of government.
- *Adoption of data-driven approaches* to identify, assess, and manage risks, and revising existing risk governance frameworks as appropriate.

- *Integration of enforcement-related considerations* in legislative proposals and related assessments.
- *Degree of co-operation* among authorities leading investigations and enforcement of regulations.

With respect to the proposed development of a taxonomy of agri-environmental regulations, these design elements are not a first priority, but designing the taxonomy keeping future opportunities in mind for inclusion of this kind of content is prudent. The survey approach taken by DEEP provides a relevant example of similar data collection and analysis.

4. Measuring regulatory cost and burden

The information on the cost of regulation is partial and heterogenous. A taxonomy of agri-environmental regulation should be structured to take advantage of what information is available to investigate regulatory costs and burden.

The previous sections of this report described best practices for regulations, investigated examples of how agri-environmental and climate taxonomies and indexes have been constructed in the past, and made some observations on the characteristics and potential structure of an agri-environmental regulation taxonomy with a specific focus on climate change. This section investigates evidence regarding the different costs associated with regulations. This, combined with the following section on effects of regulation, is intended to determine what information is feasible to include in a regulatory taxonomy and how to advance towards an implicit carbon price associated with these policies.

The costs of regulation are measured to address concerns about regulatory burden, cost-effectiveness and net social benefit. Understanding the cost implications of regulations can shed light on the abatement costs of firms as they relate to specific outcomes. This can be a pathway to quantifying the implicit price of GHG emissions reductions when such reductions are achieved through regulations. More generally, policy makers evaluate the costs of regulations, either *ex ante* or *ex post* as an evaluation criteria in the course of policy design and selection processes.

The costs of regulations can be divided into direct compliance costs and other administrative costs, whether they are borne by the regulated firm or the regulating agency. The US Environmental Protection Agency broadens the definition of costs to include social opportunity costs, but this element is not considered in this literature review (National Center for Environmental Economics, 2014[36]).[9]

A complete breakdown of the cost elements of regulations is provided by (Renda et al., 2013[37]) in a report prepared for the European Commission. This study breaks down direct, indirect and enforcement costs of regulations into different components and discusses different methods by which they may be assessed.

In general, there are few examples of agri-environmental regulation directly targeting climate change (Verschuuren, 2017[38]). In addition, quantifying the cost of environmental regulations to assess policy effectiveness has been called “a missing link” in the literature (Isik, 2004[39]). Most articles on the costs of environmental regulation use examples outside the agricultural sector (Chen, Ji and Jin, 2022[40]). Google Scholar was used to search the terms related to “agriculture” “environment”, “regulation” and “climate change” to identify existing literature for this part of the literature review.[10] Research was retained for the review if it concerned a regulatory type considered, and produced an explicit cost estimate.

[9] While these costs are potentially important, they are complex to measure and use in an international context.

[10] Related terms were also employed. For example, terms such as “livestock” and “farm” were used to replace “agriculture” in some searches. The total number of search terms and variations was too numerous to fully list here.

4.1. Direct compliance costs

Regulations typically either mandate or prohibit certain activities in a way that alters the behaviour of the regulated firm when compared with a situation without regulation. They restrict the decision-space of firms, and this implies some financial cost as firms must maximise their profits within this restricted set of production options rather than in an unconstrained manner.

Compliance costs broadly include operational costs (including input and labour costs), capital costs related to investments or disinvestment in equipment and foregone production and profits (opportunity costs) (Menghi et al., 2014[41]). Information on compliance costs is collected in a variety of ways, including farm accounting data, expert opinion, simulation models, and stakeholder consultation.

A study of the additional costs imposed by cross compliance in the EU CAP found considerable variation across countries (Jongeneel et al., 2007[42]). Jongeneel et al. is based upon the findings of ten "national reports" which were prepared by project partners in each of these countries. There was not a single method used, and different national reports may rely on literature reviews, expert interviews, focus groups, surveys, or official records.

The authors consider the cost of requirements that go beyond statutory management requirements (SMRs) such as for Good Agri-Environmental Condition (GAEC). This is because SMRs are mandatory outside of the cross-compliance system. Compliance costs related to the Birds and Habitats directives varied between EUR 33/ha and EUR 190/ha. Costs for the Nitrate directive were reported in different ways; EUR 205/head of dairy cow for manure storage and spreading costs in France, EUR 120-175/ha in additional land rent costs in Germany, EUR 0.11-0.13/kg live weight meat for pigs in Italy, EUR 40 million total for the dairy sector in the Netherlands, EUR 29 million for the United Kingdom and EUR 500-750/cow in Poland.

The same study estimates SMR costs related to the Nitrates Directive at EUR 6 300 for an average intensive dairy farm in the Bretagne area, and up to EUR 30 000 per average intensive beef farm located in a French nitrate vulnerable zone. In the Netherlands, the cost was EUR 2 100 for an average dairy farm, and EUR 5 700 for intensive livestock production. In contrast, arable farmers could realise a EUR 3 000 per average farm benefit from the regulation.

An EU report investigating the effects of regulation on competitiveness evaluated the compliance costs of regulations in several EU countries and trading partner countries. The study used a typical farm approach where one to three model farms are defined to represent the most common farm type for a specific product in a specific country or region (Menghi et al., 2014[41]). The study takes into consideration costs of land, labour and capital, along with a "non-factor" residual taken as the difference between total costs and the other three factors.

The study found that compliance costs for dairy, beef meat and sheep meat producers, the costs and benefits of compliance with the Nitrate Directive range between 0% and 2.1% of total costs among typical farms in the countries investigated. Differences exist among the sectors. Pork meat and broiler meat producers are affected by both the Nitrate Directive and the Integrated Pollution Prevention and Control Directive (2010/75/EU). The costs and benefits balance ranges between 0% and 4.7% of total costs among the typical farms of the countries investigated. Wheat, apples and wine grapes producers are mainly affected by the Nitrate Directive, the Directive on Plant protection products, the Directive on Sustainable use of pesticides, and the GAECs. The costs and benefits balance ranges between 0% and 4.1% of the total costs in the countries investigated.

Menghi et al. emphasise the differences between farm types and countries in the results. In several cases, compliance with regulations can reduce costs, such as when it sensitises farmers to organic N content in manure. The response to the Nitrates directive in the Netherlands (for example), which has intensive, land-constrained production can be expected to be very different from that of Poland. There are factors that are country-specific and factors that are due to the heterogeneity of farms.

