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ORCID

TB: 0000-0001-7203-1509

TH: 0000-0002-6137-1249

RD: 0000-0002-7227-7485

EH: 0000-0002-9487-4387

The use of innovative contracts to provide agri-environmental public goods: Comparing attitudes between Ireland and other European countries

TRACY BRADFIELD^{1,*}, THIA HENNESSY¹, RICCARDO D'ALBERTO², EMMI HALTIA³

¹ *Cork University Business School, University College Cork, Ireland*

² *Department of Economics, University of Verona, Italy*

³ *Natural Resources Institute Finland (LUKE), Finland*

*Corresponding author. E-mail: tracy.bradfield@ucc.ie

Abstract. Results-based, collective action, value chain, and land tenure contracts are means to improve the management of agri-environmental public goods. The objective of this paper is to assess the understandability, applicability, and perceived economic benefit of each of these contract types by land managers and stakeholders in twelve European countries, with a special emphasis on Ireland. Using survey data, we find that most land managers agree that results-based contracts are understandable, applicable to their farm, and economically beneficial. A lower portion of land managers in Ireland than other European countries agree that value chain and land tenure contracts are understandable or applicable to their farms. The results suggest that greater efforts are required to promote collective action contracts across Europe as they are paramount to the management of public goods. To increase the adoption of innovative contracts, providing financial certainty and autonomy should be prioritized by policymakers, particularly in Ireland.

Keywords: agri-environmental climate public goods, AECPG, results-based contracts, contract design, environmental policy.

JEL codes: H41, O13, Q28, Q58.

1. INTRODUCTION

The provision of agri-environmental-climate public goods (AECPG) such as biodiversity, water and soil quality, and emissions reduction, was very much to the forefront of the European Union's (EU) agenda in the preparation of the latest Common Agricultural Policy (CAP) (European Commission, 2023a). For example, an aim of both the EU's Green Deal and the Farm to Fork initiatives is for food systems to become environmentally sustainable (European Commission, 2023b). Therefore, it is important that land managers are encouraged to sustainably manage AECPG. In line with this purpose, the present paper investigates innovative agri-environmental con-

tract types. These are contractual arrangements that incentivise farmers to increase the provision of AECPG alongside private goods (Prager et al., 2020) and they are experimental in that they have not been a core feature of traditional agri-environmental schemes (AES) (Bredemeier et al., 2022). The analysis explores the perceptions of agricultural and forestry land managers and other stakeholders (advisers, industry representatives, scientists, researchers, etc.) in terms of the understandability, applicability, and the perceived economic benefits of results-based, collective action, value chain, and land tenure contracts, both in Ireland and in eleven other European countries. Also, we examine the factors that can contribute to the adoption of these innovative agri-environmental contracts.

This paper focuses on the attitudes of Irish land managers and other stakeholders towards innovative contract designs for three reasons. Firstly, agricultural land managers in Ireland play a particularly significant role in the management of AECPG because 72% of land in Ireland is used for agriculture, which is the highest portion of land among EU countries (Eurostat, 2022). As of 2013, 50% of agricultural land in Ireland was under agri-environmental commitments (Eurostat, 2023a). However, regardless of this figure, all land managers influence AECPG such as biodiversity, water quality and carbon sequestration to some degree. Therefore, any efforts to increase the adoption of AES by farmers can help to improve AECPG provision. Secondly, agriculture in Ireland faces considerable environmental challenges as 37% of total greenhouse gas emissions and over 99% of ammonia emissions arise from agriculture due to the large livestock sector (DECC, 2021). Additional worries include concerns over biodiversity loss (Biodiversity Information System, 2022) and unsatisfactory water quality (EPA, 2022), all of which can be managed through effective contract designs. Attitudes towards the four innovative contract designs discussed here have not been previously assessed in the context of Ireland, while a general shortage of debate in relation to the subject exists in the literature (Bredemeier et al., 2022), with studies, such as D'Alberto et al. (2023), focusing on specific territories and case studies. To advance understanding and to improve the design of innovative agri-environmental contracts, the EU has funded several projects under the HORIZON 2020 Programme, such as the CONSOLE project¹ (CONSOLE, 2023) within which the present work was carried out.

¹ The project's full name is **Contract Solutions for Effective and Lasting Delivery of Agri-Environmental-Climatic Public Goods**. Horizon 2020 Grant Agreement number: 817949. More information is available at <https://console-project.eu/>.

The remainder of this paper provides an overview of AES in Europe, agriculture in Ireland, and current environmental challenges in Section 2. Section 3 describes the data at hand. Section 4 includes an analysis of survey data to determine how understandable, applicable, and economically beneficial land managers perceive various contract types to be. Section 5 contains an assessment of land managers' and stakeholders' recommendations for improving the uptake of AECPG-related contracts.

2. BACKGROUND

2.1 Agri-Environmental Schemes in Europe

Agriculture within the EU is supported by the CAP which consists of two Pillars. Pillar 1 provides financial support to farmers to ensure they have sufficient financial resources to sustain their businesses. This Pillar also provides market measures to help support challenges such as input price volatility, financial crises, and climate change. Pillar 2 is co-financed by Member States and it focuses on rural development. Its aims include, among others, the modernisation of farms, employment support, and generational renewal (European Council of the EU, 2023). Voluntary environmental protection measures have also been traditionally financed by Pillar 2 (Kelemen et al., 2023). From 2023, these policy tools are managed by Member States through their national CAP strategic plans (EU CAP Network, 2023).

AES are financed under Pillar 2 (Kelemen et al., 2023) and they are the primary mechanisms through which land managers are financially rewarded for farming in an environment-friendly manner above that required for the Basic Payment Scheme (Teagasc, 2022). The adoption of these schemes was initially voluntary for European countries (Burton and Schwarz, 2013) and the implementation of AES became compulsory for EU Member States in 1992 under EC Regulation 2078/92 (Cullen et al., 2021). However, their adoption by farmers remains voluntary.

In 2013, 26% of the utilised agricultural area of EU countries was under AES (Eurostat, 2023a). However, the environmental effects of land managers' actions are not measurable from this figure, with several authors questioning the effectiveness of AES on biodiversity and/or other aspects of the environment (see, e.g., Bartolini et al., 2021; Batáry et al., 2015). The reward for the adoption of AES has traditionally been 'action-oriented' payments with remuneration being based on a set of prescribed actions rather than the outcome. This focus has been, in part, due to the requirement for compensation to reimburse land managers for the cost of adopting a particular

agri-environmental practice (Burton and Schwarz, 2013). Burton and Schwarz (2013) provided examples of scenarios where action-based contracts have failed to provide environmental benefits such as the failure of action-oriented approaches to increase hornworts on the Swiss Plateau, as studied by Bisang et al. (2009), and a decline in bird and butterfly numbers in Switzerland, as noted by Roth et al. (2008). However, action-based approaches continue to be the most common in EU AES despite their limited effectiveness (Olivieri et al., 2021). Their high acceptability by farmers is due to low risk, as their payments are not affected by external factors such as the weather. Action-based contracts are also a suitable option when it is difficult to measure the results of an action, including when monitoring and environmental knowledge is not sufficient (Olivieri et al., 2021).

