Views on Natural Capital and Evidence Use in Policy Processes associated with Scotland's Agricultural Reform Programme.

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List of acronyms

AECS	Agri-Environment Climate Scheme
ARE	Agriculture and Rural Economy, a Directorate of the Scottish Government
ARP	Agricultural Reform Programme
CAP	Common Agricultural Policy
EFA	Ecological Focus Area
ENCA	Enabling a Natural Capital Approach (toolset and resources for policy-makers)
GIS	Geographic Information System
LPIS	Land Parcel Identification System
NC	Natural Capital
NCAI	Natural Capital Asset Index
RESAS	Rural and Environment Science and Analytical Services, a Division of the Scottish Government
SAF	Single Application Form
SG	Scottish Government
SBS	Scottish Biodiversity Strategy
WFP	Whole Farm Plan

Summary

This report is a deliverable from the project 'Galvanising Change via Natural Capital (JHI-D5-3) within the Scottish Government's Strategic Research Programme (SRP) 2022-27. It explores how individuals connected with the ongoing Agricultural Reform Programme perceive the concept of natural capital and the role of evidence in policy processes.

Natural Capital (NC) is a way of representing nature in terms that should help the various aspects and benefits of nature to be better accounted for in decision-making (Bateman et al., 2020). A Natural Capital Approach is therefore closely related to the idea of working more holistically.

NC is potentially relevant to many policies and parts of the Scottish Government (Maes et al.,2020), and agriculture notable as a policy area which is both impacted by and impacting the state of the natural resources. Agricultural policy in Scotland is also undergoing a period of significant change via the Agricultural Reform Programme (ARP), whose guiding vision includes a commitment to supporting natural capital (Scottish Government, 2022). The ARP thus represents a potential opportunity to introduce and work with NC in policy.

However, working with NC in policy-making is rarely reported and thought to be challenging (e.g. Brandon et al., 2021). There is no clear prescription for how to go about this, and there may also be many other priorities and ideas shaping policy development. In the case of the ARP, the relative newness of the Natural Capital approach collides with the dynamics of a well-established policy such as agricultural policy, making it an interesting case study of processes of policy development.

The aim of our study was to understand policy-makers' experiences and perceptions of working with NC concepts and evidence. To achieve this, we carried out a series of semi-structured interviews in late 2024 with civil servants and other public sector staff involved with agricultural policy-making.

The main findings are:

- NC is a familiar term, but there is lack of a shared understanding of NC and of its rationale or role for inclusion in the ARP.
- We propose different profiles for how individuals regard NC in policy design: "strategic champions", "specialised champions", "pragmatic designers", "cautious strategists", and "cautious fine-tuners". Differentiating between these profiles can inform efforts to deepen engagement with NC, and influence its integration in complementary ways.
- There are a number of barriers to the integration of NC in the ARP. These include resource constraints, data gaps, lack of clarity about the NC concept, and path-dependency dynamics.
- The design of the agricultural policy instruments is shaped by existing data, and there is perceived to be a lacking comprehensive baseline on agricultural NC. Providing a baseline at farm level and across Scotland is seen as pivotal for working with NC in agricultural policy.
- So far, the Whole Farm Plan is seen as one of the main features relevant to NC that has been introduced in the ARP. These plans might help embed NC in a variety of ways, although they are not currently explicitly framed in terms of NC, but should not be assumed to be the only or main way in which NC can feature in agricultural policy.

Given the diversity of understandings and expectations associated with Natural Capital, it would be valuable to continue to explore how this concept could be feasible and productively incorporated into agricultural policy development. Given the many goals assigned to agricultural policy, it is important to question if the Natural Capital tools and concepts can help support policy design and outcomes better reflect the multiple values of nature.

Introduction

Natural Capital (NC) is a way of representing nature in anthropocentric and economic terms, that should help nature to be better accounted for in decision-making (Bateman et al., 2020). This should include decisions as part of public policy development.

The Scottish Government has endorsed working with NC, and has already made changes and resources available to reflect this – as we discuss below in more detail. Independent analysis has noted that NC is potentially relevant to many policies and parts of the Scottish Government (Maes et al., 2020), with agriculture notable as a policy area which is both impacted by and impacting the state of our natural resources. Agricultural policy is also relevant as it is undergoing a period of significant change – referred to as the Agricultural Reform Programme (ARP) – whose guiding vision includes a commitment to supporting natural capital (Scottish Government, 2022). The ARP thus represents a potential opportunity to introduce and work with NC.

However, embedding and working with NC in policy-making is rarely reported and thought to be challenging (e.g. Brandon et al., 2021). There is no single clear prescription for how to go about this, and there may also be many other priorities and ideas shaping policy development. It is therefore important not to assume that working with NC is straightforward or easy. Understanding if and how NC can be productively incorporated requires more understanding of the experiences of staff charged with policy development. This is the challenge addressed by this study, carried out as part of the Scottish Government's Strategic Research Programme 2022-27.

The aim of our study was to understand civil servants' experiences and perceptions of working with NC concepts and evidence in policy-making, with a focus on Scottish agricultural policy.

We asked the following research questions:

- What does natural capital mean for policy-makers working on the ARP? How diverse are these understandings?
- If and how are evidence or ideas of natural capital being integrated in the ARP?
- What constrains or enables the integration of natural capital in the ARP?

We answered these questions by carrying out semi-structured interviews in late 2024. We interviewed staff in a range of roles linked to agricultural policy development in Scotland.

Background to this study

In the following section we explain more about Natural Capital and its potential relevance to policy-making; the relevance of NC to Scottish policy development, and specifically the ARP. Lastly we introduce some concepts from the literature relevant to understanding how new concepts may be endorsed in policy-making, that shaped the design of our methodology.

Natural capital and decision-making

Natural Capital (NC) is a way of representing nature in terms of how natural assets produce goods and ecosystem services that underpin human well-being (Ozdemiroglu, 2019). Approaches vary but generally entail representing and quantifying the value of multiple natural assets and the ecosystem services that are supported by them. This framing is therefore expected to make nature salient to economic analyses that dominate the majority of professional decision-making processes.

NC is often associated with influencing decisions by private sector actors – see for example the Capitals Coalition and its Natural Capital Protocol[1] – but is also relevant to policy development by states and governments (Bateman et al., 2020). By representing nature in terms of assets, stocks and flows that benefit society (Missemer, 2018), NC is expected to help plans and policies properly reflect how society benefits and depends on the natural environment (Ruijs et al., 2019). In particular, it should help make clear the significance of services provided by nature that are currently not represented in market prices, but are valued or essential for society. Natural Capital Approaches are thus expected to consider multiple issues and promote holistic decision-making that can enable wise allocation of public sector resources (Binner et al., 2025).

Working with NC offers promise for delivering commitments to nature and biodiversity, such as those in the Scottish Biodiversity Strategy (SBS). However, it is important to note that NC is expected to achieve this primarily by influencing the decisions of sectors and groups that are not already strongly focused on nature. This is because NC is influenced by – or influences – many policy areas (Maes et al., 2020), with examples ranging from transport, to health and social care, defence, agriculture, forestry, or energy. (Agriculture is notable as a policy that is both strongly dependent on and influential over NC.) Therefore, taking better account of it when developing and implementing policies in these areas, may greatly change those processes. The implications of more closely considering dependencies and impacts of NC are likely diverse, and vary greatly according to the policy area. Examples range from considering water quality goals when land-use planning, hydrological risks and impacts when designing transport infrastructure, through to considering carbon emissions when designing trade policy (Liu et al., 2015).

So, NC offers promise for the perennial challenge of 'mainstreaming' nature across different areas of policy development (Aronson et al., 2012), to help support sustainable development. Its economic framing of nature means it may be especially appealing to those who develop and appraise options in economic terms; i.e. the policy analysts and other civil servants who work to deliver government commitments. However, insights about the work processes and perceptions of such policy-makers are rare; there is a need for more attention to the views and experiences of individuals who contribute to policy development (Blackstock et al., 2023). Nor are there many examples of NC being used and useful in policy development (Brandon et al., 2021). It is therefore important to understand more about progress and challenges by those individuals who might be expected to work with NC in policy development.

Scottish Government commitments and support for NC

The UK and Scottish Governments are notable pioneers in working with the concept of NC. A Natural Capital Committee was established by the UK Parliament in 2011, and the term became especially prominent a decade after the release of 'Dasgupta Review' (Dasgupta, 2021). For a full description of how and why Natural Capital has come to be endorsed by the Scottish and UK governments, consult sources such as Claret et al. (2018); Faccioli and Blackstock (2017); Hooper et al. (2019). This section summarises some current Scottish initiatives that indicate support for embedding NC, and resources that may be relevant for policy-makers seeking to work with NC.

Support for embedding NC The term Natural Capital or related terminology is used within hundreds of strategic documents issued by various policy teams (Claret et al., 2018). The idea of working with NC is often strongly associated with land use and landscape-level planning (Faccioli et al., 2023;

[1] https://capitalscoalition.org/capitals-approach/natural-capital-protocol/

Peskett et al., 2023) and the Regional Land Use Partnerships have been asked to take a Natural Capital Approach (Reed et al., 2022).

A small Natural Capital team was created in 2020, within the Scottish Government's Directorate for Agriculture and Rural Economy. This team has a strong focus on how to govern new private sector involvements in nature markets (Scottish Government, 2024a). It also works to embed natural capital into Scottish policy and planning decisions, i.e. by chairing cross-department discussions on the subject, and providing accessible resources, like fact-sheets, to introduce the topic of NC, as well as the resources below.

Resources for working with NC There are two sets of national-level metrics available explicitly framed in terms of Natural Capital. Firstly, the Natural Capital Accounts monetise aspects of the services and benefits provided by Natural Capital, including geological stocks (Scottish Government, 2024b) in accordance with the international standards on Natural Capital Accounting (Edens et al., 2022). Secondly, a Natural Capital Asset Index (NCAI), tracks changes in non-monetary values of Scotland's natural systems (McKenna et al., 2019), linked more to the underlying extent and condition of terrestrial ecosystems. The NCAI feeds into Scotland's National Performance Framework[2], the means by which Scotland's public sector holds itself to account (Mackie, 2018).

In addition to these metrics, there is also a toolset and guidance called 'Enabling a Natural Capital Approach' or ENCA (Defra, 2021). This is intended to be used by policy analysts across the UK – civil servants supporting policy development, usually economists, who are dominant in the UK civil service (Allan, 2008). ENCA is 'supplementary guidance' designed to supplement and strengthen the mandatory approaches used by analysts in order to carry out cost-benefit appraisals of policy options to help decision-making efficiently allocate public sector resources (Atkinson et al., 2018). It collates data, tools and studies and provides a framework to assess how policy options affect Natural Capital and may be affected by Natural Capital. Information about ENCA is freely available online, and has featured in some training accessible to Scottish civil servants, such as pan-UK webinars for economists (M.Cairns, pers. comm.).

The Agricultural Reform Programme (ARP)

The UK's withdrawal from the European Union created the requirement to create a new agricultural policy for Scotland that was not bound to follow the rules of the Common Agricultural Policy (CAP). The subsidies and requirements associated with the CAP have historically had a large influence over much rural land use (Hodge et al., 2015). Therefore, a new agricultural policy potentially could have large consequences for landscapes and the services and benefits they deliver to society (Bateman & Balmford, 2018).

Since Brexit, the Scottish Government has committed to a substantial Agricultural Reform programme (ARP). This is primarily the responsibility of staff in the Agricultural Policy Division – a substantial division within the Scottish Government's Agriculture and Rural Economy Directorate. Design and delivery of the ARP is a large and complex task that therefore involves hundreds of staff. Staff in the Division have also been assisted or informed by colleagues in other divisions, primarily analysts in RESAS, and in the statutory agency NatureScot, the latter of whom has been trialling new ways of working in a Farming with Nature Programme[3], that was originally titled the Natural Capital Pilot Programme.

[2] Scotland's National Performance Framework is available at https://nationalperformance.gov.scot/
[3] NatureScot's Farming with Nature Programme is available at https://www.nature.scot/professional-advice/social-and-economic-benefits-nature/natural-capital/farming-nature

The aims of the ARP include producing more food sustainably, cutting carbon emissions and farming with nature. The Vision for Scottish Agriculture (Scottish Government, 2022) specifies the goals in detail, and explicitly includes the term Natural Capital. In this vision, NC is referred to as something to benefit from the policy, another way of seeing farms and crofts, and is also used when discussing private sector opportunities and markets that may also affect land-manager decisions. In mid 2024, a few months before our data collection, an Agriculture and Rural Communities (Scotland) Act was passed by Parliament with the intention of "*enabling the support of agriculture, rural communities and the rural economy through the creation of a framework for that support; to make provision for continuing professional development for those involved in agriculture and related industries, to make provision in relation to the welfare and identification of animals, to repeal spent and superseded agricultural enactments; and for connected purposes*". This primary legislation that enables the Vision does not mention NC, although one of its five objectives are "*on-farm nature restoration, climate mitigation and adaptation".*

The Vision specified four tiers of funding potentially available to farmers, and this structure has continued to shape agricultural policy development. The design of each of these tiers (e.g. precisely what actions are required or optional) and allocation of resources across these tiers is important, as they are a key means of influence on land-manager decision-making. At the time of our interviews, relatively clear insights about the remit and resources of tier 1 and tier 2 were becoming public, with relatively more uncertainty about the details of tier 3 and 4. Tier 1 would be direct payments to all farmers who comply with essential conditions, which will include carrying out a Whole Farm Plan (WFP) whose components will include natural capital related audits (see box 1). 'Agri-Environment measures' (AES)– payments for farmers to carry out optional pro-environmental actions – would be found in both tiers 2 ('Enhanced') and tiers 3 ('Elective'). Payments in tier 2 would be guaranteed to farmers carrying out specified measures, whilst applications to be paid for tier 3 measures would depend on government priorities and budgets. These measures were referred to in the interviews we conducted with staff working on the ARP. We do not provide a further description or analysis here of the new agricultural policy arising from the ARP, but note some more detail on possible agri-environment measures is contained in (Matthews et al., 2023). The analysis in Matthews et al makes clear the variety of goals relevant to developing and selecting agri-environment measures: a mix which is potentially challenging to understand, represent and navigate. Working with the concept of NC may help with this challenge of representing and navigate the multiple goals associated with agricultural policy, by ensuring representation multiple public benefits (and costs) associated with land management choices.

