Table of History of Changes	
Version (date)	**Changes**
Version 2 (Jan 4th 2023) based on the original proposal submitted.	**1. Addressing Shortcomings.**
	a. More detail on NBRT and resilience types. We have now expanded on aspects of the theory, as requested, in Sections 1.1 and 1.2.1 (O1.1).
	b. Biodiversity Assessments. The relevant beneficiary (AZTI) has provided additional text which has been added to Section O2.2, WP5.
	c. Role of WP3 (Case Studies). Clarification of WP3's role is provided in T3.4 (Part A) to clarify the key analytical and statistical support offered by WP3 across the Case Studies and consortium.
	2. Deliverables and milestones.
	a. ***DEC Reports***. This has now been updated to Mths 6, 36, and 48 as requested.
	b. ***DMP Reports***. This has also been updated to Mths 6, 36, and 48 as requested, and changed to deliverable type DMP.
	c. ***Add website deliverable***. The original submission already contained a website deliverable (D9.1). We have brought this forward one month to Mth5.
	d. ***Deliverables and milestones to inform reporting periods***. As requested we have significantly increased the number of Milestones (from 25 to 44 – including regular reporting targets under a specific milestone) and have added clearer Milestones for each Work Package for each review period, with a particular focus on Mth18 which previously had few Milestones or Deliverables. A key aim is to provide documentation that reviewers could use to judge the successful progress of the project at each reporting period. This will be done by providing annexes to the associated periodic technical report. We have added the following text "*a detailed description of this process will be provided as an annex to the first periodic technical report*", to the means of verification for the following Milestones: M2 (WP2), M7 (WP3), M11 (WP4), M16 (WP5), M19 (WP6), M24 & M25 (WP7) and M28 (WP8). Since these Milestones all relate to data plans, and data collection will be ongoing for all WPs we believed it was more appropriate for the associated Deliverables to come after data collection and analysis was completed. Although M2 and M15 (literature reviews) appear to be discrete pieces of work that might be considered as Deliverables, M2 is only an interim review that will be discussed in the Grand Rounds and finalised as D7, and similarly M15 will serve as a discussion piece with relevant stakeholders before being finalised as part of D11. We keep them as confidential as they are working documents that will only be finalised as part of the later Deliverables. This has had very little impact on the planned work programme but rather reflects clearer documentation and recording of the targets that would have needed to have been reached for the successful completion of Tasks anyway. Tables 3.1 b/c/d (now online in Part A) and Figure 5 (Gantt chart) have all been updated to include these changes.
	e. ***Gantt Chart***: The Gannt chart has now been presented in landscape format which enabled the inclusion of Milestone and Deliverable Numbers.
	3. Check partner details.
	a. Inconsistencies between partner names in part A and B have been corrected (see participant Table in Part B).
	4. Sub-contracting.
	a. Greater details are now provided directly after original Table 3.1g now Table 3.1a.
	5. Ethics.
	a. The Ethics Self-Assessment has now been added to the end of Part B.
Version 3 (Feb 19th 2023)	**1. Clearer justification for visits to IEAB members by EU beneficiaries** In the original submission, the budget for learning visits to IEAB members from EU partners was

based on the original proposal submitted.	held by UNIVIE for allocation to partners based on an application process. Having learnt that this would not be eligible due to the movement of funds between beneficiaries we have now distributed these funds equally between the four WP partners that we envisage will benefit most from these IEAB visit opportunities (UNIVIE, ISGLOBAL, EHNet, ETIFOR). If the funds are not used by the currently allocated partner we will transfer them to another partner for this purpose in discussion with the Project Manager. Added clarification text included below: See Section O2.1: Taking a global perspective "*The global nature of this work will be supported by lab visits by key beneficiaries to our four IEAB partners in the USA (Cornell Univ. and Univ. California San Francisco), Canada (Univ. British Columbia) and Australia (Univ. of Woolongong). These exchanges will enable researchers at EU-beneficiaries to spend up to four weeks with international partners in order to: a) learn more about the different activities and programmes in those regions in order to enrich the Systematic Map (T2.2); and b) conduct locality specific Grand Round events to enhance truly global perspectives (T2.4).*" See Section 2.1: Economic Impact "*The communication, dissemination, and exploitation strategy is expanded in Section 2.2, but here we note that the mapping tool will be promoted via the five face-to-face and ten online Grand Rounds (T2.4), including ones supported by our IEAB in Canada, East and West Coast USA, and Australia, which between them are estimated to reach n~3,000 researchers, practitioners, and stakeholders*."
	2. Clearer justification for visits between researchers at different WP beneficiaries In the original submission, the budget for learning exchanges between EU partners was held by AZTI for allocation to partners based on an application process. Having learnt that this would not be eligible due to the movement of funds between beneficiaries we have now distributed these funds equally between the five WP partners that we envisage will benefit most from these cross-partner visit opportunities (UNIVIE, AZTI, UNIPD, NBSI, UNEXE). If the funds are not used by the currently allocated partner they will transferred to another partner for this purpose in discussion with the Project Manager. Added clarification text included below: See Section: O2.2 A sharper view of cross-sectoral linkages. "*In order to facilitate cross-sectoral integration we will support lab-exchanges between researchers in different WPs with different expertise. These exchanges will allow, for instance, a researcher from EHNet (WP4 leads with expertise in Health Equity) to spend several days with the AZTI team (WP6 leads with expertise in ecosystem assessment), in order to better understand the inter-linking relationships between health equity and the environment, with the aim of optimising the evaluation package developed for each of the Case Studies*." See Section: 2.1 Societal/environmental Impact. *"Some of the societal and environmental impacts will be achieved through the pathways discussed above i.e. the Toolbox incl. the Systematic Map and Guides and the cross-sectoral silo-busting lab exchanges between partners*." Purchase cost table 3.1b The original entry for AZTI "Holding budget for intra-consortium ECR exchange (€40k)" has now been removed. Instead these resources are now recorded as "1-week knowledge exchange partner lab visits €2,000 x 4 = €8,000" for AZTI, UNIVIE, UNIPD, NBSI and UNEXE). Part A. The precise wording of tasks T1.6, T1.7, T3.2, T4.2, T5.2, T6.2 and T8.6 have all been adjusted slightly in Part A to stress the knowledge exchange (as opposed to capacity building) nature of the activities.
	3. Ethics

	<u>See Section 2: Ethics, data management, and open science.</u> Clarification that an independent expert ethics advisor will be recruited by Mth 1 has now been added to Section 2. <u>Part A Changes</u> In order to avoid having two Ethics Work Packages (WP10, as included in the original submission) and WP11 (added automatically by the commission) we have moved the Tasks and Deliverables related to Data Management (e.g. 3 x Data Management Plans; now D1.2, D1.3 and D1.4 in Part A) and Open Science to WP1 (Management). The three-remaining ethics-related deliverables in the original proposal, i.e. those required for Clinical Studies, have been added to the new Ethics Work Package as *D28: Study Initiation Package; D29: Midterm recruitment report; and D30: Report on the status of posting results.* Of note, the effort associated with these deliverables, in terms of 20 Person Months (PMs), has moved to WP1, as suggested by the Project Officer.
	4. Cross-consortium collaboration In the original submission we did not know who the other consortia would be. Now that we know we have managed to have a meeting and several e-mail exchanges to discuss coordination efforts (aided by the fact the team for GreenME are colleagues at ISGlobal). The core change in the text associated with these discussions is below. <u>See section 2: O3.2: Events and cross-project collaboration.</u> *Following discussions with the two other projects funded under the 'Horizon-CL6-2022-COMMUNITIES-02-02: Developing nature-based therapy for health and well-being' call, i.e. NATURELAB and GreenME, we can confirm at the Description of Action (DoA) stage that we will align our efforts in this regard. This will be facilitated by having no duplication of research site locations. Together we agreed to include the following text in each of our DoAs*: *The coordinators of the three projects agree to coordinate their Communication and Dissemination strategies and stakeholder engagement plans to promote synergies and reduce potential conflicts (e.g. in terms of demands on specific stakeholder groups). To this end the coordinators will meet (in-person or virtually) after the projects have started and at least once annual for the duration of the projects, to update each other on activities and plans. Respective consortium team members with associated responsibilities will be in regular contact with those charged with similar tasks in the other two consortia. Project coordinators are welcome, but not required, to attend the yearly consortium meetings of the other projects, and will receive a timely invitation and respect all confidentiality issues associated with the meeting. Regardless of their presence at these meetings, each project coordinator agrees to provide a summary (video and/or PPT) of the project outcomes (or project outline, at the start) that will be shared at the consortium meetings, ensuring that all the three consortia are well informed and can better foresee and pursue joint initiatives. All events and other joint initiatives will be described in the periodic reports*. *We have set aside €6k to support these activities and will explore ways in which we, as a group, can fund support structures for NbT researchers and practitioners after the end of this cluster of projects. A report summarising all DEC activities will be submitted at the end of the project in Mth 45 (D9.5).*
	5. Changes in Person Months a. After making partners aware of these rules, Partner 13 (NVM) has realised that the submission inadvertently attributed 6 Person Months for WP3 to NVM, which in fact would be delivered, and was already accounted for, by Partner 14 (UNTWE). Accordingly, there has been a reduction of 6 PMs for both this partner and WP3 (original Tables 3.1a and 3.1f – now in Part A). b. Following attendance at the Horizons Europe Co-ordinators day (2nd Feb) it became apparent that the project would benefit from a full-time (100%) Project Manager. Accordingly, this was increased from the 80% post in the original submission in the UNIVIE Budget. These costs have been met by reducing those associated with visits to Europe by the IEAB, which will now be met through the

	UNIVIE overheads. This increase in Project Management activities of the co-ordinator (UNIVIE) is equivalent to 19.5 PMs, taking the total UNIVIE PMs to 86.5 PMs. c. IEAB member Poole was incorrectly allocated support via "Other goods and services" at UNTWE previously. This has been rectified as she is a full-time member of staff. This has not changed the budget but increased PMs by 2.5, taking the total UNTWE PMs to 8.5 PMs. These 2.5 PMs have been added to WP1 as they are concerned with the IEAB and Ethics. d. As a consequence, the total consortium PMs has increased to 703.5.
	6. Equipment costs a. UNIPD Freezer – the costs for a new freezer for storing Saliva Samples for CS4 was lower than originally estimated (due to storage requirements being only -20ºC). The reduction of these costs was countered though by increases in estimated costs for Other Goods and Services (esp. online survey coding and software licences) so no overall change in total purchase costs. b) Computers - Several beneficiaries originally reported computer and software costs in the Equipment category, however since none of these will be more than €1,500 (and potentially supplied through indirect costs where appropriate) they were removed from the Equipment listings and added to the Other Goods and Services, or in the case of NVM to the Travel budget as it was realised that travel to and from the Care Farms had not originally been included. c) UCPH – Following internal review the UCPH team believe the EEG, HRV, and Eye-tracking kit originally stated under Equipment should now come under Other Goods and Services, and the costs for these have also been adjusted based on a more up-to-date purchasing assessment.
	7. Associated Partner The UK partner UNEXE has now been reclassified from Beneficiary to Associated Partner. The Work Plan, Deliverables, Milestones, and Person Months have not changed but the costs associated with UNEXE will be financed by UKRI. The Critical Risks statement relating to UK participation has been updated in part A – recognising that several of the tasks could at least in part be conducted by Beneficiaries should there be an issue with UKRI, but this risk is identified as low in likelihood.