The approach taken by Menghi et al. (2014[41]) is a practical method to generate information on the costs of regulations. It is data intensive and requires local expertise to define the needed set of model farms, but the results are consistent across countries and grounded in economic theory. Expert opinion plays a substantial role, but it is structured around a common set of tools for evaluation. Unfortunately, the results show that cost estimates are not generalisable beyond the national level; there are significant variations

between countries, regions and farms for structural reasons that would make an average cost measure suspect.

A US study of the effects of regulations on productivity found that regulations can have a negative impact on productivity growth. This work is based on the idea that the form a regulation takes combined with the context in which it operates are important factors determining their outcomes (Balla et al., 2018[9]). The authors find that that growth in total regulation has a negative relationship with land productivity (yield) growth, and the relationship differs depending on the form of regulation. Growth in command-and-control regulations and entry-and-exit regulations are most negatively associated with yield growth. A one percentage-point increase in the growth of command-and-control regulatory restrictions is associated with approximately 0.3 percentage-point decrease in yield growth.

Njuki (2013[43]) applies a Bayesian framework and directional distance function to USDA data to estimate the economic impact associated with hypothetical regulation reducing emissions in the US dairy sector. He found that foregone output following regulatory intervention implied revenue losses ranging from 1.8% to 13.1% between 1978 and 2007. Significant differences between regions were observed. Dairy producers in the northeast part of the country had the highest marginal abatement costs, at USD 42.7 per tonne CO_2-eq while dairy operations in California had a MAC of USD 20.9.

The cost of a new regulation regarding emissions to air from medium- and large-sized dairy operations in California (US) was estimated *ex ante* by the regulating agency at USD 61.8 million per year on dairy farms (between USD 22-77 per cow). A subsequent *ex post* econometric analysis of costs found that the actual costs were negligible, though certain specific input costs (labour) increased (Zhang, 2018[44]). The author concludes that *ex ante* cost estimates such as in RIAs may overestimate costs as they neglect the capacity of producers to adjust production practices in response to regulations.

New regulations prohibiting siting of pig production units near waterways in the People's Republic of China (hereafter "China") were estimated to reduce by 8% reduction the number of pigs slaughtered and cause a 10% reduction in inventory of pigs and an 11% reduction in pork production (Chen, Ji and Jin, 2022[40]). The cost to producers was estimated to be USD 24 billion based on 2016 Chinese livestock production and price data, nearly 2.9% of the total output value of China's entire agricultural sector.

A study of a voluntary grassland-based programme that restricts the concentrate and maize use in milk production systems investigated the resulting on-farm compliance costs and the N surplus reduction potential (Mack and Huber, 2017[45]). A farm optimisation model was used to simulate changes in animal and land-use activities if all farms were to adopt the programme. The results showed considerable heterogeneity in compliance costs across different farms, with many having no additional costs of compliance with the voluntary programme. This made providing an equal payment to all participating farms a relatively inefficient way of achieving N reductions. A payment of CHF 200 per farm could be expected to result in a marginal abatement cost of CHF 95 per kg N.

A similar study estimated on-farm compliance costs and environmental effects of a grassland extensification scheme in the district of Ostprignitz-Ruppin, Germany using a farm-level modelling approach (Uthes et al., 2010[46]). As with the Swiss study, this voluntary scheme was not found to be a cost-effective way to reduce N surplus. On-farm costs ranged from zero up to almost EUR 1 500/ha, with the majority grassland having on-farm costs below EUR 50/ha. The Swiss and German studies show that voluntary programmes may be relatively cost inefficient at achieving secondary objectives (both programmes are primarily intended to promote a certain type of land use, with N reduction an ancillary benefit).

In addition to the heterogeneity of farm compliance costs, the role of fixed versus variable costs of compliance can also affect participation in voluntary schemes (Ducos, Dupraz and Bonnieux, 2009[47]). Fixed costs may have a high transactions costs component, which can be affected by not only farm size but the farmers' education and level of trust in the system.

4.1.1. Marginal abatement cost curves

Marginal abatement costs (MAC) curves can show the amount of emissions reduction potential at varying carbon price levels. In theory, a MAC illustrates the cost of abating each additional ton of emissions. They reflect the observation that the cost of an addition ton of CO_2-eq abated tends to rise as more abatement

occurs. MAC curves are not the same as the costs of regulatory compliance, but they can be connected to this if a regulation is associated with the technologies or requirements covered by the MAC analysis.

The way a regulation ties to a MAC can be complex – the policy design may influence the costs of achieving a given level of abatement. For example, command-and-control approaches are generally viewed as potentially less efficient than price-based approaches.

In addition, GHG abatement may be only one of the environmental benefits of a mitigation action. For example, many actions related to manure management may reduce both methane (a GHG) and ammonia (which affects both air quality and biodiversity).[11] Jointness in outcomes arises in many situations, and there is no easy way to incorporate this into cost estimates.

There are three main approaches to constructing MAC curves. Technical approaches compile information on the costs and mitigation potential of different mitigation measures one by one, calculating their costs and then plotting them according to increasing cost-effectiveness (see Figure 4.2 for an example). Supply-side models replicate the production opportunities of the farm without accounting for output market price adjustments. Microeconomic models, either partial or general equilibrium measure the cost of abatement actions net of related market effects. (Van Doorslaer et al., 2015[48]; De Cara, Houzé and Jayet, 2005[49]) (see Figure 4.1 for an example).

Modelling approaches to deriving MAC curves depend not only on data, but also the assumptions and structure of the model used. A meta-analysis of 21 studies that have assessed abatement potentials and costs using different modelling approaches found that the modelling approach has a significant effect on the estimated abatement potential (Vermont and De Cara, 2010[50]). Specifically, models that account for price feedbacks through general or partial equilibrium effects predict higher abatement rates than supply-side only approaches. If the reduction in emissions results from a decrease in agricultural output, higher equilibrium prices tend to increase the opportunity cost of mitigation, therefore leading to higher abatement costs.