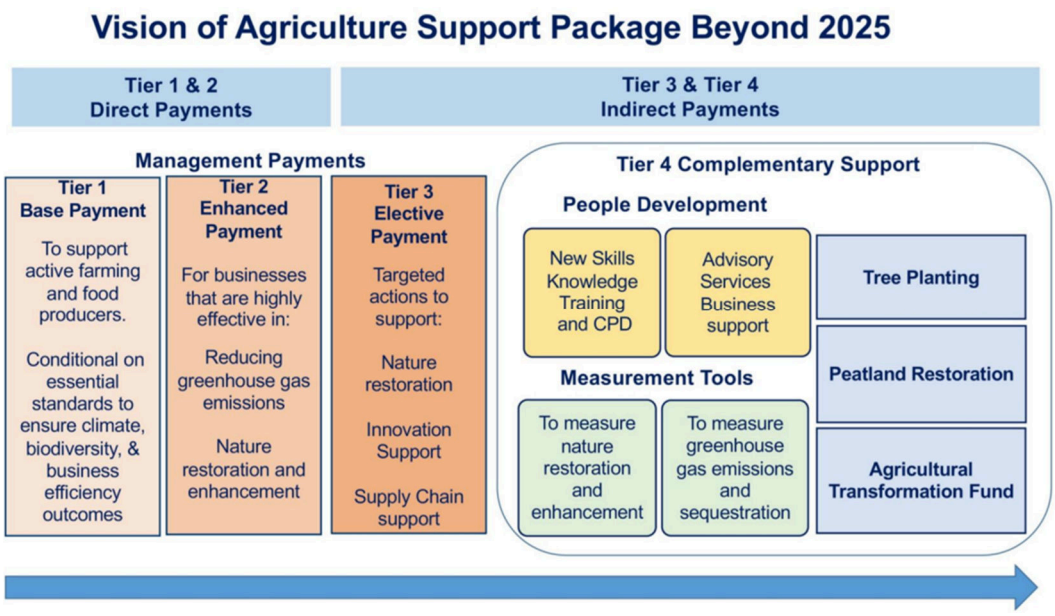

Figure 1 Representation of the main tiers of future agricultural support as specified in the 2022 Vision for Agriculture.

Text box 1. An overview of the Whole Farm Plans

Whole Farm Plans:

- Aim to provide a holistic view of a farm or croft by establishing their current performance and activities.
- It comprises five audits and plans: Animal Health and Welfare Plan, Biodiversity Audit, Carbon Audit, Integrated Pest Management Plan, and Soil Analysis.
- Whole Farm Plans will condition access to agricultural support schemes.
- Key past and anticipated work informing the development of WFPs:
    0. In 2022-2024, as part of the programme Preparing for Sustainable Farming, farmers and crofters could claim funding for doing Carbon Audits, Soil Sampling and Analysis, and Animal Health and Welfare Interventions.
    1. By 15 May 2025 all farmers and crofters who want to receive Basic Payment Scheme (Agricultural Support Package Tier 1) must have obtained at least two of the audits and plans that meet the minimum standard required for the Whole Farm Plan.
    2. Requirements for 2026 will be defined in the summer 2025 through an update to the ARP Route Map.
    3. By 2028 at the latest, all businesses will need to have all plans and audits that are applicable to their business in place.

Source: Agricultural Reform Route Map version 24 June 2024 https://www.ruralpayments.org/topics/agricultural-reform-programme/arp-route-map/

Insights from the policy sciences: Natural capital in (re)designing a new (old) policy

There are many bodies of work within the policy sciences and also on knowledge use that are potentially relevant to understanding if and how NC is integrated into policy development, but concepts of policy innovation (Goyal & Howlett, 2024) may be particularly relevant.

As the relative newness of the Natural Capital approach collides with the dynamics of an established policy such as agricultural policy, it can be seen as an interesting case study of processes of policy innovation. Conversely, the policy innovation framework, informed by a literature on policy processes

(Weible, 2023) and policy design (Howlett, 2018), provides a framework to identify how NC might be received, understood and used in the workings of policy development, so helping to uncover aspects that might facilitate or hinder the adoption of the NC approach.

The policy design literature differentiates three different levels of content: i) macro or sectoral-level, that refers to high-level policy goals and instrument logic; ii) meso or programme-level, referring to policy objectives and instrument choices; and iii) micro or operational level, related to the definition of specific measures, goal targets and fine-tuning of instruments (Capano & Howlett, 2024; Howlett, 2018; Roberts, 2020). Of these three levels, the micro (operational) remains largely under-explored in comparison to the others, perhaps partially linked to challenges in accessing the day-to-day practices of staff working on the detail of policy design and implementation. To study this level, we build on the work of Capano and Howlett (2024) who proposed to study 'policy calibration'. *Calibration* refers to the design choices on the specifications of the policy instruments, that is, how the instruments are characterised and delivered on the ground (Capano & Howlett, 2024). Calibration is thus critical, as "the choices made at this level are often the key to policy success or failure" (Capano & Howlett, 2024 p.118).

Thus, the literature emphasizes the need to look across levels, and the value of considering calibration (design choices) at every level, to understand attempts to innovate. Working with NC in the ARP would be a substantial innovation introduced from the macro scale, as it is one feature (one amongst many others) endorsed in the high goals specified in the ARP vision (Scottish Government, 2022). From there it might be expected to cascade down or permeate all other levels of policy development, but even if it does, this does not mean that a Natural Capital Approach is quickly or swiftly adopted. Critically, the operational level, the level dealing with the calibration of the policy instruments, faces the task of endorsing and operationalising the NC approach in a way that reconciles this and other high-level policy aims and concepts, together with feasible delivery and ultimately implementation by the farmers. Sharing a common understanding on NC across policy levels and along the design of the policy programme is a challenge. The ARP case study provides a unique opportunity to observe how these challenges unfold to identify key aspects.

Lastly we consider how new information, ideas or data might be used in policy-development. Knowledge is intertwined with policy processes. Different forms of knowledge are more or less easily accepted and used in policy processes, with new ideas strongly shaped by pre-existing dominant ideas and institutions (Radaelli, 1995). We especially build on the work done by Russel and Turnpenny (2020), who studied if and how the closely-related idea of ecosystem services were embedded into policy processes. Their analysis was also structured around macro, meso and micro levels, with the micro level focusing on the individual behaviour of the policy makers involved in the development of the policy. Their insights highlight the importance of 'institutional logics', i.e. pre-existing rules and norms of their departments and civil service, that influence and constrain uptake of such ideas into policy processes. In other words, individuals' agency and interests are shaped by the institutions within which they work (Blackstock et al., 2023). **Thus, it is important to understand individual choices and ideas as influenced and constrained by interactions with others and the institutions in which they work.**

Our study therefore considers how NC may be endorsed and used across levels, with a focus on individuals choices, and the connection or interaction of NC concepts with pre-existing institutions and commitments. Within policy calibration, a key dimension is the provision of procedures of monitoring and auditing/evaluation (Capano and Howlett, 2024), procedures that collect data to provide information on the results of the policy. In addition, in the context of environmental management policies, as it is the case of agriculture, monitoring and evaluation is also crucial for

informing future environmental management decisions (Waylen et al., 2019). Recent research has identified weaknesses in the monitoring of agricultural policy in Scotland at the present (Blackstock et al., 2024) that could benefit from stronger connection with existing substantial data on land management (Nicholson et al., 2025). Thus, for this study we pay particular attention to how NC data might be used and also generated via agricultural policy, potentially playing a critical role in future calibrations. **Understanding current use, limitations and future expectations on the use and characteristics of the data offers light on the complexity of the policy innovation.**

These insights about policy calibration across levels informed our methodology, with an especial focus on the micro-level and the calibration of the ARP (see table 1). Firstly, we targeted interviewees working in different levels, secondly, within interviews we sought to explore how and where NC could be tractable, and thirdly, the content of interviews was analysed with specially attention to different levels of policy design and the elements that articulate them.

Table 1.Our taxonomy of policy levels and relevant issues shaping innovation at level, building on Capano and Howlett (2024) and Russel and Turnpenny (2020).

	Macro-level	Meso-level	Micro-level
Aims	What are the new high-level policy goals?	What are the new programme level policy objectives?	What are the novelties in specific policy goals in terms of targets, expected outcomes and time-frames?
Policy Instruments	What is new in the general principles guiding policy?	What are the new specific types of instruments considered?	How are the new instruments delivered (agencies involved, resources, monitoring and evaluation, accountability rules, etc.)? What is new regarding how instruments are delivered?
Logics of innovation embedment	To what extent the innovation approach help meet wider political and societal preferences? How does the innovation challenge established societal structures, ideas, and power relations? To what extent is the innovation consistent with wider social norms?	To what extent does the innovation help the policy-making team protect resources, influence, or budget? How does the innovation challenge established decision- making roles and competencies? To what extent is the innovation consistent with how decisions are made in the policy-making team?	To what extent does the innovation help the policy-makers and civil servants in their work? To what extent are the policy makers and civil servants familiar with the new ideas? To what extent is the innovation consistent with what is expected of the civil servants and policy makers?

Methodology

This study used a qualitative research method to explore and analyse the experiences of individuals connected with agricultural policy development. This methodology received prior approval from the James Hutton Institute research ethics committee and RESAS Social Research Approval, and all data were collected and managed in accordance with UK GDPR.

Data collection

We carried out 14 semi-structured interviews with individuals connected with the ARP. These were held between September and October 2024, via teleconferencing software Webex. Individuals came from within the Agriculture Policy Division of ARE, also from RESAS and NatureScot. They were invited to interview by email, following endorsement of participation by senior staff. We sought to interview individuals in a range of a roles, to understand different perspectives and opportunities to work with NC. Our interviewees (Table 2) had roles that ranged from negotiating and overseeing the structure of future policy, to those analysing the consequences of potential AES measures, through to providing ideas about new ways for farmers to report in terms of NC. Most of the interviewees came from what they themselves called "the delivery side", concerned with the so-called 'micro-level' of policy calibration.

When first contacted, participants received in advance a one-page briefing about the study, introducing briefly the concept of Natural Capital. In this briefing we stated that it was not necessary to be familiar with natural capital before taking part, and that we could provide during discussion more information about the concept and existing tools recommended for working with natural capital in policy development. Later on, before the interviews, participants also received more detailed information about the interviews and the study in the participants information sheet that was sent along consent forms. No specific materials about NC were shared before the interview.

Interviews were primarily conducted by Diana Valero with some supported or carried by Kerry Waylen. Each interview lasted between 45 to 60 minutes and were audio-recorded and transcribed.

The main objective of the interviews was to understand how individuals engage with evidence during the policy development process in the context of Natural Capital. Interviews were therefore structured around 3 main areas:

1. The current role of Natural capital in agricultural policy development
2. The potential role of Natural Capital in policy development
3. The general role of environmental information and evidence in policy development.

For further detail, the topic guide used for these interviews can be found in appendix 1.

Table 2. Organisational distribution of participants.

Organisation/Department (*)		**Participants codes**
Scottish Government	Agriculture Transformation for Environment and Climate Change Unit	SG03, SG10
	Agriculture Support Policy Development Unit	SG01, SG08
	Rural Payments and Inspections Division	SG06, SG04, SG05, SG09
	Agriculture and Land Transitions Division; Agriculture Transformation in Productivity Unit; and RESAS (*)	SG07, SG11, SG02
NatureScot		NS01, NS02, NS03

** In order to protect anonymity of participants, departments within Scottish Government are clustered under the most detailed level possible that prevents direct identification of the participant by inference while providing as much granularity as possible. To protect anonymity, the participants of units or divisions that had only one participant are clustered here together to prevent direct identification.*

Analysis

Abductive content analysis was carried out, a method that combines elements of inductive and deductive analysis by seeking pre-existing themes in the data, but also responding to emerging insights in the data (Ritchie & Lewis, 2013). The pre-existing themes were specified based on understandings of the policy process and policy design proposed by Russel & Turnpenny 2020, and Capano & Howlett, and captured using a codebook (appendix 2) that was added to during preliminary post-interview analysis. The analysis was done manually by 4 coders applying the thematic codes to the transcripts using Nvivo, an analysis software. Once this preliminary coding was complete, a content analysis of each individual code was carried out by one researcher to ensure consistency.

Results were synthesised to answer the research questions described above. These are illustrated with verbatim quotes from the interviews (see appendix 3). Excerpts are attributed to participants using a code that protects their anonymity (see table 2). To facilitate readability, the use of "…" in verbatim quotes have been cleaned from some speech fillers (e.g. 'you know', 'so').

Results

1. Understandings of Natural Capital

This section explores how our participants interpreted NC and its relationship with the ARP. We note that for many participants, during the course of the interview as they reflected on their understanding of Natural Capital and policy development, their views on changed and evolved.

How is NC understood?

All participants had some awareness of the term, but understandings of NC were diverse, ranging from accounting and valuation to habitat management notions. Some noted that the idea was closely related to ecosystem services and it provides an opportunity to explain more about how nature supported agriculture.

All participants were (somewhat) aware of the term, and a few made a point of stating that they were "very mindful of NC" (SG03) and especially interested in the concept (e.g. SG03).

Understandings of natural capital were diverse, ranging from accounting and valuation system (NS01) to habitat management (SG04) as described in detail below. Understandings differed depending on their field of expertise or interests (e.g. SG06) whilst others saw it as a "fairly broad concept" (e.g. SG08).

Several of the participants – including those from NatureScot – noted that the idea was closely related to ecosystem services, with NC bringing more attention to the assets that underpin flows of these services. NC was seen as a means to communicate the benefits of nature. Potentially, this entails - as for D12 and SG11 – monetary valuations of assets or services. This could help make more visible the cultural values of nature. However, not all interviewees assumed that working with NC meant working with monetised valuations of nature. For example, D13 believed explaining the relationship between NC and ecosystem services gave an opportunity to explain more about how nature supported agriculture.

Is NC connected with other concepts or ideas?