Issues with the management of any contract can arise through asymmetric information with Oliver et al. (2021) noting that it can reduce the provision of public goods through agriculture. This means that one party may have more information than the other(s) and they can use this to their advantage. This asymmetric information can result in contracts being negotiated that might not have been agreed if both parties were fully truthful. Adverse selection may arise where land managers choose to include low quality land into AES because it is less productive in other uses (Quillérou and Fraser, 2010). Cullen et al. (2018) noted that extensive farms have tended to enter action-based schemes because their compliance costs are generally lower than intensive farms. In addition, Butler et al. (2013) suggested, when referring to the work of Butler et al. (2010), that a possible focus of land managers on ease of management rather than ecological benefits can limit the success of action-based schemes. Moral hazard emerges when one party acts differently, such as taking on additional risks, because they do not bear the full consequences of their actions. This can lead to free riding where, for example, land managers who receive rewards for collective action decide to rely on the positive actions of others rather than their own. These phenomena need to be considered when developing new, innovative contract types.

Four innovative contract types assessed by the CONSOLE project are analysed and discussed in this paper (results-based, collective action, value chain and land tenure contracts).

1. As part of a **results-based** contract, farmers are paid based on the results of their actions. For example, if the intention of the contract is to improve water quality, such a contract may award payments based on the results of water testing completed at agreed dates throughout the lifetime of the contract. Uthes

and Matzdorf (2013) highlighted that results-based contracts allow farmers to use local knowledge and environmental learning to ameliorate their farm's results and, hence, they are more efficient than action-based contracts. However, as previously noted, unpredictable external factors such as weather may affect the results land managers achieve and this can discourage them from taking up these contracts. Furthermore, it is sometimes difficult to develop and monitor measurable indicators of environmental improvement (Olivieri et al., 2021).

2. **Collective** contracts require land managers to become members of a group which applies jointly for compensation in order to implement environmental or climate activities (CONSOLE, 2023). For example, if the intention is to improve biodiversity, payments may be awarded based on the count of farm birds in an area at specific times within the contract duration. The rewards would be shared amongst the participants in acknowledgement that the results were a collective achievement. Prager (2015) explained that some approaches emphasise collaboration, which means that farmers work together. Other approaches are based on co-ordination, which implies that farmers work towards the same goal, but in isolation (Prager, 2015; Reichensperner et al., 2023). The Netherlands is the only EU country to introduce collective AES on a national level. If a land manager wishes to participate in such a scheme, he/she must become a member of an agricultural collective, which is responsible for the contracting and the results measuring (Barghusen et al., 2021). Olivieri et al. (2021) noted that collective contracts could particularly benefit AECPG such as water quality, biodiversity, and landscapes, which require coordinated buy-in from all land managers in an area. In addition, Olivieri et al. (2021) argue that these contracts involve a sharing of knowledge and risks, and issues of moral hazard may be low due to land managers wishing to maintain their reputation instead of free riding. However, it can be difficult to determine the optimum group size and costly to manage a large group (Olivieri et al., 2021) with Rodríguez-Entrena et al. (2019) noting that collective participation leads to a higher degree of uncertainty among the farmers. Similarly, Villanueva et al. (2015) suggested that farmers' utility from engagement in collective participation is negatively influenced by the anticipated loss of freedom of their farm management.
3. **Value chain** contracts connect the delivery of AECPG with the production of private goods (CONSOLE,

2023). The cost of these actions may be paid for by the market, mainly through a premium price. For example, if dairy farmers agree to reduce their greenhouse gas emissions to a certain rate, the reduced emissions levels may be advertised on their bottles of milk and the customer pays a higher price for this guarantee. The contract may be between a land manager and a customer, or it may include many actors along the value chain, such as producers, processors, distributors, and consumers. For example, *Neumarkter Lammsbrau* is a German beer producer that engages in value chain contracts with its suppliers of organic raw materials. The agreements are centred around the protection of soil, water, and biodiversity (Bredemeier et al., 2022). Ireland currently has a quality assurance scheme where sustainable products bear the label 'Origin Green'. However, the products that meet the criteria are not charged at a premium price, so the land managers are not reimbursed for their efforts to produce the product sustainably.

4. **Land tenure** contracts mean that a landowner accepts a lower lease payment than for comparable land under usual land tenure agreements, to compensate land managers for their additional efforts to protect the environment (CONSOLE, 2023). For example, a landowner may contractually require the tenant to comply with certain management requirements like reduced use of pesticides. In addition, long-term and secure contracts often lead to land investments, such as, soil conservation and tree planting which provide benefits for nature and human well-being (Bredemeier et al., 2022; Robinson et al., 2018). It is worth noting that Olivieri et al. (2021) described the current literature on value chain and land tenure contracts as 'poor', fostering the need for research on these contract types.

It should be highlighted that AES can consist of contracts that combine design and governance characteristics from more than one contract type (Bredemeier et al., 2022). For example, AES that aim to enhance biodiversity might involve collective action and land tenure contracts.

2.2 Agriculture in Ireland and Environmental Concerns

The importance of the livestock sector to agriculture in Ireland is highlighted by the fact that, in 2020, 93% of farms were specialist livestock farms (Dillon et al., 2022) compared to 22% in all EU countries (Eurostat, 2022). 17% of Irish farms were dairy farms compared to 5% of farms in the EU (Eurostat, 2022). In 2020, the

livestock density in Ireland was 1.3 livestock units per hectare compared to an EU average of 0.7 (Eurostat, 2023b). These relatively high livestock numbers generate environmental challenges, as agriculture produced 37% of greenhouse gas emissions in Ireland in 2020 (DECC, 2021). More than 80% of agriculture-related greenhouse gas emissions is directly linked to livestock numbers and the management of the manures they produce, while 12% is attributed to chemical fertilisers and the remaining 8% arises from fuel combustion and carbon dioxide from lime usage (DECC, 2021). In response to these environmental challenges, The Climate Action Plan 2021 commits to a 22-30% reduction in Ireland's agricultural emissions by 2030, based on 2018 figures (DECC, 2021).

Despite these concerns, livestock numbers continue to rise in Ireland with a 0.5% increase in cattle and a 6.4% increase in sheep between 2021 and 2022 alone (CSO, 2023). This continued increase may suggest a hesitancy of land managers to reduce means of production in order to provide AECPG. This is supported by the work of Cullen et al. (2021) which found that a €1,000 increase in farm income leads to the likelihood of the farmer being an AES participant falling by 1-2%.

