Transformation for sustainable nutrient supply and management

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1. Executive Summary

This deliverable (D1.7) provides the conceptual foundations and practical guidance for engaging national-level stakeholders in the trans4num project. The overall aim of trans4num is to support pathways towards circular nutrient management and sustainable agri-food systems through the integration of nature-based solutions (NbS), stakeholder engagement, and dynamic modelling tools operating across multiple governance scales.

The specific purpose of D1.7 is to establish a common framework for national stakeholder engagement that can be implemented across the project's case-study countries. Building on insights from science–policy interface literature and previous trans4num work on stakeholder mapping and transformation pathways, the deliverable provides structured guidance for engagement activities centred on three modelling frameworks developed within the project: the Food System Model (FSM), the Decision Support Tool (DST), and the Agent-Based Model (ABM).

The document first reviews relevant literature on the research–policy interface, decision contexts, and effective stakeholder engagement strategies. It then translates these conceptual insights into an operational engagement template that country teams can use when organising national-level stakeholder workshops. The guidance specifies the objectives of engagement, stakeholder types to involve, recommended workshop formats, and standardised feedback mechanisms to ensure comparability across countries.

By combining theory-informed engagement design with practical implementation guidance, D1.7 supports the broader trans4num workflow in three ways. First, it ensures that modelling tools are developed and interpreted in dialogue with relevant national stakeholders. Second, it provides a structured mechanism for gathering feedback that can inform the refinement of modelling tools and scenarios. Third, it enables the project to generate cross-country insights into how stakeholder engagement can support the governance and scaling of nature-based solutions for nutrient management.

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2. Introduction

This deliverable builds directly on earlier outputs of Work Package 1, which collectively establish the conceptual and empirical foundations for stakeholder engagement within trans4num. Deliverable D1.2 provided the project's initial framework for stakeholder engagement and co-production across scales, outlining principles and approaches for involving actors throughout the research process. Deliverable D1.4 subsequently documented the implementation of local stakeholder engagement within the project's NbS case-study sites, including the identification of key actors and locally relevant challenges related to nutrient management. Deliverable D1.6 then developed the project's approach to transformation pathways, outlining how iterative learning processes can link local experimentation with broader system change. Building on these earlier outputs, D1.7 focuses specifically on the national governance scale, providing guidance for structured engagement with policy actors and other national stakeholders in order to ensure that modelling tools and transformation pathways developed within trans4num are aligned with real decision contexts and policy processes.

3. Literature Review

3.1 Research-Policy Interface and Transformation

The relationship between scientific knowledge and policy has long been problematised within science and technology studies (STS), with linear models of research transmission replaced by theories of co-production (Jasanoff, 2004). Jasanoff argues that science and social order are "co-produced": the ways societies know the world are inseparable from the ways they choose to live in it. Thus, the science–policy interface is not a simple pipeline but a site of negotiation, in which authority, credibility, and legitimacy are continually constructed through institutional practices and social imaginaries (Jasanoff, 2003). As negotiated sites, science-policy interfaces are thus multiple, with each national and regional context producing distinct knowledge politics shaped by specific histories, nested sets of social relationships, funding architectures and research-policy cultures (Meehan et al., 2018). Meehan et al. (2018) argue that this multiplicity demands context-specific architectures of engagement, attentive to power asymmetries, epistemic differences and the specificities of institutional arrangements.

The concept of boundary work (Gieryn, 1999; Cash et al., 2003) has been applied to studies aimed at understanding or improving the science-policy interface. Within the context of science-policy engagement in environmental governance, effective interfaces have been shown to rely on maintaining *credibility* (scientific robustness), *salience* (relevance to decision needs), and *legitimacy* (perceived fairness and inclusiveness) (Cash et al., 2003; Dinesh et al., 2018). Aligned to this literature, emphasis has been placed on the importance of boundary organisations or intermediaries that act across the science-policy interface to stabilise translation between epistemic and policy communities through routines of co-production, iterative communication, and mutual accountability (Bednarek et al. 2018).

3.1.1 Challenges in the policy realm

Engaging policymakers presents unique challenges because of the distinct institutional logics that govern political and bureaucratic systems, with policymaking operating under pressures of accountability, timeliness and legitimacy that may differ markedly from scientific norms of accuracy, rigour and cumulative knowledge (Emery et al., 2015). Policy actors function within bounded mandates, short electoral cycles, and contested value environments. Consequently, their demand for evidence is rarely "open-ended" but highly selective, shaped by problem framing, political salience, and administrative feasibility. Emery et al. (2015) summarise the challenges for researchers through recourse to:

i) a *temporal mismatch* – whereby scientific research unfolds over years, whereas political windows for influence may last weeks or months;
ii) *an epistemic mismatch* – whereby policy institutions prioritise instrumental knowledge (what works now) over analytical depth (why it works).
iii) *Procedural opacity* - whereby decision pathways are often informal, relying on trust networks, tacit negotiation, and symbolic actions rather than linear evidence application.

Emery et al. (2015) argue that the opacity of the bureaucratic spaces of policy-making should shift our attention away from trying to achieve policy impact to that of policy 'resonance'. Rather than measuring uptake (for instance), this implies that researchers should assess their propensity to influence – the extent to which ideas and framings circulate and gain traction within policy discourse. Meehan et al. (2018) further emphasise that scientists need to better understand policy-making as a political practice infused with power relationships and asymmetries. Robins et al. (2022), meanwhile, demonstrated that instability of partnerships, frequent personnel turnover, and politically sensitive topics impede sustained learning. Effective engagement, they argue, demands continuous relationship management rather than episodic consultation.

These studies converge on the insight that policymaking is inherently non-linear, contingent, and negotiated. Political institutions are "arenas" rather than "targets" (Pielke 2007): scientists entering them, therefore, need to expand their role as brokers of knowledge and develop an ability to understand the organisational cultures, incentives and risk perceptions that shape policy behaviour. As proposed by Dinesh et al. (2018), science-policy engagement succeeds when it aligns with policy cycles, mobilises policy champions, and produces usable knowledge framed around ongoing agendas.

3.1.2 Engagement across scales of interaction

The trans4num project adopts a multi-actor, multi-scalar approach to engagement as part of its transdisciplinary approach to socio-ecological transformation (Figure 1). It is important to consider, however, that different designs of multi-scalar engagement have different applications, benefits and limitations. It is generally accepted that scientific research and associated engagement needs to be aligned or matched with the scale of the policy problem being addressed. Moreover, the multi-actor and multi-scale approach need to achieve an appropriate level of coherence and integration relative to the understandings of, and ambitions for transformation.

In their analysis of 200 case studies of multi-actor co-innovation partnerships in European agriculture and forestry, Fieldsend et al. (2022) concluded that there is no single ideal model of engagement. Instead, "contextual contingencies"—actor capacities, aspirations, networks and enabling environments—determine which configuration is most appropriate. Within this broad framework, and rather general conclusion, however, Fieldsend et al. (2022)

distinguishes between two modes of multi-scale engagement: diverse and focused. *Diverse Engagement* mechanisms involve broad, heterogeneous partnerships involving multiple sectors and scales, whereas *Focused Engagement* involves smaller, more homogeneous groups addressing specific problems. At the broader or project-level, the question is not whether to engage across scales, but whether to engage across scales simultaneously or more distinctly.

Each approach has its benefits and drawbacks. Fieldsend et al. (2022) argue that whilst *Diverse Engagement* builds legitimacy, inclusivity, innovation through heterogeneity and bridges policy levels, it also entails complex coordination; potential dilution of objectives, and higher transaction costs. In contrast, *Focused Engagement* has the advantages of being more efficient, goal-oriented, clearer accountability, and more likely to achieve consensus, but also suffers from the risk of exclusion, limited legitimacy and reduced system learning. In terms of issues pertaining to power and justice proponents of diverse approaches argue that co-presence fosters mutual understanding and trust, which is essential for transformative governance (Newig et al., 2018). On the other hand, Reed et al. (2014) have suggested that diversity can reveal power imbalances which serve to suppress marginal voices and that separate but linked processes may produce more equitable outcomes. Indeed, empirical evidence from Horizon 2020 projects shows that hybrid models—where diverse engagement informs visioning and agenda-setting, followed by focused task groups for implementation—often achieve the best balance between inclusivity and effectiveness (Fieldsend et al. 2022; Klerkx et al. 2012).