Participants associated NC with the impacts of the agricultural sector on the environment, and also with topics such as nature restoration, climate change mitigation and adaptation, biodiversity and habitats. Additionally, some participants saw NC as related to a landscape scale approaches, connecting multiple issues and disparate elements that happen on the land.

In general, the topics that participants link to NC are associated with what SG02 summarised as "impacts of the agricultural sector on the environment": nature restoration, climate change mitigation (and adaptation), biodiversity and habitats. Appendix III gives some more detail and excerpts about these associations (table 5). It was not possible to discern why some and not others mentioned different concepts, though as noted above NatureScot employees were more likely to invoke ecosystem services.

In some cases, participants' indicated that they somehow saw NC as entangled and connected with multiple issues. For example, the following quote from NS01, that seems to link it to holism whilst also suggesting hesitancy about what is feasible:

> *I think at the moment… farmers and agricultural policy can only deal with some of the aspects of natural capital approaches. So the priority at the moment is looking at climate change and mitigation, adaptation, as well as biodiversity, halting biodiversity loss. That in its own right is*

quite a significant challenge. It's only part of what natural capital approach can do. But if that's—at the moment, that's worth focusing on. (NS01)

Relatedly, this interviewee and some others such as SG03 saw NC as related to a landscape scale approaches, including land use and land use planning. NC would constitute an approach to "tie in" all disparate elements that happen on the land, and so working at landscape level (NS03) This was noted to require area-based data (e.g. maps) overlaying different type of data (e.g. on biodiversity, land use, water quality, etc.) (SG03). Landscape scale approaches would be seen as championed by NatureScot (e.g. SG09) and something desirable although challenging due to complexity (e.g. SG09).

What is the role of natural capital within the ARP?

Understandings of the role of natural capital within the ARP were very diverse; ranging from a key concept driving reform, through to a redundant term. There are also middle-ground views, with some seeing NC as a new label for continuing the work done in agri-environmental schemes, or thinking that NC thinking should inform policy development. This diversity of views demonstrates some uncertainty and ambiguity about the distinctiveness of NC and links between different environmental concepts and approaches in agricultural policy.

Understandings of the role of natural capital within the ARP were very diverse. For some (e.g. SG02, SG10), natural capital is a key concept driving the agricultural policy and hence the ARP, something that is "front and centre" (SG02) in the reform. Others would see natural capital as an evolution or continuation of the work done in agri-environmental schemes, even (as for SG05) just as a new label. For others, the absence of the specific "natural capital" terminology from the written policy instruments indicated that is not part of the policy (SG07). These participants were likely to identify NC as something pushed for by stakeholders, in particular, NatureScot. There was also a middle-ground view (e.g. NS03) on the role that natural capital plays in the ARP: NC is not at the core of the design of the policy framework, but NC thinking should inform policy development.

This diversity of views was apparent across the sample, but also in the narratives of some participants. For example, see quotes from SG07 (Text box 1 below). When asked about how natural capital and the concept are used in their work portfolio, their response was that it had been "centre stage" from some time, albeit not using the specific "natural capital" terminology, but rather "habitats and biodiversity" ; then later referring to "biodiversity audits" and stating that "natural capital hasn't entered into any considerations in terms of policy development". This evidences some uncertainty and ambiguity about the distinctiveness of NC and links between different environmental concepts and approaches in agricultural policy.

Text box 2. Incongruous views on the relationships between NC and agricultural policy by participant SG07.

From—to be quite honest, it [natural capital] has been centre stage from [...] when the SRDP, the Scottish Rural Development Programme, was initially launched. And we encompass the need to take forward the Farm Advisory Service, and habitats, biodiversity were part and parcel of the objectives of the arrangement under SRDP. And similarly, with the Knowledge Transfer and Innovation Fund as well, it was included as part of the success criteria for eligibility. It didn't mention natural capital. It mentioned habitats and biodiversity, and it encompassed things like landscapes as well. But it didn't use that terminology at the time. […]

I'm aware that in terms of biodiversity and whole farm plans driving forward the policy in whole farm plans, biodiversity audits feature within that particular consideration. And those plans might translate into actions on the ground and measurable benefits in terms of the Agricultural Reform programme as a whole. But that relates to the terminology of biodiversity audits rather than

natural capital. Natural capital hasn't entered into any considerations, really, in terms of policy development as far as I'm aware. […]

In terms of eligibility under the Knowledge Transfer and Innovation Fund, [...] there's certain projects being taken forward that promote biodiversity and habitats and nature conservation. But none of that, aside from the fact that project proposals might mention in the passing 'natural capital', they don't feature in the assessment criteria… or form centre stage in terms of the proposals themselves.

Overall, almost all participants expected that there was confusion regarding the meaning of NC, and its meaning for agricultural policy (e.g. SG03, SG04, SG07). Only one participant (SG08) felt that most colleagues within the ARP would share an understanding of the term. For SG04, a lack of data and insight on Scotland's natural capital was exacerbating ambiguity and confusion:

> *We then go on to talk about natural capital, is that if, as policy makers, we don't have a basic understanding of what we've actually got as a baseline at the moment, then the whole concepts of natural capital don't get out the starting blocks.* (SG04)

It was suggested the lack of connection with NC terminology would be especially true for staff working on the "delivery side" of the agricultural policy. For SG02, these staff "would not be familiar with the term natural capital" at all even if "there would be a high level of knowledge around, you know, the value that farms can provide for nature or for climate" and SG03 worried that the term could even be a "barrier" to communication.

For whom else is NC seen as relevant?

The terminology of NC was perceived as mostly used by those working on environmental policy, or by specific teams, but not so widely used within agricultural policy development. There were concerns as to whether NC terminology was suitable for use with farmers and crofters, although some participants expected NC concepts to resonate well with farmers' views on farm assets. NC was also seen as related to private sector actors and new nature markets.

Within government, the terminology of NC was referred to as mostly used by those in the environmental domain (e.g. ENFOR, NatureScot) and certain specific "pockets" of the Scottish Government (e.g. its small Natural Capital team), but would not be widely spread in the agricultural policy in general (SG02). Beyond the understanding of NC internal to the ARE and the development of the ARP, the interviews demonstrated concerns regarding the suitability of the natural capital terminology with the 'end users' of the agricultural policy - the farmers. The more optimistic views came from participants based in RESAS and NatureScot (SG02, NS02), who expected that the concept of NC resonates well with the understanding of the assets in the farm. According to D13 this was proved correct in the pilot run by NatureScot (NS02).

Several saw NC as related to private sector actors and new nature markets. For example, carbon audit tools (SG03, SG05), carbon code (SG04), value chain methodologies (SG05). carbon credits (SG05), carbon trading (SG07), peatland code and woodland code (SG10). Private investments are seen as needed for facing the costs of addressing and adapting to the climate and biodiversity crisis in a context of changing support mechanisms. In this case, the role of the SG would be seen as to try to influence these other schemes, standards and markets, and help farmers to understand and engage with other opportunities; rather than directly influencing farmers through agri-environment schemes. Although this was not the focus of our interviews, we noted there were doubts voiced about exactly what this means for the role(s) of government, and how to avoid risks for various parties, especially from "greenwashing" (SG03).

2. Natural Capital evidence in and for agricultural policy development

In this section we explore the evidence and data on NC in the design of the ARP: what data is used or needed, how it is used, and what constraints or helps the integration of NC evidence in the ARP.

The policy processes that were most discussed in the interviews corresponded to the calibration of the ARP instruments, that is the design specifications of the ARP instruments. This is a critical phase because it determines how the agricultural policy will be delivered on the ground. The consideration of evidence and data to adjust the calibration, including policy implementation and monitoring and evaluating processes is critical in the case of the ARP, as payments to farmers will depend on measurements.

Calibrating the ARP entails considering data needs and operational changes in data collection (e.g. farm inspections, whole farm plans), data use (e.g. calculation of payments, monitoring) and dissemination (e.g. mapping) (SG04). As part of this, the design of the policy includes fitting a monitoring and evaluation framework (SG11, D5). Regarding NC, the big question mark shared by almost all participants was how the concept is going to be considered 'on the ground', and the need to have a baseline:

> *We're talking about it in a conceptual manner to say that there's a value there to be had and that that can feature. But […] I've certainly not seen any detail about how that could actually be taken in a data context. And, it's been talked about in a conceptual level, but without the knowledge of the existing baseline. (*SG04)

In the next sections we unpack in detail what type of data is being considered, how it is used, their characteristics, and the barriers and levers in the use of data that were identified in the interviews.

What NC data are considered?

The ARP entails the use of a substantial amount of information, building on significant existing data resources. However, past data is felt to be insufficient to allow a NC approach. Participants report significant ongoing work to improve the quantity and accuracy of data, but also flagged up that some topics or aspects of NC would not be being monitored (yet). A key challenge is finding a way to work with existing data to understand NC, without waiting for perfect data.

At the moment the ARP seems to involve "quite a lot of kinds of data and information" (SG03, SG06, SG05). Most of the data comes from the running of operations (e.g. the support schemes) and from surveys like the Scottish Agricultural Census or the Farm Business Survey (SG03). Some information is provided by internal collaborators in the analytical services or external collaborators such as NatureScot or The James Hutton Institute (SG03, SG06). Initially, most information would not have been captured geospatially, but this is done nowadays, even if with certain limitations (SG06). All suitable data have been included into an online map visualisation tool (the Land Parcel Identification System - LPIS[4]) in the form of layers and groupings (SG06), providing data at field parcel level (SG05).

Nevertheless, all this information was still felt to be insufficient to allow a NC approach. The interviews demonstrate that there is significant ongoing work to improve the quantity and accuracy of data. The overall quantity of data would be increasing as the tools used for collecting data improve (NS01). SG06 reported ongoing efforts on mapping a third of Scotland every year with data being as much accurate as possible".

[4] https://www.ruralpayments.org/topics/lpis/introduction-to-lpis-and-its-purpose/

However, regarding the quality or appropriateness of the existing data, some participants shared doubts regarding having reached a limit regarding the quality of the NC, at least for specific topics. Also some topics or aspects of NC are not monitored. This could have impacts as to how far or how well the impact of the policies can be monitored. The following quotes illustrates, for example, show how SG09 explained their doubts on peatland data:

> *We've managed to create a reasonable map of peatland, but we can't accurately, accurately tell the depth all over the country. We can't tell the quality, the degradation of it, how wet it is. Do we need to know all that information? Possibly not. But it's… how do we measure any improvements to that, if we had to put measures in place? Like we're putting a change across compliance to protect peatland a little bit more. Now, it's not gone as far as I think it was intended to go initially, and probably because we couldn't measure and totally understand the level of peatland that's already out there. What they're putting in place works, but I don't think we could go any further with it at this point in time.* (SG09)

Nevertheless, waiting for data to be perfect could get in the way and it is necessary to work with the data that is available, including proxies. SG03 summarised it saying "wishing the perfect gets in the way of the good, and sometimes we have to work with the data that we have".

What issues are associated with existing data?

Our interviewees identified a number of issues with existing data about the NC that related to farmers' land-holdings: limitations and gaps, including the lack of baselines, no qualitative data; disconnection from the farmers' experience; unsuitability for accounting for the diversity of habitats and farming practices, inconsistency of data and models, challenging timeframes for data generation.

For our participants, existing data, in the current form, seems not to be enough to monitor natural capital on agricultural land (SG03). Capturing and monitoring NC information seems quite difficult, and it still would be unclear how to translate the concept into existing data, linked back to the uncertainties around the definition of the concept (SG03).

According to the interviews, there seems to be important limitations and gaps in the existing data regarding how assets are measured, how farmers manage their NC assets (SG02), and on longitudinal data (SG11). Also, land cover data in high resolution would be still "very patchy" (NS01), with many data not being available for the whole country (SG05). In particular, the interviews highlighted the lack of a baseline a national level (SG03, SG05) but also for each farm (NS03). The lack of baseline seems to create a problem in the policy development (SG07) because the staff involved would lack a common understanding on what is currently in existence and upon which the programme needs to be set up (SG04, SG05), and on how to measure progress towards policy objectives (SG05, SG08, SG09).

Participants highlighted that lacking a baseline on NC potentially affects multiple decision-makers. Data can help design and monitor policy, but is also needed to allow monitoring and awareness from the farmer side (SG04, SG11). This relates as well to the aspiration expressed by NS01, that data be "*public" and "free to use"* and not a commodity that some people cannot afford to purchase. (Presently much of the data on agricultural land-holdings is not confidential so not availably publicly).

There are also important hesitancies regarding up to what point the existing data represents the farming experience. For SG04, for example, there is a disjuncture between the data captured at the moment and the farmer's experience. Existing monitoring processes have developed primarily to check compliance with required actions and eligibility for payments, rather than to understand

existing habitats within farms (SG04) or the systemic consequences changes in farming practices (SG05). Overall, current information about farmland in terms of NC assets is rather limited, and future monitoring will be based on rather few proxies (SG02).

Data and models could also appear to be inconsistent, with one participant highlighting the need for more integrated work between different governments, areas of government, universities, and research institutes that collect the data and build models (SG02). The insight and data from external collaborators could be helpful to resolve or navigate this but, when sourced through commissioned work, their data and insights may not be available early in enough at the start of the projects (SG09).

Finally, SG11 also alerted to relying only on quantitative data without paying attention to the variation and patterns that underlie trends – for example, farmers and crofters that do not conform with the norm, to understand the limits and consequences of policy interventions. Collecting and connecting in different types of data, including qualitative data, can be challenging.

What uses are there of NC data?

The discussions about the ARP centred on answering questions about operationalisation of the new programme, and the gathering and monitoring of data to support. Again, the need for baseline came through clearly, entailing decisions about what data to capture and how to best capture it, including by farmers and Whole Farm Plans. More examples were sought on how to take a NC approach.

At time of our study, the policy development seemed centred on trying to answer questions about operationalisation of the new programme, in particular the detail within the tiers (e.g. SG11) and the gathering and monitoring of data (e.g. SG04, SG05) circling back to the need of establishing a baseline (SG04, SG11). The issue seems to be on deciding what data to capture and how to best capture it.