Participant No.	Participant organisation name	Country
1.	Universität Wien (UNIVIE)	Austria
2.	Fundación Privada Instituto de Salud Global Barcelona (ISGLOBAL)	Spain
3.	Fundacion Azti - Azti Fundazioa (AZTI)	Spain
4.	Etifor SRL (ETIFOR)	Italy
5.	EuroHealthNet ASBL (EHNet)	Belgium
6.	Universita degli Studi di Padova (UNIPD)	Italy
7.	NBS Institute AB (SVB) (NBSI)	Sweden
8.	Meditcinsky Universitet-Plovdiv (MUP)	Bulgaria
9.	Paracelsus Medizinische Privatuniversität Salzburg Privatstiftung (PMU)	Austria
10.	Uppsala Universitet (UU)	Sweden
11.	Københavns Universitet (UCPH)	Denmark
12.	Natuurvoormensen Omgevingspsychologisch Onderzoek (NVM)	Netherlands
13.	Universiteit Twente (UNTWE)	Netherlands
14.	University of Exeter (UNEXE) (Associated Partner)	UK

1. Excellence

Aim ***RESONATE*** *will bring together a* ***consortium of world leaders*** *in nature-based therapy (NbT) research, practice, policy, and innovation with stakeholders in the* ***health, environmental, economic, and societal sectors*** *to: a) build a* ***stronger causal evidence base*** *of the links between nature, health, and well-being by demonstrating nature's* ***biopsychosocial resilience*** *building capacities; b) demonstrate how multi-sectoral stakeholders can* ***collaborate to implement locally acceptable and inclusive NbTs****; c) increase* ***awareness and acceptance*** *of these benefits among the public, multi-sectoral stakeholders, and policy makers; and d) ensure* ***wider utilisation of cost-effective NbTs****, to help build more* ***resilient individuals and communities*** in urban, rural, and coastal settings.

1.1. Objectives & ambition

Despite significant improvements in many areas of public health across Europe in recent decades important challenges remain[1]. The prevalence of non-communicable diseases (NCDs) such as ischaemic heart disease, diabetes, and depression, for instance, is rising[2]. The costs of mental ill-health alone are estimated at €600bn annually across 28 EU countries (4% of GDP)[1]. Although urban[3], rural[4], and coastal[5] communities face their own specific health challenges, many of the most common NCDs in all localities are linked to ***stress***[6]. Stress occurs when situational demands exceed a person's coping resources[7]. Chronic stress is damaging to biological, psychological, and social processes, with the cumulative burden referred to as allostatic load[7]. Stress can be exacerbated through environmental factors such as air pollution and excess heat[6], economic factors, such as regional inequalities in income evident for many rural/coastal communities[4,5], and social factors such as crowding and noise in urban communities[8]. Regardless of locality, evidence is also emerging that individuals and populations are losing touch with nature, spending less recreational time in parks and woodlands and on beaches than previous generations[9]. Changing societal habits, including the growing use of technology, are also associated with a reduction in psychological connectedness to the natural world[10]. This is important, because spending time in and around nature can reduce stress. Natural settings are associated with less air pollution, lower ambient temperatures, and less crowding and noise[11], and may help reduce income-related inequalities in health and well-being[12]. Reconnecting urban, rural, and coastal individuals and communities physically and psychologically to the natural world thus holds considerable potential to improve health and well-being, and thereby address many of the leading causes of disability and death in Europe.

Accordingly, health promotion and disease prevention through nature contact is a cross-cutting theme in several **EU *Green Deal Actions***[13] and in specific initiatives such as the ***Forest Strategy***[14] and the ocean-related ***Sustainable Blue Economy***[15]. The ***Green City Accord*** aims to support cities to become "*greener, cleaner and healthier*"[16] and the ***Biodiversity Strategy for 2030*** has the goal of "*bringing nature back into our lives*"[13]. Although an appealing call to arms, the goal raises a number of issues that need to be addressed: a) what precisely does it mean to bring nature back into our lives; b) why does contact with the natural world help reduce stress and the risk of chronic disease, i.e. what are the causal mechanisms; c) what can we learn from good practice innovations globally that could be adapted for the European context; d) which sectors and stakeholders need to be involved to ensure that nature-based interventions are not just effective but also equitable, environmentally sustainable, value for money, and socially acceptable and inclusive; e) how can such actors be brought together to achieve these goals; and f) how can research

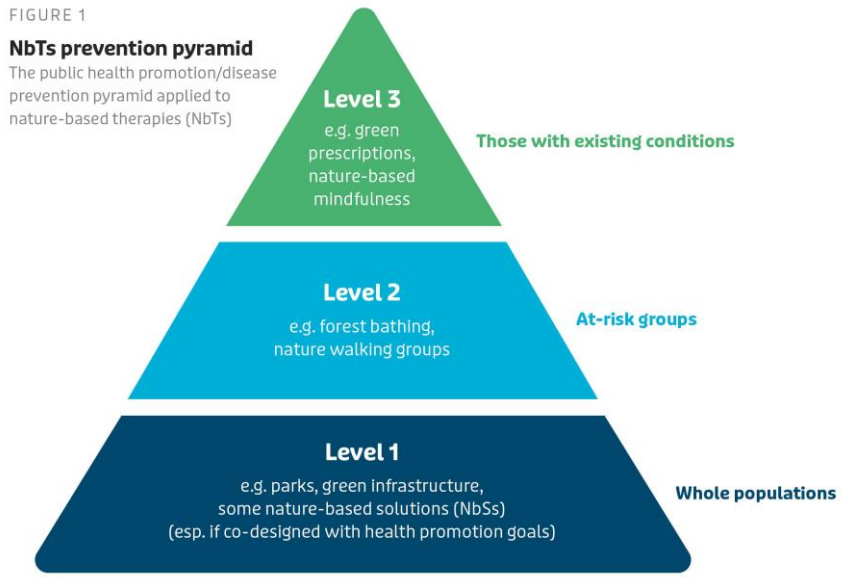
findings be exploited for long-lasting impact? The scientific literature has recently seen exponential growth in work on nature contact and health[17], including 'nature-based social prescribing', 'green prescriptions', and 'green care' (in sum ***Nature-based Therapies – NbTs***), but has concluded that substantial knowledge gaps remain for all these questions[18]. It is important to fill these evidence gaps, because they are hindering the widespread adoption of efforts to connect individuals and communities to the natural world, especially those at risk-of or experiencing chronic disease. Cross-sectoral actors, including health professionals, land-owners/managers, environmental protection organisations, policy/decision makers, civil society bodies, investors, the general population, and potential service users themselves, urgently need firm evidence of the benefits, as well as collaboration models to capture the benefits and develop tools that allow them to manage any potential risks. Only then will the wider utilisation of nature for disease prevention and health promotion achieve its full potential.

RESONATE (RESilience thrOugh NATurE-based therapies) brings together an interdisciplinary, cross-sectoral consortium of world leaders in nature-health research, practice, policy, and innovation, in order to: a) clarify what "bringing nature back into our lives" means in practice; b) apply a novel conceptual framework to explain and test the causal mechanisms by which nature contact reduces stress, promotes health, and reduces disease; c) capture global advances in NbT innovation and practice; d) identify the key actors that need to be involved in NbT programme development and maintenance; e) demonstrate how effective cross-sectoral collaboration can be achieved through a Social Innovation Action (SIA) approach; and f) provide, coordinate, and deploy a set of resources, methods, and tools, to ensure lasting impact at the EU and global level. Our evidence base, practical tools, and guides will raise awareness of the benefits, offer clear guidance on establishing, evaluating, and funding nature-health initiatives, with the ultimate ambition of NbT programmes, and related policies, becoming mainstream across Europe.

Our proposal is built on a conceptual framework that consortium members developed specifically for this proposal: ***Nature-based Biopsychosocial Resilience Theory (NBRT)***[19]. This framework places the concept of ***resilience*** at the heart of why nature helps reduce stress, promote health and prevent disease, and distinguishes between two related but distinct mechanisms for "bringing nature back into our lives"[13]: **Nature-based Solutions (NbSs)** and **Nature-based Therapies** (**NbTs**). NbSs integrate elements of the natural world into urban infrastructures, e.g. through tree planting or urban wetland restoration[20]. Broadly speaking, ***NbSs bring nature closer to people***. In synergy, NbTs support people to connect with natural elements available in their surroundings, including those associated with NbSs. ***NbTs bring people closer to nature***. In line with the call, RESONATE is primarily concerned with NbTs, but our aim is to take a broad and inclusive approach that recognises multiple ways of connecting individuals and communities to nature by building resilience. By bringing nature closer to people, NbSs play a role in building and maintaining community level or ***social-ecological resilience*** to environmental stressors such as air pollution, excess heat, and noise[11]. NbSs promote health and reduce disease by reducing the number and severity of environmental stressors communities encounter.

In contrast, by bringing people closer to nature, NbTs build and maintain 'stocks' of intra- and inter- individual level resilience[21] that can be used to help people better respond to and recover from a range of stressful situations and circumstances (e.g. bereavement, economic hardship, mental ill-health). Resilience at this level is generally considered in terms of biological processes (e.g., immune functioning), psychological processes (e.g., threat appraisals), and social processes (e.g., social networks) which interact to provide a person's set of *biopsychosocial resilience* resources[22]. Based on an extensive literature review, NBRT[19] argues that contact with nature can contribute significantly to all of three types, i.e. biological resilience (e.g. improved immune functioning)[23], psychological resilience (e.g. more accurate threat appraisals)[24], and social resilience (e.g. richer social networks)[25]. Although many other circumstances (e.g. genetics) and behaviours (e.g. indoor exercise) can also build biopsychosocial resilience resources, NBRT refers to that portion of these resources built though nature contact, and NbTs in particular, as ***Nature-based Biopsychosocial Resilience***.

The notion that nature might build resilience resources that can be used to help mitigate the impact of stressful circumstances is not new, and is reflected in the nature-health literature by terms such as 'inoculation'[26], 'immunisation'[27] and 'buffering'[28]. However, to date this work has been fragmentary, generally only considered biological, psychological and social resilience resources in isolation, and not really explored where in the stress-recovery process these resilience resources might be deployed. NBRT brings greater clarity to this issue by following the World Health Organisation's climate resilience framework[29], in arguing that these resilience resources can be deployed at two separate stages, an initial *response stage* where people first encounter the stressor and quickly appraise the level of the threat and their ability to cope, and a later *recovery stage* where people return to a homeostatic equilibrium. NBRT refers to these as ***response resilience*** and ***recovery resilience*** respectively and identifies previous literature which shows that prior nature contact can support both these processes[19,30.]
Such a distinction between response and recovery resilience is important here because it highlights how NbTs are not simply "therapies" that help people experiencing stress to recover, they also have the potential to be "therapeutic" by building biopsychosocial resources that can protect people against the impact of future potential stressors. Indeed,



NbT types can be identified at all three levels of the health promotion/disease prevention pyramid (Fig.1)[31]. Level 1 initiatives target whole groups/populations and use nature to help people take control over their own health and build response resilience; they tend to come under the umbrella of health promotion. For instance, people in countries that encouraged citizens to visit local nature during early COVID-19 lockdowns, showed fewer symptoms of anxiety and depression, presumably because they could use nature places to help cope with the stressfulness of early pandemic lockdowns[32]. Level 2 initiatives tend to focus on at-risk populations, encouraging those with, for instance, high blood pressure, to access nature in order to engage in physical activity and build biological resilience resources (e.g. greater cardiovascular fitness)[33]. Due to their more targeted nature, Level 2 initiatives are generally considered as disease prevention. Finally, Level 3 initiatives support individuals with existing mental and/or physical conditions (e.g. clinical psychological symptoms, restricted mobility) in accessing nature, to help manage their symptoms, reduce further complications, and possibly treat certain issues (i.e. recovery resilience)[34]. Level 3 initiatives are thus more in line with lay perceptions of "therapy", as a treatment for existing conditions.

Moreover, building individual-level biopsychosocial resilience through NbTs not only helps people manage stress and promote/protect their own health, it can also improve the resilience of social-ecological systems. For instance, NbTs can support environmental goals by engaging people in conservation activities[35] and by strengthening nature connectedness and pro-environmental attitudes/behaviours[36], which help to promote and protect NbSs. This virtuous circle demonstrates how we can build both 'individual and community REsilience thrOugh NATurE-based therapies' (RESONATE).