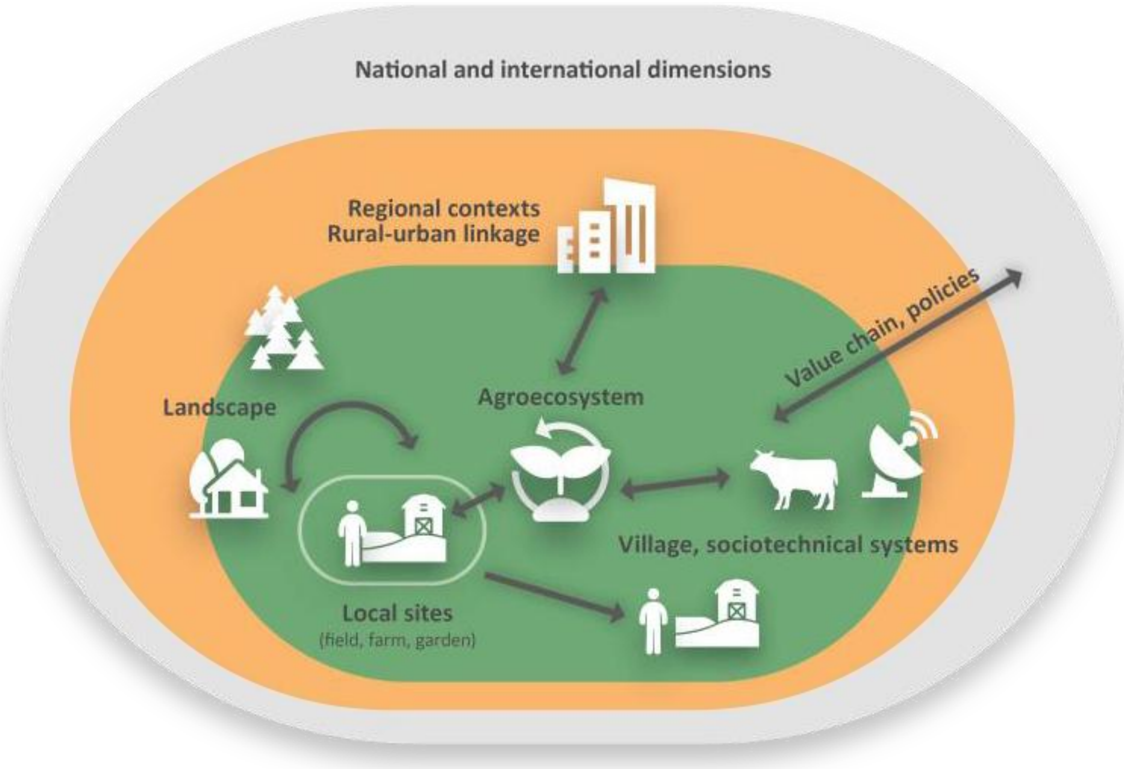

Figure 1 Trans4num's nested level of analysis (Source trans4num Proposal)

A hybrid approach has been demonstrated by Royer et al. (2020) through their *bi-scalar* design for addressing nutrient pollution: local watershed councils generated place-specific data and priorities, while state-level policy forums translated these into regulatory instruments and funding mechanisms. The two scales were linked by a dedicated communication team ensuring information symmetry. This design, therefore, fostered both *vertical integration* (alignment between local experience and national policy) and *horizontal learning* among sites. These considerations are important when extending the same principles to trans4num's tri-scalar approach to stakeholder engagement. The approach, therefore, should convene differentiated spaces for actors with distinct authority levels but ensure structured interconnection through boundary organisations/intermediaries, ensuring information reciprocity (whereby knowledge generated at local levels informs national agendas and vice versa) and embedding reflexive monitoring to track cross-scale learning and adapt engagement structures over time. Trans4num's approach to transformation as both *iterative and cumulative* (see Deliverable 1.6) allows both engagement and project phases to build upon one another and progressively increase the level of intervention and impact. This progression is designed to create robust pathways that can be refined and adapted to effectively transform nutrient management practices.

3.2 Understanding the decision-making context

Appropriate engagement within the realm of national-level stakeholders and policymaking requires a sound understanding of the existing context in which decisions get made and in which innovations, incremental transitions or more paradigmatic shifts take place.

3.2.1 Stakeholder analysis

Stakeholder analysis provides the empirical and conceptual foundation for any engagement process that seeks to be both inclusive and effective. In the context of transformation toward sustainable agri-food and environmental governance, the purpose of stakeholder analysis extends beyond listing participants—it involves mapping relationships, influence, power and legitimacy within a complex decision system (Reed et al. 2009; Reed 2008). Reed's review identifies three broad phases: *identification*, *categorisation*, and *prioritisation*. Identification draws on document review and snowball sampling to reveal all potentially affected or influential actors. Categorisation applies typologies, such as power–interest grids or salience models (Mitchell et al. 1997), to distinguish key, secondary and marginal stakeholders. Prioritisation then determines the appropriate mode and intensity of engagement for each group.

In the context of transdisciplinary research such as trans4num, stakeholder analysis performs several vital functions:

1. **Revealing decision architectures**—understanding who actually makes, funds, or blocks decisions within national agricultural or environmental policy networks (e.g. ministries, agencies, advisory councils, farmers' unions, corporate actors).
2. **Diagnosing institutional linkages**—mapping vertical relationships (national ↔ regional ↔ local) and horizontal ones (across sectors or ministries).
3. **Clarifying values and incentives**—which guides the tailoring of communication strategies and co-production methods.

Stakeholder analysis should thus be conceived as a diagnostic tool for mapping how different knowledge, values, and rules interact in the context of NbS in agricultural settings (see Deliverables 1.2 and 1.4 which further cover stakeholder analysis in trasn4num – approach and outcomes).

3.2.2 The decision context

Colloff et al. (2021) argue that achieving transformative change in socio-ecological systems depends less on producing new information than on reconfiguring the decision context in which choices are made. Building on Gorddard et al. (2016), they define decision contexts through the dynamic interplay of *values*, *rules* and *knowledge*—the VRK framework (Figure 2). The model rests on the premise that governance outcomes are co-determined by the three interacting domains of:

- *values* (normative preferences and goals that determine what outcomes are desirable (e.g. food security, biodiversity));
- *rules* (formal institutions (laws, policies) and informal norms (customs, conventions) that structure how decisions are made), and;
- *knowledge* (scientific, technical and experiential understandings that define what is considered true or feasible).

Transformation occurs when feedbacks among these domains enable the system to cross thresholds from one governance regime to another. For example, shifts in societal values (toward climate justice) may generate political momentum to revise rules (carbon pricing) and mobilise new knowledge (emissions accounting).