Much of the discussion on future data collection referred to what farmers could do and provide. There is ongoing work on designing instruments for farmers to capture data at farm level, with the rationale that they know best the farm and natural capital assets in their farm (SG06). Such instruments are the Whole Farm Plan (WFP) and a natural capital tool developed by NatureScot to help capturing and monitoring NC data at farm level (SG03).

The WFP is intended to provide baseline data at the land-holding levels through a series of audits and will function as a requirement for accessing basic payments from 2025 (see text box 1 earlier). It was felt that this may help build farmers' and crofters' awareness of their natural assets. However, information from the WFP is not explicitly framed in terms of NC and it was flagged that the information from the WFP is not being gathered in a complementary way to existing data (SG04). NatureScot is working on developing a separate NC Tool for use at the landscape scale, potentially with groups of farmer - if and how that could use or connect with data from the WFPs was unclear.

Beyond operationalisation, and regarding needs for unlocking the NC thinking at land and landscape scale, NS01 mentioned the need for more good examples on how NC approach improves decision making and businesses. NS01 believed this would be good both from the perspective of raising awareness with farmers as well as within the Scottish Government.

Expectations and aspirations for future monitoring and evaluation

All participants noted the need for developing a baseline of NC in agriculture, to inform a new monitoring and evaluation system. It seen as desirable that the approach is first tested and then roll-out in phases. The baseline is expected to build upon the dataset integration. Robust data is expected to represent not only the existing NC, but also its quality, with some degree of granularity. Aspirations also include flexibility, and reducing administrative burden.

When discussing the work needed for developing the baseline, the participants described a number of features that would be desirable in such baseline and monitoring system (Table 3). The starting point, as identified by SG05, would be that the whole process is formalised and agreed at programme level, comprising the identification of the baseline, and the process for monitoring and evaluating and the changes to it. For SG03, both, baseline and monitoring, should be roll-out in stages, starting with just a sample that would allow for testing, rather than directly general across Scotland.

Expectations for the baseline refer to the quality, scope, and granularity of data and the integration of datasets. For SG03, data should be robust, come from "good evidence sources", and be validated if needed. Regarding the scope of data, several participants mention a desire that data captures not only of the existing NC, but also the quality level of such NC (SG03, SG04, SG09). It is also expected that is captured at different levels or scales – from small scales (e.g. parcel-level) up to regional or national level (SG05).

It is also desired that the baseline is built upon the integration of datasets, considering already existing datasets (SG03) and data coming from farmers' audits (NS03). There is also an expectation that datasets are geospatially represented, overlaying different data sources and offering a land-based perspective (SG03).

Then, the monitoring system should work positively both for farmers and the government. It is desired that the monitoring process does not become an administrative burden for farmers and crofters (SG04), and that it is flexible enough to take into consideration for potential unforeseen circumstances that could occasionally impact a farmer's assessment (for example due to the effects of adverse weather events) (SG04). Additionally, it is desirable that the new monitoring system may reduce the need for 'on the ground' inspections via automatic or remote checks (SG11, SG06).

Table 3. Participants' expectations for the new monitoring system

Regarding the process:	Regarding baseline:
- Process formalised and agreed for defining the baseline, monitoring and evaluating. - Approach tested, and potentially rolled-out to be in stages. - Flexibility to account for unforeseen circumstances that could occasionally impact a farmer's assessment. - Looking into consistency over a timeframe. - Avoid becoming administratively burdens for farmers. - Reduced need for inspections on the ground by doing things remotely and automatically. - Regular data collection or data checks to allow for annual monitoring.	- Defined in an agreed process. - Good quality data: robust, from trusted sources, and validated if needed. - Integrated datasets considering already existing datasets and data coming from farmers' audits. - Data geospatially represented, overlaying different data sources and offering a land-based perspective. - Data captured at different levels/scales (very detailed level (e.g. parcel-level) vs regional/national level). - Data capturing the existing NC and also the quality level of such NC.

Legitimacy, relevance and credibility of data

Legitimacy, credibility, and relevance of data are criteria for understanding whether information will be deemed useable. This section discusses how participants views on data related to these criteria. They emphasise the need to consider *how* data are produced and shared, as well as the topics represented, in order to ensure data are perceived as useful and used.

Legitimacy, credibility, and relevance of data are criteria widely accepted as desired characteristics of effective information (Sarkki et al., 2015), including for decision-making related to agricultural policy or nature management. The interviews offered insights on these three criteria that allow us to further understand data requirements.

Legitimacy refers to considerations on the fairness and balance of views considered in the baseline, monitoring and evaluation process. Two main aspects were identified on this regard in our research. First, in general terms, participants mentioned the need to capture data on equality aspects that would not be present at the moment (SG01), and to reflect "people's views and opinions and the kind of social side of things" (SG03). Second, being more specific regarding the representation of farmers' views, for some participants current approaches would not be "seeing things through the farmer's eyes" (SG04). In that vein, along the need from experts' input, it would be seen as necessary to include data captured at farm-level (SG05), and the farmer would be the best positioned to capture (their own) data because of their knowledge of the land (SG06).

Credibility refers to the perceptions of quality, validity and adequacy and reliability of the knowledge and evidence. On this there was a general appreciation for expert knowledge and data provided by reliable sources of expertise (SG03, SG09), internal to the Agriculture and Rural Economy Directorate (subject matter experts (SG09), RESAS (SG03, SG08)), other bodies of the Scottish Government (e.g. Scottish Forestry (SG06)) or external collaborators (e.g. Nature Scot (SG03, SG09), the James Hutton Institute (SG09)). In general, information coming from professional experts would be seen as credible (SG09). Among the experts on NC referred to, NatureScot had a prominent space. However, a participant from NatureScot was self-aware that their data/information could be perceived as biased towards biodiversity (NS01) and they would advocate for diversifying the sources of information with inputs from different organisations. An avenue to get expert-based data on NC is the commissioning of external work to experts, mostly academics (e.g. through CXC), to inform internal thinking (SG09).

Beyond the involvement of experts and in alignment with the considerations on legitimacy, for at least one participant (SG09) data provided by or involving farmers would be perceived as more accurate. However, despite references to the WFP and the collecting data at farm level being a topic discussed at length during most of the interviews, there were no further participants' reflections on how farmers' data is perceived by the policy-makers.

In addition to the reliability of the sources of information, other aspects of data under the remit of credibility that were flagged up in the interviewees are: having robust sample sizes (SG03); information being triangulated (SG11) or reviewed and validated by others with interest and expertise on the topic (SG03); and the need to avoid risks of data being corrupted during data sharing processes (SG05).

Beyond the data itself, there was also consideration of the credibility of the monitoring and evaluation process and the policy itself on the basis of the need to establish a clear baseline (SG04, SG05, SG07, SG08). Without such baseline, farmers actions and policy results cannot be successfully measured (SG05).

Relevance refers to the suitability of data to fit the processes established by the ARP. A number of features that characterise data that could be relevant for approaching NC were identified in the interviews in reference to the qualities of the data, and the nature and external use of the data.

Relevant data would integrate with or complement existing datasets (SG03, SG04), and would be geo-spatial, as it represents a land-based issue (SG03) and high-resolution (e.g. at parcel level) (SG05) to provide granularity. Data generated by remote sensing would be considered adequate regarding geospatial location, but there are doubts regarding the information that they could provide (SG05), in particular about quality (of the assets) that can provide (SG09).

Another characteristic highlighted by participants and that speaks to the suitability of the data refers to allowing NC being operationalised and quantified rather than just a concept (SG03). In particular, participants spoke of the need for standardised (SG05) and operationalised (SG11) information, that it is used in the same way across the board (SG06) bridging policy, operational and digital teams (SG11).

Relevant data would also be tested and grounded (also relating to credibility). Relevant data would have resulted from an approach tested successfully in a small area (SG03). And for some participants data needs to be grounded on the practical farming context – a characteristic that was so far missing (SG04). For some, the WFP is seen as a starting point to build appreciation of natural assets at the farm level (SG04) and for viewing and thinking in a holistic way (NS03).

Other two characteristics that would make data relevant refer to how data could be accessed and used specifically by farmers and crofters. Firstly, relevant data would be presented in an accessible form (SG11), even if this might require training people on datasets and their analysis (SG11). Secondly, data has to be informative in terms of the key concepts, tools, tasks or goals that are already salient to these users. So, interest in NC data might be enhanced by engaging people on Natural Capital, other tools using it - as for example the NatureScot NC Tool (SG03) - or showing the link with existing obligations such as the whole farm plan (SG04).

Barriers and opportunities to enhancing NC evidence

A number of interrelated issues were reported, that could challenge achieving adequate and accessible data on NC; these include: (i) existing resources (financial and technological) that constrain access to and accessibility of data; ii) complexity and costs of data sharing; and iii) considerations of privacy and land data; and iv) the lack of consistent shared understanding about the information available and how it is used. Opportunities include using data or tools from other organisations.

Our interviewees identified a number of barriers for achieving adequate and accessible NC data. The barriers are interrelated, linked to existing resources and the complexity of data management. Firstly, limited existing resources (financial and technological) constrained access to and accessibility of data. For example, it was noted that increasing the baseline data through LiDAR surveys would be costly (NS01). Also, it was flagged up that there would not be ability at that time to take in new data that is not being captured through the existing Scottish Government's systems (NS01). Secondly, the complexity of data management, data sharing – that would be needed – adds complexity (and cost) related to the maintenance of datasets (SG05). Thirdly, the intersection of privacy and land data, and what level of data is considered confidential (SG06) is also considered a barrier. Lastly, the lack of consistent shared understanding about the information available and how it is used would be a major issue (SG05, NS01).

Interviewee NS01 noted two opportunities for furthering the development of NC evidence were clearly identified across the participants' discourses. Firstly, data from a number of other organisations was noted (e.g. Soil Association, NatureScot) developing platforms for farmers to capture NC information. The ARP could capitalise on those to gather information and raise awareness the state and values of nature. Secondly, there would be an opportunity to avoid silo-ed or biased thinking by including diverse organisations in the development of the NC data. These two points may also be interpreted as a way to legitimise further the role of NatureScot informing the development of the ARP.

3. Barriers and opportunities to work with Natural Capital in the ARP

In addition to the barriers and opportunities above regarding factors that shape the use of evidence, the interviews allowed us to identify further barriers and opportunities for working with NC in the ARP. Some are internal to the civil service and policy teams (e.g. profile of civil service, resource constraints, internal communication) and other are external (e.g. market forces).

Language and communication

Communication is critical in policy design, particularly for building common understanding of objectives. Communication around NC was seen as challenging, within policy teams but also with farmers. Views varied as to whether and how to use and train on NC terminology or whether to use alternative terms. For communication with farmers, it was noted that facilitating knowledge transfer (e.g. guidance on NC and reporting of data) is critical to achieve any changes sought by the policy.

Communication is critical in policy design, particularly towards ensuring common understanding of objectives, and it was recognised as such (e.g. by SG01, SG03), being described as "step one" by SG03. Communication issues were discussed in particular in relation to the need to clarify the meaning of NC, and how the NC approach is transferred/spoken about with farmers.

Communicating at different policy levels: Interviewees demonstrated the need to reconcile communication between macro, meso and micro policy levels, due to existing differences in the use of terminology. SG01 described this issue as "being separated by a common language at times". For example, SG01 mentioned policy and delivery teams using terminology to mean different things, starting with the understanding of the very concept "policy" or "co-development".

In particular, regarding the NC terminology, some participants mentioned that it works at strategic level, but not so effectively beyond that (SG03). That interviewee even thought the term could be a barrier for embedding consideration of nature's values (SG03). The term can be problematic as it "is not particularly well understood" (SG03) (SG11). See for example following statement from SG07: "*I've got an understanding of what that means, but that's not necessarily the case, that other people have got the same understanding*". In particular, the interviews evidenced that there is also confusion between NC and nature finance, because the terms would "have been used interchangeably" when referring to different things (NS01). For SG02, the term "ecosystem services" was used a bit more than NC, but most interviewees did not mention that as a better term, so there may not be any better or less confusing terms.

Two very different strategies for dealing with the problem of using the NC concept came up in the interviews: upskilling staff on NC and avoiding the NC terminology completely. On the one hand, some participants advocated for insisting on the use of NC and upskilling the ARP staff on the NC approach (SG01, SG03, NS02). SG01, for example, talked about the necessity of "confronting"

colleagues on what NC is about to get them thinking about it and NS02 referred to the need to upskill people across policy divisions. On the other hand, some participants recognised avoiding the use of NC terminology risk 'losing the listener' (SG02, SG03, SG05). SG02 recognised for example avoiding the use of NC when communicating with colleagues working in the micro-level of the ARP and using instead the generic term "policy outcomes" and in a similar vein SG05 stated that there is no need to talk about NC to deliver NC outcomes (SG05).

NC in the implementation of the policy and the communication with farmers: There was also the concern about the need to communicate NC externally beyond the policy teams, and that is seen as a challenge, due to need to simplify terms (SG03). There were doubts regarding farmers' level of understanding of NC. This concern was described by NS01 and evidenced in the inputs from SG03, SG04, SG05. There is a general worry that farmers could already have difficulties understanding the new requirements of future agriculture policy (SG04). For SG05, using NC with wider publics could even create confusion and even fear.

This concern means they need to "be careful" in how the NC approach is communicated to the farmers (SG05). SG04 highlighted the need to make information relatable to farmers using terminology and concepts that they are already familiar with, "in terms of what they've got at the moment and expressing that to then be able to target in a better way, perhaps spatially or at landscape level". Communication with farmers that facilitates transfer knowledge (e.g. guidance on NC) is critical to achieve the change sought with the policy (SG04). Adapting communication should include the reporting of data as well (SG04). Also, interviewees highlighted the importance of facilitating the transfer of knowledge timely and in advance so farmers can adapt (SG04, NS02).

Work dynamics in the Agriculture and Rural Economy Directorate

The interviews evidenced potential barriers in the advancing of the NC approach in the ARP due to institutional and work-related dynamics in the Scottish Government civil service in general and in the agricultural civil service in particular: limited agility, limited churn, personal connections with the agricultural sector, and workload and IT constraints.