To date, however, providing clear causal evidence of the effectiveness of NbTs has been difficult because, in public health terms, NbTs are '***complex interventions***'[37]. Complex interventions are hard to evaluate because they are characterised by interconnected causal processes and a range of potential confounds (e.g. is nature exposure *per se* important or is it the physical activity and/or social contacts that occur in nature that are key?). NBRT can help address this challenge by arguing that they are all important because they help build different types of nature-based biopsychosocial resilience. NbTs are also hard to implement because they involve sectors beyond health. These include sectors linked to the locations where NbTs take place (e.g. land-managers/owners, conservationists, planners) and groups affected by the use of these spaces for therapeutic purposes (e.g. regular park users, local residents). As well as needing to be sensitive to environmental concerns and social acceptability, NbTs also need to be financially sustainable. Existing providers often stress that a lack of stable financing undermines long-term planning and creates stress and uncertainty among service users[38].

RESONATE will address all of these challenges through a highly ambitious program of research and innovation that goes ***beyond-the-state-of-the-art*** in terms of ***theory***, ***approach***, and ***methods***. These innovations are linked to four overarching General Objectives (GOs, linked to the call's Expected Outcomes) and nine more specific Objectives (Os, see Table 1.1).

In terms of ***theory innovation***, NBRT was designed by the consortium for this application. It goes beyond the two theories that currently dominate the nature-health field, Attention Restoration Theory[39] and Stress Reduction Theory[40] in two key ways. First, by stressing the tripartite role of bio-psycho-social resilience processes, it provides a coherent structure for multiple causal pathways/mechanisms that is currently lacking. Second, it's focus on resilience brings together the health sector's primary interest in using nature to promote individual level health and well-being, via biopsychosocial resilience, and the environmental sector's interest in using nature to promote community level health and well-being through social-ecological resilience. If we are to provide a "*sharper view of green space management, nature protection, agriculture, and forestry sectors as care providers and their possible linkages with the healthcare, social and educational sectors*" (GO2), it is essential to begin by identifying key cross-sectoral commonalities on which to build such linkages and the concept of resilience spans all sectors. Operationalising this new theory for testing across multiple contexts is RESONATE's first objective (O1.1).

Testing the theory, and providing a stronger evidence-base of causal relationships between nature and health/well-

being (GO1), is our second objective (O1.2). This will be achieved by focusing on the causal mechanisms relating to biological resilience (e.g. immune functioning), psychological resilience (e.g. self-efficacy) and social resilience (e.g. functional social support) across a series of nine Case Studies (CSs). A key beyond-the-state-of-the-art innovation will be the simultaneous, coordinated exploration of 3 CSs at each level of the health promotion/disease prevention pyramid. Led by Work Package 3 (WP3) the three general population Level 1 CSs will use two existing longitudinal cohorts and a prospective longitudinal cohort to answer novel questions raised by the call including "*when people choose to go*", "*what experiences they have*", "*the type and dose of interactions necessary for long term health and well-being benefits*", the moderators of these relationships *"such as age, gender, socio-economic status or culture*", and how "*greenness quantity and quality*" and "*geographical locations and factors.. affect the health-nature relationships*". The three Level 2 CSs will use a set of three, matched Randomised Controlled Trials (RCTs) across urban, rural, and coastal communities "*to provide more evidence of the causal relationships between nature, health and well-being"* through increasing nature contact for a key group exhibiting health risks rarely explored in the NbT field, i.e. people with metabolic syndrome. Finally, the Level 3 CSs will use two RCTs and a Community of Practice (CoP) intervention to test the potential of *"nature therapy sessions*" to help individuals manage current conditions by further extending existing state of the art interventions for people with clinical levels of psychological distress (CS7), restricted physical mobility (CS8), and a range of cognitive related challenges (CS9). A key feature of our Level 3 CSs is the promotion of inclusive nature access in order to 'Leave No One Behind', reflecting RESONATE's strong commitment to reducing discrimination, exclusion, and inequality.

Table 1.1: RESONATE's general objectives (GO) and specific objectives (O)

General Objectives	Objectives (O)
GO1 Stronger evidence-base of causal relationships between nature and health/well-being.	**O1.1** Operationalise the causal mechanisms proposed by **Nature-based Biopsychosocial Resilience Theory** (NBRT) by identifying appropriate metrics of the biological, psychological, and social resilience processes affected by Nature-based Therapies (NbTs). **O1.2** Test these processes with 3 Case Studies (CSs) at each level of health promotion/ disease prevention (total 9 CSs) across urban, rural, coastal settings, using **3 *longitudinal cohorts*, *5 Randomised Controlled Trials (RCTs)***, and ***1 Community of Practice Trial***.
GO2 Sharper view of cross-sectoral NbT linkages spanning health, environment, economy, and wider society.	**O2.1** Identify ***existing, evidence-based NbTs*** and explore their cross-sectoral linkages via an interactive ***Global NbT Systematic Map*** that can be used by stakeholders/decision makers for cross-sectoral collaboration, inspiration, and best-practice guidance. **O2.2** Explore ***cross-sectoral linkages*** by conducting multiple CSs assessing actors' networks and multi-sectoral outcomes spanning the health (***effectiveness/equity/ inclusiveness***); environmental (***impact/ carrying capacity/connectedness***); economic (***cost-effectiveness/funding/jobs***) and societal (***acceptability/empowerment***) sectors. **O2.3** Demonstrate how to promote cross-sectoral cooperation & partnership to ensure locally acceptable and empowering NbTs that build biopsychosocial and social-ecological resilience through 3 Social Innovation Action guided *'**NbT Resilience Hubs**'*.
GO3 Greater citizen and policy-maker awareness of nature benefits for health.	**O3.1** Identify target audiences among public, practitioners, and policy makers and increase their awareness of NbT benefits by deploying a set of ***traditional and innovative communication and dissemination tools*** to share and exchange data, outputs, and policy recommendations in accordance with best practice Open Science principles. **O3.2** Establish a Network Nature style Task Force for NbTs, via a ***multi-consortium collaboration*** which engages in joined-up communication and exploitation plans/activities.
GO4 Wider utilisation of cost-effective NbTs for disease prevention/ health promotion.	**O4.1** Explore what a scaled-up and scaled-out offering of selected NbTs might look like under different social/financial/climate futures through ***cross-sectoral scenario analysis***. **O4.2** Support potential NbT programmes to address the social, legal, administrative, and financing challenges of implementing sustainable NbT programs at scale by providing a 360^{O} toolbox of ***systems-thinking-based Guides***, based on the evidence and insights gathered from the Global Systematic Map, the 9 CSs and the 3 Resilience Hubs.

In terms of ***approach innovation***, despite appeals to the contrary, scientific, sectoral, and policy actors continue to "*operate in silos, focusing only on 'their' targeted aspects (e.g. physical, biological, or social)*"[41], including in the NbT field[38]. RESONATE will go beyond-the-current-state-of-the-art by developing a highly reflexive and integrative "*interdisciplinary cross-sectoral approach*"[42], to include not just the health and environmental (incl. "*green space management, nature protection, urban planning and landscape architecture*") sectors, but also researchers and actors from the economic and societal sectors in order to "*identify legal and administrative arrangements, partnerships, and financial mechanisms for implementation of nature therapy sessions*". We do this in two key ways. First, we

have WPs for each of the four core sectors: Health (WP4), Environment (WP5), Economy (WP6), and Society (WP7). This will ensure that the issues in each sector are explored in the requisite depth across our nine CSs, in terms of not just ***effectiveness*** (health) but also ***equity*** (fairness), ***sustainability*** (environment), ***cost-effectiveness*** (economy), and ***acceptability*** (society) (O2.2). Second, WP8 (What Works) will work closely with sectoral WPs 4-7 to support the integration of results and insights into a systems-based approach[43]. Combined, this will result in a toolbox of guides (with accompanying tutorials) aimed at meeting the needs of specific sectoral actors as well as an overarching guide that synthesises sectoral learnings into an integrated, systems perspective (O4.2). This approach will be achieved via our international, transdisciplinary consortium including academics, SMEs, and NbT practitioners, supported by an International Expert Advisory Board (IEAB) of global NbT leaders and specialists in Public Patient Involvement (PPI) and environmental ethics.

In terms of ***methodological innovation***, we will use several beyond-the-state-of-the-art methods to operationalize our approach. First, WP2 (Global Perspectives) will employ innovative ***Systematic Mapping*** techniques[44] to review existing NbT programmes globally and synthesise them in a novel, interactive, on-line mapping tool for public, practitioner, and policy maker use (O2.1). Second, we will apply formal ***process evaluation*** methods, established for complex interventions in other fields, to all of our Level 2&3 CSs to establish the *barriers/enablers* of cross-sectoral collaboration that need to be overcome/exploited for NbTs to be scaled-up and scaled-out, and to establish not just if the programmes are working, but *why* they are working and *for whom*, with a focus on potential inequalities such as gender, age, and income (O2.2). Third, to facilitate such collaboration we will build on ***Social Innovation Action***[45] methodology to establish three demonstrator Resilience Hubs (O2.3). These Hubs will provide an innovative working context in which *the "health care sector, and… green space management and nature protection sectors*" can come "*together with a variety of community and health sector representatives, businesses, civil society organizations and citizens*" to deliberate over and co-produce NbTs that are effective, inclusive, environmentally sustainable, cost-effective and financially viable, as well as acceptable and empowering to local communities. Fifth, we will use cutting edge analytical methods[46] to integrate sectoral specific data to produce a set of cross-sectoral scenario analyses that will estimate what a scaled-up and scaled-out offering of selected NbTs might look like under different social/financial/climate futures (O4.1). Finally, we will engage with the other consortia funded under this and related calls to co-ordinate our research, communication, dissemination, and exploitation efforts, and discuss the highly ambitious notion of establishing a Network Nature style Task Force with a specific focus on NbTs (O3.2).

R&I Maturity. NbTs are primarily social/environmental interventions rather than technological ones, so we mainly consider RESONATE's state of maturity in terms of Societal Readiness Levels (SRL)[47]. The problem has already been identified (SRL1), so planned activities range from SRL2 to SRL7. CSs 4-6, and the WPs associated with them, will engage relevant stakeholders through the NbT Resilience Hubs (SRL2) to develop local solutions and conduct initial testing (SRL3). Further, given that CSs 7-9 build on and develop existing, evidence-based NbTs (SRL6), the geographical scaling-out (CS7) and/or refinement (CS8/9) of these programmes falls under SRL7. Designing, implementing, and testing NbTs with clinical groups takes many years, including ethical approval processes. Therefore, integrating such groups within the 4-year constraints of RESONATE requires connecting with projects that are already well advanced in terms of societal readiness. Nonetheless, these CSs are highly innovative, because they apply the new framework, examine adaptations/extensions through the lens of biopsychosocial resilience processes, and assess in detail their cross-sectoral implications in terms of health, environmental, economic, and societal outcomes. Although our focus is primarily on SRLs, there are also tasks related to technology in RESONATE, where consideration of Technology Readiness Levels (TRLs) is appropriate. WP2's Systematic Map will develop an open-access interactive on-line mapping tool, with results digitised using an open-source virtual platform including a Geographical Information Systems (GIS) environment, a data catalogue/attribute repository and an Application Programming Interface (API) for global open access and usability. As noted below, there will be three key development steps, broadly reflecting TRLs 3-6. Further, CS8 plans to test a prototype App that is already under development, which supports people with mobility issues in accessing and deriving maximum benefit from the Move Green forest and park trails. The planned testing will broadly cover TRLs 7-9. Finally, CSs 4-6 will use well-established on-line Apps for recreational nature visits/walks (e.g. https://www.outdooractive.com/), to support participants navigate their planned routes but these will not be new technologies produced by the project (TRL9).