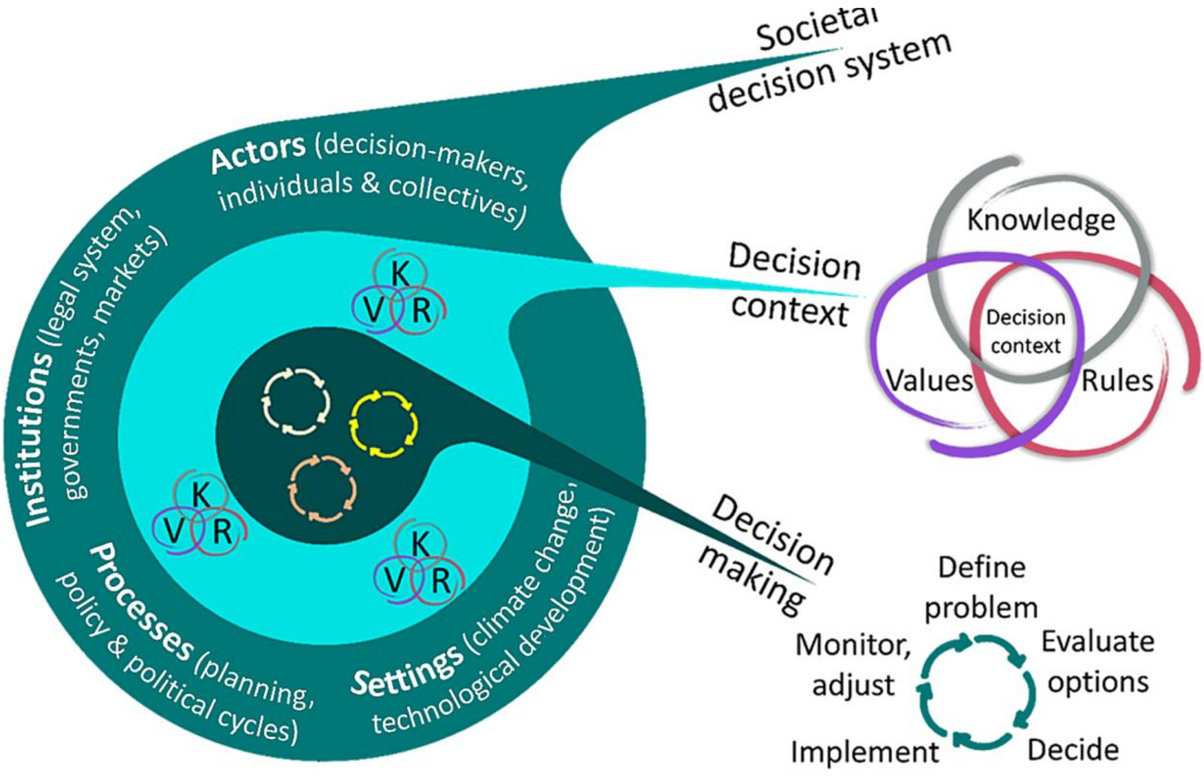

Figure 2 The decision-context, determined by the interaction of values, rules and knowledge (VRK) and its role in linking how decision-making processes interact with the broader societal decision system (Colloff et al., 2021: 166).

While the original VRK framework identifies the "what" of decision-making, practical applications (e.g., Rust et al. 2020) suggest that trust serves as the essential medium through which these domains interact. Without a baseline of trust, knowledge is often rejected as "biased," and rules are viewed as "impositions," and values remain "clashing" rather than "negotiable." Transformation occurs when feedbacks among these domains enable the system to cross thresholds; however, these feedbacks are only possible when stakeholders operate within a "safe space" where the risk of sharing values or testing new rules is mitigated by mutual trust.

Colloff et al. (2021) integrate VRK with pathways thinking—a planning method from adaptation science that sequences actions over time under uncertainty. Their *VRK–Pathways Framework* links (i) diagnosis of the existing decision context, (ii) co-development of desired futures, (iii) identification of enabling actions, and (iv) iterative monitoring and learning. This approach contrasts with conventional policy analysis, which often treats rules and values as fixed and focuses solely on knowledge deficits. Colloff et al.'s insight is that transformational capacity depends on expanding the *decision space* itself, not merely filling information gaps.

The VRK framework has been applied particularly within the context of climate adaptation and resilience studies. Carmen et al. (2022) used it to evaluate UK community resilience projects, finding that interventions succeeded where they explicitly addressed value pluralism and institutional rigidity. Wyborn et al. (2021) incorporated VRK into global biodiversity governance assessments, highlighting its utility for connecting local knowledge systems with global policy targets. VRK, when applied to national-level stakeholder decision interfaces provides a tool for understanding why well-evidenced policy options fail to gain traction. Moreover, addressing changes in VRK can form the centrepiece of transformative adaptations which link the co-production of visions and the development of theories of change (see Section 1.3 below).

By combining effective stakeholder and VRK analysis it is possible to include relevant actors in appropriate ways and understand the institutional and normative barriers to transformation. Stakeholder analysis identifies who is involved and how they relate, whilst VRK analysis reveals why decisions unfold as they do and what must change.

3.3 Approaching effective stakeholder engagement at the national level

There is a breadth of literature exploring stakeholder engagement in broad terms, and this has been substantially discussed in trans4num deliverable 1.2. Here, we outline conceptual frameworks, guiding principles and design actions that have been identified in relation to national-level or policy-level stakeholder engagement and/or processes aimed at facilitating transformation.

At a conceptual level Colloff et al (2017; 2021) explores case studies of Intentional Transformative Adaptation (ITA) in social-ecological systems, especially pertaining to climate change. Despite the name, in accordance with the trans4num approach Colloff et al. (2021) argue that to best engage actors ITA should combine a mix of incremental and transformative actions rather than approaches that are explicitly seeking radical change. Whilst goals need to be framed as transformative, participants also need to engage with incremental processes

(Termeer et al., 2017; Butler et al., 2016). Colloff et al.'s (2017; 2021) conceptual framework combines three elements (Figure 3):

i) ***Co-producing visions for the future –*** rather than forecasting the effects of drivers of change on ecosystems (as with scenarios) visions are normative expressions of the beliefs of participants, involving imaginative deliberation to reveal preferences and dispositions;

ii) ***Reframing the values, rules and knowledge (VRK) of the decision context -*** VRK constitutes the decision context, which define the choices and possibilities for change and set boundaries on how societies address complex problems;

iii) ***Theories of change and adaptation pathways –*** enablers of adaptation actions. Theories of change typically operate at the project scale, and adaptation pathways at the systems scale.

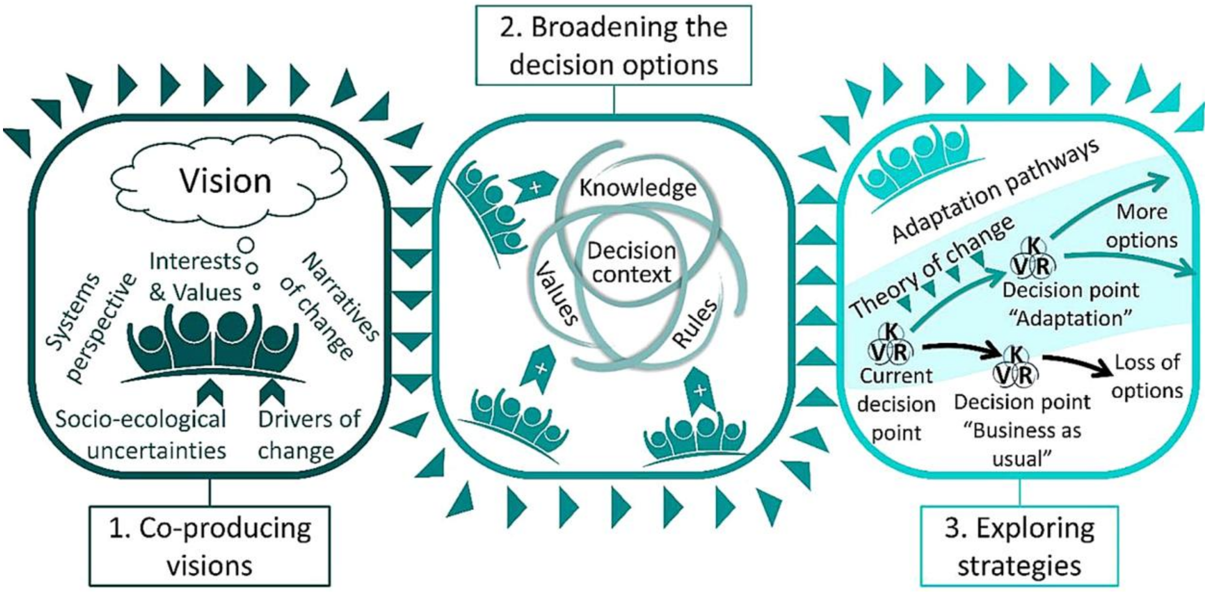

Figure 3 Processes for operationalising and implementing Intentional Transformative Adaptation (Colloff et al., 2021: 167).