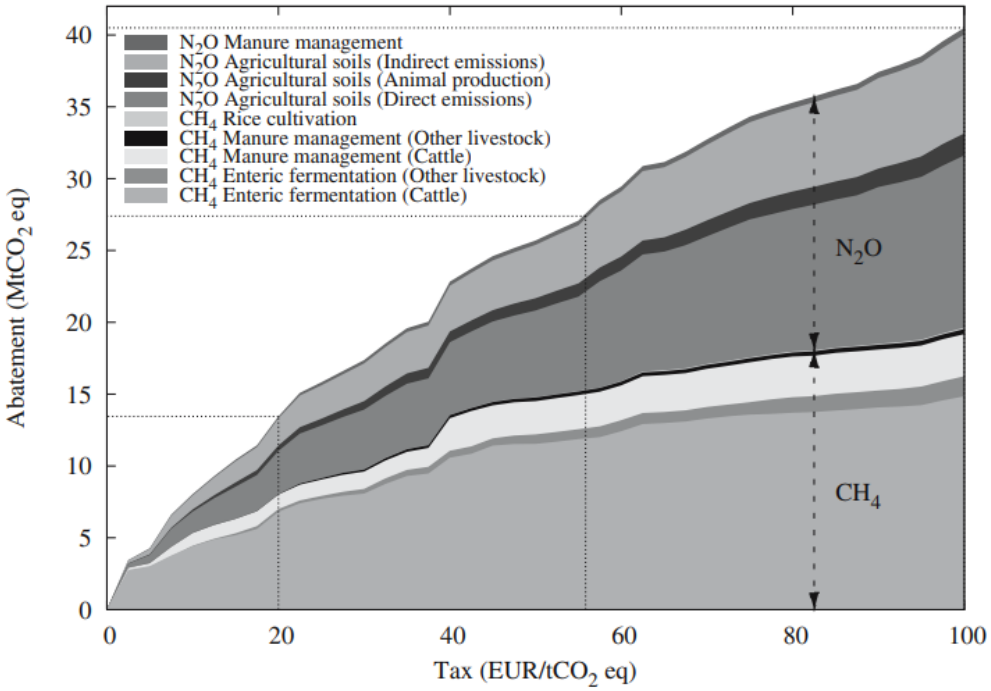
MAC studies of abatement costs typically demonstrate the same heterogeneity of costs as was observed in the previously mentioned studies. There are three major sources of abatement cost heterogeneity:

- Activity-data heterogeneity related to farm-size parameters such as the area allocated to each crop, animal numbers, fertiliser use, and so on.
- Emission-factor heterogeneity from the variability of climate and soil characteristics, input productivity, management systems and agricultural practices.
- Heterogeneity in the flexibility between production activities depending on the technical and economic possibilities of substitution in the short run.

A MAC study of methane and nitrous oxide emissions varied an emissions tax in a linear programming model based on FADN data to map out the MAC curve for GHG emissions reductions (Figure 4.1) (De Cara, Houzé and Jayet, 2005[49]). These results imply an abatement target of 27.5 $MtCO_2$ (8% of 2001 emissions) would have a marginal abatement cost slightly higher than EUR 55. This result does not include market or trade effects; it is only the technically feasible set of abatements with current technology.

[11] The relationship can also be negative, termed “pollution swapping” when action to reduce one form of emissions increases another. For example, manure application techniques designed to reduce ammonia emissions may increase N runoff into groundwater.

Figure 4.1. Aggregate abatement supply by emission sources

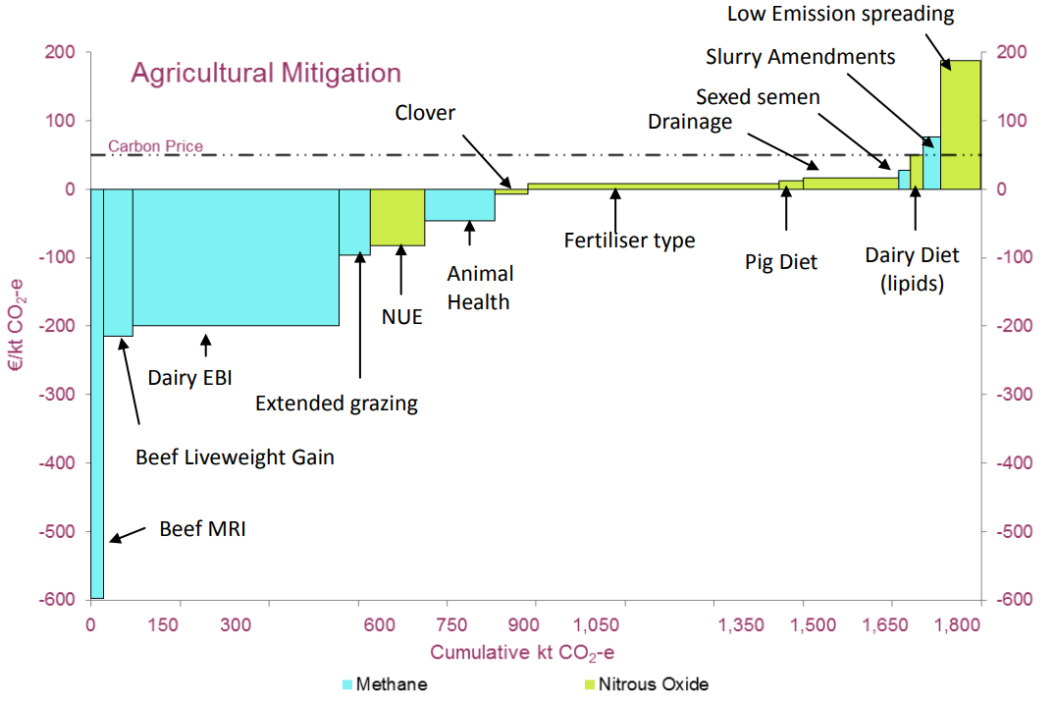


Source: De Cara, Houzé and Jayet (2005[49]), "Methane and Nitrous Oxide Emissions from Agriculture in the EU: A Spatial Assessment of Sources and Abatement Costs", https://doi.org/10.1007/S10640-005-0071-8.

An Irish study of climate change mitigation potential derived the marginal abatement cost curve for agriculture based on 2015 data (Lanigan and Donnellan, 2019[51]). The net costs of the measures were based on the estimated technical costs and benefits of the mitigation measures at the farm level, on a partial budget basis. This approach took into account the costs and benefits (both annual changes and capital investments) arising from the positive and negative change in expenses and income associated with the changes in farming activities and outputs.