1.2 Methodology

RESONATE will meet its objectives through 10 Work Packages (WPs). A schematic overview of the programme's structure and how the WPs feed into each other is provided, as per template instructions, in Section 3, *Figure 4 (p.30*). A brief examination of this Figure may clarify how the following sections fit together in an over-arching framework. Each WP has several Tasks (numbered T1.1, T1.2 etc.) that address specific objectives. The mapping of WP Tasks to objectives is presented in Table 1.2. The table highlights two key things. First, it shows how parallel Tasks of co-creation, data collection support, and data analysis/synthesis are occurring simultaneously for multiple CSs across the

different sectoral WPs in a highly integrated, co-ordinated fashion. Second, the Table highlights the tasks involved in producing an integrated and co-ordinated package of key Deliverables (D) aimed at exploiting RESONATE results to provide the evidence, inspiration, and methodological tools for impact via coherent scaling-up and scaling-out of NbTs across Europe and beyond. Specifically we will co-produce: a) sector specific guides targeting the health, environmental and economic (x2) sectors, b) practical guides explaining how to set up Social Innovation Action-inspired NbT Resilience Hubs to enable co-creation and local empowerment and detailing how to evaluate the processes that support intended outcomes; and c) a final, all encompassing, "What Works NbT Guide" which will provide a summary of the six more sectoral specific and technical guides alongside the results of our cross-sectoral scenario analyses, bringing the various opportunities and challenges together. Further details are provided in Section 2, but they are highlighted here to explain our overall vision and why we adopt the methods we do.

Table 1.2: Mapping selected RESONATE's Tasks (T) to general objectives (GO) and specific objectives (O)

General objectives (GO)	Objectives (O)	Tasks (T)
GO1 Stronger evidence-base of causal mechanisms	**O1.1** Operationalise NBRT	T3.1 Support CS design and co-creation to operationalise NBRT constructs T4.1 Co-design health equity data needs T5.1 Co-design environmental data needs T6.1 Co-design economic data needs T7.2 Co-design cross-sectoral linkages data needs T8.1 Co-design process evaluation data needs T8.5 Co-create scenario data needs
	O1.2 Test NBRT using 9 Case Studies (CSs) across 3 Levels of the health promotion/disease prevention pyramid	T3.2 Support multi-sectoral data collection T3.3 Support data collation and distribution T3.4 Analyse and synthesise resilience outcomes T1.10 Support all ethical requirements/practices
GO2 Sharper view of cross-sectoral linkages	**O2.1** Systematic global map	T1.6 Support lab visits to IEAB member projects T2.2 Conduct systematic literature review T2.3 Develop interactive online-map T1.7 Support cross-sectoral integration T2.1 Co-create multi-sectoral literature review searches
	O2.2 Cross-sectoral linkages	T4.2 Support health equity data collection T4.3/4 Analyse and synthesise health equity outcomes
	O2.3 Nature-based Resilience Hubs	T5.2 Support environmental data collection T5.3 Analyse and synthesise environmental outcomes T6.2 Support economic data collection
	(These are combined here because the cross-sectoral linkages for CSs 4-6 will be achieved through the Resilience Hubs)	T6.3 Analyse and synthesise economic outcomes T6.4 Identify sustainable financing options T7.1 Assess societal awareness/acceptance T7.3 Run Resilience Hubs as Social Innovation Actions T8.2 Support process evaluation data collection T8.3 Analyse/synthesise process evaluation outcomes
GO3 Greater awareness	**O3.1** Communication and dissemination	T2.4 Host Grand Rounds T9.2 Develop/update dissemination/exploitation plan T9.3 Support communication/dissemination activities T9.4 Coordinate stakeholder/policy engagement T9.5 Coordinate academic engagement T9.6 Compile project impact report T1.8 Ensure data is managed/stored and accessible according to FAIR principles
	O3.2 Multi-consortium collaboration	T1.4 Coordinate joint events, targeted/tailored activities, communications. T1.5 Co-create NbT "Task Force"
GO4 Wider utilization	**O4.1** Cross-sectoral scenario analysis	T8.6 Support scenario data collection T8.7 Analyse and synthesise scenario outcomes
	O4.2 Deployment via tools, guides and open-access practices	T4.5 Develop the NbT Health Practitioner Guide T5.4 Develop the NbT Environment Assessment Guide

	T6.3 Develop the NbT Economic Assessment Guide T6.4 Develop the NbT Sustainable Financing Guide T7.3 Develop the NbT Resilience Hub Guide & establish Memoranda of Understanding T8.4 Develop the NbT Process Evaluation Guide T8.8 Develop the overarching NbT What Works Guide T1.9 Make all resources open access

While recognising important overlaps and synergies throughout, the following sections focus on how we will deliver the outputs related to GO1 and GO2. The steps we take to deliver GO3 and GO4 are explained in Section 2.

1.2.1 Methods for achieving GO1

O1.1 Operationalising NBRT. The concepts of stress and resilience are central to RESONATE, underpinning our entire programme of work. The theory argues that NbTs "work" because nature contact can promote health and prevent disease by reducing people's allostatic stress load through building and maintaining a range of biological, psychological and social resources (i.e. biopsychosocial resilience) that mitigate the impact of stressful circumstances, (e.g. pollution, income-inequalities, crowding) in two ways. First the stock of nature-based biopsychosocial resilience resources can be deployed at the response stage, e.g. by helping to make more accurate threat and coping appraisals which dampen the initial emotional and physiological reaction (i.e. response resilience)[19,29]. Second, this stock of resilience resources can be deployed at the recovery stage, e.g. by talking through the issues with a friend during a walk in the park (i.e. recovery resilience)[19,29]. A key innovation of our approach lies in its focus on causality and in analysing how different types of nature contact affect different biopsychosocial resilience processes at the intra- and inter-individual level and how these interact with broader resilience processes at the social-ecological level. NBRT answers the call's request to "*develop a common framework"* to help us understand the "*mediating*" and "*causal mechanisms*" and help *"recognize and promote contact with nature… for the prevention and treatment of human health and well-being*".

Nature can build biological resilience by bolstering clinically relevant anti-inflammatory immune-profiles including natural killer cells and anticancer proteins[48], it can reduce pro-allergic cytokines such as IL-13 and IL-5, and induce anti-inflammatory IL-10 producing T cells in certain groups[49]. Nature contact can also boost biological resilience through physical activity. Just 30 minutes of moderate-intensity activity can buffer against blood pressure responses to psychosocial stress[50], and regular physical activity reduces the risk of many chronic NCDs[51]. More people are willing to engage in, often informal, nature-based physical activity than in formal/indoor exercise[52], and walking/jogging on uneven terrain also induces a more complex and demanding patterns of movement, with benefits for the musculoskeletal system[53]. Even short nature contact experiences can build psychological resilience by promoting positive emotions that reduce the biophysiological arousal resulting from stressful tasks[19], as well as "broaden-and-build" problem-solving repertoires that increase creativity and are key mechanisms in coping[54]. Regular and/or extended periods of nature contact can build people's self-esteem and global sense of self-worth[55] as well as practical skills, reducing the probability that situational demands are perceived to exceed available resources. Finally, nature contact can also build social resilience. People are more pro-social[56] following short nature exposures, which can strengthen social networks used to support individuals in times of stress[25]. In short, NBRT's answer to questions such as, "is it nature *per se*, physical activity in nature, or positive social interactions that are key?", is to respond that it is ***all of these processes*** because they each build and maintain ***different types of biopsychosocial resilience***. Although we have already identified a range of potential metrics that appear to be good operationalisations of our constructs (Table 1.3), Ts3.1-8.1 will finalise them.

O1.2 Testing NBRT across 9 Case Studies. We will test NBRT using 3 CSs from each level of the health promotion/disease prevention pyramid (Fig1.). Each CS is designed to examine the potential causal relations between NbTs and health/well-being along with the hypothesised biopsychosocial resilience mechanisms. A summary of each CS is presented in Table 1.3 with full details provided in the ***Annex for Clinical Studies***.

Table 1.3: RESONATE Case Study 1-9 Summaries

Case Study	Design Prevention level (Fig. 1)	Sample*	Stressor/ risk mitigated by nature	Nature contact / NbT intervention	Health/ well-being outcomes	Biopsycho-social resilience mechanisms	Social-ecological resilience mechanisms
1. UK, Population representative	*Level 1*: 11yr. long. cohort	N~ 37,000	Stressful life events (e.g.	Urban, rural, coastal neighbourhoods	GHQ-12 Life sat.	Psych. GES Social.NSCS	Equity. HEA

(UNEXE)			divorce)	Occupational			
2. UK, Dementia risk Cohort (UNEXE)	*Level 1*: 10yr. long. cohort	N~ 24,000	COVID-19 & other societal level stressors	Urban, rural, coastal neighbourhoods Occupational Recreational	SF-12 GAD-7 PHQ-9, SPANE	Psych. NAT Social. LS	Equity. HEA Envi.† GEBS
3.Bulgaria, bespoke panel (MUP)	*Level 1*: 12mth. long. Cohort (3 waves, 6 months apart)	N=1,500 incl. n=250 bio-marker cohort	Everyday stressors (e.g. traffic emissions, financial)	Urban/rural neighbourhoods Occupational Recreational	SF-12 GAD-7 PHQ-9, SPANE	Bio. Immune (e.g. IL-6), metabolic (e.g. lipids), Psych. BRS Social.BSCS	Equity. HEA Envi. INS, GEBS Econ.QALY Social. SAS
4. Italy, Padua urban woods (UNIPD)	*Level 2*: Two-arm RCT (Intervention vs. waiting control)	N=134*	Having or being at-risk of metabolic syndrome (larger waistline, high blood pressure, abnormal blood lipid levels, high blood sugar	5-week guided, + technology assisted/self-guided, nature immersion Basic design in each locality will be enriched with locally supported SIA insights. CS4 Urban CS5 Rural CS6 Coastal	SF-12 EQ-5D PHQ-9, GAD-7, SPANE NRS SWLS IPAQ-SF	Bio. Chronic stress (allostatic load). Immune function (e.g. IL-6/10); metabolic function (e.g. SAA) Psych. BRS Social. BSCS, ST	Equity. HEIAs Envi. EIA, INS, GEBS Econ.QALY Social. SAS
5. Austria, Alpine mountains (PMU)	*Level 2*: Two-arm RCT (Intervention vs. waiting control)	N=134*					
6. Spain, Barcelona seafront (ISGLOBAL)	*Level 2*: Two-arm RCT (Intervention vs. waiting control)	N=134*					
7. Sweden, Urban gardens (UU)	*Level 3*: Four-arm RCT (ReST vs. mindful; vs. nature; vs. waiting control)	N=260*	Clinically elevated psycholo-gical symptoms (DASS-21)	5-week 'Restoration Skills Training' (ReST) = formal mindfulness training + nature immersion	DASS 21 SF-12 GAD-7 PHQ-9 SPANE	Psych. Attention (CFQ), BRS Social. BSC, ST	Equity. HEA Envi. EIA, INS, GEBS Econ.QALY Social. SAS
8.Denmark, Urban forest/park (UCPH)	*Level 3*: Two-arm RCT (App-visits vs. waiting control)	N=110*	Chronic mobility issues (e.g. wheelchair users)	5-week technology enhanced nature immersion in the Move Green Urban Forest	SF-12 GAD-7 PHQ-9, SPANE	Psych. Attention (EEG, Eye tracking), BRS Social.BSCS	Equity. HEA Envi. EIA, INS, GEBS Econ.QALY Social. SAS
9.Netherlands, Care farms (NVM/ UNTWE)	*Level 3*: Community of Practice trial (Standard vs. Enhanced practice)	N=24 care farms (N~450 clients)	Cognitive impairment (e.g. dementia)	Co-created staff training for enhanced support of client centred nature-based experiences.	Feasibility assessment of new procedures plus pilot outcome assessments including GCCWB		