The examples reviewed by Colloff et al (2021) demonstrated that combined processes could help participants in key challenge areas associated with socio-ecological transformation: namely reframing human-nature relationships, dealing with uncertainty, engendering empowerment and agency and addressing conflicting values and interests.

Kliskey et al.'s (2021) conceptual framework for stakeholder engagement does not relate specifically to national scale and policy-making contexts, but does apply specifically to Food, Energy and Water Systems. Their framework is presented as a conceptual scaffold for best practice in community and stakeholder engagement across food–energy–water systems comprising ten iterative components:

1. Situational awareness (being fully cognizant of the local context);
2. Culture for engagement (sharing values, respect and trust);

3. Early, iterative and lasting engagement;
4. Collaborative power-sharing (managing power dynamics);
5. Co-ownership of process (clear definition of roles and responsibilities);
6. Co-generation of knowledge and outcomes;
7. Regular and transparent communication;
8. Formative evaluation;
9. Reflective and reflexive experiences;
10. Explicit integration of engagement and evaluation into technical processes.

It is argued that together, these reinforce the process quality criteria of transparency, inclusion and responsiveness identified by Reed (2008).

Dinesh et al. (2018) analysed 34 case studies of science-policy engagement in the field of climate smart agriculture. They analysed the case studies against ten principles proposed by Vermeulen and Campbell (2015):

i) ***Navigate towards specific points of leverage –*** identify leverage points which are tangible and have the ability to drive change;

ii) ***Allocate resources in three thirds*** – Equal allocation of resources to research, engagement and improving the capacity of next users;

iii) ***Join in external processes –*** rather than creating new processes or events engage through existing processes of next users;

iv) ***Use research products to build scientific credibility –*** generate high impact scientific outputs to generate legitimacy, salience and credibility;

v) ***Sustain co-learning throughout policy engagement and implementation*** – allows tailoring of research products to next user needs;

vi) ***Tackle power and influence*** – Researchers should be mindful of gender and other power differentials;

vii) ***Invest in and monitor capacity enhancement*** – research efforts should focus on enhancing capacity of next users;

viii) ***Mainstream higher-level goals –*** align with higher level policy goals such as social inclusion and environmental sustainability;

ix) ***Create mechanisms for internal learning –*** include processes to review theory of change and realign strategy for impact;

x) ***Communicate strategically and actively*** – communication should facilitate knowledge brokering to link closely with impact pathways.

In their analysis Dinesh et al. identified considerable overlap between the ten principles and reformulated the principles according to the three thirds principle (distinguishing between i. engagement between partners and stakeholders, ii. Developing evidence, and iii. Outreach through communication and capacity building) and the key imperatives of credibility, salience and legitimacy (Figure 4):

Figure 4 Program theory for effective science-policy engagement (Dinesh et al. 2018: 15)

Across the principles and conceptual frameworks described in this Section it is possible to ascertain many recurrent themes that should be taken into account when designing stakeholder engagement at the National level. However, perhaps most striking of all, and exemplified by Dinesh et al.'s programme theory is the need for engagement mechanisms to create an adaptive engagement ecosystem capable of navigating the fluid realities of national policy environments. This incorporates being highly **attuned to local context** (Colloff et al., 2021); being **demand-led** (fitting to existing policy-questions and co-designing research questions) (Dinesh et al., 2018), **flexible** (capable of adjusting to political timings) (Cash et al., 2003), **opportunistic** (exploiting windows where evidence can enhance emergent policy priorities) (Pielke, 2007), and **embedded** (engage through existing fora and champions) (Robins et al., 2022).

This cautions against one-size-fits-all engagement processes and necessitates a pragmatic approach across the different trans4num contexts. Indeed, precisely because of the importance of contextual specificities and the particular vagaries of policy-making (such as temporal and epistemic mismatch and procedural opacity) it is essential that engagement activities are foregrounded by effective stakeholder analysis in combination with decision-context analysis.

3.4 Scenarios

Scenario planning and visioning exercises have become central to engaging policymakers in long-term sustainability transitions. These methods provide structured spaces for deliberation under uncertainty and help align diverse actors around shared futures. Kok et al. (2019), for instance, have shown that multi-scale European socioeconomic scenarios (EU-SSPs) have successfully guided national adaptation strategies by providing common reference frames while allowing contextual tailoring.

Good-practice reviews (Oteros-Rozas et al. 2015; Reed et al. 2013) converge on several methodological imperatives:

1. **Co-production** – scenarios must be built jointly with policymakers, scientists and stakeholders.
2. **Integration of quantitative and qualitative tools** – link narratives with models to maintain credibility.

3. **Policy linkage** – embed scenario outputs in decision processes (e.g. national strategies, foresight reviews).
4. **Iterative updating** – revisit scenarios periodically to account for new knowledge and shocks.

4. Trans4num Template for Engagement with National Stakeholders

The following sections translate the conceptual insights presented in the literature review into a practical engagement framework that can be implemented by trans4num country teams. The guidance provided here is intended to support the organisation of national-level stakeholder engagement activities linked to the project's modelling frameworks. While recognising that engagement formats must remain flexible and responsive to national contexts, the guidelines establish a common structure for engagement activities across countries. This includes specifying the objectives of engagement, the types of stakeholders to involve, the information that should be presented during workshops, and the mechanisms through which stakeholder feedback should be collected and reported. In this way, the framework ensures that engagement activities contribute both to model development and to the generation of comparable insights across the different trans4num case studies.

4.1 An Introduction to the National Stakeholder Engagement Template

The *trans4num* project aims to identify and support pathways toward circular nutrient management and socio-ecological transformation in agricultural systems by integrating nature-based solutions (NbS) with dynamic modelling and decision support across scales. Transforming nutrient systems requires navigating interactions among farming practices, food systems, trade, governance, market incentives, and environmental regulation. To support evidence-informed decision-making under these conditions, *trans4num* deploys three complementary modelling frameworks: the **Food System Model (FSM)**, the **Decision Support Tool (DST)**, and the **Agent-Based Model (ABM)**. Each is intended to inform different types of decisions and different governance levels; however, their utility depends on alignment with real decision contexts, including stakeholder objectives, policy instruments, and data realities.

For this reason, *trans4num* explicitly embeds the FSM, DST and ABM within a participatory transformation process. National- and supra-regional stakeholder engagement is required to: (i) ensure scenarios and assumptions are plausible within country-specific governance and market contexts; (ii) test whether outputs are understandable, credible, and decision-relevant; (iii) identify constraints (e.g., data limitations, institutional barriers, absence of regional planning tiers); and (iv) maximise uptake into policy and planning processes that can enable scaling of NbS beyond individual case-study sites.