Additional environmental concerns include water quality, with the Environmental Protection Agency noting that agriculture substantially contributes to its decline (DECC, 2021). Almost one fifth of monitored river water bodies are of 'poor' or 'bad' status and are severely polluted (EPA, 2022). In addition, 85% of habitats in Ireland are classified as being of 'unfavourable status' and 39% are categorised as 'bad' (EPA, 2023). As an EU member, Ireland is subject to the core targets of the Farm to Fork strategy which are a 50% reduction in chemical or hazardous pesticide use, a 50% reduction in nutrient loss, and a 20% decrease in fertiliser use by 2030 (European Commission, 2020).

2.3 Agri-Environmental Projects in Ireland

Irish AES have evolved since the introduction of the Rural Environment Protection Scheme (REPS) in 1994. There were three subsequent iterations up to 2009 (McGurk et al., 2020). Farmers received the highest payments for the first 20 hectares, with different rates of declining payments for additional hectares across various iterations of the scheme (Cullen et al., 2021). This led to farm size strongly influencing farmers' decision to participate (Hynes and Garvey, 2009).

The Agri-Environment Options Scheme (AEOS) replaced REPS in 2010. It differed in that the focus was on improving particular landscapes and habitat types (McGurk et al., 2020; Murphy et al., 2014) and scheme

entry was prioritised for farms with certain features such as land designated as a Special Areas of Conservation² or Special Protection Area³ (Cullen et al., 2021). However, participation was lower than REPS due to low payments (DAFM, 2017; McGurk et al., 2020). The Green Low-Carbon Scheme (GLAS) replaced AEOS in 2015 and it involved the further targeting of funds to achieve greater scheme results (Cullen et al., 2021). GLAS also had a greater focus on measures aimed at reducing carbon emissions from agriculture. Entry into GLAS was by a three-tier system of priority which considered farms' 'Priority Environmental Assets'. The highest tier included farms with Natura 2000 sites, important farmland birds, rare breeds, commonages, and High-Status waterbodies⁴. The second tier included those with Vulnerable Water Areas and those choosing to undertake 'Priority Actions' which were low emission slurry spreading, minimum tillage, catch crops, and wild bird cover. The third tier applied to the remaining farms (Cullen et al., 2021). All of these schemes have been terminated.

A new agri-environmental climate measure called the Agri-Climate Rural Environment Scheme (ACRES) was introduced in Ireland in January 2023. Its objective is to address biodiversity decline mainly in designated regions, while also serving as an income support. This scheme is funded by the Irish Government and the European Agricultural Fund for Rural Development of the EU, under Ireland's CAP Strategic Plan 2023-27 (DAFM, 2022). There are two entry points to the ACRES, with the ACRES General approach being available nationwide and offering a range of measures for individual land managers. The ACRES Co-operation approach, by contrast, is available to land managers in defined high priority geographical areas where land managers receive results-based payments, and a level of co-operation is required amongst participants (DAFM, 2022).

Eco-schemes, funded under Pillar 1, are conceptually similar to the AES of CAP Pillar 2 and may contain the four innovative contract designs discussed in this study. However, land managers are legally entitled to eco-scheme payments, whereas a granting procedure is used to allocate AES payments. Member States are free

to choose eco-scheme measures, as long as they respect the legal requirements in Article 31 of the Strategic Plan Regulation⁵ (Runge et al., 2022). This means that their design may benefit greatly from national and local knowledge. In Ireland, land managers qualify for eco-scheme payments by undertaking specific agricultural practices on their farms and they have the flexibility to opt in/out of such schemes and/or change the agricultural practices annually (DAFM, 2023).

2.4 Examples of Recent Voluntary AES in Ireland

Aside from AES that have been directly designed and funded by the Irish Government or the EU and eco-schemes, some locally run agri-environmental projects have provided environmental benefits in recent years and, in many cases, they have included innovative contract designs. The Burren Programme, funded by the Irish Government, seeks to protect biodiversity in the Burren in West Ireland, which is an UNESCO Geopark area of exposed limestone. Participating land managers may enrol in results-based contracts and five-year environmental targets are agreed between land managers and farm advisors. Payments are dependent on land managers implementing plans and performing according to an evidence-based scoring system. The benefits of this project are attributed to the fact that it is locally led, that there are high levels of local engagement and that farms' assessment is based on scientific evidence (CONSOLE, 2022a).

The Biodiversity Regeneration in a Dairying Environment (BRIDE) Project, funded by the EU Commission and the Irish Government, also uses results-based contracts and land managers agree to improve the quality of the habitats on their farms. Similar to the Burren Programme, farms are assessed and those with higher scores on habitat quality gain higher payments. The project has benefitted from strong engagement from local land managers showing that the introduction of biodiversity measures contributes to tangible environmental, economic, and social benefits (CONSOLE, 2022b).

The Results-based Agri-Environment Payment Scheme (RBAPS) Pilot in Ireland, funded by the EU Commission and the Irish Government, aimed to

² The EU Habitats Directive lists certain habitats and species that must be protected within Special Areas of Conservation. 'Irish habitats include raised bogs, blanket bogs, turloughs, sand dunes, machair (flat sandy plains on the north and west coasts), heaths, lakes, rivers, woodlands, estuaries and sea inlets' (National Parks and Wildlife Service, 2023).

³ Sites of importance for the conservation or protection of a natural habitat or the population of a species.

⁴ Coastal, transitional, river and lake water bodies that have a High-Status Objective under the EU Water Framework Directive (Environmental Protection Agency, 2020).

⁵ This Article establishes that all EU Member States must define and provide support for voluntary schemes for the climate, the environment and animal welfare (the 'eco-schemes') under the certain conditions that are set out in this Article and as further specified in the CAP. Participants are active farmers or groups of active farmers who make commitments to observe agricultural practices beneficial for the climate, the environment, animal welfare and combatting antimicrobial resistance. Further information is available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R2115>.

improve biodiversity on 35 farms in an area of High Nature Value farmland by using results-based payments. Small scale, low intensity beef cattle, and sheep farming were targeted (CONSOLE, 2022c). RBAPS was similar to the Burren and BRIDE Projects in that it focused on improving biodiversity in a small area, which means that collective action is also at play within each project.

The Carbery Greener Dairy Farms scheme is also results-driven. However, the reward for farmers are the savings they make rather than the receipt of payments. The project was introduced by Carbery Group⁶ and Teagasc⁷ to measure, monitor, and optimise resources allocation with regard to environmental sustainability on dairy farms. The programme was based on a previous European project called the Dairyman Project, where 120 dairy land managers in 10 regions of Northwest Europe focused on farm resources efficiencies and management (CONSOLE, 2022d). Carbery was the first to start such an endeavour in Ireland. Various environmental efficiency measures were introduced on each farm to improve performance and achieve financial savings. The benefits from this project are improved carbon footprint of the farms, viability of farms through greater efficiencies, higher quality products, and an evolving ecological mind-set of land managers which spills-over into the wider community (CONSOLE, 2022d). To improve environmental efficiencies, various capital expenditure was required, such as the introduction of smart meters, plate coolers in milking parlours, and water storage tanks. The funding was provided by Carbery, State grants and, in some instances, the land managers themselves (CONSOLE, 2022d). This is an example of land managers, industry, and the State working together to achieve environmental objectives.