***** *See Clinical Studies Annex for detailed power analysis. Envi.† = Environment, incl. connectedness/behaviours. BMI: Body Mass Index; BRS: Brief Resilience Scale; BSCS: Brief Sense of Community Scale; CFQ: Cognitive Failures Qaire; DASS21: Depression, Anxiety & Stress Scale-21; GAD-7: Generalised Anxiety Disorder-7; GCCWB: Greater Cincinnati Chapter Well-Being Observation Tool; GEBS: General Ecological Behavioural Scale; GHQ-12: General Health Qaire-12; FFSQ: Functional Social Support Qaire; GSS: General Self-Efficacy Scale; IL6/10: Interluekin 6/10; INS: Inclusion of Nature in Self; IPAQ: International Physical Activity Qaire; LS: Loneliness Scale; NAT: Network Attention Task; NSCS: Neighbourhood Social Cohesion; PHQ-9 Patient Health Qaire -9; QALY: Quality Adjusted Life Year; SAA: Serum Amyloid A; SF-12: Short-Form Health Survey; SAS: Social Acceptance Survey; SPANE: Scale of Positive/Negative Emotions; ST: Social Trust. HEA: Health Equity Audit; HEIA: Health Equity Impact Assessment; EIA: Environmental Impact Assessment.*

Level 1 CSs. CSs 1-3 will use longitudinal data, tracking samples of general populations over time, to monitor

nature contact (e.g. neighbourhood greenness, recent nature visits), and metrics of biopsychosocial resilience and indicators of health/well-being before, partly during, and after stressful circumstances. The large samples sizes will allow us to answer the following research questions: a) Does nature contact mitigate (buffer) the effect of a given stressor on health/well-being; b) is this process mediated by one or more biopsychosocial resilience related processes; c) are these effects similar or different for different groups in society (e.g., '*age, gender, socio-economic status or culture'*); and d) how important is '*quantity vs. quality*'? **CS1** will use the UK's longitudinal household panel (N~37,000) to explore whether neighbourhood nature contact can mitigate the effect on mental health from personally stressful life events (e.g. divorce, unemployment) via psycho-social resilience processes. **CS2** uses data from the UK's longitudinal dementia risk panel (N~24,000), run by the UNEXE team, to explore whether neighbourhood nature contact and recreational visits mitigate the effects of societal level stressors (e.g. COVID-19; cost of living shocks) on mental health. This enables us to look at '*dose-response*' effects and focus on an older age cohort at risk of additional health issues. **CS3** is a RESONATE specific prospective longitudinal study in Plovdiv, Bulgaria, monitoring 1,500 individuals over a 12-month period. CS3 will explore whether nature contact mitigates the effects of everyday stressors (e.g. traffic emissions, financial worries) on mental health, and which biopsychosocial mechanisms underlie this. It will also include a sub-sample (N=250) to investigate a rich selection of biopsychosocial resilience metrics including immune function (e.g. IL-6/10, TNF-α, CRP, TB-NK cells), oxidative stress (e.g. chromogranin), stress hormones (cortisol) and general allostatic load biomarkers (e.g. cholesterol).

Level 2 CSs. CSs 4-6 are conceptually linked in order to facilitate later comparison, although specific operationalisations of the design will be sensitive to local conditions and co-developed with local stakeholders using a Social Innovation Action approach (WP7). Systematic reviews in the nature-health field often call for more standardised processes, interventions, and outcomes to improve study comparability, but a multi-centre trial adopting exactly the same protocols is neither feasible nor desirable for NbTs which require sensitivity to context and local co-creation. Our hybrid approach will create three Level 2 CSs that can be meaningfully compared, while leaving enough flexibility to make each CS reflect locally applicable social innovation. Based on a series of studies by RESONATE partners at UU[57] and a recent meta-analysis[58], the three CSs will focus on testing similar nature-based mindfulness interventions. In terms of NBRT, the benefits may include greater exposure to immune-function promoting microbial-biodiversity, greater physical activity, and more positive social interactions. Our target 'at-risk' group will be sedentary, low nature-users (<30mins per week) with metabolic syndrome (a combination of at least 3 of 5 risk factors: large waistline, high blood pressure, abnormal blood lipid levels, low HDL cholesterol, and high blood sugar), a condition common across Europe associated with an increased risk of stress and allostatic load related conditions such as heart disease, stroke, and type 2 diabetes[59]. CS design will adopt a two-arm wait-list design, randomising one group to an assisted nature-based mindfulness intervention and one to a waiting list control condition (no treatment). We will use gender stratification in the randomisation procedure to explore the gender dimension. The control group will receive the same intervention after the active intervention group. The ~5-week interventions will extend existing mindfulness-in-nature practices and involve elements of movement, rest, and mindful contemplation through different sensory modalities. Based on previous studies by the teams, but depending on co-creation results, the intervention will involve approximately three semi-structured 40-minute walks per week, 15 sessions in total. The initial sessions will be led by a guide, with later sessions supported through established on-line Apps that help people navigate selected nature routes (e.g. https://www.outdooractive.com/), with the final decision on the number of in-person vs. self-directed walks determined through the co-creation processes in each location. Data will be collected pre, during, post, and at 3-month follow-up, to explore longer-term health/well-being effects and maintenance of higher nature contact. In order to explore geographical, cultural, meteorological, and other contextual factors, the CSs will be set in urban nature (**CS4**, Padua, Italy), rural mountainous settings (**CS5**, Salzburg, Austria), and urban coastal zones (**CS6**, Barcelona, Spain). Metrics of biological resilience (e.g. via saliva samples) will be collected in all sites but analysed by PMU who have the requisite laboratory facilities. Structural design similarities will facilitate data synthesis and meta-analysis, while unique elements will increase ecological validity, local ownership, and long-term sustainability, rather than a "one-size-fits-all approach".

Level 3 CSs. CS 7-9 will design/test innovations for established NbTs for people with existing conditions, including: an RCT for people with clinical levels of psychological symptoms (CS7); one for those with chronic mobility issues (CS8); and a multi-site Community of Practice trial across a set of Care Farms catering for clients with dementia and other cognitive and functional impairments (CS9). As noted in 1.1 (R&I Maturity), the design and implementation of high quality, robust, interventions "ex novo" with Level 3 groups within the 3-year time-frame to inform Year 4 deliverables is not feasible. Therefore, we extend existing programmes by scaling-up/scaling-out, adding trial-arms, and/or analysing biopsychosocial resilience processes. **CS7** will build on the successful Restoration Skills Training (ReST) programme, developed by partners at UU, Sweden, which integrates mindfulness training with restorative nature experiences for people suffering from clinical levels of stress and/or depression/anxiety related disorders. Although ReST has already shown sustainable advantages compared to standard mindfulness

interventions[55], the relevant biopsychosocial resilience processes are unknown, and will now be measured here through evaluations of protective resilience (i.e., resistance to fatigue induction) and recovery resilience (i.e., restoration efficiency). Further innovations include an ambitious 4-armed RCT design with a 6-month follow-up to compare ReST, conventional mindfulness training, and nature-on-prescription interventions with each other and a waitlist control condition. Further, the interventions will take place at multiple locations by trained instructors to explore the programme's scaling-out potential. **CS8** will build on an ongoing project in Denmark called Move Green, an NbT programme exploring the potential health and well-being benefits for individuals with mobility issues who visit an urban forest park designed according to the 'Evidence-based health design in landscape architecture' (EBHDL) process model. People with mobility issues tend to be more exposed to stress and have significantly poorer QoL compared to the able-bodied population[60]. The Move Green Lab site uses a 'designed-in' accessibility approach to support people with limited mobility, thus 'leaving no one behind' in terms of the benefits of nature contact. Move Green has developed a prototype App with guided restorative nature experiences for individual use. The App's aim is to enhance sensory experiences, physical interactions, and connectedness with natural environments. The trial will use a two-arm RCT with a 6-month follow-up to analyse whether App-enhanced visits increase biopsychosocial resilience, compared to a waiting control group, for people with mobility issues. The intervention group will visit the Move Green forest for at least 2hrs (actively 60 minutes) a week for five consecutive weeks. **CS9** will use a collaborative action approach to explore how to support the building of biopsychosocial resilience by adapting existing practices of a region-wide care farming programme. It will work with a Foundation of Care farmers (SZZ), the largest organisation of care farming in the Netherlands with more than 100 care farms and offering day care for about 3,800 clients with special needs. Building on an ongoing relationship, CS9 will work with SZZ to identify 24 care farms willing to take part in the two-stage study. Stage 1 will be a co-creation stage where staff of 12 care farms will participate in a Community of Practice (COP) with experts and researchers to co-design and test nature-based activities tailored to the special biopsychosocial resilience needs of adults with dementia and other cognitive and functional impairments. Reflecting the elements of mindfulness in several of our CSs, the proposed training programme will be designed according to principles of 'attentive presence' where caregivers are trained to be especially attentive to how the client is captured and guided by affordances in the natural environment (e.g. how the bark of a tree feels, birdsong, insect behaviour), and to support the client in engaging in these activities safely. Stage 2 will then compare the biopsychosocial resilience and health and well-being outcomes of clients (N ~ 450), using a 'lighter touch' quantitative and more qualitative evidence gathering approach than the RCTs above, at the 12 intervention farms with a matched control group of 12 (practice as usual) farms. CS9 is also firmly embodied in the 'Leave no one behind' agenda, and will derive particular support from one of the International Expert Advisory Board (Nicole Prop) who is the Director of Austria's care farming programme (Green Care Österreich).

WP3 (Case Studies) will oversee and support the development, implementation, data management, and data analysis of CSs via Tasks 3.2-3.4. To achieve an integrated body of evidence across CSs, we will, where possible (i.e. CSs 2-8), use the same primary health outcome variable, the Short Form-12 (SF-12) general health questionnaire to assess the impact of nature contact on both mental and physical health. The SF-12 was chosen due to its strong predictive validity of health conditions[61], and suitability for estimating cost-effectiveness[62]. Secondary health/well-being outcomes, and metrics of biopsychosocial and social-ecological resilience will also be the same across CSs where possible. Each CS will submit a preregistration detailing hypotheses, protocols, and planned analyses etc. to the Open Science Framework portal. Three data syntheses on the novel data measuring primary and secondary health/well-being and biopsychosocial resilience outcomes will be conducted, one for each Level (Deliverables **D.3.1-3.3**). Social-ecological resilience outcomes from WP3 will be explored in WPs dedicated to these specific issues. All outcomes will inform the RESONATE "Toolbox" and "What Works" guide (see Section 2.1).

All CS leads are globally recognised researchers in the NbT field with excellent track-records of delivering high quality outputs using the designs and methods to be used for their respective CSs (Section 3.2). Consortium members are also at the forefront of the use of digital and virtual nature in both research[63] and applied projects for people who are unable to access nature in person[64]. Nevertheless, all of our CSs focus on "real" nature, consistent with RESONATE's goals of: a) focusing on the interconnections between NbTs and NbSs; b) exploring biological, psychological, and social resilience processes; c) building a sharper view of cross-sectoral linkages (including the environmental sector); and d) developing a series of beyond-the-the-state-of-the-art social innovation actions to promote cross-sectoral collaborations in practice. Nevertheless, the potential of VR-based nature therapies will be included at various points in the project, e.g. during the systematic mapping exercise, the Grand Rounds, and the cross-consortium collaborations. Our ongoing work in the VR area funded through other projects will inform, and be informed by, RESONATE as it progresses.