Limited agility: Only one interviewee, SG06, directly mentioned this, but they discussed this at length. They described work in the civil service as "not very quick", and could lead to frustration during policy development. The solution, in their view, would be introducing more 'agile' modes of work. Those changes would involve concurrent work, not only affecting internal policy processes but also opening more channels to communicate with the farmers, rather than only using the SAF (Single Application Form). To some extent this may already be happening - it is worth noting that SG03 made reference to the work in the ARP being developed following an agile methodology[5].

Limited "churn": The Agricultural Policy Division would be an (almost) exceptional case within civil service in not having as many people regularly moving between departments, versus most other policy areas (SG01, SG02). This was particularly highlighted by participants who had joined the division in the last few years and who were used to moving between topics and teams within the civil service. Stability in staffing can reflect accruing expertise, foster networking and build institutional

[5] Agile methodology is an approach to project management and delivery of services that follows a process that is iterative and incremental rather than sequential, in contrast to traditional approaches. Information of agile methodology and stages is available in the UK government Service Manual https://www.gov.uk/service-manual/agile-delivery and the Scottish Government Service Manual https://servicemanual.gov.scot/browse/agile

knowledge. However, the limited churn was noted by some interviewees as potentially problematic for the task of reforming policy, since it can add to "inertia" in how things are done (SG02).

The longevity in the posts could hinder the adoption of change and innovation, such us the introduction of a NC approach. In particular, staff in the Agricultural Policy Division would have developed their career working on the CAP policy structures, rules and requirements for paying farmers for farming (SG01), which potentially could be substantially different to the implications of the ARP. This could potentially create a "cultural challenge" regarding the way of doing things (SG01). Certain practices might be institutionalised (e.g. how on the ground inspections are carried out) and seen as threatened (particularly for those involved) (SG01), but also because of a natural aversion to change (SG06).

Personal connections with the agricultural sector: Many staff working on agricultural policy are perceived as being "close to the land" (SG01) i.e. with close personal relationships in farming or the agricultural sector (SG01, SG02, SG04, SG09). This is a great asset as it brings personal insight into those who are the primary targets of the policy. However, some interviewees identified this connection as making development of policy “really complicated” (SG02). Staff without a farming background might perceive themselves as having a fresh perspective being able to do (more) “neutral examinations” (SG11), something that, from their perspective, the ARP needs.

In particular, agricultural policy staff with a farming background, showed a degree of scepticism around NC and private financing when thinking from the farmers perspective:

> *If I was on the farmer side of the farm gate, I wouldn’t be going near of it. It just feels a bit like bitcoin or cryptocurrency. […] I just couldn’t trust it because of that corporate dimension*. (SG04)

However, having farming experience in the team is also valued (e.g. SG06) and sometimes intentionally sought (e.g. SG09). One such interviewee, self-described as providing a holistic vision, being able to see in terms of policy and also the farmer's perspective and the implementation on the ground (SG04, SG06, SG09).

Workload and IT constraints: Staff working on the ARP have a broad and complex portfolio. One participant, for example, described the scale of work to do as 'vast' (SG03). This constraint inevitably challenges the development of the policy processes or the attempt to develop any specific initiative. Constraints affecting the IT system were mentioned in particular. These constraints include an “aging IT system that needs to have priorities for security and other bits” (SG05). The limits of the IT system would restrict the flexibility and particularly “to deal with any particular new data that isn't already capturing through its systems” (NS01).

Market forces

The interviews highlighted a number of market dynamics (e.g. product requirements, prices) that could either hinder or hasten adoption of new approaches to measure and manage for NC. For example, those farmers with tight operating margins and little spare capital, may not engage with new activities to understand, decide on or manage NC. Conversely, supply chain demands for sustainability may help to drive the transformation of farming and farming businesses, albeit also adding to criteria for managing and reporting. Future ARP work on the ‘Enhanced’ tier could explore complementarity with these new private markets for nature.

The interviews highlighted a number of market dynamics (e.g. product requirements, prices) that could further the NC approach, or pose obstacles if there are misalignments with policy requirements.

Farming costs and agricultural prices: Farming costs are important drivers and constraints on farmers' uptake of new practices. Adopting/preparing some new tools or data that relate to NC can be costly, especially if there is the need to pay an agent to do it for them (NS01). Likewise, altering farming towards sustainable practices that better protect and reflect natural assets may entail new costs, at least in the short-term. Meanwhile, many supermarkets would still be pushing for lower costs and prices (SG11). Thus, for those farmers with tight operating margins and little spare capital, new activities to understand, decide on or manage NC may seem prohibitive. Meanwhile, farming sectors that depend less on public subsidies (e.g. arable and dairy sectors), could be disincentivised to engage at all with the NC approach (NS03).

Premiums in the supply chain and the development of NC standards: Markets may be increasingly looking at high-value nature farming produce, so one of the aims of the policy is to drive farming on to it (SG01, SG05, SG11). For example, whilst supermarket were cited as driving down costs, it was also mentioned that some are already be imposing requirements on farmers that are to NC or sustainability requirements (SG11, SG05), and so may help to drive the transformation of farming and farming businesses (NS01). Sustainability requirements might even come even from the banking sector (NS01). Again, farms and farmers vary, but some were already known to be adapting their practices to access premium prices for their products, for example in farming malting barley for distilleries (NS01).

However, the lack of consistency in criteria among supply chain buyers could make it difficult for the farmers to adjust (SG05). As such, one of the participants alerted of the potential risk that new requirements in the ARP could interfere with the market process with a different standard, and so become an obstacle in the agricultural transformation process (SG05). In their view, a solution would be to wait for the market to develop and become a bit more mature in terms of the development of common criteria and so avoiding potential duplication of standards (SG05).

Nature finance and nature markets: Several interviewees alluded to the topical and related subjects of nature markets, green finance, entailing new partners agreeing to buy new nature-related services from land-managers – often carbon sequestration - or even buying land-holdings (NS02). These private investments are often associated with NC terminology, and for many of our interviewees these subjects created uncertainty (SG05) and even confusion (e.g. SG07). While some farmers would be "getting really excited" about the opportunities for private investments, others would be "getting really concerned" about the implications of entering the markets in terms of what is sold, because it is "quite a confusing market" at the moment (SG07). For SG04, the introduction of NC considerations in specific sectors (e.g. in planning in England) illustrated pervasive market trends affecting farms (e.g. the selling of land-holdings and farm assets for new purposes). For SG03, tapping into private financing seems to be an opportunity, although still unclear and a possibility would be let the market do that and we'll just play catch up or [..] come up with a single approach". SG07 explained that the ARP work on the 'Enhanced' tier will consider potential complementarity with these new private markets for nature, over the next few years.

Farmers' culture, expectations and practices

Participants were very mindful of the implications of any change on farmers and crofters. Farmers were described as motivated by custodianship of their local environment, monetary incentives and by social norms. It was important to frame new messages or options in terms of these motivations.

Participants were very mindful of how the introduction of NC in the ARP could impact the uptake by farmers and crofters, target public of the policy, and ultimately the outcome of the policy. Both aspects – target population and policy outcome – are part of the elements considered at micro level along the calibration of a policy.

Encouraging farmers to care for natural capital: According to SG01, the underlying thinking for the ARP was that there is potential to bring all farmers to a high-nature-value farming, if blockers are removed and prescriptive models of farming for getting support are provided. There was also an expectation, that farmers can be motivated to care about NC in their farms when it is framed in terms of impacts in their local environment (rather than a global, more abstract, impact) (SG02). For SG02, this is an opportunity for buy-in to NC, even if using a different terminology.

Farmers take pride on the nature that they have in their farms (SG04) and several alluded that they see themselves as custodians of their local environment (SG02, SG11). SG02 referred to data from Defra on this, though SG11 flagged-up that the self-perception of farmers as contributing to nature could potentially in some cases be not backed-up or even contradicted by data. Assuming most farmers do see themselves in this way, then explanations of NC could resonate with the understandings that farmers have (NS02). Being a custodian of the environment would mean looking at the land management decisions through a generational and legacy perspective (SG02). However, for some, there would be a misalignment or at least disconnection, between the data informing policy targets (e.g. on biodiversity crisis) vs the experience of the farmers (SG04).

Our interviewees cited money as a key motivator for farmers in adapting their practices, via grants and subsidies (SG09) or productivity (NS03). This would link to the effectiveness of 'carrot' mechanisms to the existence of enough economic incentive. For some participants, farmers are still expecting government to pay for the ecosystem services provided by the farms (SG02). SG09 warned about farmers applying a business mindset and trying to maximize access to grants with the minimum investment possible. In any case, SG09 also recognised that there might be some farmers that are keen on taking the measures forward for environmental reasons and for whom the grant is an added bonus, but not the main driver. However, NS03 warned that if the agricultural policy is too ambitious regarding the NC targets, some farmers could completely disengage and try to maximise production with farming intensification strategies.

Farmers' capacity and attitudes towards the changes: Farmers and crofters were described as "very intelligent" (SG06) and resourceful to comply with policy requirements, including in provision of data (SG06). However, other participants (e.g. SG09) see more diversity among farmers and recognise that fulfilling some requirements (e.g. habitat maps) might be more difficult or alien for some.

Farmers might need to adapt their business choices in order to recognise the values of their natural assets. However, in order to take these decisions about their land, they would require access to data on NC (NS01). However, farmers were also perceived as private people and resistant of sharing data about their farms, which would act as an important barrier for developing information or baselines in terms of NC (SG06). They were also seen as suspicious of jargon, which could complicate the uptake of NC related measures (NS02).

Lastly, farmers were perceived as protective of their food production role (SG08, SG11) and suspicious of environmental requirements that could minimise their production (SG08). Social dynamics in rural communities and among farmers are also perceived as aspect that drive or hinder changes in farming. Farmers can be actors playing active roles in their communities, in a way that would not occur with other actors linked to the stewardship of nature (e.g. actors around forestry) (SG11). This could be a factor in decisions about land use change. For example, SG11 said that many farmers would consider what their community would think or how neighbours might react, before selling farmland to purchasers who might manage land for carbon or other nature markets associated with NC.

4. Profiles of work with Natural Capital evidence in the ARP

In this section we describe different types of approaches working with NC in the design of the ARP identified in the interviews. For this, we first consider the potential link with different policy levels.

Expectations for working with NC across policy levels

The difference between macro, meso, and micro policy levels in the ARP was made clear across the interviews as interviewees noted specificities regarding the reception and use of natural capital from other colleagues, as well as the need to coordinate work across levels. Overall, NC is seen as interesting for those working at the macro and meso level, but mainly something to be connected with the micro levels in terms of specific mechanisms. The micro level consists of defining what needs to be implemented to deliver the outcomes of the four-tier model. This level was expected by many to hold the key to the consideration of NC in the ARP, with the key issue being the calibration of the specific measures. The Whole Farm Plan is seen by many participants as the instrument placing the discussion on NC.

In Table 1, page 11, we outlined a three-level taxonomy to distinguish different levels and types of policy design: macro or sectoral level, looking into high-level policy goals and instrument logic; meso or programme-level, looking into policy objectives and instrument choices; and micro or operational level, that focuses on specific measures, goal targets and instrumental calibrations (Capano and Howlett 2024).

The difference between these levels in the ARP was made clear across the interviews (e.g. SG03, SG09) as interviewees noted differences or specificities regarding the reception and use of natural capital from other colleagues, as well as the need to coordinate work across levels. Overall, Natural capital is seen as interesting for those working at the macro and meso level (e.g. SG03), but mainly something to be connected with the micro levels in terms of specific mechanisms (SG03, SG08). However, this "translation into deliverables" (SG03) might not be straightforward, and could risk seeming "pointless" (SG11). These tensions could even cause frustration in the different ARP teams (SG01).

The **macro level** corresponds to the high-level policy goals and aspirations. Only two interviewees (SG01, SG02) linked the introduction of a natural capital approach with this level of agricultural policy. For SG01, NC comes up as an approach for the transition in the agricultural sector that is faced not only in Scotland, but in other advanced economies as well. Still, for SG02, NC "is much more embedded in environmental policy-making than it is agricultural policy-making" (SG02).

The **meso level** corresponds to the design of the policy objectives and instruments choices in the ARP. For SG01, it does not go into detail of the policy ("the nitty-gritty"), but drives it. This develops the set of principles shaping the structure and content of the elective tiers. A critical challenge is

'instrument choice' i.e. to identify the projects desired , and then sequence them over time (SG03). Instrument choice requires revisiting existing approaches such greening and AECS (SG09). It also requires making room for revisiting it and allowing scheme on scheme strategies (e.g. SG11)

The **micro level** consists of defining what needs to be implemented to deliver the outcomes of the four-tier model. This level was expected by many to hold the key to the consideration of NC in the ARP, with the key issue being the calibration of policy instruments (SG04, SG11 – in table 10 in the appendix III). Many participants (SG02, SG04, SG07, SG09, NS02, NS03) cited NC as relevant to the whole farm plan that farmers would be required to create. The WFP is a new instrument introduced in the ARP , albeit an evolution of pre-existing conditions and requirements, and seen "good place to situate that kind of discussion of natural capital" (SG02). It is expected to help farmers understand their impacts on climate, biodiversity and nature (SG02, SG04). Other specific measures mentioned by the participants in which they saw links with NC are the 'new good agricultural environmental condition' (SG04), the 'voluntary cattle support in the beef sector' (SG04), the 'green mechanism 2026' (SG04, SG05), and tier 3 more generally (SG09).

The WFP is an information gathering tool that sets a task for the farmers – including audits of carbon, biodiversity, soils and habitats - so engaging farmers in thinking with the terms used in the new approach (SG04). The reception of the WFP might be varied among farmers depending on their understandings and capacity (SG09). Thus, establishing adequate guidance for the farmers on how to develop the WFP is key (SG04, d13)) along with the early communication of the new approach (NS02). Carrying out the WFP was hoped to generate improved understanding of existing NC to allow for making informed land management decisions (NS03). However, an issue identified was that data gathered through the WFP is not optimising being complementary with the information already held in the mapping systems (SG04).