This study found that achieving climate targets will be challenging. Mitigation of methane and N_2O (1.85 $MtCO_2$-e), combined with carbon sequestration (2.97 $MtCO_2$-e), and energy displacement (1.37 Mt CO_2-e) delivers a 6.19 Mt CO_2-e per annum saving for the periods 2021-2030 at a net cost (including efficiency savings) of circa EUR 34 million per year. When cost savings from efficiency measures are removed, the gross cost of measures is EUR 223 million per year.

Figure 4.2. Marginal Abatement Cost Curve for agriculture for 2021-2030 (methane and nitrous oxide abatement), Ireland



Note: Values are based on linear uptake of measures between the years 2021-2030 and represent the mean yearly abatement over this period. Dashed line indicates Carbon cost of EUR 50 per tonne CO_2. EBI= economic breeding index, MRI=improved maternal traits, NUE=Nitrogen use efficiency.
Source: Lanigan and Donnellan (2019[51]), *An Analysis of Abatement Potential of Greenhouse Gas Emissions in Irish Agriculture 2021-2030*, https://www.teagasc.ie/media/website/publications/2018/An-Analysis-of-Abatement-Potential-of-Greenhouse-Gas-Emissions-in-Irish-Agriculture-2021-2030.pdf.

MAC curves are a fundamental concept in quantifying the costs of specific actions or policy options and have been developed for many countries. However, the main benefit of MAC curves is not necessarily understanding the total abatement potential and associated costs, but rather the provision of a coherent forum for the complex discussions surrounding agri-environmental outcomes like GHG mitigation, and to visualise opportunities and low- hanging fruit in a simple and graphical form (Eory et al., 2018[52]).

The MAC curve shown in the above figure for Ireland is constructed by compiling information on the costs and mitigation potential of technical mitigation measures one by one, calculating their costs and then plotting them according to increasing cost-effectiveness. A common observation from such studies is that there are some abatement activities that have negative costs; that is, they should be profitable to undertake without any regulatory compulsion. Why these should not be already in practice is debatable. It could have to do with risk-aversion, non-market barriers to adoption, or inadequacies in the study methods used.

A key question when calculating costs of mitigation measures is to decide which costs should be included. Specifically, inclusion or exclusion of support measures can alter the calculated cost efficiency of the abatement measures. For example, excluding the feed-in tariff for electricity produced using biogas from anaerobic digestion increased the cost from EUR 17 to EUR 55 t/CO_2eq (Pellerin et al., 2013[53]). They found that excluding the tax exemption on agricultural fuel reduced the cost of reduced tillage from EUR 8/tCO_2eq under the current tax exemption system to EUR -13/tCO_2eq without tax exemption on fuels. Higher energy prices increase the financial returns from reduced tillage, which would be a more profitable option if fuel tax exemptions were eliminated.

Investigations of MAC curves based on technical approaches measure the carbon price that would be required to make specific on-farm actions profitable. This is not the cost of regulatory compliance *per se*, but can reflect such compliance cost for the case where a regulation mandates the activity in question. There is a good deal of work on MAC curves in agriculture, both technical and model-based, and these

are not all covered in this review (Pellerin et al., 2013[53]; Biggar et al., 2013[54]; De Cara, Houzé and Jayet, 2005[49]; Van Doorslaer et al., 2015[48]; Bockel et al., 2012[55]). This research has some potential to inform on the implicit price of carbon associated with specific on-farm measures, with the already mentioned caveats about the variability and generalisability of results.

4.2. Administrative and transactions costs

There was relatively more extensive research found on the administrative costs of regulation than for compliance costs. This is perhaps for two reasons: (i) measuring on-farm direct costs requires specific micro analysis and is technically challenging; and (ii) governments have a clear interest in reducing administrative costs. Higher administrative costs can reduce the acceptability of regulations and are a deadweight loss to society. By comparison, farmers' compliance costs resulting from regulation can be optimal when they reflect internalised externalities. Administrative costs are borne both by the regulator and the regulated firm. For example, for the regulator these include costs for implementation and enforcement and for the regulated firm there are costs of reporting and record-keeping, as well as license application processes and fees.

The EU Better Regulation initiatives identifies regular review of existing administrative obligations as key components of Better Regulation (EC, 2005[56]). The Commission found that specific cost-based quantification of legislation helps in assessing measures from the point of view of those affected, contributes to regulatory transparency and provides a relevant indicator for simplification work and monitoring progress in reducing administrative burden.

Reducing the cost or burden of regulations is often hampered by a lack of good information on how regulations impose costs on the regulated. In the United Kingdom for example, it was observed that *"the government does not know how much cost businesses incur as a result of its existing regulations. This means that it cannot know how ambitious its target for reducing regulatory costs is. Many departments have only a partial understanding of how the existing 'stock' of regulations for which they and regulators are responsible affects businesses, and of where burdens could most easily be reduced. While some departments are working to improve analysis of their stocks of regulation, five of the 14 departments with regulatory responsibility within the scope of the Target told us they have no plans to quantify existing regulations."* (Bayliss et al., 2016[57])

For many farmers, administrative burden is a significant downside to regulation and a major reason why they prefer voluntary measures. This burden is not only to do with the time involved with administrative paperwork, but also with the psychological stress involved. Higher levels of administrative burden correlate with greater dissatisfaction with the related programme (El Benni et al., 2022[58]). Reducing administrative burden through education and outreach can help increase support for and compliance with programme requirements.

A 2005 study showed that the administrative costs of regulation can be substantial, that large variations exist and that the results are difficult to generalise (Huusom, 2005[59]). While the study is largely out of date, their observation that there are relatively more studies of the administrative costs of voluntary programmes like Agri-Environmental Schemes and hybrid programmes like cross compliance still holds true. This could be a result of formal requirements to evaluate budgetary policies.

Administrative costs for the regulator have to do with the preparation, implementation and administration of a regulation. These can be *ex ante*, having to do with search, drafting and negotiation costs incurred before the implementation of a regulation or *ex post*, related to monitoring and enforcement and possibly renegotiation of agreement terms in the case of voluntary measures. Administrative costs for firms have to do with application for licences and permits, reporting and bookkeeping costs, time spent learning about regulations, as well as paying fees.