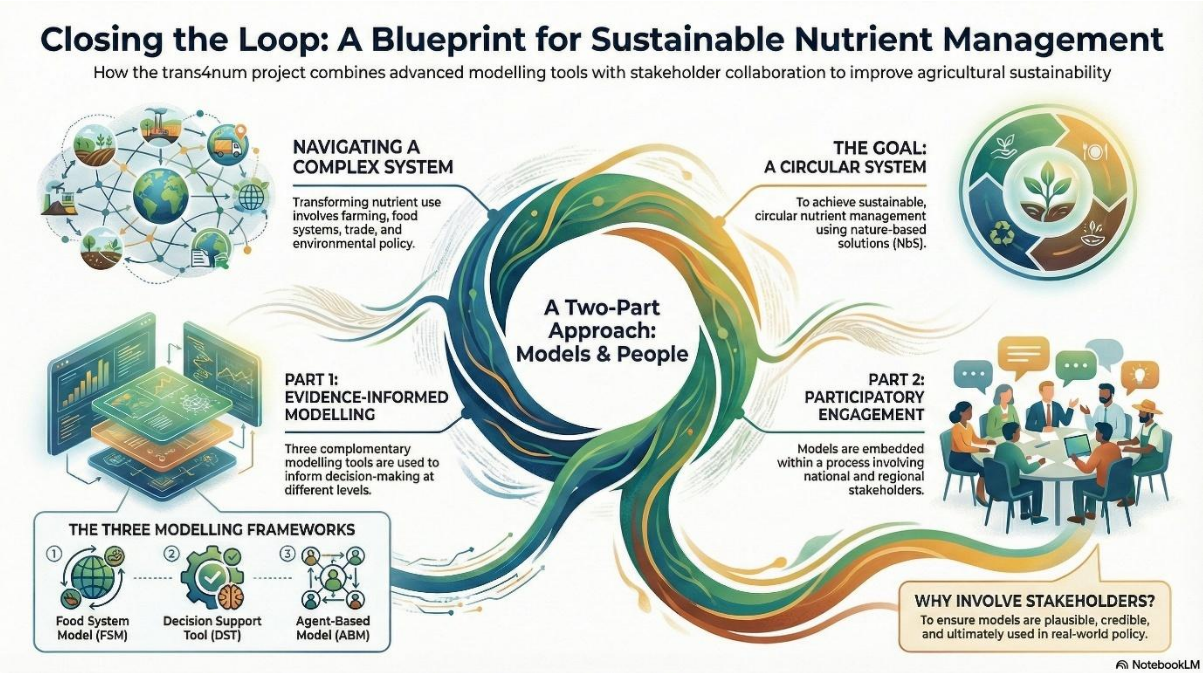

Figure 5 The trans4num blueprint for national-level stakeholder engagement.

While the integration of NbS with dynamic modelling (FSM, DST, ABM) is a core project pillar, the identification of transformation pathways requires more than model-informed dialogue. It demands a rigorous scrutiny of how dialogue develops through diverse interactions among stakeholders over time. The Danish case serves as a unique longitudinal study within Trans4num. Unlike cases where stakeholder contact is episodic, the Danish case utilizes an established, ongoing relationship with national stakeholders (the Regulatory Sandbox). In this context, the three models act as supporting tools to inform concrete policy decisions, but they are not the sole basis for dialogue. Thus, the Danish case will additionally document and describe the evolution of stakeholder contact and the mechanisms by which scientific knowledge becomes embedded in national decision-making. By expanding the project's goals in this manner, the Danish case contributes to consolidating the theory of Pathway Development. This allows for a comparative analysis with the other three NbS cases, contrasting the "established-contact" model of Denmark with the more "episodic-engagement" models elsewhere to understand how institutional trust affects pathway sustainability.

4.2 Co-design approach

Across all three modelling frameworks, and consistent with good practice described in Section 1, *trans4num* adopts a participatory co-development approach that integrates: system knowledge (how nutrient and food systems currently operate), targeted knowledge (visions and targets for sustainability), and transformational knowledge (pathways, barriers, and leverage points for change). This approach relies on inputs from diverse stakeholders - local farmers and practitioners, but also national-scale actors who shape regulatory environments, innovation support structures, and economic incentives. Co-design ensures that scenarios are anchored in lived experience with policy realities and that they describe plausible futures that resonate with decision-makers beyond case sites.

The participatory approach is implemented through multiple engagement layers.

First, scenario development has been undertaken with local actors. As set out in the local stakeholder engagement process described in Deliverable 1.4, farmers, advisors, local authorities and other relevant actors were consulted to identify key challenges, plausible futures, and locally meaningful pathways for nutrient management and NbS implementation. This ensures that scenario assumptions reflect real-world constraints and opportunities in each case-study region, rather than being imposed solely from model-driven or academic perspectives.

Second, modelling tools have been co-designed with local experts. For the Food System Modelling, for example, exchange between the modelling team and national project partners have been organised for each case study site. The focus was on providing a detailed basis for understanding, in terms of which types of scenarios the FSM can model; which potential results the FSM then may produce and which data would be required for this (e.g. detailed data on grassland yields from national databases to improve data from international databases such as FAOSTAT or EUROSTAT). Another focus was on organising the input from the case study sites, as the model can take up various aspects of interest for each case study site, in order to then best produce results of relevance for a range of stakeholders. Examples are concrete policy targets or prevalent debates in the agricultural sector or wider society, where modelling could provide some definite numbers as an objective input to the debate. In a next step, the FSM modelling team will compile a short abstract for each case study site, containing specific suggestions on what could be modelled with respect to upscaling NBS and which data would be required for that. With the case-study project teams, these suggestions would be consolidated and then first modelling runs would be implemented to provide a detailed basis for the stakeholder interactions (see Section 2.2.1 below).

Third, engagement at national and regional governance scales is required to ensure that model scenarios are relevant to national priorities (e.g., greenhouse gas targets, self-sufficiency debates, nitrate regulation), and that model outputs can be interpreted and trusted by decision-makers who are positioned to influence policy, incentives, advisory systems, and planning. National-scale engagement also provides structured feedback on usability and clarifies which institutional actors could realistically adopt and apply the modelling outputs. This supports legitimacy, transparency, and practical utility, which are all preconditions for uptake into policy debates and scaling of successful NbS.

Additionally to this, the Danish case will utilise an 'Expert-Led, Scenario-Based' approach. Aarhus University will perform the technical modeling, while stakeholders will be presented with high-level scenarios. This ensures that the co-design process focuses on 'Transformation Knowledge' (pathways) rather than 'Technical System Knowledge' (model operation).

4.3 Guidelines for Engagement with National Stakeholders

This section provides the *trans4num* guidelines for engagement with national stakeholders for each modelling framework (FSM, DST and ABM respectively). The intention is that country teams can implement engagement sessions directly from this document and generate comparable outputs across countries.

A common principle within these guidelines is that each country has flexibility in delivery format (i.e., bespoke to their governance structures, policy landscape and availability of stakeholders), provided that the required inputs, discussion topics, feedback mechanisms, and data collection are retained. For example, engagement may be delivered:

- as one combined event covering FSM, DST, and ABM; or
- as three separate events, potentially using different modes (e.g., one in-person session for DST and two online sessions for FSM and ABM); or
- through a mix of synchronous workshops and asynchronous engagement (e.g., recorded presentations plus structured written feedback), where feasible.

However, to ensure comparability across countries, teams should aim to keep consistent: (i) stakeholder types and numbers; (ii) workshop objectives; (iii) feedback instruments (especially post-event surveys); and (iv) data collection procedures (recordings, notes, qualitative reaction report).

4.3.1 Engaging National Stakeholders with the Food System Model (FSM)

The FSM is designed to explore how changes in production, consumption, trade, and input use - including the introduction of NbS at scale - affect nutrient flows and food-system outcomes at regional and national levels. Because the FSM operates at scales where policies, regulations, and market structures exert strong influence, it must incorporate system knowledge on governance frameworks, dietary trends, trade linkages, and national sustainability targets to simulate plausible alternative futures. Engagement with national stakeholders (e.g., ministries, industry bodies, policy advisors, planners) ensures that model assumptions, parameters and scenarios reflect strategic priorities and institutional constraints, supporting policy relevance rather than purely theoretical modelling.