Critically, the calibration of the specific measures, i.e. the definition of how they are going to be implemented, monitored and evaluated, takes place at this micro-level. SG04 spoke of "operational changes" when giving examples of aspects changing with the new ARP, all of which refer to different types of work that calibration entails. They illustrated the diversity of aspects that calibration entails, from changes in data and information gathering and dissemination, to different ways to calculate payments, but also how information elements are connected:

> *But what that would mean is, is that we need to make sure that we've got mapping information that's available for people to look at. And that can be viewed online to give people an indication that they may have the peatland on their holding that requires to be protected. So that's been done. So that's an operational change. What we'll also have to do is ensure that we incorporate questions in our inspection routines. That if we go out on farm to inspect—[...] has she got peatland that requires to be protected in line with the new requirement? We need to be sure that we're looking at that when we're on farm. So that's an operational change. If you then looked at the calving interval, again, we're utilising existing systems but we're calculating the payment differently. So again, we need to work out how we actually deliver that different payment calculation. So that—it's at the smaller end of the level of change scale, if you like. And then if you go to the whole farm plan, in 2025, we're introducing mechanisms in which to gain a better understanding of what people have done in the context of the whole farm plan. So again, that introduces a small change to the way that we gather information. (SG04)*

This quote shows how calibration entails the collection of new data (e.g. through farm audits, via remote mapping), through new means of collection (e.g. the whole farm plans), but also through changes in existing instrument (e.g. new questions in the inspections). All the new information needs

to be made available to farmers (e.g. viewing tools). The new information available is to be included in the calculation of existing or new payment instruments (e.g. changes in the payment of the calving interval). Establishing a collective approach for monitoring and evaluation (SG05, SG11) is so a critical piece at this level of policy design.

The measures discussed in the interviews pointed out not only to the design of new instruments but also to changes in the calibrations of some pre-existing policy instruments. For example, SG04 mentioned novelties regarding "some simplicity around inspection levels, with penalty levels".

Beyond the perspective of what type of 'instrument adjustments' the calibration of the ARP entails, the interviews provided insights on the criteria considered in those adjustments. From this perspective, calibrations can also entail how to give recognition to specific in farm features (e.g. peatland) (SG04) and taking into consideration giving enough flexibility to accommodate many diverse circumstances that might hinder the adaptation of practices (SG05). NC is one of such criteria being considered in the calibration of the ARP. However, on this, there seems to be a critical question mark regarding how the concept is going to be considered in the ground, given the lack of a baseline (SG04).

A diversity of relationships with NC

We identify five unique profiles of how individuals regard NC in agricultural policy policy-making: "strategic champions", "specialised champions", "pragmatic designers", "cautious strategists", and "cautious fine-tuners". These are linked to roles in policy design and views on NC. Differentiating between these profiles can inform efforts to deepen engagement with NC within policy teams.

We considered associations between interviewees different responses. We identified up to 5 unique profiles of how individuals regard NC in agricultural policy policy-making (Table 4).

Table 4. Profiles identified regarding contribution to policy design (working categories).

Profile	Strategic champions	Specialised champions	Pragmatic designers	Cautious strategists	Cautious fine-tuners
Features	- Working in macro or meso design levels. - Positive views on policy process impacts. - Link NC to ecosystem services approach.	- Working mainly in micro level - NC seen as helpful and understandable by farmers. - Views from supporting specialists or advisory roles.	- No particularly positive views or concerns about NC. - Disengaged from debate about the NC approach.	- Working in macro or meso design. - Open to integrating the NC approach. - Concerns about usefulness.	- Working in the design of the micro level. - Concerns about calibration impacts and final impact on farmers. - Flagging up clarifications needed.
Participants	SG01, SG11, NS01	SG02, SG06, NS02, NS03	SG08, SG10	SG03	SG04, SG05, SG07, SG09

These profiles are linked to i) the professional role of the interviewees and contribution to policy design and ii) their stance on Natural Capital. Profiles could not be rigidly predicted from respondents' roles in relation to the different policy levels, although there was some association; for example, those in macro-level roles might be strategic champions, those in micro-level where more likely to be "pragmatic designers" or "cautious fine-tuners". Below we describe each profile:

- **Strategic champion**: Strategic champions are SG staff working at macro or meso level in the design of the ARP, or SG staff or external stakeholders informing the design or the ARP and choice of instruments. They hold a positive general view of NC and see opportunities to

integrate into the ARP to transform future agricultural policy so it reflects environmental goals. Those individuals supporting the design of the agricultural policy (e.g. providing or managing information) see opportunities to integrate the NC approach in specific aspects related to the work that they support. This profile tends to understand NC in line with the ecosystem services approach.

- **Cautious strategist:** Cautious strategists are SG staff working at macro and meso levels in the design of the ARP. They hold a cautious view of the NC approach, flagging areas where they see further work is needed to clarify the concept and optimise its integration in the ARP.
- **Specialised champion**: Specialised champions are those within and beyond the core agricultural division (e.g. NatureScot) that provide instrumental information on policy design. They hold a positive view of NC and see opportunities to integrate it into specific aspects and instruments. They believe NC is easily understandable by farmers. This profile also tends to understand NC in line with the ecosystem services approach.
- **Cautious fine-tuner:** Cautious fine-tuners are staff working in the calibration of the policy instruments in the ARP. They hold a very rich view of the complexity of the delivery of the specific ARP instruments, and flag up potential issues arising from the integration of NC.
- **Pragmatist designer**: These are SG staff working in the calibration of the policy instruments, i.e. mostly at the micro level. They do not show a particularly positive or inquisitive view of NC, and attend to the subject only as required and guided by the 'upper' policy levels.

These are working categories and labels to be refined in future communication and analysis. These different perspectives on NC may have implications for any future work to embed consideration of NC and related ideas into agricultural policy development.

Discussion

This study has used an exploratory approach to provide insights on how Natural Capital is currently understood by staff working on the Scottish Government's ARP, uses of evidence and data related to Natural Capital, and identify diversity in individual views on NC. The results allow us to provide some insights to the research questions, as well as flagging up a number of barriers and opportunities in the work with NC in the ARP, which may merit further research and attention.

Diverse understandings of NC and its links to agricultural policy

At the moment, there is lack of a shared understanding of NC and of its role in agricultural policy. Our study demonstrates there is a diversity of understandings of what the term implies, sometimes linked to one or more environmental concepts or goals (nature restoration, biodiversity, climate change action, ecosystem services) in combination with topics such as valuation, landscape scale approaches, agricultural value chain considerations, and nature finance and private investments. Whilst NC is related to all those topics, its use is not intended to be synonym for any one of those topics. It was not possible to discern reasons behind the variation between these associations, such as from job role, leaving us the impression that many people had rather vague or imprecise associations with NC.

Our study has also demonstrated diverse -and sometimes even contradicting- understandings of the links between NC and agricultural policy. While for some NC is a concept driving the agricultural

policy, for others is completely absent, or a mere rebranding of existing work. There was wariness or even scepticism about the value of this terminology. Importantly though, many pointed out the need for holism, which is one of the intentions of working with NC (e.g. Binner et al., 2025).

Evidence and data on Natural Capital

Our study indicated that although data related to NC are understood to be available, the what is available is not always easily used, so constraining how it can be integrated in the ARP. In particular, there was a desire for more comprehensive baselines on NC on agricultural systems. That said, the possibilities of acquiring or gathering new data (e.g. remote sensing data, data from the whole farm plans) and integrating existing datasets seemed to be an important subject for those we spoke to, which offers opportunity to improve NC baselines in future.

Among the instruments being developed by the ARP, the Whole Farm Plans (WFP), seem to hold another key piece in the integration of the NC approach. From the policy design perspective, the WFP are a particularly interesting policy tool. Anchored in 'nodality' – policy design terminology for the use of information (Hood, 1991; Howlett, 2018) – they are tools to describe land-holdings, in terms of NC, to be used by farmers and crofters. They are required as a condition of receiving tier 1 payments, will collect new data, and may also raise farmer and crofter awareness and understanding of NC. WFPs therefore are currently the most tangible way in which NC is embedded in future agriculture policy.

This highlights the critical role of the 'calibration work' in the ARP. The work done in the design of the delivery of the monitoring and evaluation of the policy seems to be a critical pillar for the integration of the NC approach. While strategic aims and objectives are set up at macro and meso levels, it is the only work done to configure policy instruments at the micro level which allows the new agricultural policy to become feasibility. This echoes observations that high-level policy statements by themselves are necessary but not sufficient to achieve policy integration (Candel & Biesbroek, 2016): with a focus on individuals and process, the work of macro, meso and micro levels are all needed before an innovation such as NC can be said to be embedded.

Implications for policy

If NC is to be further embedded in agricultural policy development, developing a common understanding across teams of natural capital, not only associated terminology but also the rationale and holistic outcomes expected from working with it, seems important to avoid misunderstandings. Whilst there is some scepticism about terminology, since Natural Capital is already endorsed or embedded in parts of agri-policy, so it would be sensible to further communicate and encourage its further use. To assist with this, we have articulated the range of views in terms of five profiles (Table 4, page 30). These may need further refinement, but can help to target communication and support in complementary ways, to encourage individuals with different views and in different roles to understand and work with each other to embed NC.

The differing profiles also indicate how individuals and teams could interact to encourage NC to be embedded in policy-making. 'Strategic' and 'specialised champions' can identify and advocate for NC. Leadership from senior roles is especially important (e.g. Shea, 2021), especially if complemented by practical ideas from, i.e. from the 'Pragmatists designers', updated with feedback from the 'fine-tuners'. All roles are crucial to ensure the refine and adjust it for ensuring the impact sought with farmers and crofters.

However, we do not want to imply that this will be a straightforward process. This report has identified some of those weaknesses of the current process among the barriers to work with NC in

the ARP. Outwith the constraint of resources in comparison with the existing workload in ARE and data limitations (see subsection below on this), the other main barriers for the integration of NC in the ARP seem to be the lack of clarity about the concept and path dependency -the first one referring to the content of the policy (NC), and the other one, to the policy process. In other words, although some related data and tools are available (e.g. Defra, 2021), there are not (yet) clear views or guidance about how specifically this can be connected with interviewee's ongoing work. This is probably related to many interviewees mentioning that NC is more directly relevant to other levels, sectors or other roles, than their own work.

As the study is based on interviews with a limited numbers of participants connected to the ARP, it is important to consider that implications considered here might be influenced due to self-selection effects. In other words, the individuals who were less interested or aware of NC may have been less likely to agree to participate in the interviews. This reinforces a need to champion and communicate NC, even whilst acknowledging uncertainties, ambiguities and tensions in what it means to embed NC into agricultural policy. Staff working in the ARP have a wealth of knowledge and experience based on accumulated years of service: this should be seen as a valuable asset for flagging potential hurdles and issues, rather than seeing caution as something to be dismissed or overcome. Improved internal communication and coherence over NC may also benefit communication with farmers and crofters and other external stakeholders about NC and related issues.

Presently, the WFP is seen as the main place in which NC will be integrated into future agriculture policy. This has already been subject to careful 'calibration', as it has arisen from years of testing with farmers by NatureScot, seeking to balancing ideals for monitoring with concerns over feasibility. It is not solely focused on NC – it has five parts which focus on different aspects of the farm[6]. However, since, this places extra emphasis on the need for future reflection of it, in terms on what aspects of NC are illuminated by these plans, to what end, and how the resulting datasets are used. If any issues are overlooked – for example, water was not mentioned much in our data, and others have earlier pointed a need to better integrate it into agricultural policy (Matthews et al., 2023) – then perhaps this could be altered and/or potentially complemented with other datasets and models. However, it is also important to question the path-dependency of only considering NC in relation to WFPs. There may be other possibilities for innovation in support of a holistic approach to agricultural policy that reflects a multiple benefits and environment-related policy goals.

Potential activities to consider in future, to understand and achieve the potential:

- (Re)share materials on NC acknowledging ambiguities, concerns and connections with pre-existing concepts, to target the full range of profiles of NC.
- Discuss with teams focused on specific work tasks in agricultural policy development, if and how existing NC tools, notably ENCA, could be further used; also if other existing or potential tools would be relevant and feasible.
- Review, in future, the consequences of the WFP on awareness and understanding in terms of the ethos of NC (multiple aspects and benefits of nature).
- Identify how NC will be embedded in future monitoring and evaluation of agricultural policy, including but not limited to how to build on and improve current baselines of agricultural NC.

[6] https://www.ruralpayments.org/topics/agricultural-reform-programme/whole-farm-plan-quick-guide/

Implications for academia

Further research is needed to identify how the different understandings of NC have developed and how might have shaped the substantive agricultural policy tools considered in the ARP. If carried out collaboratively – potentially linked to the activities listed above – this can help to identify further productive opportunities to embed NC in agricultural policy. Studies of working with NC in decision-making by other sectors may help to illuminate the specific possibilities of agriculture and non-agricultural policy development. Sharing such case studies was also flagged up by participants in this study as helpful for helping to raise awareness and make NC seem a more tangible and feasible thing to embed into policy.

Our research has hinted that the exploration of institutional dynamics and identified historical logics of path dependency as one of the main barriers for integrating NC in the ARP. However, further research is needed to explore the role that other institutional logics e.g. sociological logic, rational logic (Russel & Turnpenny, 2020) might be playing in the development of the ARP and the work with NC. Applied research studying the specific path-dependent tensions in the development of the ARP and how these are addressed and solved might be of great value not only for advancing the understanding of agricultural policy dynamics, but also the understanding of policy innovations in general.

Policy calibration is an area of research that has not received much attention in the study of public policy, relative to the dynamics of macro and meso levels (Capano & Howlett, 2024). Continuing to follow the calibration of agricultural policy, and how the policy instruments are finally formulated, might be particularly helpful to unpack how very different societal goals regarding balancing out environmental, social and economic considerations are balanced out. Studying the 'institutional grammar' of the ARP (Crawford & Ostrom, 1995; Cumming et al., 2020; Siddiki & Frantz, 2022) could provide interesting insights to thinking on policy design, whilst also helping to clearly 'unpack' the structural elements of the agricultural policy.

Among the instruments considered in the ARP, the Whole Farm Plan, is singled out because of its potential role in the integration of the NC approach, and its complex nature serving to a mix of objectives. Further research following up on 'take up' of WFPs by farmers, crofters and other land managers would help to provide evidence that might refine the tool in the future and provide further evidence of the impact of the ARP among farmers in terms of raising awareness about NC. Also, on studying the potential use(s) of the data resulting from the implementation of the WFP, land-manager confidentiality is an important issue shaping uses of land-holding data. It is important to appraise the insights these data may permit, given the wide range of public and private benefits generated from agricultural land.