2.5 Factors Influencing the Perceived Benefits of Innovative Agri-Environmental Contracts in Ireland

In the literature, the understanding, applicability, and perceived economic benefits of AES by land managers have been shown to influence their adoption. For example, Wilson and Hart (2000) found that non-familiarity with AES can increase the likelihood of farmers being unable to agree with their benefits. To overcome this, Morris et al. (2000) argued that while mass media and generic literature are useful for increasing the under-

standing of AES, personal contact and demonstration are more important for the adoption of environmental measures. Similarly, Defrancesco et al. (2008) and Dessart et al., (2019) found that the more a farmer perceives he/she can easily implement a practice associated with a given agri-environmental contract, the more likely he/she will participate in it. It is indeed crucial that land managers understand AES and the possible contracts that may exist within each scheme, so that they can perceive them as being applicable and beneficial to their land.

Cullen et al. (2020) studied AES adoption in Ireland and they discussed a potential link between understanding and perceived economic benefits. For example, farmers who self-identify as ‘Productivists’⁸ are more likely to participate in AES if there is a potential increase in the profitability of their farm. While monetary incentives already exist in AES, Cullen et al. (2020) note that it is important that the added economic benefits of environmental measures are demonstrated to land managers to encourage their adoption. These measures may include optimising nutrient application, increasing pollinator numbers, and improved slurry management. Promotion of these measures may also increase the participation of ‘Forward-Looking Farmers’ who are seeking means to enhance the long-term performance of their farms. Cullen et al. (2018) also note that the involvement of farmers in the designing of AES will help to ensure that they suit land managers’ interests and practices.

Kelemen et al. (2023) studied the same four innovative contracts as those outlined in our study. They asked stakeholders in fifteen countries to compare the innovative contract types with existing mainstream action-based AES and they found that results-based contracts are perceived to require a ‘a broader knowledge base and a more developed infrastructure’ than mainstream AES and the other three innovative contract types. This further highlights the need for land managers to understand the nuances of contract types to increase their adoption.

The findings of Kelemen et al. (2023) question the applicability of collective contracts as they are considered to be the least suited to existing institutions, and the social and cultural context. One stated reason was the opinion that farmers only collaborate when there is a business interest and that collective contracts might require additional coordination and management. The authors also stress concerns over the perceived economic benefits of results-based contracts. They found that European stakeholders perceive results-based contracts

⁶ A global leader in food ingredients, flavours, and cheese. More information on this organisation is available at <https://www.carbery.com/>.

⁷ A State body which provides research, advisory, and training to the agricultural and food sector in Ireland. More information on this organisation is available at <https://www.teagasc.ie/>.

⁸ Cullen et al. (2020) use the term ‘Productivists’ to describe farmers who express a desire to produce more food and maximise income, even if the environment is harmed in the process.

to be ‘more costly to implement’ than mainstream AES and the three other innovative contract types. However, they do not study this on a per country basis.

In the study by Kelemen et al. (2023), the preferred policies stated by the stakeholders to improve the adoption of the four innovative contract types were formal education, peer-to-peer learning, and financial top-ups. Education and learning would help understanding, while the top-ups would help to reduce financial uncertainty. The provision of top-ups allows farmers to retain their flat payment and lose only the top-up if environmental targets are not met (Kelemen et al., 2023).

3. DATA AND METHODOLOGY

3.1 Overview of data collection

Data were collected as part of the EU Horizon 2020 funded CONSOLE Project (*Contract Solutions for Effective and lasting delivery of agri-environmental-climate public goods*). Surveys were conducted in twelve European countries (Austria, Bulgaria, Finland, France, Germany, Ireland, Italy, Latvia, Poland, Spain, Netherlands, and the United Kingdom), with 2,275 land managers and 486 stakeholders surveyed between December 2020 and July 2021 based on non-probability sampling. The Irish sample of respondents includes 210 land managers and 16 stakeholders (farm advisors, researchers, and industry experts). The survey questionnaires were designed by means of a common approach by the project partners, in English, and they were then translated to national languages (D’Alberto et al., 2022). The questionnaires were disseminated by project partners directly, as well as by non-profit organizations, farmers unions, and local institution boards. The non-probability sampling is due to the fact that the questionnaires, conducted during the COVID-19 pandemic restriction period, were distributed mainly via the CONSOLE Project’s website, through local institutions’ mailing lists, and local institutions’ official social media accounts. Therefore, respondents were self-selected.

3.2 Land manager surveys

In Ireland, the land manager surveys were distributed by an agency which provides administrative and technical advice to farmers and all surveys were completed online. The characteristics of the Irish sample are outlined in Table 1, as well as those of all twelve Euro-

pean countries studied. The data of the survey respondents can be compared to nationally representative data which is derived from the Farm Accountancy Data Network (FADN, 2021) and Eurostat data⁹ (Eurostat, 2016; Eurostat, 2021a, Eurostat, 2021b)¹⁰. Farm Accountancy Data Network (2021) data on farm types and data collected by Eurostat (2021) on formal agricultural training can be directly compared with the sample of this study. However, Eurostat (2021) collected data on farm holders’ ages under categories that differ from those used in our survey. We use data collected by Eurostat (2016) on farm holders who describe their main economic activity as being derived from their farm as a proxy variable for farm income being more than 50% of total income.

Table 2 includes descriptive statistics related to the surveyed land managers’ experiences and opinions of innovative agri-environmental contract designs. As noted in Table 2, 30% of surveyed land managers in Ireland are currently using results-based contracts, 17% are using collective action, 16% are using value chain, and 3% are using land tenure contracts. Between 1 and 5 years is the most preferred contract duration. To the best of the authors’ knowledge, data on the current use of innovative agri-environmental contracts are not currently collected on a level that is representative of the European Union or its Member States.

Respondents were asked to select a scoring option on a 5 points Likert scale, expressing whether a characteristic of a potential agri-environmental contract would increase their willingness to enrol in such contracts. The options were: *increases willingness considerably, somewhat increases willingness, no effect, somewhat decreases willingness and decreases willingness considerably*. These characteristics of potential contracts are listed in Table 3.

Then, descriptions of results-based, collective action, value chain, and land tenure contracts (as described in Section 2.1) were provided to participants. They were asked whether they *strongly agree, agree, are neutral, disagree or strongly disagree* with the following statements: 1) ‘The contract type is easy to understand’; 2) ‘The contract type is applicable to my farm’; 3) ‘The contract type is economically beneficial for my farm’.

3.3 Stakeholder survey

Each project partner selected local stakeholders to complete surveys and attend workshops at a local level.

⁹ Data on farm holders’ ages and formal agricultural training in the United Kingdom are not reported by Eurostat and, therefore, are not included in Table 1.

¹⁰ This datasets do not include forests.

Table 1. Descriptive statistics of surveyed land managers.