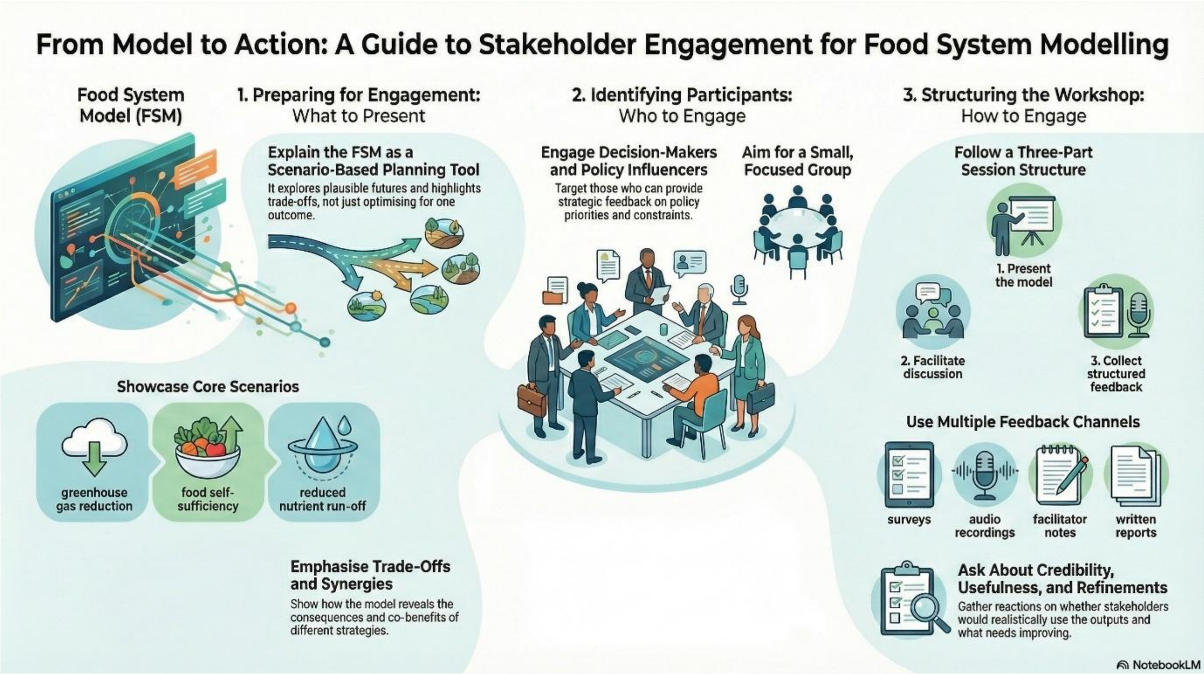

Figure 6 A summary of national-level stakeholder engagement for the Food System Model (FSM)

4.3.1.1 What needs to be presented to national stakeholders

The FSM engagement focuses on presenting model results relevant to regional/national strategies and eliciting stakeholder feedback on their plausibility and usefulness. The FSM is particularly interested in exploring what happens if strategies are rolled out across a region or country, including:

- Bottom-up strategies (e.g., scaling NbS implementation across landscapes); and/or
- Top-down strategies (e.g., meeting greenhouse gas emissions reduction targets, nutrient run-off reduction targets, or other national commitments).

Stakeholders should be shown how the FSM can highlight trade-offs and synergies among strategies.

Illustrative example (Switzerland): In Switzerland, current debates include national food self-sufficiency. The FSM can model reduced-meat diets and highlight the impacts of reduced livestock production and associated feed production. Scenarios can include reducing feed production for monogastric species while maintaining pasture-fed ruminants only, with implications for land use, self-sufficiency, emissions, and nutrient outcomes. The country-specific choice of scenarios should reflect the interests of the relevant case study sites and national policy context. For details, see the publication Muller et al. 2025: “Higher Swiss Self-Sufficiency with Lower Environmental Impact - Agrarforschung Schweiz”

The FSM should be described clearly as a social planner model (not an optimisation model) that runs scenario-based analyses and reports outcomes and trade-offs.

FSM scenarios to present (core set):

- Greenhouse gas emissions reduction
- Food production self-sufficiency
- Reduced nutrient run-off

Objectives of the FSM stakeholder testing workshop:

- Introduce the *trans4num* FSM and its functionality to national stakeholders.
- Gather feedback on FSM usability, clarity, and practical value/relevance from the stakeholders' perspective.
- Identify site-specific regional goals (where relevant) and key data requirements/constraints for the FSM application in the local context.
- Understand stakeholder needs and challenges in landscape-level decision making.
- Explore the role of NbS in local farming strategies.
- Identify barriers and motivations to adoption and trust-building strategies.

4.3.1.2 Which stakeholders to engage

FSM engagement is important with two types of stakeholders:

1. Stakeholders who provide input into scenarios (policy priorities, targets, constraints, plausible futures).
2. Stakeholders who can refine and adapt scenarios and interpret results for policy and planning relevance.

Stakeholders should be decision makers or policy influencers who can react to presented results and provide strategic feedback.

Recommended stakeholder types:

- National policy makers (e.g., agriculture, environment, climate)
- Policy influencers and advisors (government agencies, advisory bodies, industry organisations and farmer unions)
- Regional stakeholders and regional planners
- Representatives involved in nutrient regulation and environmental targets
- Researchers/practitioners with interest in digital tools and agricultural policy

Suggested participation profile:

- ~5–10 stakeholders
- 2–3 project facilitators/researchers (to present, facilitate discussion, navigate the FSM outputs, and collect feedback/data)

Participants should have a solid understanding of nutrient-related challenges and regional environmental or agricultural objectives.

4.3.1.3 The feedback needed (and how it should be collected)

The FSM team seeks feedback primarily from national decision makers on:

- Immediate reactions to presented outputs (credibility, clarity, perceived usefulness)
- Whether stakeholders would realistically use such outputs (and in what setting)
- Which elements should be refined (including missing outputs, unclear assumptions)

- Follow-up requests for additional scenarios, indicators, or country-specific adaptations

Preferred feedback format is a written qualitative reaction report following the workshop. In addition, all teams require a post-event survey, with collated results shared back to the modelling teams.

Data to collect during FSM workshops (standardised across sites):

- Participant numbers, demographics and roles (e.g., ministry representative, planner, advisor)
- Audio recording of workshop discussions (e.g., if required for transcription and analysis)
- Post-workshop survey responses (quantitative + qualitative)
- Facilitator observational notes (participant engagement, concerns, suggestions)

FSM post-workshop survey instrument (minimum required items):

- Before the workshop, how familiar were you with food systems models in agriculture? (5-point Likert: Not familiar at all → Very familiar)
- After the workshop, how well do you understand what the trans4num FSM can do? (5-point Likert: Not at all → Very well)
- How easy was it to understand the FSM logic (goals, constraints, maps)? (5-point Likert: Very difficult → Very easy)
- Which elements of the FSM were clearest? (select all that apply)
    - Overall concept of landscape-level optimisation
    - Setting goals and constraints
    - Understanding trade-offs (economy vs. N-load)
    - Maps and visual outputs
    - Data needs
    - None of these / Not sure
- Which elements need more explanation? (free text)
- How relevant do you find a landscape-level FSM for decision making in your country? (5-point Likert)
- Who would be the realistic primary users of such a tool in your country? (multi-choice)
    - Policy makers (national level)
    - Advisors/extension services
    - Chamber of Agriculture
    - Investors
    - Researchers
    - Farmer groups
    - Individual farmers
    - Other (free text)
- What potential use cases do you see for the FSM in your country? (multi-choice + other)

    - Policy scenario development
    - Testing nutrient regulations (e.g., nitrate limits)
    - Planning composting/organic matter strategies
    - Evaluating rotations under drought (e.g., maize → sorghum)
    - Soil carbon / soil health scenarios
    - Water protection
    - Economic and environmental trade-off analysis
    - Land-use change scenarios
    - Not sure
    - Other (free text)
- Which regional challenges could the FSM help explore? (free text)
- What are the main barriers to using a collaborative FSM in your country? (multi-choice + other)
    - No regional decision-making level
    - Farmers reluctant to collaborate
    - Lack of economic incentives
    - Data limitations
    - Limited digital tools
    - Regulatory barriers
    - Cultural barriers
    - Other (free text)
- What would help support adoption of such a tool? (free text)

A MS Forms template for this survey, which can be copied & translated can be found here: Food System Model (FSM) Post-event feedback survey – Copy form

4.3.1.4 Timeline for engagement

From early March 2026 onwards, countries are expected to have calibrated FSM configurations ready for demonstration. Remaining tasks include calibration for greenhouse gas inventories and FAO food balance sheets. Development of an R graphics library is being explored to support visual outputs, but this is not critical for the engagement events.

Where national policy processes have specific windows (e.g., pre-consultation periods, parliamentary debates, strategy reviews), countries are encouraged to align workshop timing with those decision points to maximise relevance and uptake.

4.3.1.5 Suggested format for engagement

In-person delivery is preferred, but remote or hybrid formats are acceptable and may be necessary. The FSM should be framed as a model that can appear as a "black-box" to non-specialists; therefore, clear walkthroughs of what inputs drive outputs and how scenarios are defined are essential.