Several factors influence the size of administrative costs related to a regulation (Huusom, 2005[59]). These include:

- *Asset specificity*, the degree to which regulatory processes are unique or require specialised knowledge.

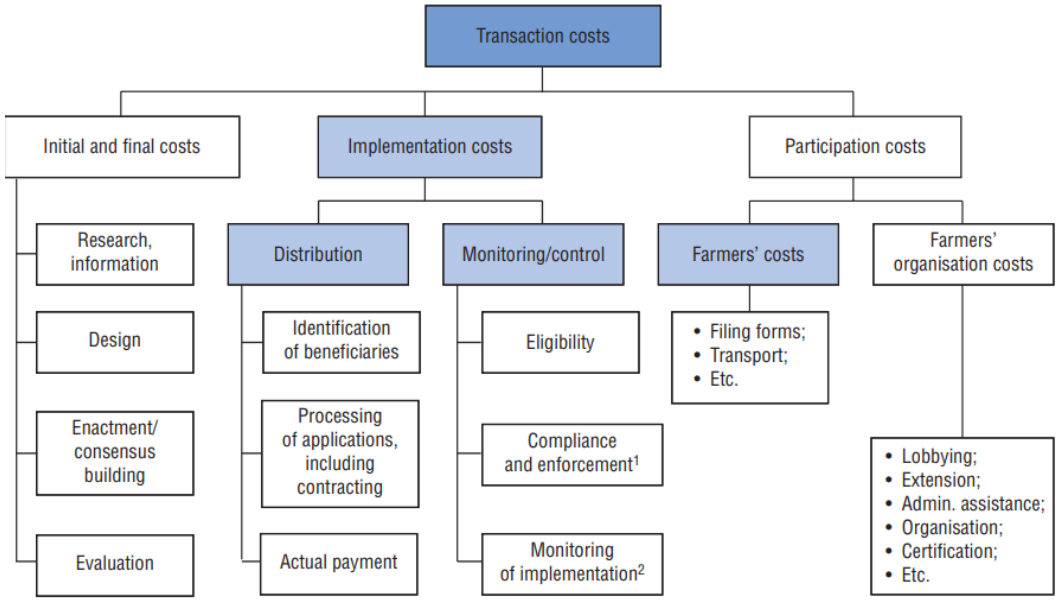
- *Frequency, duration and recurrence*, where monthly reporting is more costly than annual reporting and so on. Also, when repeatedly performing similar requests, the transactions costs of each individual response is reduced due to automation and learning.
- *Uncertainty and complexity* can increase costs as they require more time to cope with requirements. This can be a function of the education and experience of the regulated person, the number of agencies involved and the volume of data required.
- *Economies of scale:* the number of regulations will influence the total administrative cost, but sharing of fixed costs and learning are two reasons to expect some efficiencies as the number of regulations increases.
- *Observability and measurability* are often cited as a complicating factor for agriculture regulation, such as for GHG emissions. Difficulty in observation can increase costs and governments may respond by reducing the degree of targeting as a trade-off with costs.
- The more a regulation is integrated into *existing market structures*, the less additional administrative costs may be imposed by the regulation. For example, a tax on fertiliser is administratively simple compared with fixed application rate limits by farm.

There is an optimal level of administrative burden that balances the value of increased targeting and precision with the additional oversight costs that this implies (European Commission, Directorate-General for Agriculture and Rural Development, 2019[60]).

An OECD survey of small and medium sized enterprises in ten countries found that administrative compliance costs represent around 4% of Business Sector GDP. The estimates varied from less than 2% in Finland to 7% in Spain (OECD, 2001[61]). A 2014 OECD report on Greece estimated total administrative costs in the agricultural sector to be EUR 315.85 million, 92% of which was administrative burden and only 8% considered as "business as usual" costs (OECD, 2014[62]).

OECD work on policy-related transaction costs (PRTCs) identified a broad set of costs faced by different stakeholders (Figure 4.3) (OECD, 2007[63]). The set of costs for regulations is broadly similar, except for the implementation costs of the actual budgetary payment.

Figure 4.3. Policy-related transactions costs for budgetary payments



Note: Shaded boxes contain PRTCs that are expected to be significantly different across policies.
1. Detection of non-compliance and enforcement of compliance, litigation.
2. Includes management and organisation costs
Source: OECD (2007[63]), *The Implementation Costs of Agricultural Policies*, https://doi.org/10.1787/9789264024540-en.

An example of a direct cost would be the costs of infrastructure for manure storage (when such storage is required by regulation). The administrative costs for the business include the cost of documenting and reporting on the use of the storage. Government administration costs include monitoring and enforcement. In Canada, the Red Tape Reduction Act defines administrative burden as "anything that is necessary to demonstrate compliance with a regulation, including the collecting, processing, reporting and retaining of information and the completing of forms" (Trnka and Thuerer, 2019[64]).

Countries will have differences in the measurement method used and other local factors affecting administrative costs. Comparing administrative costs is also difficult because legislation varies. An EU reports suggests that comparability can be improved by looking at Information Obligations (IOs) rather than at entire pieces of legislation. That is, IOs constitute the building blocks of any administrative cost reduction programme.

The Standard Cost Model (SCM) provides a method to calculate administrative costs (Box 4.1). The SCM is intended as a tool to reduce the administrative burden of regulations. The SCM methodology is an activity-based measurement of the businesses' administrative burdens making it possible to follow the development of administrative burdens. At the same time the results from the SCM measurements are directly applicable to governments' simplification work, in that the results show the specific regulation and its details which are especially burdensome for businesses (SCM Network, 2004[65]).

Box 4.1. The Standard Cost Model: A framework for defining and quantifying administrative burdens for business

The Standard Cost Model is a framework defining and quantifying administrative burdens for businesses. It was developed by an international working group on administrative burdens consisting of Denmark, Sweden, Norway, Belgium, the United Kingdom, and the Netherlands. It contains the framework for a quantitative method that can be applied in all countries. It first defines the administrative burdens (AB), whose cost is to be measured. The individual activities to be carried out then need to be identified. The number of times activity i is performed (Qi) depends on the number of businesses (Bi) and the frequency of the activity (Fi): [Qi = Bi * Fi]. The cost of the single activity i (Ci) depends on the time required to perform it (Ti) and the per unit cost (Pi): [Ci = Ti * Pi]. The unit cost of activities carried out internally is based on employees' wages, and material and overhead costs, while the cost of activities carried out externally are based on the costs of contracting out. The administrative burden of all activities is therefore the sum of costs for individual activities: AB = sum(i) [Qi Ci].