1.2.2 Methods for achieving GO2

O2.1 Taking a global perspective. Several NbT programmes already exist in Europe and beyond, including those involving RESONATE partners and IEAB members in the USA, Canada and Australia. RESONATE will ensure this existing evidence base is used to systematically inform the proposed research, social innovations, and impact activities, through several interlinking mechanisms covered by WP2 (Global Perspectives). First, WP2 will work with WPs 4-7 to support a suite of sectoral specific reviews (health, environment, economy, society) of existing NbT programmes globally, by helping to produce and run a single search strategy spanning all review needs with results then funnelled back to the respective WPs (T2.1). This will not only avoid duplication of effort, but will embed a focus on cross-sectorality from the start. Second, WP2 will itself lead an overarching 'Systematic Map' of NbTs in the peer-reviewed literature (T2.2). Given our involvement in on-going mapping reviews in related NbS projects (e.g., Naturvation, GoGreenRoutes, Connecting Nature), our NbT Systematic Map will have several distinctive features to ensure it is complementary yet unique. First, it will focus only on NbTs in the peer-reviewed literature, to clearly distinguish it from reviews that are looking at: a) NbSs more broadly; and/or b) NbT programmes only discussed in the grey literature (see WP4). Second, it will use a state-of-the-art Systematic Mapping approach[65]. Unlike traditional systematic reviews which attempt to review evidence in support of a specific research question, these approaches have a broader remit and try to scope or "map out" the field in more generic terms by creating a specific typology, which for NbTs might including: geographical location, nature-setting, target-population, stakeholder involvement, funding mechanisms, and health/well-being outcomes monitored (T2.2). All reviews will follow standard review protocols as set out by the Collaboration for Environmental Evidence to reduce potential bias. Third, and drawing on consortium member experience of a similar digital mapping exercise for a United Nations Environmental Program[66], the results from the mapping exercise will be converted into a literal map, with results digitised in an open-source virtual platform to visualise NbT patterns and trends globally (T2.3). The platform will be developed in a multi-stage process and include alpha, beta, and stable release versions to ensure a robust final product. The map will serve as a repository for supporting multi-sector collaboration, inspiration, and guidance at the local, regional, national, and international levels. Finally, WP2 will use the map to generate multi-sectoral discussion at a series of events (T2.4). These 'Grand Rounds' are discussed in more detail in Section 2. The global nature of this work will be supported by lab visits by key beneficiaries to our four IEAB partners in the USA (Cornell Univ. and Univ. California San Francisco), Canada (Univ. British Columbia) and Australia (Univ. of Woolongong). These exchanges will enable researchers at EU-beneficiaries to spend up to four weeks with international partners in order to: a) learn more about the different activities and programmes in those regions in order to enrich the Systematic Map (T2.2); and b) conduct locality specific Grand Round events to enhance truly global perspectives (T2.4). WP2 will be led by an expert team at ISGLOBAL who have themselves spent time working on NbT programmes in Canada (van den Bosch) and the USA (Litt) and who have already conducted global reviews of nature-health relationships for organisations such as the World Health Organisation (WHO)[11], as well as reviews of "nature-assisted therapy"[67].

O2.2 A sharper view of cross-sectoral linkages. For NbTs to be equitable, environmentally and financially sustainable, socially acceptable, and inclusive, cross-sectoral collaboration between representatives of these four sectors is key: health (incl. health professionals, link workers, and local health partnerships), the environment (incl. land owners/managers, planners, forestry, and agricultural organisations), the economic/financial sector (incl. public and private funders, SMEs, and local economic partnerships), and society more broadly (incl. legal institutions and authorities, educational bodies, civil society organisations and local residents/green space users). RESONATE includes these sectoral perspectives and linkages by having a distinct WP devoted to each sector: WP4: Health (equity); WP5: Environment; WP6: Economy; and WP7: Society). Finally, WP8: What Works, will conduct formal *process evaluations* for relevant CSs, as recommended for complex interventions, focusing on *how* the interventions work (or not) and for *whom*, as opposed to merely whether they work. Since the focus here is on "interventions", WPs 4-8 will primarily focus on the cross-sectoral linkages in the Level 2&3 CSs. Issues of cross-sectorality for Level 1 CSs will be considered within WP3. In order to facilitate cross-sectoral integration we will support lab-exchanges between researchers in different WPs with different expertise. These exchanges will allow, for instance, a researcher from EHNet (WP4 leads with expertise in Health Equity) to spend several days with the AZTI team (WP6 leads with expertise in ecosystem assessment), in order to better understand the inter-linking relationships between health equity and the environment, with the aim of optimising the evaluation package developed for each of the Case Studies. Although WPs 4-7 cover different sectors, each WP has five common elements that will be harmonised between and across them.

Each WP will conduct a sector relevant literature review, supported by WP2. These reviews will be used to inform the development of tools used to collect data across multiple CSs and/or other tasks. Many relevant metrics already exist, but these will need adapting to: a) reflect new learnings from the respective reviews; b) the specific context of each CS; and c) be compatible with our multi-sectoral data collection activities. These adaptations will require co-creation with CS leads, CS stakeholders, and the other WPs (facilitated by cross-WP lab visits) to assess the feasibility

and acceptability of collecting certain types of data, and avoid duplication and excess demands on CS participants/stakeholders (Ts 4.1, 5.1, 6.1, 7.1, 7.3, 8.1). Once a data collection strategy is agreed, WPs will provide oversight and support of data collection to each CS, e.g. to help adapt measurement tools (Ts 4.2, 5.2, 6.2, 7.3, 8.2). On completion of data collection, each CS will share their data with the relevant WPs for analysis and synthesis. Given there are 6 Level 2&3 CSs, 4 sectoral WPs, and 1 process WP, this amounts to 30 data "packets". To ensure efficient, secure, and traceable data management, WP3 will act as a "data distribution point" collating all relevant data from CSs and distributing it to the relevant WPs (T3.3). Once received, each WP (again in collaboration with CSs) will analyse and synthesise their data to meet their specific objectives (Ts 4.3, 5.3, 6.3, 7.3, 8.3). The final stage for each WP involves disseminating the results and providing tools and/or guidelines that target different sectoral actors and which feed into the overarching "What Works" guide. Below we give a more detailed description of each of these WPs.

WP4: Health and health equity impact of NbTs. WP4 aims to understand the concerns, challenges, barriers, needs, and opportunities of the health sector related to implementing NbTs, and provide tools and guidance for health professionals to make greater use of NbTs in their work to improve health/well-being. Drawing on EHNet's expertise in health equity issues across Europe, and co-ordination of EU Horizon 2020 projects such as INHERIT, WP4 will focus on: a) the health sector's role in supporting or restricting (if lack of causal evidence), the wider uptake of NbTs; and b) how health determinants and access to green/blue spaces are distributed across the population, and the potential distributional effects of interventions on participants' physical and mental health (i.e. does everyone benefit equally?) as part of the biopsychosocial resilience framework. WP4 will conduct either detailed Health Equity Impact Assessments (HEIA) or lighter Health Equity Audits (HEA) for all Level 2&3 CSs depending on data availability. Data needs will be based on a comprehensive model of health including social and environmental determinants, and focus on site factors (e.g. air quality, noise, walkability, public transport links), participant characteristics (e.g. education levels, employment status), and local health contexts (e.g. current NbT attitudes/practices). Both methods will follow the five key stages laid out by the WHO[68] and the EU's Joint Action Health Equity Europe (JAHEE[69]), health impact assessment tools: ***Screening*** (deciding which CSs will undertake an HEIA vs. HEA, T4.1); ***Scoping*** (establishing how to conduct/evaluate the HE(I)As and supporting CS specific steering groups, T4.2); ***Appraisal*** (supporting CSs gather the relevant data analysing evidence on health impacts and their (potential) distributional effects due to inequalities, T4.3); ***Reporting*** (presenting results and providing recommendations, T4.4); and ***Monitoring*** (identifying goals for monitoring and evaluating the effectiveness of the HEIA process). Stakeholder participation will be encouraged at all stages, aiming to contribute to empowering participants and leading to consensual policy decisions. RESONATE will strive to ensure inclusive, diverse participation including vulnerable groups, both in terms of the process (e.g., in CS steering groups), as well as in the focus groups and surveys. Results will be summarised in a health equity impact assessment guide (M14), which will feed into WP8's overarching What Works Guide (**D8.2**). WP4 will use its review to focus on the health sector's role in NbTs and equity issues (T4.5). Based on an initial literature scan, and to avoid overlap with WP2's Systematic Map, WP4 will focus on the NbT grey literature, much of which describes in more detail the health sector related enablers and barriers, the interlinkages with NbSs, as well as issues such as difficulty in recruiting individuals from certain socio-economic and cultural groups in society. The review will be supplemented by in-depth interviews with n~10-15 health professionals about their awareness and perceptions of appropriateness, acceptability, and equity of NbTs. Interviewees will be diverse, spanning primary care (e.g. General Practitioners), specialists/doctors in secondary care, and health service administrators/funding priority setters. Interviewees will be from a range of geographies/countries and have varying levels of experience with NbTs including those with no experience. Recruitment will be facilitated by EHNet's extensive European health partner network, members of the IEAB, and through the Resilience Hubs. Results will be synthesised into a '*Nature-based Therapy Guide for Health Professionals*' (**D4.1**).

WP5: Environmental impact/opportunities of NbTs. Human and environmental health are deeply interconnected[70]. Environmental quality is thus a key determinant of nature's potential to contribute to human health and well-being[71], including for NbT's. However, NbTs could, if not carefully managed, also generate pressures on the environment itself, reducing the quality of the NbT experience with negative effects on both social-ecological and biopsychosocial resilience processes. WP5 will thus build on the team's extensive experience in environmental impact assessment to assess the potential environmental impact of our Level 2&3 CSs, both in terms of current activities, but also implications if the programmes were to be scaled-up, in order to estimate each site's "carrying capacity" in terms of the number of users it can support before significant degradation occurs. Despite their potential negative impacts on natural settings, NbTs may nonetheless have the potential to be environmentally net positive. Spending more time in natural settings, especially engaging with it in a mindful manner, is associated with better nature connectedness and more pro-environmental behaviours[36]. Therefore, WP5 will begin by reviewing environmental characteristics of successful NbTs for evidence of positive as well as negative impacts. This information will then be used to co-create environmental data assessment and participant environmental attitude/behaviour assessment needs with CSs (T5.1)

to develop an NbT specific environmental assessment based on similar tools developed by consortium members. WP5 will support the use of this assessment tool in each CS site, and with participants both pre- and post-intervention (T5.2). Biodiversity/ecosystem indicators will be identified for each case study. Whenever possible, existing thresholds will be used to determine good/bad condition of the indicator. Otherwise, those may be developed or adjusted to the different cohorts (acceptable conditions in this case are not only determined environmentally, but socially). Indicators and thresholds will be used for the development of socio-ecological models, in which cascading effects of conditions will be observed. If appropriate the NEAT (Nested Environmental Assessment Tool) will be applied. Although we might expect relatively little direct environmental impact of trials of this nature and time-scale, the environmental assessment will develop a risk matrix to identify the environmental characteristics and quality levels that could condition the success of NbTs, and levels of impact that would hinder effective prescriptions (including carrying capacity, T5.3). Processes and results will be summarised in a '*Nature-based Therapy Environmental Assessment and Impact Guide*' (**D5.1**). Involvement of diverse environmental stakeholders in these tasks and processes (e.g. land owners/managers, planners, forestry and agricultural sectors etc.) will be supported through the Resilience Hubs for CSs 4-6 and existing in-place networks for CSs 7-9.

WP6: Economic potential of NbTs. Many NbT providers are concerned about a lack of sustainable financing[38], partly due to a lack of clear business cases that can be made to public or private funders/investors. Building on our leadership of the Erasmus+ funded Green 4C (GreenForCare) project exploring innovation and entrepreneurship in the 'green care' sector, WP6 will begin with an updated review of the more economically relevant literature (T6.1). Key features of this exercise will be to identify which level of analysis will be performed at each CS and to define: a) the asset being assessed (what is the object of estimation – i.e. single ecosystem service, co-benefits, nature in general, etc.); b) the reference population (who is benefitting from the ecosystem service(s)); c) the most appropriate/feasible evaluation method for each CS (cost-based, demand-based, cost-effectiveness and/or cost-benefits methodologies); d) the sampling plan; and e) definitions related to economic impact. WP6 will support the relevant data collection by CS leads (T6.2). Once collected, analysis will focus on the extent RESONATE's NbTs might save health and social-related costs for their users, society, and public/private health institutions (T6.3). For CSs with clear current practice comparators (e.g. CS7), cost-effectiveness analysis will also be undertaken. Although the economic potential of any given trial is likely to be small, the synthesised data can be used to develop evidence-based scenarios about what a scaled-up/scaled-out offering of selected NbTs might look like. Based on CS results, it will be possible to quantify the hypothetical impact of a generalised adoption of NbTs, for example considering job creation and local economy improvements, and identify, catalogue, and assess business cases and the market for NbTs. These kinds of results are of paramount importance for demonstrating the value of NbTs and could be used to orientate policies and justify forms of infrastructure and therapy-related investments. Processes and results will be summarised in a '*Nature-based Therapy Economic Impact Assessment Guide*' (**D6.1**). Finally, WP6 will identify sustainable financing options (T6.4). Developing the public and private business and market case for NbTs requires a market analysis of the supply and demand potential for NbTs in different sectors (green space management, agriculture and forestry) and in the public/private sectors including health insurers. Such an analysis will include the barriers and opportunities for accessing public/private finance for NbTs and what makes them bankable and will result in a '*Nature-based Therapy Sustainable Financing Guide*' (**D6.2**).