When considering the potential of the WFP – and also other forms of data that are potentially related to NC – it may be useful to consider the credibility, legitimacy and salience (Sarkki et al., 2015). This arises not just from attributes of data itself, but also from the processes by which it is presented and shared (Cash et al., 2003). These perceptions will vary by individuals, according to their roles and pre-existing understandings. Distinguishing the views and agency of policy-makers, farmers and wider publics may be helpful, both when evaluating possibilities and also when appraising the consequences, of initiatives to work with NC.

Conclusions and next steps

We have explored views on NC and its relation to policy development, with individuals connected with the Scottish Government's ongoing ARP. Our findings show that while NC terminology is not

being widely used policy development, there is some familiarity with the term, and some micro-level calibration of the policy instruments that relates to NC.

The individuals we spoke to – and probably others – do not currently share a common understanding of NC and its role within the ARP, so communicating the rationale and content of the concept will be important if NC is to be further embedded in the work practices of ARP teams. It is essential to communicate the idea of achieving holistic understanding and encouraging actions that balance multiple benefits, rather encouraging use of NC terminology NC solely to relabel existing work or concepts. Some are sceptical about the terminology of Natural Capital, but the existing use of the term suggests that this is something to reinforce and further embed.

There are some data and tools already existing that relate to NC, but in our study use of these was not yet common or easy to imagine. Probably relatedly, individuals may perceive NC to be something more relevant to others. There is a therefore a need to connect NC more closely with existing work processes, in terms of content or outcomes. Our interviews identified a need to establish a baseline more closely framed around NC at the farm level. The development of such baseline, both at methodological and technical level, is ongoing, and may help future monitoring and evaluation of agricultural policy to reflect multiple aspects of NC. What the baseline captures, would be key to shape the key aspects and limits of NC work in the new agricultural policy.

Presently, Whole Farm Plans, to be completed by farmers, are seen as a key instrument to gather information related to developing a NC baseline at farm level. NC is by no means the only framing or issue that land-managers must attend to when completing the plans, and the plans do not even promote use of the terminology. However, they do promote consideration of multiple environmental issues and dependencies, thus making the ethos of NC salient at the farm level. Therefore, it will be valuable to evaluate WFP consequences and framing after their implementation in 2025.

We hope to continue exploring the integration of NC into Scottish agricultural policy development later in 2025. First, we will seek to discuss, possibilities of using different specific NC tools and approaches with those working in the ARP. We will also refine the typology of approaches to NC identified in this study with the aim to contribute to scholarly work on policy design. Ultimately, in 2026, we expect to inform a wider synthesis study on the potential to embed natural capital into policy processes.

Appendices

Appendix I: Interview guide

Section	Topics / Questions	Purpose
Introduction	• Introduction to research team • Introduction to the study, including aims and objectives • Purpose of the interview • Confidentiality, anonymity and recording • Length of interview: • Feedback and future engagement	To make clear that interviewees understand the research aims, their rights and chances to make questions.
Participant Background	• Professional background - Academic background - Total length of time working in civil service • Current Job role - General responsibilities /competencies expected of the post - Length of time in this unit and/or role? • Previous positions at different units	To explore participants' profiles To explore potential connections between specific backgrounds/experiences and position regarding NC.
Current NC role in policy development in Agriculture and Land Use	• How do you approach NC in your work? / What's your understanding of NC? • How did NC enter in your work? • What are the concepts and data that you use? How do you use them? • Has there been any changes in the content or the process of policy development since then?	To explore understandings of NC and experiences of working with NC.
Potential role of NC in policy development	• Is there potential for NC to be used more/differently in policy development? How could it be used? • What do you think would be the consequences in terms of policy development? • (If any negative consequence, how that could be prevented/limited?) • How can that potential for NC can be made happen? • What would be the driving forces for those changes approaching NC in policy development? • What are the challenges/barriers that may influence the inclusion of NC?	To explore how NC potentials and limitations are being perceived.
Role of environmental information in policy development	• Including NC, but including also other concepts relevant to sustainability, what type of evidence is needed/used? What counts as 'good' evidence for policy development? • How is evidence identified and included in the policy processes? • Which are the stages or situations in policy development where sustainability is considered?	To explore how civil servants engage with "evidence"
Closing remarks	• Thank you, opportunity to ask us questions • Reminder on confidentiality and opportunity to get in contact to discuss or if need to withdraw data. • Provide sources of more information	

Appendix II: Codebook

Theme	Nodes		Definition/examples/ keywords	
Understandings of NC	Biodiversity		Biodiversity conservation, biodiversity audit, habitats	
	Ecosystem services			
	Climate change mitigation			
	Nature restoration		Including peatland restoration and soils	
	Nature finance or markets		Private finance, carbon markets, carbon code, peatland code, woodland code	
	Natural capital			
	Landscape scale approaches			
	Positive/optimistic view of NC			
	Hesitant/negative view of NC			
	Policy level	Macro/sectoral-level	High-level policy goals and instrument logic (Capano & Howlett 2024)	
		Meso/programme-level	Policy objectives and instrument choices (Capano & Howlett 2024)	
		Micro/operational level	Specific measures, goal targets and instrumental calibrations (that is, the specificities of the measures) (Capano & Howlett 2024)	
Calibration of the agricultural policy	Resources	Financial resources	The level of financial resources needed/attached needed for developing the new agricultural policy. (Capano & Howlett 2024)	
		Other resources	The level of organisational and other resources other than funding needed for developing the new agricultural policy. (Capano & Howlett 2024)	
	Monitoring and auditing	Credibility	Perceptions of quality, validity and adequacy and reliability of the knowledge and evidence.	Planned procedures of monitoring and evaluation and data needs. (Capano & Howlett 2024)
		Legitimacy	Fairness and balance. Also whose views are reflected in commissioning, producing or communicating evidence.	
		Relevance	Suitability of data to fit with existing questions and also institutional processes and framings.	
		Experiences with existing data		
		Expectation on data		

	Target population		Designation of the target population – who specifically is targeted by the intervention (Capano & Howlett 2024)
	Expected outcome		What precisely is expected to be done by the target population (the farmers) with respect to natural capital. (Capano & Howlett 2024)
	Agencies responsible		Agencies responsible for implementation - if there is only one public agency, or if there are more agencies, even private, programmatically charged of implementation. (Capano & Howlett 2024)
	Accountability mechanism	Stick (sanctions and fines)	Accountability rules - rules that are expected to activate mechanisms leading to effective implementations based on the provision of sanctions and fines to activate compliance. (Capano & Howlett 2024)
		Carrot (incentives)	Accountability rules - rules that are expected to activate mechanisms leading to effective implementations based on performance funding that can activate utility maximization, etc. (Capano & Howlett 2024)
	Time-frame		Time frame for achieving the desired aim - "when" or the time by which the intervention is expected to be undertaken (Capano & Howlett 2024)
	Public visibility		Whether and how much the process of fine-tuning the policy instrument is visible to the public (Capano & Howlett 2024)
Barriers and enabling conditions	Language and communication		
	Institutional (civil service) culture and dynamics		Culture of the SG government, agri-policy departments, and of the civil service in general, It might include aspects such adversity of change, or silo thinking.
	Profile agricultural civil service		Profile of the agricultural civil service (e.g. farming background of many policy-makers and civil servants in the department)

Appendix III: Excerpts from data

Table 5 Interviewees perceived connections between NC and other environmental concepts

Nature restoration	For some, the natural capital focus in the ARP would be related to the goal of encouraging farmers to "restore, renew and protect" all the different natural elements impacted by land use (e.g. of rivers, peatland, wetland, particular species) (SG10). In particular, for some participants (SG05, SG10), there seems to be a clear focus on the restoration of soils, with the work on peatland restoration being a clear referent. For SG05, for example, peatland restoration seems to provide a good example of a "well-defined action" in the remit of NC, and so an example of the kind of action to move forward. • *The outcomes of the vision are that we want nature restoration; we want to incentivise farmers to undertake practice which drives nature restoration, which builds climate adaptation, mitigation, which in turn—and in the very, very general sense again, this is building blocks of natural capital. (SG01)* • *In terms of natural capital and where that interacts is, the ARP programme is very clear that we want to restore, renew and protect our natural capital, with farmers—well, agriculture having such a large percentage of the land use in Scotland, then we need to encourage those farmers to restore the natural capital they've got, whether it be, you know, better protection of rivers, peatland, wetland, particular species, an area of scientific, historical, you know, interest. (SG10)* • *In terms of natural capital and where that interacts is, the ARP programme is very clear that we want to restore, renew and protect our natural capital, with farmers—well, agriculture having such a large percentage of the land use in Scotland, then we need to encourage those farmers to restore the natural capital they've got, whether it be, you know, better protection of rivers, peatland, wetland, particular species, an area of scientific, historical, you know, interest. (SG10)* • *And we're now back to a point where many of the soils, in particular, we've got are quite depleted. And actually we need to get back to a point where we start working with these soils to improve them and help them. (SG05)* • *So they're looking for people to maintain soils and improve soils, for example, which would be part of the natural capital, soils, obviously. (SG05)* • *One of the things that focuses on recently is round about peatlands, for example; on the maintenance of peatland in good condition and other bits like that. (SG05)*
Biodiversity	For some, there is a clear connection between biodiversity and NC (e.g. SG08), and so, biodiversity (and biodiversity targets/policies) would benefit from using a NC approach ["*Biodiversity is clearly the winner in my head from natural capital*". (SG08)]. Biodiversity, and more specific biodiversity loss, would be one of the aspects of NC that agricultural policy and farming can deal with (NS01). NC is understood as a measure for biodiversity, that it be in specific terms (e.g. SG02) or more broadly, as under the remit of measuring it (e.g. SG07). Within the scope of "biodiversity", NC is connected in particular into the measurement of healthy levels (SG07). Specific policies, tools and concepts related to biodiversity are mentioned. 'Biodiversity net gain' and its use in England in relation to planning raises doubts for SG04. 'Biodiversity audits' is understood as a feature of whole farm plans (SG07, D14). It is also connected to training for farmers on biodiversity and habitats assessments (SG07). SG08 connects it to 'greening activities and EFAs'. For NatureScot, biodiversity is an element of the NC approach -one they have worked for to be embedded by creating a specific tool, the 'natural capital assessment' (NS02).

	• *Biodiversity is clearly the winner in my head from natural capital. There are other things beyond it that I, in terms of climate mitigation, that I don't think are just natural capital because there's a lot of other bits and pieces that we can be doing which aren't just natural capital related in terms of climate mitigation within agriculture… because like you're thinking house gas emission reductions—that's not—to me, doesn't seem to fit with natural capital, whereas there are other aspects that are. (SG08)* • *There's the whole concept of natural capital just existing as a concept, which I would—I'd be more inclined to call habitat. [...] what is natural capital? You know, is it the combination of habitat species and management (SG04)* • *So, I understand it's about the natural capital of landscapes or water or water bodies, habitats and diversity. (SG07)* • *it's more or less all the non-agricultural style elements. It's in the landscapes. So, I'm thinking your hedges, your grass bankings, your—the sides of your rivers. Your uncultivated kind of areas that aren't getting used productive—well, they might be being used productively. But they're getting managed in a way that is adding value to the environment, is what I kind of think of. So, areas of trees up the side of fields, your windbreaks etc. would be that kind of things that I'm thinking of as—when I'm thinking of natural capital anyway. (SG09)* • *We'd measure the contribution it was making towards biodiversity. You know, you'd have two nice numbers and you could pay them on the basis of how well they do to that. But both those things are very difficult to measure.* (SG02) • *I think there's a lack of understanding about exactly where we are in terms of the state of habitats and biodiversity.* (SG07) • *I'm aware that in terms of biodiversity and whole farm plans driving forward the policy in whole farm plans, biodiversity audits feature within that particular consideration. And those plans might translate into actions on the ground and measurable benefits in terms of the Agricultural Reform programme as a whole. But that relates to the terminology of biodiversity audits rather than natural capital. (SG07)* • *The more we got into it, the more we discovered that back then, there wasn't so much a focus on biodiversity and nature, and I think for our assessment, we wanted to ensure that nature and biodiversity were embedded in the natural capital process. And subsequent to that, then the biodiversity element of the natural capital assessment was introduced (D13)*
Climate change	For SG01, NC is linked to the advance on climate change mitigation (and adaptation). Beyond that, climate change action (both mitigation and adaptation) would be one of the bounded remits of NC, along with nature restoration. For NS01, climate change mitigation would be one of the aspects of NC, and in particular, one of the aspects that agricultural policy and farmers can deal with, and an entry point for NC thinking. On the side of climate change mitigation in particular, some participants associate NC to carbon sequestration in particular, and so credits or similar schemes aimed to the manage emissions and carbon sequestration (e.g. SG08, NS03). • *We want to incentivise farmers to undertake practice which drives nature restoration, which builds climate adaptation, mitigation, which in turn—and in the very, very general sense again, this is building blocks of natural capital.(SG01)* • *I think at the moment… farmers and agricultural policy can only deal with some of the aspects of natural capital approaches. So the priority at the moment is looking at climate change and mitigation, adaptation, as well as biodiversity, halting biodiversity loss. That in its own right is quite a significant challenge. It's only part of what natural capital approach can do. Because it's quite—one biggest ones for farmers. And in embarking on that, like, better understanding of data and… the—what the pressures are on the farming business from climate*