Variable	Frequency			
	Ireland		All surveyed countries	
	Sample (n=210)	Nationally representative data	Sample (n=2,721 ¹)	Representative data
<i>Farm type</i>				
Dairy	0.55	0.17	0.14	0.11
Cereals	0.01	0.03	0.21	0.19
Field crops/Permanent crops	-	-	0.13	0.16
Mixed systems	0.01	0.02	0.11	0.10
Cattle	0.21	0.60	0.08	0.10
Sheep/Goats/Poultry	-	0.17	0.03	0.08
Mixed livestock	0.21	0.01	0.02	0.01
Forestry	0.01	-	0.16	-
Fruit/Vineyards/Horticulture	-	-	0.10	0.25
Other	-	-	0.02	-
<i>Agriculture/Forestry Education</i>				
Completed	0.82	0.54	0.60	0.65
<i>Age</i>				
18-30 Years	0.06	-	0.07	-
31-50 Years	0.53	-	0.42	-
51-70 Years	0.39	-	0.44	-
71 Years and older	0.02	-	0.07	-
< 25 Years	-	0.01	-	0.01
25-29 Years	-	0.08	-	0.08
30-34 Years	-	0.07	-	0.08
35-44 Years	-	0.10	-	0.11
45-54 Years	-	0.27	-	0.30
55-64 Years	-	0.24	-	0.29
65 Years and older	-	0.23	-	0.13
<i>Farm To Total Income Ratio</i>				
Farm income > 50% Total income	0.66	0.52	0.88	0.75

¹ 2,721 valid land manager surveys were considered from the 2,275 units initially retrieved.

Of the total sample, 61% of participants were scientists, 19% represented environmental NGOs or advisory services, 10% worked in administration, 7% were farmers, foresters or landowners, and 3% worked in industry. The aim of the workshops was to discuss and select the most promising examples of existing contract solutions among those retrieved by the common literature review. The reasons for the failure or success of these contracts were identified and discussed too. In October 2020, a pan-European web-seminar with 105 participants (excluding the organisers and panellists) was held online (for further details, please refer to Viaggi et al., 2020). Stakeholders from the local level workshops were called to discuss, together, the results from each country. In addition, stakeholders were asked whether they *strongly*

agree, agree, are neutral, disagree or strongly disagree with the statement that the features of contracts outlined in Table 4 would increase the willingness of land managers to enrol in an agri-environmental contract.

In addition, stakeholders were asked the following question: *'In your opinion, for which environmental objective provision would the four contract types be the most suitable? Choose only one environmental objective for each contract type.'* The options were landscape and scenery: biodiversity, soil health and quality, carbon storage, and water quality and quantity.

Table 2. Descriptive statistics of surveyed land managers' experiences.

Variable	Frequency	
	Ireland (n=210)	All Surveyed Countries (n=2,721)
<i>Experience of results-based contracts</i>		
Currently using results-based contract	0.30	0.21
Never used results-based contract	0.66	0.73
Previously used results-based contract	0.04	0.06
<i>Experience of collective action contracts</i>		
Currently using collective contract	0.17	0.06
Never used collective contract	0.81	0.91
Previously used collective contract	0.02	0.03
<i>Experience of value chain contracts</i>		
Currently using value chain contract	0.16	0.16
Never used value chain contract	0.82	0.81
Previously used value chain contract	0.02	0.03
<i>Experience of tenure based contracts</i>		
Currently using tenure contract	0.03	0.07
Never used tenure contract	0.96	0.90
Previously used tenure contract	0.01	0.03
<i>Preferred contract length¹</i>		
< 1 Year	0.05	0.23
Between 1 and 5 Years	0.72	0.66
> 5 up to 10 Years	0.23	0.11

¹ Respondents answered this question regardless of whether they have used entered a contract before or not.

4. RESULTS AND DISCUSSION

4.1 Land managers' attitudes to innovative contract designs

Figure 1 details the percentage of land managers who agreed that a characteristic of a contract would increase their willingness to enrol in a hypothetical agri-environmental contract/programme. The data for Ireland is labelled 'IRL' and the data for the other eleven European countries is noted as 'Others.'

Figure 1 suggests that self-chosen measures increase the willingness of most surveyed land managers to enrol in novel AES in Ireland and other European countries. This supports the work of the EU in ensuring that each Member State develops its own national CAP Strategic Plan in consultation with land managers and other stakeholders. More specifically, it is important that land managers have autonomy over how they manage their land to achieve environmental benefits and the design of AES should allow for this. When the means of the

Table 3. Contract Characteristics Evaluated by Land Managers.

Contract characteristic	Definition
Self-chosen measures	In the contract, the land manager is free to decide about the management practices used to achieve the specified environmental result.
Common payment	A group of land managers receive a common payment and they jointly agree on the distribution of the payment.
Paid by customers	The contract is not paid by public money, instead the compensation that a land manager gets for environmentally friendly production is paid by buyers of products.
Reduced rent	Land managers pay reduced rent on land rented in if they agree to follow environmental management clauses as specified in the lease contract.

responses¹¹ are calculated for each contract characteristic, the results for Ireland and the other countries are very similar.

It is important to highlight that common payments are not desired by many respondents in all countries, which plays as a major obstacle for the implementation of collective contracts. A reluctance to share a common payment may be due to increased uncertainty (Rodríguez-Entrena et al., 2019) or a fear that they will lose autonomy by working collectively (Villanueva et al., 2015). They may also fear that others will act as free riders, benefitting from the group's actions without contributing themselves, which would contradict the perception of Olivieri et al. (2021) that the desire of group members to maintain their reputation would reduce the risk of moral hazard. Our finding supports the work of Kelemen et al. (2023) which noted that collective arrangements are not considered to be the suited to existing institutions, and the social and cultural contexts.

As previously mentioned, descriptions of results-based, collective action, value chain, and land tenure contracts were then provided to participants who were asked to rate their level of agreement with the understandability, applicability, and economic benefits of these contracts. Figure 2 details the percentage of surveyed land managers who agreed that a contract type is easy to understand/applicable/economically beneficial.

Figure 2 shows that results-based contracts are considered understandable, applicable, and economically beneficial by more land managers in Ireland than other European countries. Of the four innovative contract

¹¹ Based on the points of the Likert scale ranging from 1 (decreases willingness considerably) to 5 (increases willingness considerably).

Table 4. Contract characteristics evaluated by stakeholders.

Contract characteristic	Definition
Annual compensation	Land managers receive compensation payment on an annual basis.
Authority control	The results that land managers achieve are regularly controlled by the competent authority visiting a farm e.g. once a year.
Self-chosen measures	In the contract, the land manager is free to decide about the management practices used to achieve the specified environmental result.
Better results, higher payment	The better the environmental result, the higher the payment.
Collective agreement	Land managers can collectively agree on environmental targets and measures at landscape-level together with other land managers.
Common payment	A group of land managers receive a common payment and they jointly agree on the distribution of the payment.
Free training	Land managers are offered free training and advice that enables them to reach the environmental targets.
Labelled product	Land managers sell their products labelled as environmentally friendly (e.g. climate friendly products) when following management measures as prescribed in a processor or retailer contract.
Paid by customers	The contract is not paid by public money, instead the compensation that a land manager gets for environmentally friendly production is paid by buyers of products.
Reduced rent	Land managers pay reduced rent on land rented if they agree to follow environmental management clauses as specified in the lease contract.
Sales guarantee	Land managers receive a sales guarantee from a processor or retailer in return for implementing environmental measures.
Self-monitoring	Land managers do the monitoring of the environmental results themselves (e.g. count specific plants).
Periodical payment	Land managers receive half of the environmental payment at the beginning of the five-year contract period, and half at the end of it.