WP7: Societal perspectives and social innovation actions (SIAs). NbTs often take place in publicly accessible/shared spaces, and thus other users (e.g. recreational visitors) are also stakeholders. Understanding their perspectives, as well as those of the local community more broadly, is critical for the long-term acceptability of NbTs. Regardless of type, successful NbTs tend to have a core social element, including community engagement in green-infrastructural design[72] and group-based nature activities[42]. Consequently, NbTs can be viewed as 'social innovations'[73]. Although the term has a multi-disciplinary heritage, social innovations tend to reflect social processes that are built on the voluntary engagement and collaboration of citizens to help create new social networks, civil society partnerships, and social entrepreneurships that help deliver services to vulnerable groups[74]. With this in mind, WP7 aims to contribute to a better understanding of factors affecting awareness and societal acceptance of NbTs and facilitate the establishment, implementation, and scaling of selected NbT interventions through Social Innovation Actions (SIAs). It will meet this aim by: identifying and examining the factors that promote/hinder awareness and social acceptance of NbT interventions in different socio-economic, institutional and geographical contexts (T7.1); identifying and building on possible linkages between healthcare, social, and educational sectors with green space management, nature protection, agriculture, and forestry sectors on the analysis of networks and characteristics of three CSs with social innovation potential (CSs4-6; T7.2); and facilitating the design, implementation and/or scaling of CSs 4-6 to help local communities turn NbTs into opportunities for community resilience, green job creation, and nature protection, using a SIA approach. Ultimately, we will work with local communities to arrive at a situation where relevant stakeholders feel comfortable preparing and/or signing a Memorandum of Understanding for future implementing/scaling of the respective interventions (T7.3).

WP8: What Works: A 360º cross-sectoral view of effective, equitable, replicable, sustainable & scalable NbTs. The primary aim of WP8 is to take an overarching cross-sectoral view and integrate these various perspectives into a single unified overview in order to provide a "*sharper view of green space management, nature protection, agriculture and forestry sectors as care providers and their possible linkages with the healthcare, social and educational sectors*". We will develop a systematic process evaluation protocol[75] for Level 2&3 CSs that will take a meta-perspective monitoring how the sectors work together, and how such collaborations can be improved, in order to "*identify best-practices"* and *"improve monitoring schemes of nature-health linkages to enhance the evidence base*". Key aspects will include how patients are/could be referred to such programmes (e.g. directly by health professionals or through link workers), the appropriateness of referrals (are the projects appropriate for specific clients?), how costs are reimbursed or covered, and the existence of any quality appraisal systems to ensure standards of care exist etc..[76] As with other WPs, these evaluations will be co-designed e.g. in the Hubs (T8.1), data collection for them supported during the CSs (T8.2), and data from multiple CSs synthesised (T8.3). Findings will inform a '*Nature-based Therapy Process Evaluation Guide'* ***(D8.1)*** to support future NbT programmes optimise cross-sectoral working. WP8 will also conduct cross-sectoral scenario analyses for selected CSs that will combine the biopsychosocial and social-ecological systems perspectives and integrate multi-sectoral data in order to understand the potential NbT-related cross-sectoral trade-offs and synergies (T8.5-T8.7). Scenarios will estimate the cross-sectoral impact of scaling-up and/or scaling-out a given programme under different future conditions (e.g. temperature, population density, land-use etc.). The social-ecological system dynamics will be simulated using modelling tools which can test the resilience of a system, simulate the behaviour of the elements under plausible future conditions, compare management alternatives, and facilitate the communication of scientific results to managers and policy makers, by estimating multi-sectoral implications of various scaling-up and scaling-out options for different geographical or socio-economic contexts[71]. Cross-sectoral scenario results will feed into the '*What Works Nature-based Therapies Guide For Decision Makers, Practitioners & Funders'* (**D8.2**), and be led by AZTI given previous experience and expertise with these scenario modelling systems[77].

O2.3 Demonstrating how multi-sectoral actors can collaborate in practice. While our Level 3 CSs 7-9 already have well-established cross-sectoral networks, our nascent Level 2 CSs 4-6 present an opportunity to build new local stakeholder co-creation partnerships to develop locally acceptable NbTs by combining new social, technological, and/or organisational practices via Social Innovation Actions (SIAs). Due to the centrality of both biopsychosocial and social-ecological resilience in our approach we refer to these SIAs as "Nature-based Therapy Resilience Hubs". The 3 Resilience Hubs, one each for CSs4-6, will build on, strengthen, and enlarge existing local networks to establish and run local NbT initiatives by empowering individuals to be partners in NbT innovation processes (T7.3). Drawing on best-practice H2020 SIMRA (Social Innovation in Marginalised Rural Areas) project guidance, and following the quintuple helix[78] approach, stakeholders will include actors from all relevant sectors including health/social care, planning, agriculture, forestry, marine, education, public/private finance, and resident associations. In each CS, a preparatory Social Network Analysis (SNA[79]) will use snowball sampling techniques, semi-structured interviews, and specialised software (e.g. Gephi), to analyse the existing cross-sectoral linkages and identify the potential gaps in relations between key actors. The Hubs will then act as focal nodes for community engagement, guiding the cross-sectoral co-creation process, and seek to find new governance solutions and financial instruments to support a stable reconfiguration of nature-based social practices for more resilient communities. Further cross-sectoral support will be provided by the WP lab-exchanges. By enriching these NbTs through SIA practices we will ensure locally-sensitive, community-acceptable, and technically feasible NbTs, and provide a set of examples of how NbTs can realise their potential through SIA approaches. Combined, these processes will support our understanding of how NbTs can be scaled-up (e.g. changing policies/regulations to support NbTs) and scaled-out (e.g. increasing numbers, rolling out to different locations). Lessons learned from these three demonstrator Hubs will be synthesised in a '*How to Set up Resilience Hubs for Nature-based Therapies Guide*' (**D7.2**).

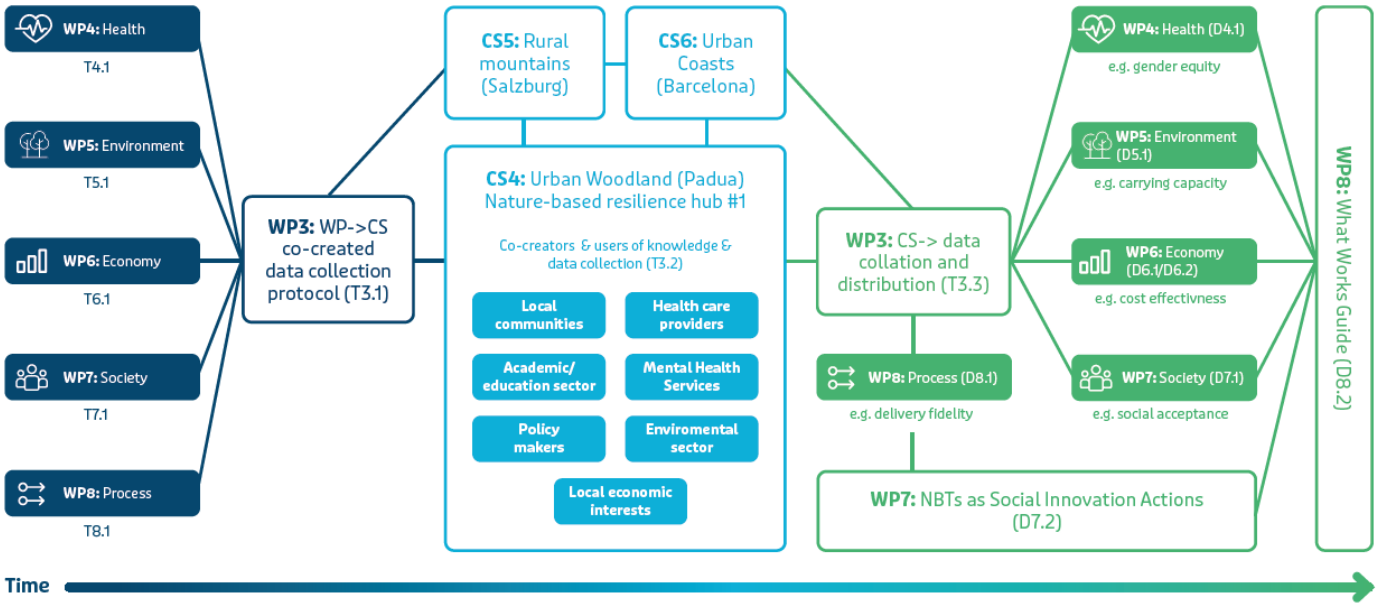
A schematic view of how these cross-sectoral processes and Resilience Hubs will work in practice is provided in Fig.2, taking CS4 (Padua) as an example. Fig.2 also shows how key tasks across WPs lead to specific deliverables (when scaled up across all CSs) and thus represents a type of ***PERT diagram*** (inserted here rather than Section 3.1 to aid clarity). The Hub is the central focal point, with members drawn from different local sectors and supported through SIMRA-inspired processes and expert knowledge/advice from consortium and IEAB members. Once established, Hubs will be presented with the same "seed" NbT study design across CSs 4-6 and members stimulated to discuss the pros/cons and enablers/barriers of such a study in their locality, co-develop solutions and adapt the protocols to make them appropriate for local needs and sensitivities. Simultaneously, the four sectoral WPs and one process WP will be developing a data needs package (Ts 3.1, 4.1, 5.1, 6.1, 7.1, 8.1) spanning the research objectives. These processes will occur in parallel in the rural (CS5) and coastal (CS6) locations, with data outputs from the 3 CSs collated in T3.3 for subsequent distribution to the WPs for analysis. WPs 4-7 will produce sectoral specific guides that in turn feed into the overarching What Works guide (**D8.2**). WP7 and 8 will also synthesise process evaluation

results and metrics of how the Hubs are working as SIAs, results of which will feed into the Resilience Hub Guide (**D7.2**) and ultimately the overall What Works guide, which are designed to help meet GOs 3 & 4 (greater awareness and utilisation of NbTs) as discussed further in Section 2 Impact.