	change and from biodiversity loss, they will be a way of getting the entry into wider natural capital thinking.(NS01) • *So it's like carbon credits I can visualise, to the extent that's saying that I'm going to plant like a hundred hectares of trees, this, is what that trees will do in terms of emissions and sequestration and so on and so forth. That's got a value because the Carbon Code's there. (SG08)* • *I think also it would be—it could be very hard to provide— to really calculate accurate valuations, because [...] we don't really have a great way of measuring carbon sequestration in different types of grassland, but we know the value of permanent grassland and rough grazing for storing carbon. But it's a lot easier to do the calculations for woodland, so I think you could get into a lot of difficulties trying to provide the valuations… (NS03)*
Ecosystem services	For some, ecosystem services is a more familiar concept than NC (e.g. SG02: "I think we talk about ecosystem services a bit more"). For NatureScot interviewees, NC relates to ecosystem services, and specifically refers to accounting to think about ecosystem services and inform decisions on impact on ecosystem services (NS03). For SG02, NC relates to assets rather than flows, that is what would be understood by ecosystem services. And SG02 continues pointing out that in agriculture, "*we probably talk more about the stock and the assets rather than we do about the flows*", being so NC more important to agricultural policy than ecosystem services. For SG11, NC relates to communicating about the benefit of nature and its cultural importance, and giving it a figure. Moreover, that communicating would be "important". In a similar vein, for NS02, NC tools give an opportunity to explain about ecosystem services in agriculture, although without valuation attached to it. • *Natural capital in our understanding is coming from a—quite a global movement of thinking around economic theory, where all of the ecosystem services that nature provides society are properly accounted for and recognised in a—account—effectively an accounting system, natural capital system, that identifies what those values are, beyond traditional economic evaluation techniques, which tend to focus on the financial benefits. So, you—we can use the natural capital thinking approach in different contexts, but essentially around about the ecosystem services approach. (NS03)* • *And building in natural capital approaches in terms of understanding and judging the ecosystem services provided by that land, what would be the best opportunity for maximising ecosystem services in a land or minimising the impact of ecosystem services from developing the land (NS03)* • *Natural capital way of looking of things is really a kind of an asset. You know, like, "How do you maintain these assets?" And then—but then, ecosystem services is more about, "Well, what's the flow of benefits that we're getting from these assets?" (SG02)* • *I think that we probably talk—when it comes to agriculture, we probably talk more about the stock and the assets rather than we do about the flows. So we talk more about, you know, maintaining hedgerows, not cutting them enough, or expanding them. You know, leaving buffer strips on fields. Replanting around rivers. All this sort of stuff. And I think that's probably—that's much more salient to agricultural policy colleagues than this idea that, you know, you get this flow of the ecosystem services on there.(SG02)* • *But is it, is it important to talk about that—the intangible, sometimes intangible, sometimes put a figure on—benefit of nature and the importance to Scotland culturally. (SG11)* • *I think with our template, that's partly what we wanted to do was explain what all of the different elements mean and all the services and ecosystem services. (NS02)* • *We made a conscious decision at the start that we wouldn't have valuation as part of it. We were very much focused on showing the—focusing on ecosystem services and looking at potential for, you know, water quality, air quality, soil*

	health. So it was very much focused on what are your natural capital assets that you've got, and what are they delivering in terms of social, economic production and all those elements? (NS02)

Table 6. Cross-cutting approaches in NC.

Landscape approaches	• *I suppose from a natural capital perspective, then sometimes it might be almost overlaying different data sources. […] But if you've got a kind of land map and then you think, well this is our biodiversity data, this is our—you know, our kind of land use data, if there's trees or peatland, or you know, other things that could be seen as part of natural capital. This is our, you know, data around kind of water quality. So, to me, a really helpful data source would be a kind of that land-based perspective. (SG03)* • *I think a key thing would be that's where a natural capital approach really does come in. To tie in these disparate elements. To make it a coherent, sort of, whole-farm approach that then can work at a landscape scale. And, above landscape scale, at a region scale. (NS03)* • *Landscape style approaches, I know they're [NatureScot] very keen on that. That—and it's something I think we would all love to do. (SG09)* • *How do you build in natural capital principles into that? The next level down is looking at landscape scale, particularly land, but also at sea. Land use and land and sea use planning. Making decisions about land use change and how you make opportunity costs in terms of where woodlands would go, where farmland would go, where we produce food versus where you develop land for—built development and so on. (NS03)* • *The planning system at the moment—land use planning, just really is only focused around development planning. Not in around land use planning. There is a lot of—there are strategies—land use strategies, Scottish Government and others local authorities do look at. I mean, there's Indicative Forestry Strategy, for instance, that local authorities—some local authorities have. But they're not really fit for purpose in doing that proper opportunity mapping at a landscape scale. And I think that's where natural capital approaches will have the biggest impact… of which—and farming would be part of that land use change. (NS01)*
Nature finance and nature markets	• *There's lots of opportunity—or there could builds opportunity to the future to tap into private financing. (SG03)* • *So my natural reaction there was first of all to focus on natural capital markets, you know, and putting a monetary value on them. (SG04)* • *I understand there's quite a bit of discussion and theoretical debate about how to recognise that value and realise that value and ensure that private investment comes into the equation rather than just public investment. (SG07)* • *It's a bit more obvious when you're having conversations with the natural capital finance teams because, obviously, they're natural capital finance. They're looking at how to bring finance into support it from the private sector. (SG10)* • *There'll be opportunities to tap into private funding. Which, you know, we need—the cost of addressing the climate biodiversity crisis is vast and way more money than the government needs. (SG03)* • *As we move away from the current support mechanisms we've got, undoubtedly we're going to have to depend on private finance. (SG05)* • *And it's one of the things we looked at, for when we started looking at Enhanced, was how we could integrate the private finance into—or recognise private finance as part of Enhanced. I feel it's too early yet. But it's definitely something in the next few years, it definitely has to be part of the schemes that by doing that under private finance. (SG09)*

	• *But I guess we're very mindful that we want responsible investment, but that also could bring other opportunities. (SG03)* • *And obviously we don't want greenwashing, so it needs to be done the right way. (SG03)* • *So, in some respects we can let the market do that and we'll just play catch up. Or in other respects, you know, government could lead a little bit more. (SG03)* • *You've got that corporate requirements in terms of the ESG requirements and corporate entities to make sure that they're compliant with that at a corporate level. And again, you know, there's been a lot of talk around, you know, these corporate entities buying up large estates for that purpose. And, you know, whether you call it rewilding or tree planting or otherwise, it just seems that it's very much corporately driven. (SG04)* • *If you had globalised companies, for example, big conglomerates, purchasing whatever to offset their so-called obligation, how would that benefit us locally within Scotland? I'm not sure. (SG07)* • *Going back to my point about the market, if I'm going to sell some natural capital in the market, what is it? What is it that I'm selling? (SG04)* • *And also [there's] confusion and lack of clarity as to whether some of the assets will be tradeable. So that's causing a lot of confusion for people and nervousness. So we've—I mean, you can read quite regularly in things about people who are, you know, planting trees, for example, on land on the basis of creating carbon credits and people wanting to buy carbon credits and all the rest of it, but nobody really knows what the rules of engagement are. So they can do some of these things, but in ten or fifteen years' time, is that going to have been a good investment? Nobody really knows at this stage. You could be an early adopter and get your fingers burnt quite hard here. Or you could be an early adopter and make a lot of money out of it. But there's a lot of confusion out there and I think it's stifling innovation a wee bit at the moment. (SG05)* • *I am aware of a similar concept to carbon trading, and that in the worldwide stage, companies can offset their carbon obligation by purchasing and offsetting through the encouragement of alternative activities. I am aware of the notion that biodiversity and habitats and natural capital might be treated in the same way, but what I'm not aware of is how that would actually work in practice and, furthermore, how it benefits Scotland. (SG07)* • *I can't fully work out how we can…. how we can monetise it all. It just feels, at the moment, it's so vague. And a lot of farmers are getting really excited about it. A lot of them are getting really concerned about it because they're scared about giving—selling the rights or giving away the rights and then losing them forever. I think it's quite a confusing market, at this point in time. (SG09)* • *If we could get a handle on a natural capital approach and help our—I say farmers, but land managers, it's not just farmers- to understand that [NC approach], then I think there'll be opportunities to tap into private funding. [...] So, I think, you know, helping understand that, so we can do that in a responsible way (SG03)*
Value chain	• *We have a lot of buyers in the market who are now insisting on certain things being done in order to sell produce through their particular supply networks. So if you look at some of the big supermarkets, they're looking at imposing requirements on farmers and crofters who are their suppliers, and are linking a lot of that into the natural capital terminology and definition. (SG05)* • *Say you are a milk retailer and you're buying milk. It's quite easy to say to your contracted milk suppliers that, "in order to be a supplier of milk to us, you need to do the following actions on your farm." And the actions may involve a third party doing some form of carbon monitoring and carbon assessment or carbon audit on the farm. And if the supplier basically—or, sorry, if buyer basically says you have to do that in order to meet the contract requirements, the farmers will adopt it very quickly. The consequence is that we have lots of different variations of the same. So, you know, the risk is that you have a requirement from buyers to do some form*

	of carbon audit and you end up with ten or fifteen different variations of what a carbon audit is. (SG05) • *But if these standards are not consistent across the board that makes it very difficult for farmers and crofters to adjust and to know which ones they're applying to, and from a Scottish government point of view, it makes it very difficult for us to try and implement standards if we've already got five different schemes out there that are doing something different. And, actually, there's an argument that says we shouldn't be trying to replicate or copy what's out there already. There's an argument we should potentially try to influence some of the things that are out there and piggyback on the back of them, to avoid duplication. (SG05)*

Table 7. Understandings of Natural Capital

Front and centre of the ARP	• *You wouldn't see the words, but I think the concept is there pretty front and centre. (SG02)* • *In terms of natural capital and where that interacts is, the ARP programme is very clear that we want to restore, renew and protect our natural capital, with farmers. (SG10)*
New terminology but not new work	• *Natural capital is something that we've been dealing with for many years, to be perfectly honest, so it's not new, it's just a new name. (SG05)* • *it's been centre stage from [...] 2016 when the SRDP, the Scottish Rural Development Programme, was initially launched. […] It didn't mention natural capital. It mentioned habitats and biodiversity, and it encompassed things like landscapes as well. But it didn't use that terminology at the time. (SG07)*
Informing discussions but not at the core	• *I think natural capital thinking does inform discussions. But I don't think it is explicitly couched in the terms of natural capital. [...] I don't think—in term—[...] the design of the policy framework at the moment, it isn't at the core of it. (NS03)*
Not being part of the ARP	• *I'm aware that in terms of biodiversity and whole farm plans driving forward the policy in whole farm plans, biodiversity audits feature within that particular consideration. And those plans might translate into actions on the ground and measurable benefits in terms of the Agricultural Reform programme as a whole. But that relates to the terminology of biodiversity audits rather than natural capital. Natural capital hasn't entered into any considerations, really, in terms of policy development as far as I'm aware. (SG07)* • *In terms of eligibility under the Knowledge Transfer and Innovation Fund, [...] there's certain projects being taken forward that promote biodiversity and habitats and nature conservation. But none of that, aside from the fact that project proposals might mention in the passing 'natural capital', they don't feature in the assessment criteria… or form centre stage in terms of the proposals themselves (SG07)*

Table 8. Views on common understanding of NC

Acknowledging lack of common understanding about natural capital	• *I've got an understanding of what natural capital is. [...] But that's me, so I'm not sure what other people think of it. In terms of how I, or we, within the Scottish Government within the section that I'm in control of, we ensure that natural capital is adequately covered... (SG07)* • *So, the term natural capital isn't particularly well understood. (SG03)*
No confusion about natural capital	• *That's certainly how I would perceive it. And I think that that would be fairly common amongst colleagues. That's what—how we see natural capital. It's everything that's already there and can be improved upon. (SG08)*

Table 9. NC across policy levels

Challenge of translating NC into the micro level	• *We've seen this raised to the operational board level of the Rural Support—the Ag Reform Programme a few times, about… policy folk not—the allegation, "Policy folk just don't deal with reality." They—we can't accept the constraints; we can't accept the limitations on matters. So there is frustration on both sides of this. (SG01)* • *Because natural capital's much more strategic than—or much more holistic, then it's quite a difficult thing to then translate into deliverables. [..] I'm very aware of it and mindful of it, and it all sounds really positive and a really good thing to be doing. But then I haven't really understood how we translate it into actual deliverables… (SG03)* • *If there's a way in which natural capital could contribute in a way that was measurable, and we could reward it if we had a mechanism that we could reward that, I would suggest that that is a route that we would—Scottish Government would be interested in looking at. (SG08)* • *We really do need our operational teams to be working with our policy teams, to be working with our digital and data to be able to say, you know, "You may—you might want to come up with a wonderful policy that will solve all our problems. But if we don't have a way of operationalising it, it's pointless." (SG11)*
Need of coordination	• *We've got our policy division. We've got our implementation division. So, we manage the scheme, they manage the policy. So, our policy colleagues are more dealing with the vision, dealing a lot more with the CAP secretaries, the ministers. But they can add feedback. In saying that, we're involved a lot with the CAP secretaries now as well. Because co-development, it makes sense to have both sides of the table in the meeting so you don't just—so that we can progress properly. So, there's less of a division between the two sort of areas now. Which is the way it should work, you know (SG09)* • *Policy can have the vision but we need to be in the room when you're having that vision to make sure it's a practical vision that can be delivered and can be worked as well. (SG09)*
NC at the macro level	• *I guess what's very much on my mind at the moment is if we zoom out, and we look at, say, all advanced economies that are having to make this sort of transition with their agricultural sector. And obviously, some countries have bigger agricultural sectors than other. But, you know, many, many countries around the world are doing this. And it's fascinating to see the very different sorts of approaches that are being taken forward in different countries. And the different ways that concepts like natural capital or others are being included or not. (SG01)* • *NC "is much more embedded in environmental policy-making than it is agricultural policy-making". (SG02)*
NC at the meso level	• *So it's about just making sure we can—our colleagues, as they develop the operational policy—the realisation of this, bear that in mind. So in the most simple sense, that's how we would look at it. Not necessarily get our hands too dirty with the nitty-gritty of it, occasionally diving in, as I said, on the detail here or there, but trying to encourage that it's there, that it's locked in from the outset (SG01)*
NC at the micro level	• *But if you're thinking in the context of what has changed, so we've introduced some simplicity around inspection levels, with penalty levels and so on and so forth. But in terms of changing things on the ground, there hasn't been that substantial shift. So, in terms of changing the job, if you like, that's the period that we're in at the moment, where we're looking to see what do we need to implement in order to get us to deliver the outcomes set against the four-tier model that, you know, that's been out in the public domain since prior to—just prior to the agricultural bill consultation. (SG04)*

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