Source: SCM Network (2004), International Standard Cost Model: Measuring and reducing administrative burdens for businesses.

In the United Kingdom, the government's primary metric is the equivalent annual net direct cost to business. This is a measure of the direct impact of a regulatory decision on business, where a direct impact is defined as "an impact that can be identified as resulting directly from the implementation or removal/simplification of the regulation" (Bayliss et al., 2016[57]). This metric for regulatory costs includes consideration of factors such as clarity, rigour, relevance to business experience and simplicity. The authors note some of the complications of this approach:

- The distinction between direct and indirect impacts has only partial grounding in business experience and economic principles. The focus on direct impacts could give a misleading picture of the effects of regulation, for instance when a regulation is important in promoting consumer confidence and enabling markets to operate effectively.
- The concentration on a single metric does not draw distinctions between different types of burden, with sometimes counter-intuitive results. For instance, the Department for Environment, Food & Rural Affairs' regulation requiring larger retailers to charge for single-use plastic bags is counted as a reduction in regulatory costs. This is because the expected administrative costs of implementing the charge are outweighed by the reduction in costs from purchasing fewer bags.

- The metric is based on the impacts of individual regulatory decisions, rather than looking at systemic effects. This ignores that the cumulative effect of regulations can be greater than the sum of their individual impacts (Bayliss et al., 2016[57]).

An application of the SCM to quantify the administrative cost of environmental licencing and reporting for Portuguese poultry firms identified the cost per firm at EUR 15 940, with a total cost to the industry of EUR 3 million per year. They note that e-government reduces administrative costs significantly, by only when there are no redundant e-government platforms. That is, a whole-of-government approach to digital reporting is more effective than a piecemeal one (Santos and Bilhim, 2018[66]).

SCM was also applied to the Scotland's Environmental and Rural Services (SEARS). The objective of SEARS is to minimise the regulatory burden imposed on land managers by working closely together to avoid duplication of effort. The SCM analysis failed to produce conclusive results because the complex requirements of SCM were not matched by data availability, and land managers had little incentive to participate. This shows that SCM may be more difficult to implement outside of traditional business firms (Halcrow Group, 2010[67]).

Administrative burden on farms due to regulatory requirements and cross compliance in Switzerland were estimated using the SCM. These costs totalled CHF 136 million in 2018, with dairy farmers facing the largest regulatory burdens (37% of total sector administrative burden) (El Benni et al., 2021[68]). This represented 5.4% of the direct payment budget spent for the programmes related to food security, cultural landscapes, biodiversity, landscape quality and environmental and animal friendly production systems.

Several common means to reduce administrative burden of regulations have been identified. These include the use of information technology, lower number of licences and reporting, no duplication in reporting, lower frequency and simplification of reporting and grouping of regulations pertaining to the same field (codification) (Kotnik, Klun and Slabe-Erker, 2020[69]).

Administrative simplification is becoming a priority of OECD countries seeking to improve public governance and the acceptability and cost-efficiency of regulations. Cutting red tape is expected to improve the framework for doing business, thus stimulating competitiveness and growth.[12] Many governments have programmes to identify and cut red tape, or "one in one out" legislation requiring that for every new regulation, one or more must be eliminated (Trnka and Thuerer, 2019[64]).

Agriculture regulations can feature prominently in red tape cutting exercises. In the Netherlands, a reform abolishing the obligation to conclude and file a manure contracting agreement and lifting of the requirement for an annual statement on manure for some farmers was considered a "top ten" most important burden reduction initiative (OECD, 2007[70]). This reform was estimated to save EUR 87 million. Another important reform was a new decree harmonising and simplifying rules. This resulted in about two-thirds of the Netherlands' agricultural businesses no longer being subject to permits, but only a reporting obligation, whereby fewer reports and surveys need to be submitted, saving EUR 40 million.

The United Kingdom has reviewed agricultural legislation as part a wider effort to reduce bureaucracy called the Red Tape Challenge, launched in 2011. That review proposed to eliminate or revise 56% of the 516 regulations considered. Of these, 156 were considered obsolete and 134 to be improved to simplify the regulatory landscape or reduce burdens on business (Defra, 2014[71]). The United Kingdom has also set a "Business Impact Target" of GBP 10 billion in administrative cost savings for businesses, of which Defra should contribute GBP 2.35 billion (Bayliss et al., 2016[57]).

4.3. Conclusions regarding cost and burden

In summary, the evidence found in the literature review indicates that there is little opportunity to use empirical measurement of direct costs of regulatory compliance in a taxonomy of regulations. These types of costs are commodity-specific, highly variable across firms and depend on the specific context of the farm operation. Drawing generalised conclusions from this kind of data would be unreliable. Model based

[12] See https://www.oecd.org/regreform/regulatory-policy/cuttingredtapeseries.htm for OECD's Cutting Red Tape book series.

approaches may be more adapted to a multi-national context, but there are substantial challenges in this approach as well.

There is somewhat more potential to include information related to administrative costs and burden. These costs are a pure deadweight loss and all governments aim to reduce these as much as possible. They are well-characterised in terms of their components (fees, paperwork, inspection…) and intimately connected to policy design and delivery. Lower compliance cost can also increase the acceptability of a regulation to farmers and therefore its likely effectiveness. Administrative costs and burden are an important consideration of the practicality of regulations as a policy choice.

5. Connecting regulations and outcomes

RIA is a less viable source of comparable data than anticipated. Other sources of data exist; model-based approaches may be best suited. This is a long-term endeavour.

Regulations are designed to achieve a positive outcome, in terms of either reducing a negative externality or providing a public good. However, many environmental benefits are difficult to quantify or observe directly, leading to a number of approaches to estimate or find a proxy for the effect of a policy. Identifying the effect of a specific policy is even more difficult when it is only one of many drivers connected to the environmental outcome of interest. This difficulty in quantifying outcomes is one reason why many regulations are process-based rather than performance based. Process based regulations specify the actions that must be taken by the regulated firm, not the result they must achieve.