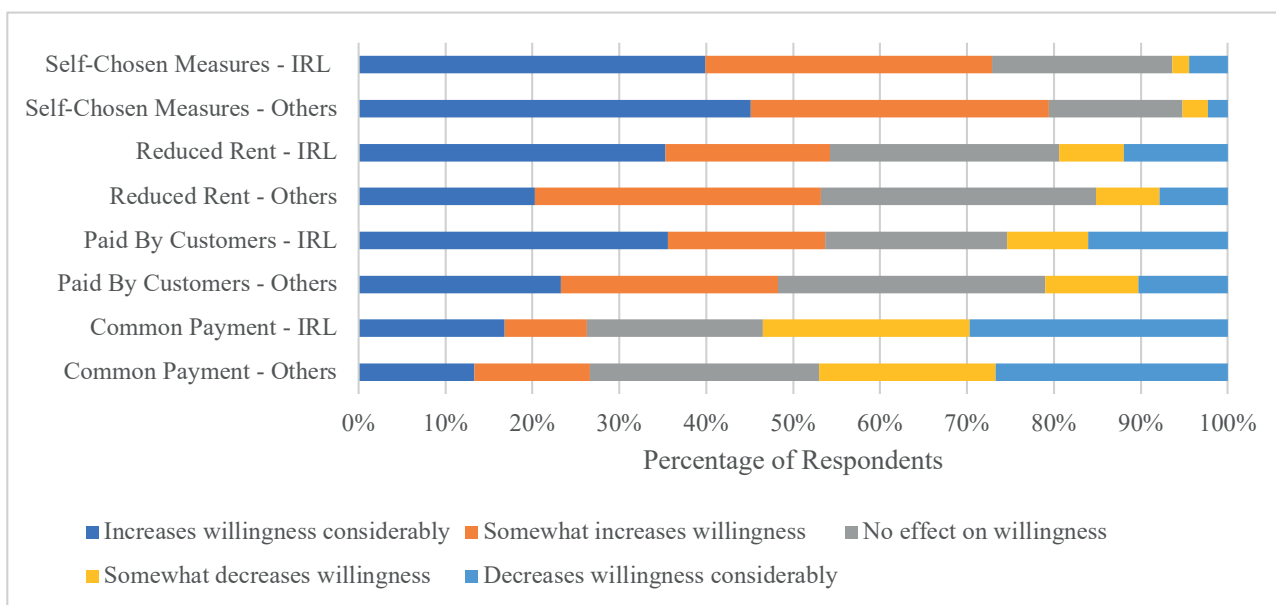


Figure 1. The impact of contract characteristics on willingness to enrol in agri-environmental contracts.

types, the understandability of results-based contracts in Ireland scores the highest, at a mean of 4.0¹², while the

mean score of this characteristic for all other countries is 3.8. In relation to results-based contracts, the greatest difference in means between Ireland and the other European countries is related to the applicability of results-based contracts. The mean score in Ireland is 4.1 compared to

¹² Based on the points of the Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

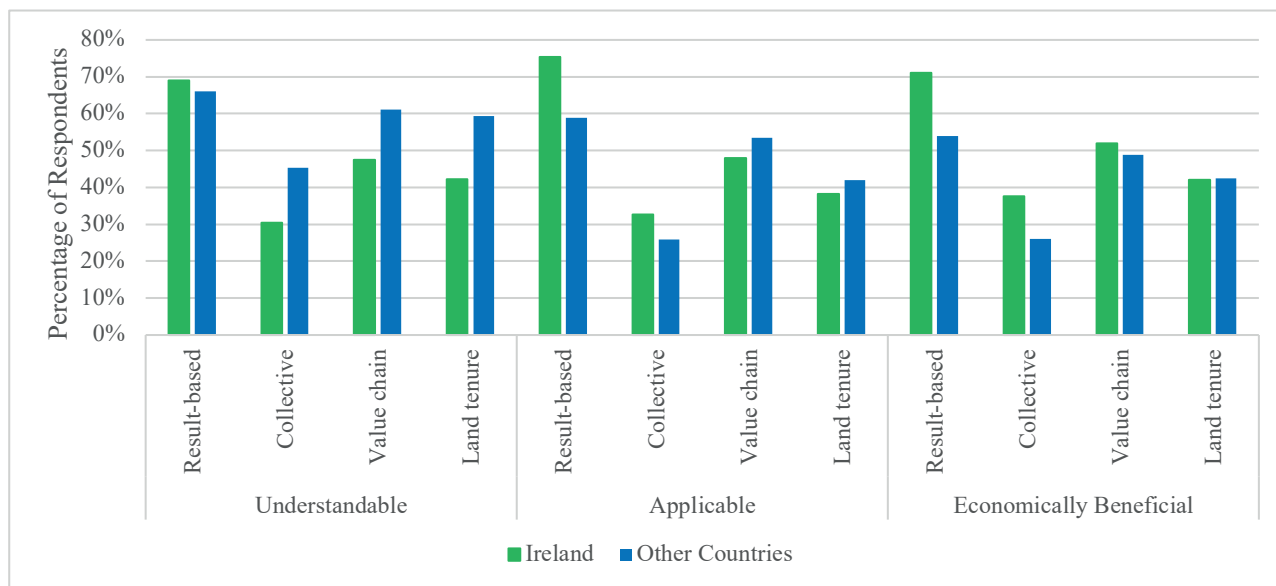


Figure 2. The percentage of land managers who (strongly) agree that a contract type is easy to understand/applicable/economically beneficial.

3.6 in other countries. This finding is plausible considering that they are the most common of the four contract types in the sample for Ireland. They are also perceived by many to be economically beneficial which follows the connection between familiarity and perceived benefits previously highlighted by Wilson and Hart (2000). Given their relative popularity in Ireland¹³, it is possible that some farmers with no first-hand experience of results-based contracts may have gained some insights from those who have personal experience of them.

Compared to other European countries, agreement with the understandability and applicability of value-chain and land tenure contract types in Ireland is relatively low. This is an important finding because, as previously noted, the more a farmer perceives that he/she can easily implement an element of a given agri-environmental contract, the more likely he/she will participate in it (Defrancesco et al., 2008; Dessart et al., 2019). Therefore, our findings call for greater education of these contracts in Ireland to increase their adoption. Approximately one half of surveyed Irish land managers consider value chain contracts to be economically beneficial and, despite their rarity, this suggests there is some interest amongst land managers in Ireland to enter this type of contract.