Possible delivery options include:

- Live in-person presentation with facilitated discussion
- Hybrid meeting with a central FSM presenter and remote participants

- Recorded presentation shared in advance, followed by a structured live discussion session

Minimum structure for FSM engagement sessions:

1. Presentation of the FSM
    - Purpose, scope, and scenarios
    - Explanation of key outputs and how trade-offs/synergies are represented
    - Contextual introduction of local agronomic/ecological challenges and NbS trials (as appropriate to stakeholder background)
2. Facilitated discussion
    - Nutrient-management challenges and priorities
    - Interpretation of outputs and plausibility of scenarios
    - Policy relevance and realistic use cases
3. Feedback collection
    - Audio recording (if required)
    - Facilitator notes
    - Post-workshop survey
    - Written qualitative reaction report (requested from participants or generated by the facilitation team based on discussion + survey)

4.3.2 Engaging National Stakeholders with the Decision Support Tool (DST)

The DST operates between field and regional scales, helping stakeholders assess where NbS practices can be most effective in achieving environmental and nutrient-management targets. It includes an optimisation component that considers geographic aspects to strategically place NbS ,so that targets can be optimised at landscape scale. The DST is designed explicitly for collaborative workshop settings, where farmers, advisors, planners, and policy makers jointly define inputs and constraints. Outputs enable comparison between the status quo and one or more optimised solutions through maps, graphics, and numerical indicators (e.g., goal attainment, economic impacts, nutrient balance), providing a shared basis for discussion and reflection. Additionally, in Denmark, the DST will also be used as a visualization tool to present the outcomes of predefined scenarios. This serves to inform and underscore the socio-ecological effects of policies advocating for NbS, rather than requiring stakeholders to engage in the technical definition of inputs.

A prototype DST has been developed for the Danish NbS site, using local data. Because NbS ambitions and governance contexts differ across trans4num sites, the DST's functionality requires adaptation at each site through:

1. Defining site-specific optimisation goals collaboratively with local partners
2. Providing relevant data required for the tool backend

Figure 7 A summary of national-level stakeholder engagement for the Decision Support Tool (DST)

4.3.2.1 What needs to be presented to national stakeholders

The DST team will present the Danish prototype as an exemplar of tool functionality. This approach has already been used successfully (e.g., at a stakeholder event in Hungary) as a "blueprint exercise" and should be replicated in additional countries (including the UK and others). Stakeholders are asked to interrogate the Danish prototype and provide structured feedback on how the DST would need to be tailored for their country context, including data requirements, governance fit, and desirable outputs.

Objectives of the DST stakeholder testing workshop:

- Introduce the *trans4num* DST and its functionality to national stakeholders.
- Gather feedback on DST usability, clarity, and practical value/relevance from the stakeholders' perspective.
- Identify site-specific regional optimisation goals and key data requirements and constraints for DST application in the local context.
- Understand stakeholder needs and challenges in landscape-level decision making.
- Explore the role of NbS in local farming strategies.
- Identify barriers and motivations to adoption and trust-building strategies.

4.3.2.2 Which stakeholders to engage

Experience from the Hungary workshop indicates that a mixed stakeholder group strengthens discussion (e.g., statistical offices, ministries of agriculture, large-scale farms, precision farming companies). It also revealed that critical contextual constraints (e.g., absence of regional/local planning tiers) may not be known until engagement occurs - highlighting the importance of including stakeholders who can clarify governance structure and decision pathways.

Priority stakeholder types (DST):

- Nutrient management authorities and agencies
- Agricultural environmental management bodies
- Environmental protection organisations
- Water quality protection organisations
- Regional planning and land-use change agencies (where they exist)
- Large farm clusters / large landowners (e.g., National Trust-type actors where relevant)
- Ministry of Agriculture staff (e.g., Defra in the UK) involved in tools/models for decision making

Suggested participation profile:

- ~5–10 stakeholders
- 2–3 project facilitators/researchers

It is recommended that initial DST workshops focus on regional-level stakeholders. Participants should have a solid understanding of nutrient-related challenges and regional environmental or agricultural objectives.

4.3.2.3 The feedback needed (and how it should be collected)

DST feedback is required at two levels:

1. Feedback on general tool functionality (clarity, usability, interpretability of outputs)
2. Feedback on country-specific adaptation (what a bespoke DST should include, and how it fits governance/data conditions)

To support comparability across sites, sessions should be recorded and transcribed, and the recording protocol standardised. A post-workshop survey is required (building on instruments already used in Denmark and Hungary). Collated results should be returned to the DST team and, where relevant, shared with FSM/ABM teams for harmonisation.

Standard data collection (DST workshops):

- Participant numbers, demographics and roles (e.g., ministry representative, Nutrient management authorities, farm cluster)
- Audio recording of workshop discussions (e.g., if required for transcription and analysis)
- Post-workshop survey responses (quantitative + qualitative)
- Facilitator observational notes (participant engagement, concerns, suggestions)

DST post-workshop survey instrument (minimum required items):

- Before the workshop, how familiar were you with decision support tools in agriculture? (5-point Likert: Not familiar at all → Very familiar)
- After the workshop, how well do you understand what the trans4num DST can do? (5-point Likert: Not at all → Very well)
- How easy was it to understand the DST logic (goals, constraints, maps)? (5-point Likert: Very difficult → Very easy)

- Which elements of the DST were clearest? (select all that apply)
    - Overall concept of landscape-level optimisation
    - Setting goals and constraints
    - Understanding trade-offs (economy vs. N-load)
    - Maps and visual outputs
    - Data needs
    - None of these / Not sure
- Which elements need more explanation? (free text)
- How relevant do you find a landscape-level DST for decision making in your country? (5-point Likert)
- Who would be the realistic primary users of such a tool in your country? (multi-choice)
    - Policy makers (national level)
    - Advisors/extension services
    - Chamber of Agriculture
    - Investors
    - Researchers
    - Farmer groups
    - Individual farmers
    - Other (free text)
- What potential use cases do you see for the DST in your country? (multi-choice + other)
    - Policy scenario development
    - Testing nutrient regulations (e.g., nitrate limits)
    - Planning composting/organic matter strategies
    - Evaluating rotations under drought (e.g., maize → sorghum)
    - Soil carbon / soil health scenarios
    - Water protection
    - Economic and environmental trade-off analysis
    - Land-use change scenarios
    - Not sure
    - Other (free text)
- Which regional challenges could the DST help explore? (free text)
- What are the main barriers to using a collaborative DST in your country? (multi-choice + other)
    - No regional decision-making level
    - Farmers reluctant to collaborate
    - Lack of economic incentives
    - Data limitations
    - Limited digital tools
    - Regulatory barriers
    - Cultural barriers
    - Other (free text)

- What would help support adoption of such a tool? (free text)

A MS Forms template for this survey, which can be copied & translated can be found here: [Decision Support Tool (DST) Post-event feedback survey – Copy form]

4.3.2.4 Timeline for engagement

The Danish DST is ready to demonstrate, running on local data from the Danish Limfjord region. For other sites, basic visualisation with dummy data from a field level can be introduced quickly. This is expected to be useful for stakeholder discussions about what data are needed to operationalise the DST in each country.

By early March 2026, the DST is expected to have demonstrable material suitable for national/regional stakeholder engagement.

4.3.2.5 Suggested format for engagement

Experience indicates the DST is complex and not fully self-explanatory; therefore, a DST team member should ideally present and walk stakeholders through the tool. Where travel, staffing, or budget constraints limit in-person participation, remote technical support is acceptable and may be complemented by a recorded walkthrough presentation.

Preferred setup:

- In-person workshop facilitated locally
- DST team provides either in-person lead or remote lead + technical support
- Recording of the DST presentation is encouraged as a reusable resource across countries

Minimum structure for DST engagement sessions:

1. Presentation of the DST
    - Purpose, optimisation logic, outputs
    - Demonstration using Danish prototype
    - Local context introduction (nutrient challenges, NbS trials) as needed
2. Facilitated discussion and hands-on interrogation
    - Translate Danish prototype into national context: “How would this work here?”
    - Identify governance fit (who would own/use it?)
    - Identify key constraints and data needs
3. Feedback collection
    - Audio recording (if required)
    - Facilitator notes
    - Post-workshop survey
    - Written qualitative reaction report (requested from participants or generated by the facilitation team based on discussion + survey)

Previous workshops in Denmark lasted approximately three hours, including informal networking and refreshments.