Several factors contribute to the difficulty of evaluating outcomes. Many regulations target general environmental objectives and thus lack a measurable outcome. Even if a measurable output exists, there may be a lack of data at the firm level. To perform an evaluation, a reasonable baseline from which to make a comparison must be established. This requires comparing the actions of regulated firms to non-regulated firms or tracking firms over time (National Center for Environmental Economics, 2014[36]).

The difficulty in correctly assessing the degree to which the expected consequences of stricter regulations (e.g. increased mitigation expenditures or observed lower pollution intensity) can be attributed to environmental policy stringency is the “identification problem”. Observed environmental outcomes can be due to other regulatory instruments (for instance, affecting labour and capital) and country-specific characteristics: geography, market imperfections, skills, level of development, access to technology or trade openness and outsourcing. All these features tend to interact with each other, making it difficult to link measures of relative environmental performance (or emissions) to actual policies. Moreover, differences in implementation and enforcement may cause important variation in outcomes for equivalent regulations in different countries.

Despite the difficulties, understanding the outcomes of policies such as regulations is a fundamental part of good policy design, and in many cases there are statutory requirements to evaluate and report on the outcomes of policies. In the case of regulations, this most frequently takes the form of regulatory impact assessments.

5.1. Regulatory Impact Assessment (RIA)

RIA is a focus of OECD work on regulations. According to this work, making better regulations requires good processes. Regulatory impact analysis supports this by providing evidence for regulatory decision making, including through the testing of alternative approaches and consulting with those affected.

An RIA assesses the impacts of all options considered. They ideally quantify costs, benefits and distributional effects of a regulation. RIA, along with any *ex-post* monitoring and evaluation of performance, may be the only time such impacts of regulations are quantified.

The rules regarding the need for an RIA are not the same in every country. In some countries it may be mandatory in all or most cases, while in others there may be significant discretion regarding their use. Those regulations deemed to have a low impact or limited scope may not be subject to an RIA, but the fact that a regulation may be impactful does not guarantee an RIA in all cases. In Australia, it was found that while around 75% to 85% of all proposals with *significant* impacts had an RIA, only 40% of proposals with

highly significant impacts had an RIA (Productivity Commission, 2012[72]). The Productivity Commission also found limited quantification and monetisation of impacts in many RIAs. Less than one-quarter of OECD members systematically assess whether regulations achieve their objectives (OECD, 2021[35]). Incentives for improvement are currently weak: less than one-third of OECD member countries have a body in charge of checking the quality of reviews of existing regulation.

Quantification and monetisation of impacts is not always a feature of RIAs. Eastern European countries have traditionally placed more emphasis on RIA as an explanatory document. The United States on the other hand has devoted considerable effort to monetising impacts, including for non-market goods such as biodiversity or the value of human lives, in order to increase the transparency of decision-making and the measurability of impacts over time (United States, Executive Office of the President [William Clinton], 1993[73]).

The European Commission has strengthened the emphasis on quantitative analysis since 2005, and later with the appointment of the Regulatory Scrutiny Board (Renda, 2010[74]).[13] This Board found that impact assessments (for all sectors) with a focus on environmental or climate policy objectives increased to 38% of all cases from an average of 23% in 2017-19. In 2020, 74% of all impact assessments quantified benefits and 83% assessed costs (Regulatory Scrutiny Board of the European Commission, 2020[75]).

The government of New Zealand carried out an RIA regarding farm level pricing of GHG emissions from agriculture as part of an emissions trading scheme (Government of New Zealand, 2019[76]). Including the value of avoided purchases of international carbon credits in the benefit cost analysis resulted in a benefit cost ratio (BCR) of 1.1 – only marginally positive. This is because it is only an interim measure with initial set up and transaction costs. It is part of a long-term policy with much greater potential to change farm practice leading to much larger emission reduction benefits over time. This result highlights the difficulty in estimating regulatory effects at a point in time.

An RIA of the US Environmental Quality Incentives Program (EQIP), a voluntary programme for conservation activity on working lands, estimated benefits for three key performance indicators related to soil, one of which being soil carbon (Table 5.1). This RIA also reported on other benefits of the program having to do with nutrient loss, productivity, habitat and more (USDA, 2019[77]). EQIP uses cost-sharing payments to encourage the adoption of conservation practices on working lands. Reduced soil erosion and improved soil quality are important objectives of the programme, so quantification of these results is highly relevant in the RIA.

Table 5.1. EQIP Performance – Benefits to the environment

Key Performance Indicator	2014	2015	2016	2017	2018
Tonnes of sediment prevented from leaving cropland (Million tonnes)	3.4	3.4	3.2	4.8	4.4
Soil carbon retained on cropland (Thousand tonnes)	56.5	59.9	50.3	64.9	77.3
Cropland with conservation to improve soil quality (Million acres)	3.1	3.0	2.7	3.0	4.8

Source: USDA (2019[77]), *Regulatory Impact Analysis for the Environmental Quality Incentives Program (EQIP).*

5.2. Other quantification of regulatory impact

The evidence regarding the direct effects of regulation, in either quantity or value terms, is not extensive. In general, the literature shows that the effects of regulations are contingent on many other mediating factors (see for example (Hansen et al., 2019[78])). This section reviews some of the evidence found in the literature, both within and outside the agricultural sector.

In a study using an index of clean air regulations in OECD countries, only a weak connection between regulations and emissions levels was found (Knill, Schulze and Tosun, 2012[27]). Increases in clean air regulatory policy density and intensity did not translate directly into decreases in emission intensities. This

[13] See https://ec.europa.eu/info/law/law-making-process/regulatory-scrutiny-board_en.

indicates that there is a slippage between regulatory policy outputs and impacts and factors such as GDP per capita and urbanisation have larger explanatory power.

Eliste and Frederiksson (2002[79]) use a model to investigate how providing compensation for regulations affects trade in agricultural products. The existence of transfers to polluters is shown to yield counter-intuitive effects on trade patterns of higher pollution taxes. The compensation neutralises the effect of the pollution tax on output, and therefore on imports and exports. This demonstrates that when regulations are part of a larger set of policies, and especially where there are compensation payments, their effects can be hard to identify. Indeed, they find that regulations in the form of pollution taxes are likely to provoke compensation payments.