As land rental levels in Ireland are the second lowest in Europe, after Portugal, (European Commission, 2022), it may be difficult for some Irish land managers to imagine that a land tenure contract would be suitable

for them. Land is also typically rented on eleven-month contract agreements in Ireland and the Irish Government is already encouraging the renting out of land on long term leases through tax incentives (Bradfield et al., 2023a). Longer contract durations may encourage landowners to include environmental management conditions in their contracts, as the added time may allow them to reap greater benefits from the tenants' practices.

Collective contracts are considered to be understandable, applicable, and economically beneficial by the lowest percent of Irish and other European land managers. A lack of understanding may be driving the other two factors to be low. It may also be the case that land managers enjoy the autonomy of managing their own farm and do not wish to be contractually linked to other land managers which is supported by respondents being in favour of self-chosen measures (Figure 1). Previous work by Raina et al. (2021) also supports this conclusion as they noted that some studies have found that farmers prefer individual management and discrete compensation. Another example is offered by Rodríguez-Entrena et al. (2019) who stated that collective participation leads to a higher degree of uncertainty among the farmers. Farming already bears considerable risk, whether it be financial risk, unpredictable weather or susceptibility to international economic shocks. Consequently, land managers may be reluctant to bear more uncertainty through collaborative work (Rodríguez-Entrena et al., 2019).

In summary, of the four innovative contract types presented in this paper, results-based are considered to

¹³ 34% of Irish farmers in this sample have experience of using these contracts compared to 27% in all twelve surveyed countries.

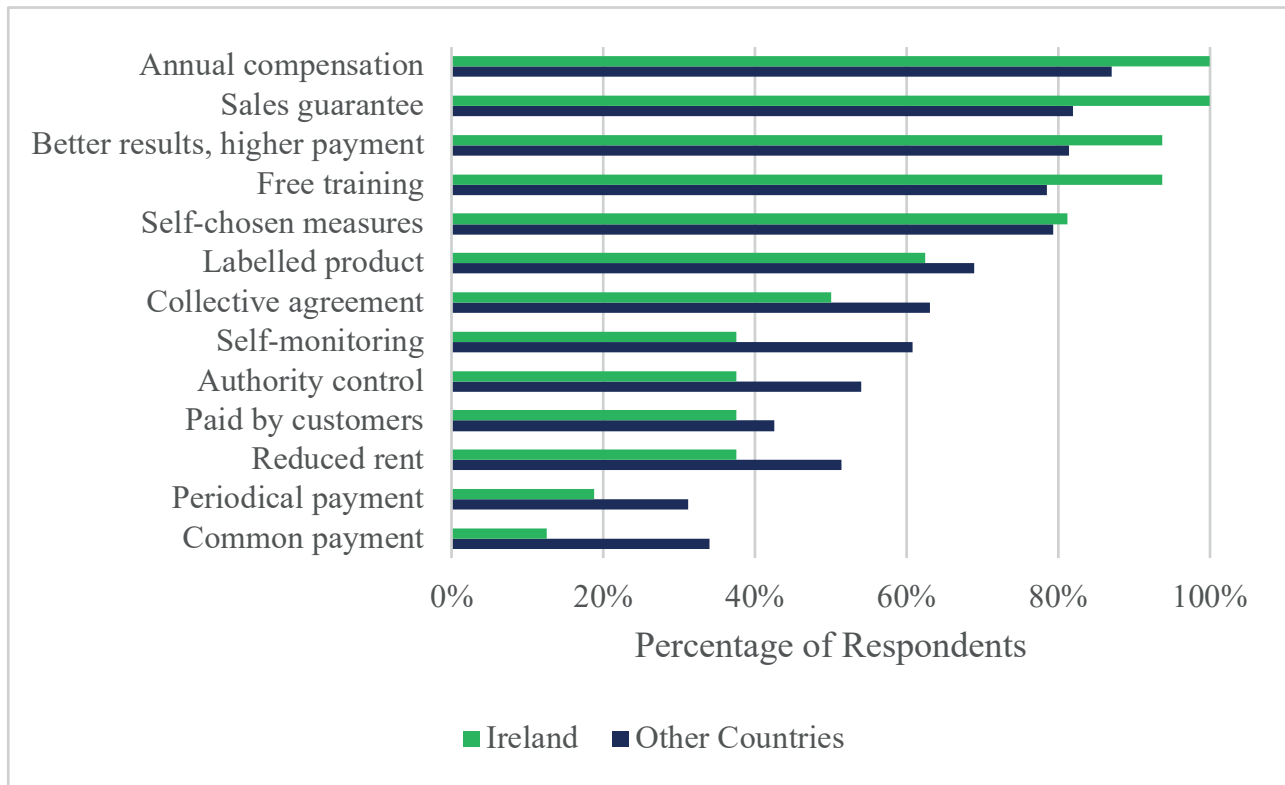


Figure 3. The percentage of stakeholders who agree that a characteristic increases land managers' willingness to enrol in an environmental contract/programme.

be understandable, applicable, and economically beneficial by approximately 70% of surveyed land managers in Ireland which is higher than in other European countries. This high percentage may be driven by the existing familiarity with this contract type and the fact that they allow for autonomy over both work and its potential results. Compared to data from other European countries, the understanding of value chain, collective action and land tenure-based contracts is low in Ireland, and further research may explore the reasons why this is the case.

4.2 Stakeholders' attitudes to innovative contract designs

A previously mentioned, stakeholders were asked whether they agree that a characteristic increases land managers' willingness to enrol in an environmental contract/programme and their responses to this question are presented in Figure 3.

'Annual compensation' and 'sales guarantee', which both provide financial certainty, were considered by most stakeholders to be particularly important to land managers in both Ireland and across Europe. A reward system of better results generating higher payments

('better results, higher payment') also scored highly. This is also a contract characteristic that supports the desire for financial certainty, as well as environmental benefits. Free training is also considered to be important for the uptake of such contracts. When compared to other European countries, land managers in Ireland tend to be less in favour of collective action or authority control. This supports our conclusion in Section 4.1 that there is a strong desire for autonomy amongst land managers. This may be related to the memory of the fight for independence in the early 1900s to remove authoritative control from English landlords (Bradfield et al., 2023b).