4.3.3 Engaging National Stakeholders with the Agent Based Model (ABM)

The ABM simulates farm-level decision-making dynamics relevant to NbS uptake, focusing on how profitability, social influence, and interventions shape adoption trajectories. While the ABM represents local behavioural dynamics, it is strongly influenced by policy levers and economic incentives originating at higher governance levels. Engagement with national stakeholders - including policy designers, advisory organisations, and agricultural agencies - is essential to define realistic interventions, identify structural barriers, and ensure assumptions about incentives and constraints are credible. The ABM supports ex-ante exploration of "what if" policy questions by comparing intervention scenarios to baseline trajectories.

Figure 8 A summary of national-level stakeholder engagement for the Agent-based Model (ABM)

4.3.3.1 What needs to be presented to national stakeholders

ABM engagement is intended to use model results as a basis for structured stakeholder feedback, improving both model assumptions and the usefulness of outputs for policy dialogue. While early engagement to map stakeholder relationships and concerns was originally envisaged, initial emphasis has been placed on developing ABM results (currently focused on Denmark). As a result, the immediate engagement format will mirror the DST approach: i.e., use the Danish ABM prototype as a demonstration case study for other countries, rather than developing a country-specific ABM for each site within the current timeframe.

The Danish ABM includes (at minimum) two policy options:

1. Nitrogen reduction quota linked to a Danish policy proposal
2. Local feed production via rotations and biorefinery systems

Objectives of the ABM stakeholder testing workshop:

- Introduce the *trans4num* ABM and its functionality to stakeholders.
- Gather feedback on ABM usability, clarity, and practical value/relevance from the stakeholders' perspective.
- Identify key data requirements and constraints that would shape ABM applicability in other contexts.
- Understand stakeholder needs and challenges in landscape-level decision making and policy design.
- Explore the role of NbS in local farming strategies and adoption dynamics.
- Identify barriers and motivations to adoption and trust-building strategies.

4.3.3.2 Which stakeholders to engage

ABM stakeholders are complementary to the DST and FSM and largely overlap with FSM audiences.

Priority stakeholder types (ABM):

- Policy makers and policy designers (agriculture, environment, water, climate)
- Policy influencers and advisory organisations
- Regional planners and relevant administrative bodies
- Stakeholders familiar with incentive structures and adoption constraints
- Representatives of processing stakeholders in the NBS-related value chain (e.g. composters, biorefineries, biogas plants, etc.).

Suggested participation profile:

- ~5–10 stakeholders
- 2–3 facilitators/researchers

Participants should have a solid understanding of nutrient-related challenges and regional environmental/agricultural objectives.

4.3.3.3 The feedback needed (and how it should be collected)

The ABM requires the same type of feedback and format as FSM and DST:

- Feedback on general functionality (clarity, credibility, interpretability)
- Stakeholder views on what such a model should include for country-specific contexts
- Practical views on policy relevance and realistic use cases

Standard data collection (ABM workshops):

- Participant numbers, demographics and roles (e.g., ministry representative, planner, advisor)
- Audio recording of workshop discussions (e.g., if required for transcription and analysis)
- Post-workshop survey responses (quantitative + qualitative)
- Facilitator observational notes (participant engagement, concerns, suggestions)

ABM post-workshop survey instrument (minimum required items):

- Before the workshop, how familiar were you with agent based models in agriculture? (5-point Likert: Not familiar at all → Very familiar)
- After the workshop, how well do you understand what the trans4num ABM can do? (5-point Likert: Not at all → Very well)
- How easy was it to understand the ABM logic (goals, constraints, maps)? (5-point Likert: Very difficult → Very easy)
- Which elements of the ABM were clearest? (select all that apply)
    - Overall concept of landscape-level optimisation
    - Setting goals and constraints
    - Understanding trade-offs (economy vs. N-load)
    - Maps and visual outputs
    - Data needs
    - None of these / Not sure
- Which elements need more explanation? (free text)
- How relevant do you find a landscape-level ABM for decision making in your country? (5-point Likert)
- Who would be the realistic primary users of such a tool in your country? (multi-choice)
    - Policy makers (national level)
    - Advisors/extension services
    - Chamber of Agriculture
    - Investors
    - Researchers
    - Farmer groups
    - Individual farmers
    - Other (free text)
- What potential use cases do you see for the ABM in your country? (multi-choice + other)
    - Policy scenario development
    - Testing nutrient regulations (e.g., nitrate limits)
    - Planning composting/organic matter strategies
    - Evaluating rotations under drought (e.g., maize → sorghum)
    - Soil carbon / soil health scenarios
    - Water protection
    - Economic and environmental trade-off analysis
    - Land-use change scenarios
    - Not sure
    - Other (free text)
- Which regional challenges could the ABM help explore? (free text)
- What are the main barriers to using a collaborative ABM in your country? (multi-choice + other)

  - No regional decision-making level
  - Farmers reluctant to collaborate
  - Lack of economic incentives
  - Data limitations
  - Limited digital tools
  - Regulatory barriers
  - Cultural barriers
  - Other (free text)
- What would help support adoption of such a tool? (free text)

A MS Forms template for this survey, which can be copied & translated can be found here: Agent Based Model (ABM) Post-event feedback survey – Copy form

4.3.3.4 Timeline for engagement

At present, ABM development is progressing primarily for Denmark and China, and there is no requirement for ABM implementation across all NbS countries within current deliverables. However, for national engagement events and cross-country consistency, the Danish ABM demonstrator is considered suitable for use as the common example to meet timelines. This demonstrator is available now.

By early March 2026, all tools and models are expected to have demonstrable material suitable for national/regional stakeholder engagement.

4.3.3.5 Suggested format for engagement

Because of time and budget constraints, ABM engagement is expected to be delivered **online or in hybrid form**, supported by recorded presentations where helpful. ABM sessions may be run:

- as a standalone online workshop, or
- as part of a combined hybrid event together with FSM and/or DST.

Minimum structure for ABM engagement sessions:

1. Presentation of the ABM
    - Purpose and scope (adoption dynamics; policy intervention testing)
    - Demonstration using Danish model scenarios
    - Explanation of baseline vs intervention scenario comparison
2. Facilitated discussion
    - Plausibility of assumptions and interventions
    - Relevance to national context and policy levers
    - Data needs and feasibility for country adaptation
3. Feedback collection
    - Recording + facilitator notes
    - Post-workshop survey

4.3.4 Cross-cutting standardisation

To maximise comparability across countries and modelling frameworks, all national stakeholder engagement sessions for FSM, DST and ABM should, as a minimum:

- involve ~5–10 stakeholders and 2–3 facilitators,
- record audio for transcription (if required and where consent is provided),
- collect participant roles/demographics,
- administer a post-workshop survey using the standard instrument above (model-specific familiarity question),
- produce a short written qualitative reaction report summarising key messages and recommended refinements.

5. Conclusion

This deliverable provides a structured, theory-informed and operational framework for engaging national-level stakeholders in the trans4num project, recognising that the effectiveness of modelling tools depends not only on technical robustness but on their alignment with real decision contexts, institutional arrangements, and policy priorities. By integrating insights from science–policy interface literature with practical guidance for co-design and engagement around the FSM, DST and ABM, the document establishes a common yet flexible approach that can be implemented across diverse national settings while maintaining comparability and coherence at project level. The emphasis on stakeholder analysis, decision-context mapping, iterative co-learning and standardised feedback mechanisms ensures that engagement activities contribute simultaneously to model refinement, policy relevance and transformative learning. Taken together, the guidelines set out here are intended to support country teams in delivering engagement processes that are credible, salient and legitimate, while enabling trans4num to generate transferable insights into how nature-based solutions for nutrient management can be scaled through informed, context-sensitive governance pathways.

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