The European Commission assesses the effectiveness of the CAP in reaching its environmental targets by using environmental data to produce a comprehensive set of indicators collected under the common monitoring and evaluation framework (CMEF) (European Commission, Directorate-General for Agriculture and Rural Development, 2015[80]). A complementary set of 28 agri-environmental indicators further tracks the integration of environmental concerns into the CAP. As part of the CMEF, evaluations and external studies on environmental sustainability are carried out by independent experts on behalf of the Commission.

The data collected by the Commission provides comprehensive information on:

- the state of the rural environment in the European Union and developments over time
- the impact of farming on climate, natural resources, and biodiversity
- the implementation of the CAP's environmental measures across the European Union
- the success of environmental measures in reaching their targets and their wider impact beyond their stated objectives.

The assessment of the CAP's environmental measures takes into account the complex links between policy measures, changes in farming practices and environmental improvements, as well as numerous other intervening factors, such as weather events, the impact of market trends, and differences in environmental conditions across EU countries and regions.

5.3. Conclusions regarding regulations and outcomes

When they are expressed in terms of processes or practices, agri-environmental regulations will not usually contain quantified objectives in terms of specific environmental outcomes. Their objectives may instead be defined by the adoption rates of the involved processes or practices (see for example the content of Table 2.2). Regulations are also usually part of a larger policy package that includes budgetary and other policy types. Therefore, it is difficult to connect the influence of specific agri-environmental regulations to measurable outcomes. This means that using a taxonomy of regulations directly to predict or measure outcomes will be difficult.

However, it is worth watching this space. A rule of good policy design is that instruments should have SMART (specific, measurable, achievable, relevant, time-bound) objectives and modern approaches have increasingly reflected this. The EU CAP is placing greater emphasis on results-based schemes over past implementation-based approaches for Agri-Environmental Schemes, and the proposed EU Nature Restoration Law also emphasises achieving specific outcomes. A common weakness of many of the policy indices identified in this review is the weak connection to environmental outcomes. Though it is difficult, working towards some reflection of this aspect of agri-environmental regulations can increase the value of a taxonomy considerably.

6. Discussion

This literature review has evaluated some existing methodologies to assess the impacts of regulations and relevant policy taxonomies and indicators. The objective is defining next steps to improve our understanding of agri-environmental regulations in order to have a better picture of overall agri-environmental policy packages with a view to helping to guide policy making. The review has looked at: best practices for regulatory design; evidence on the costs and benefits of regulatory policy; and some useful examples of taxonomies and indicators such as the OECD EPS, PINE, DEEP and the upcoming CAPMF. What lessons can be drawn regarding how to design a structured inventory of environment-related regulations in agriculture?

Regulatory Impact Assessment (RIA) continues to grow in importance as a tool to assess cost effectiveness, but application of this tool remains highly variable and many of the elements evaluated are not monetized. The literature review finds that these are not expected to be able to provide the data needed to systematically analyse the cost-effectiveness of agri-environmental regulations. RIA still can be a valuable source of information on policies in many specific cases. For example, RIA can help indicate the environmental domains of a regulation.

Marginal abatement cost (MAC) curves that describe the costs of alternative GHG mitigation activities show some promise, presuming that the technical measures assessed are potentially linked to regulation. MAC curves may be derived using technical cost estimates or synthetic models and may include or exclude market adjustments to price changes. Bottom-up MAC analyses are generally contingent on heterogeneous local conditions, but ignore market-adjustments, while model-based approaches incorporate these adjustments but tend to be top down and can lack detail.

The review of this literature highlights the difficulty of quantifying costs and benefits, as information is scarce and often depends on heterogeneous factors strongly affected by local conditions and technologies. Results are also difficult to generalize. This may explain why many of the examples found in the literature review follow an alternative approach, focusing on counting and categorising policies rather than evaluating their effect on outcomes.

There are many complexities that confront the development of a taxonomy of agri-environmental regulations. In addition to the data problems already mentioned, there are also the different administrative levels where such regulations operate, especially in federal states and the European Union. Regulations also cross sectors and policy domains such that finding an appropriate scope of analysis will be a key success factor. Despite these difficulties, a well-designed taxonomy can add value in connecting policies with their impact using subsequent analysis of this information, to estimate impacts and measures of regulatory stringency or effectiveness. Such a taxonomy could help countries achieve their agri-environmental objectives and measuring progress towards shared environmental objectives and with respect to GHG emissions reductions.

OECD work provides a useful starting point to develop such taxonomy, with many central principles already well elaborated as well as examples of practice for similar analysis. There is also potential for work on agri-environmental regulation to complement or supplement other OECD initiatives such as the CAPMF, the annual Agricultural Policy Monitoring and Evaluation or the PINE database. These initiatives also offer important lessons on how to build and populate a database. For example, the PINE uses a distributed approach via an approved set of contributors from government and research communities that seems well suited to this application. The OECD DEEP shows how a survey-based approach can add information on administrative burden and other qualitative aspects of regulations.

The literature review already provides some insights about how the way forward for a taxonomy of agri-environmental regulations should look like:

- It should identify and include a wide range of regulatory forms, beyond command-and-control style regulations to include other regulatory approaches such as voluntary agreements as outlined in Table 1.1.
- It should use a common frame of reference to define characteristics of policies that are present in many countries and which can be taken to represent the full range of agri-environmental regulations.

- It should build on past OECD experience; for instance, an implementation-based approach to a taxonomy would build on existing OECD agricultural policy monitoring expertise, while a flexible database structure like OECD Policy Instruments for the Environment (PINE) can maximise opportunity for collaborative analysis.
- It should identify the environmental domain of the regulation (emissions reductions, biodiversity, nutrient management, etc.), the population that is covered by the regulation, and other basic information on implementation.
- It should also be developed keeping in mind future opportunities to integrate work done elsewhere. For instance: on regulatory design, administrative costs and burden, and other features connected to the cost-effectiveness of agri-environmental regulation; on measuring impact of regulations; or as complementary information on environmental constraints associated to the existing Producer Support Estimate database.

The most important first step in the process is building an inventory and developing the core classification aspects. Once established, such an inventory and classification can already support further analysis and contribute to the broader OECD work in agri-environmental policy. This can improve overall understanding of agri-environmental policy packages.

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This report was approved and declassified by the Joint Working Party on Agriculture and the Environment in March 2023 and was prepared for publication by the OECD Secretariat.

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