In Ireland, a lower percentage of respondents perceive that the self-monitoring of environmental results encourages enrolment, when compared to other European countries. It may be the case that authority control is thought to be undesirable by land managers in Ireland, because it reduces autonomy over land management practices, but the monitoring of environmental outcomes by external agencies is accepted. Keleman et al. (2023) highlight that the monitoring of results poses a challenge for innovative contracts with the definition of indicators, use of information technology and farmers'

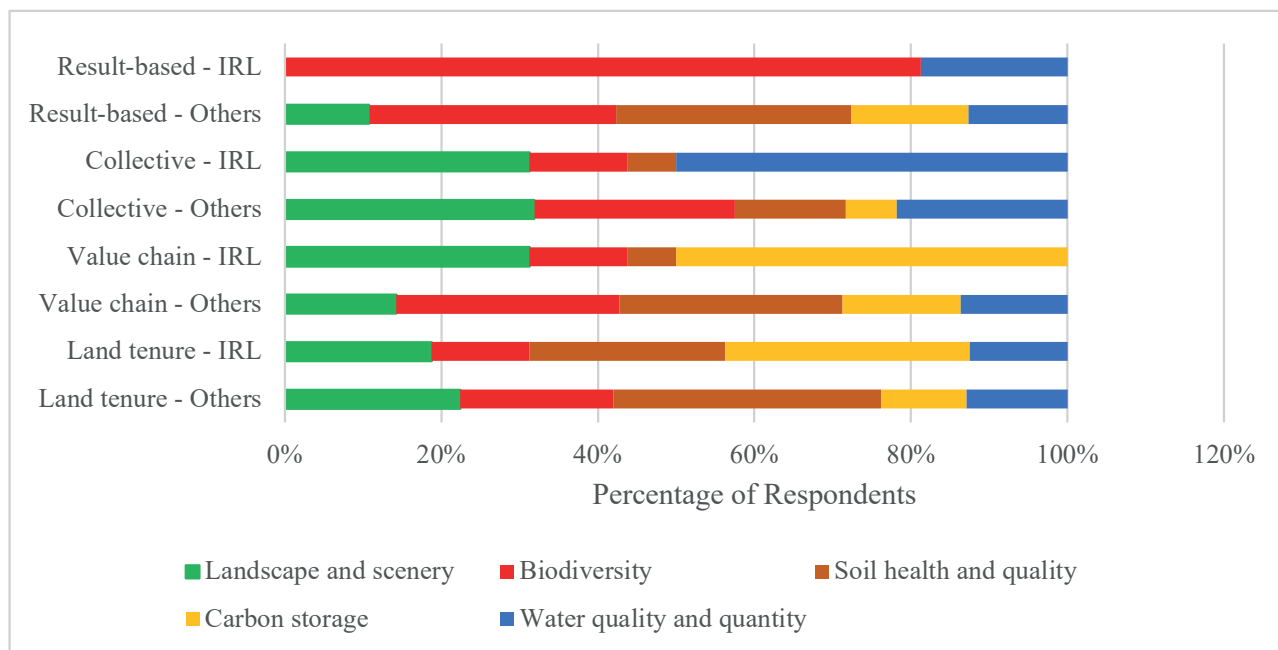


Figure 4. Perceived suitability of contract type for environmental objective (Ireland). Also available in D’Alberto et al. (2022).

expertise being some examples. These may be reasons why farmers are hesitate to self-monitor their actions. All countries perceive periodical payments¹⁴ or common payments to be the least likely to increase enrolment which further supports a desire for control over incomes.

As the aim of AES and agri-environmental contracts is to improve environmental outcomes, we wish to discover which agri-environmental goods are considered to benefit most from a particular contract type. Therefore, stakeholders were asked the following question: ‘In your opinion, for which environmental objective provision would the four contract types be the most suitable? Choose only one environmental objective for each contract type.’

Figure 4 displays the percentage of respondents who stated that a particular agri-environmental objective would benefit the most from a specific contract type. Data for Ireland is labelled ‘IRL’ and the data for the other eleven European countries is noted as ‘Others’.

In Ireland, most surveyed stakeholders believe that biodiversity would benefit the most from results-based contracts. As previously shown in the description of AES case studies, results-based contracts in Ireland have so far mainly targeted improved biodiversity, which may explain why stakeholders in Ireland see a link between

these contracts and biodiversity gains. We find that collective action is perceived as the most beneficial for improving water quality amongst respondents in Ireland. However, it is the innovative contract type that scores the lowest in terms of understandability, applicability, and perceived economic benefit, and further education may be needed to highlight its potential environmental benefits. A high portion of surveyed stakeholders in Ireland feel that value chain contracts are best suited to support carbon storage. Fewer of the surveyed stakeholders in other European countries believe that individual contract types can benefit one particular AECPPG. This suggests that they perceive the contracts as having a wider range of environmental benefits which is appropriate given that, for example, collective contracts can benefit AECPPG such as water quality, biodiversity, and landscapes across large regions (Prager, 2015; Olivieri et al., 2021).

A limitation of this study is a lack of representativeness of the farming population, given the fact that the survey has been carried out on a non-probability sample. However, the large spectrum of respondents questioned, both in Ireland and at the European level, support the conclusion that our results remain informative, and the common European survey perspective adds relevance to the comparisons made. Further research could include analysis of the factors that cause land managers and stakeholders to either agree or disagree that a contract

¹⁴ Stated as follows: ‘Land managers receive half of the environmental payment at the beginning of the five-year contract period and half at the end of the contract’.

type is understandable, applicable, and economically beneficial. Additionally, more complex experimental research, such as discrete choice experiments, could be utilized to determine the extent to which land managers prefer some characteristics of agri-environmental contracts over others.

5. CONCLUSIONS

Understanding the factors influencing farmer decision-making is important for policymakers in their design and promotion of agri-environmental schemes. Existing evidence suggests that action-based contracts have not maximized environmental benefits (Burton and Schwarz, 2013) and, as an alternative, four innovative contract types have been studied by the EU funded CONSOLE Project. This research highlights the perceptions of land managers and stakeholders in terms of the understandability, applicability, perceived economic benefits, and characteristics of such contract forms, which have not been previously studied in the context of Ireland despite the challenges the agriculture sector faces in becoming more environmentally sustainable. This research fills a gap in the literature as discussion of these contracts has been limited to date (Bredemeier et al., 2022) and it is important that we understand how attitudes differ in Ireland compared to other European countries so that further research and the CAP can be tailored to fit the local context.

Our findings show that the understanding of the four innovative contract types, as well as their applicability and economic benefits, could be greatly improved in European countries. This calls for greater promotion and education of these contracts to encourage their adoption. Results-based contracts, which are the most common of the four innovative contract types in Ireland, are considered understandable, applicable, and economically beneficial by the majority of Irish land managers. This suggests that practical experience or the hearing of other people's experiences can boost understanding and this form of promotion should be encouraged. This is important for land managers in Ireland who have relatively low levels of understanding of collective action, value chain, and land tenure contracts due to the fact that they may have had little direct experience of them.

With respect to the need for increasing the adoption rate of agri-environmental contracts, self-chosen measures and financial certainty should be the priority, as advised by land managers and stakeholders across Europe, and this is particularly the case in Ireland. Therefore, it is of importance that agri-environmental policies in Ireland provide autonomy for farmers. These

findings also help to explain why collective contracts are not considered to be economically beneficial by many land managers in this study, as they potentially expose land managers to uncertainty (Rodríguez-Entrena et al., 2019). Training and guidance from expert stakeholders are also considered important for the uptake of such contracts, supporting our conclusion that education about innovative contracts is fundamental.

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