FIGURE 2

Example Case Study Collaboration

Schematic of cross-sectoral collaboration and research for CS4 (Padua Urban Woods)



1.2.3 Directly relevant projects involving RESONATE partners and International Expert Advisory Board

RESONATE consortium members are among the most-established, funded, productive, and highly-cited researchers and practitioners in the nature-health field. Each partner provided a summary of up to 5 relevant projects in Part A of the original submission. We broadly categorise these into four types:

a) Nature-based Therapy projects. Between them, consortium and IEAB members are currently involved in at least 10 major NbT programmes including 4 funded through the commission: RECETAS (H2020), Green4C (Eurasmus+), GreenCare Austria (EAFRD), HEALPS2 (INTERREG); and 6 funded through national/regional bodies: Green Social Prescribing, MoveGreen, Nature-based Social Prescribing, Nature Recipes, NEST, Community for Action Prevention Study, and PaRX Canada. Some projects feed directly into specific CSs by extending ongoing methods and using existing established networks, e.g. CS5 (HEALPS2), CS6 (RECETAS), CS7 (ReST), CS8 (Move Green/NEST) and CS9 (Nature Therapies). Others feed more directly into WPs by bringing relevant insights and skills into potential NbT entrepreneurship and cost-effectiveness (WP6: Green4C/ Nature-based Social Prescribing) and NbT process evaluation (WP8: Green Social Prescribing). Major NbT programmes run by our IEAB, including PaRX Canada, Greener Cities Healthier Lives (Australia), and Stay Healthy In Nature Everyday (SHINE, USA), will support WP2 (Global Perspectives) and offer insights across the whole project.

b) Nature-based Solutions projects. Consortium and IEAB members also have a long history of leading and being involved in NbS projects. Current ongoing projects include Connecting Nature (H2020), GoGreenRoutes (H2020), GroundsWell (UK, MRC), RECONNECT (H2020), REGREEN (H2020), URBiNAT (H2020) and Better Parks, Healthier For All? (NHMRC, AU/UKRI, UK). A common theme across all of these projects is the need for community co-creation and innovation to achieve equitable health goals, with experiences and insights directly feeding into relevant community co-created CSs 4-6 and the development of the Resilience Hubs. Ensuring that NbSs protect environmental (as well as human) health and well-being is also an aim of several of these projects (e.g. REGREEN), whose results will directly inform WP5 (Environment). Other projects (e.g. RECONNECT) have inspired us to work with other related programmes to develop an "NbT Task Force" (see Impact).

c) Relevant networks. The relevant networks that consortium and IEAB members have is already extensive. Some members are also deeply embedded in specific networks with direct relevance to RESONATE activities. EHNet, for instance, are a central partner in CHAIN (The Centre for Global Health Inequalities Research) which is the leading global network for the international study for health inequalities, with direct relevance for WP4. Similarly, PMU are core members of the INTERREG-funded Forest-based Health Tourism Network which promotes cross-border development of sustainable business models for the use of forests for nature-based health tourism. The insights from this network feed into several WPs, most notably WP7, and have directly inspired the methods proposed to seed the

community co-creation discussions for CSs4-6. Finally, the University Global Partnership Network funded 'Less Netflix, More Nature!' project (Astell-Burt) is a global research network examining the acceptability of, demand for, and perceived barriers and enablers of 'green social prescriptions' across contrasting cultural, economic and climatic contexts, with insights feeding directly into WP2 (Global Perspectives) and WP7 (Society).

d) Relevant methods. Further projects use methods directly relevant to RESONATE. PROTECT (NIHR, UK) is a UNEXE run prospective longitudinal panel of older adults. The analytical methods used to explore environmental and behavioural predictors of dementia here will be extended to the as yet unexplored issues of nature contact before and during times of stress to build biopsychosocial resilience resources (CS2), with parallels to the Nature, Healthy Ageing and Dementia project (NHMRC, AU). Similarly, the statistical life-course methods being used in Equal-life (H2020) and Greener Cities, Healthier Lives (Hort Innovation/UOW) will be adapted to explore the role of prior and ongoing nature contact in mitigating the impact of both major life (CS1) and every day (CS3) stressful events through biopsychosocial resilience processes. Consortium member projects such as Healthy Green Hospitals (NWO, NL) and JAHEE (DG-SANTE) have already informed our metrics for measuring health and health equity outcomes, based on reviews and best-practice recommendations within those projects. The development of the Social Innovation Action Resilience Hubs will use the steps recommended by UNIPD's role in the SIMRA (H2020) project, as well as other aspects of social innovation and network-based governance solutions in agriculture, forestry, and rural development inspired by SINCERE (H2020). Finally, the cross-sectoral scenario analyses planned in WP8 will use a system dynamic modelling tool (VENSIM) to build a social-ecological model that was developed as part of the MARS (FP7) project exploring how environmental changes can impact the benefits that humans obtain from ecosystems.

Transdisciplinary Approach (including social sciences and humanities)

RESONATE is inherently transdisciplinary reflecting the cross-sectoral needs of successful NbTs. Consortium members work across disciplines, with backgrounds including medicine (Dimitrova, Fleming, Lem, van den Bosch), paediatrics (Razani), immunology, molecular medicine & public health (Freidl, Hartl, Pichler), epidemiology (Astell-Burt, Dzhambov, Grellier, Litt), health policy (Costongs, Godfrey), process evaluation (Morgan Trimmer), health geography (Wheeler), medical sociology (Lovell), clinical/motivational psychology (Lymeus, Moe), environmental psychology (Elliott, Hartig, Pahl, Wells, White, Van den Berg, Van Rompey), environmental economics (O'Driscoll, Doimo), forestry (Konijnendijk, Rogelja, Secco), agriculture (Prop), marine ecology (Borja, Pouso, Uyarra), landscape architecture (Bekke-Hansen, Stigsdotter), statistical methods (Voracek), and data management (Karlsson Nyed). Most individuals already work in interdisciplinary teams in NbT research and practice, including recognised pioneers (e.g. Hartig, Stigsdotter, Van den Berg, Van den Bosch, Wells), and have demonstrable experience and core skills needed to achieve our objectives, including: global systematic and mapping reviews in the nature-health field (WP2); analysing longitudinal nature-health datasets and developing and administering NbTs (WP3); health equity assessments (WP4); environmental impact assessments (WP5); economic impact assessments and NbT financing (WP6); social and digital innovation actions, including co-creation mechanisms (WP7); and NbT process evaluation, multi-sectoral scenario analysis, and preparing overarching NbT policy documents (WP8). RESONATE is deliberately designed to represent and gather information from different interdisciplinary and sectoral perspectives through its WP structure (esp. WPs 4-7) and innovations such as the Resilience Hubs, which are designed to promote and facilitate transdisciplinary collaboration, and the sectoral specific Guides that feed into the overarching What Works guide aimed at synthesising the multi-sectoral perspectives. Our International Expert Advisory Board is composed of experts who run their own NbT programmes in Austria (Prop), Australia (Astell-Burt), Canada (Lem), and the USA (Razani, Wells), alongside experts in public patient involvement (Maguire) and environmental/ecological ethics (Poole), see also Section 3.2 (Consortium as a whole).

Gender, intersectionality, & socio-demographic inequalities

Despite efforts to equalise health and well-being across genders and socio-demographic groups, including SDG 5 (Gender Equity), widespread inequalities remain. Although women tend to have higher life expectancy, they also tend to live more years with a disability, with ischemic heart disease and stroke being the leading causes of mortality[80]. Women and girls also report higher rates of mental health disorders across the life-span[80]. Importantly, these NCDs are precisely those that NbTs can address[11]. Nevertheless, there is also considerable evidence that men and women perceive and use greenspaces differently. While safety concerns are a widely discussed reason for women to visit urban nature less than men[81], a large UK study found that being "too busy at home" was a far more important reason for women's reduced nature visits, reflecting wider gender disparities in domestic and caring roles[82]. Other disparities also exist. The same study found that those in the lowest *vs*. highest social grade, those over 65years *vs*. 16-34yrs, those with *vs*. without a long-term illness/disability, and those from an ethnic minority *vs*. being 'white British', were all approximately half as likely to visit nature for recreational purposes, raising the issue of intersectionality in the nature-health field. In short, those who may benefit most from nature are often those who access it least, and reversing this trend may help to reduce health inequalities, a so-called equigenetic effect[12].

RESONATE takes these inequalities extremely seriously, devoting WP4 to their exploration, and including widespread efforts to make NbTs more inclusive, fair, and available to all. WP2 will investigate gender and other sources of inequality in the global Systematic Map; the large-scale longitudinal cohorts of CSs 1-3 will enable analysis of relationships between nature exposure and outcomes to be stratified on a range of potential sources of inequality, including gender, age, income, and ethnicity; CSs 4-6 will recruit approximately equal numbers of males and females to observe potential differences in both NbT outcomes and procedural factors such as drop-out rates across gender (the size of these studies will make it difficult to explore relationships for those identifying as non-binary); CSs 7-9 deliberately target under-represented groups in the nature-health field including people with clinical levels of psychological distress which is more prevalent among women (CS7), people with physical disabilities (CS8), and older adults with cognitive impairment (CS9). WP7 will stratify the analysis of awareness and acceptance by gender, and The Resilience Hubs will actively promote inclusivity and openness to all, a requirement for genuine community representation and long-term effectiveness and sustainability of NbT programmes. In addition, our IEAB member Maguire is an expert in Public Patient Involvement (PPI) and will help us ensure that all perspectives are inclusively captured and utilised across all aspects of the project. We will follow the Sex and Gender in Research (SAGER) publication guidelines in our publications and reports, and report sex/gender disaggregated analysis regardless of positive or negative findings to avoid publication bias.

Ethics, data management, and open science

Recognising the importance and interconnectedness of ethics, data management, and open science, WP1 will oversee the coordination of all ethical, data management, and open science needs and practices and will support all partners achieve the highest standards of ethical and open science, and FAIR data management. T1.8 will produce a FAIR Data Management Plan (**D1.2**) which will be updated for subsequent reporting periods (D1.3 and D1.4) summarising the management of data including: bibliometric, biological, geospatial, observational, and self-report. Plans will include a clear variable naming convention and information on data format, file size, and anonymisation protocols. ***Findability*** protocols will include repository information, a DOI (where applicable), and metadata (enabling fast/efficient data location). ***Accessibility*** protocols will identify embargoed data and provide a timeline for full open access, and software needed for further scrutiny. We have already begun discussions on the IPR of those requesting (i.e. WPs) and collecting (i.e. CSs) data and on collaboration agreements regarding use of the data and joint publications. Following recommendations, we plan to make all anonymised data Open Access within 24 months of collection. ***Interoperability*** protocols will record data capture mode, equipment used for data processing and analysis, and the shared data format. ***Re-usability*** will be ensured by keeping full records of data provenance (incl. contributors/version tracking), research documentation (to support replication), by using open-source software (e.g. QGIS, R) where possible, and identifying an appropriate Creative Commons licence for re-use. WP1 will also support each CS produce a *Study initiation package* (**D10.5**), a *Midterm recruitment report* (**D10.6**), and a *Results posting report* (**D10.7**), where appropriate (see *Clinical Studies Annex*). Individual reports will be collated by WP1 into single overarching documents that are ethics-related mandatory deliverables located in WP10. Given that ethical issues in this area tend to focus on the rights of participants, an innovation of RESONATE's IEAB is the inclusion of an environmental ethicist (Poole) who will advise on broader ethical issues surrounding NbT's use of public/natural spaces and potential spill-overs (e.g. the rights of wildlife to be undisturbed). Further, an independent, external expert in EU Data Management law will be recruited by Mth1 (**D10.1**), to verify compliance with all ethical requirements with reference to: a) Humans, especially in relation to the inclusion of vulnerable individuals (e.g. CS9); b) Human cells / tissues (esp. CSs3-6); c) Processing of personal data, including data identifiability and data transfers (all CSs and other activities including participation in the Grand Rounds and Resilience Hubs); and d) Participation of non-EU countries (e.g. CSs1-2 and WP8). In support of Open Science, where appropriate CSs will pre-register their planned research, hypotheses, and data analysis protocols, e.g. through the Open Science Framework (OSF). For CSs where co-creation is an integral part of the process (e.g. CSs 4-6 and 9), more open-ended pre-registrations will be required. Partners will also ensure that published academic work is Open Access, and where possible Gold Open Access, and will be linked to the website even after the project is finished, so that outputs are collated in a single repository for easy accessibility. Open Science is inclusive science and PPI expert (Maguire) will help us ensure that patients and members of the public are partners in the knowledge co-creation and dissemination processes. We are acutely aware that RESONATE will be funded through public resources, and that the public is entitled to share in these processes and has a right to fully access its outcomes. Ultimately, all outcomes will be uploaded to institutional repositories, and/or Oppla or Zenodo where appropriate, and UNIVIE have agreed to continue to support these processes and update the RESONATE website for at least 5 years post-project to ensure continuation and support legacy and impact.

2. Impact

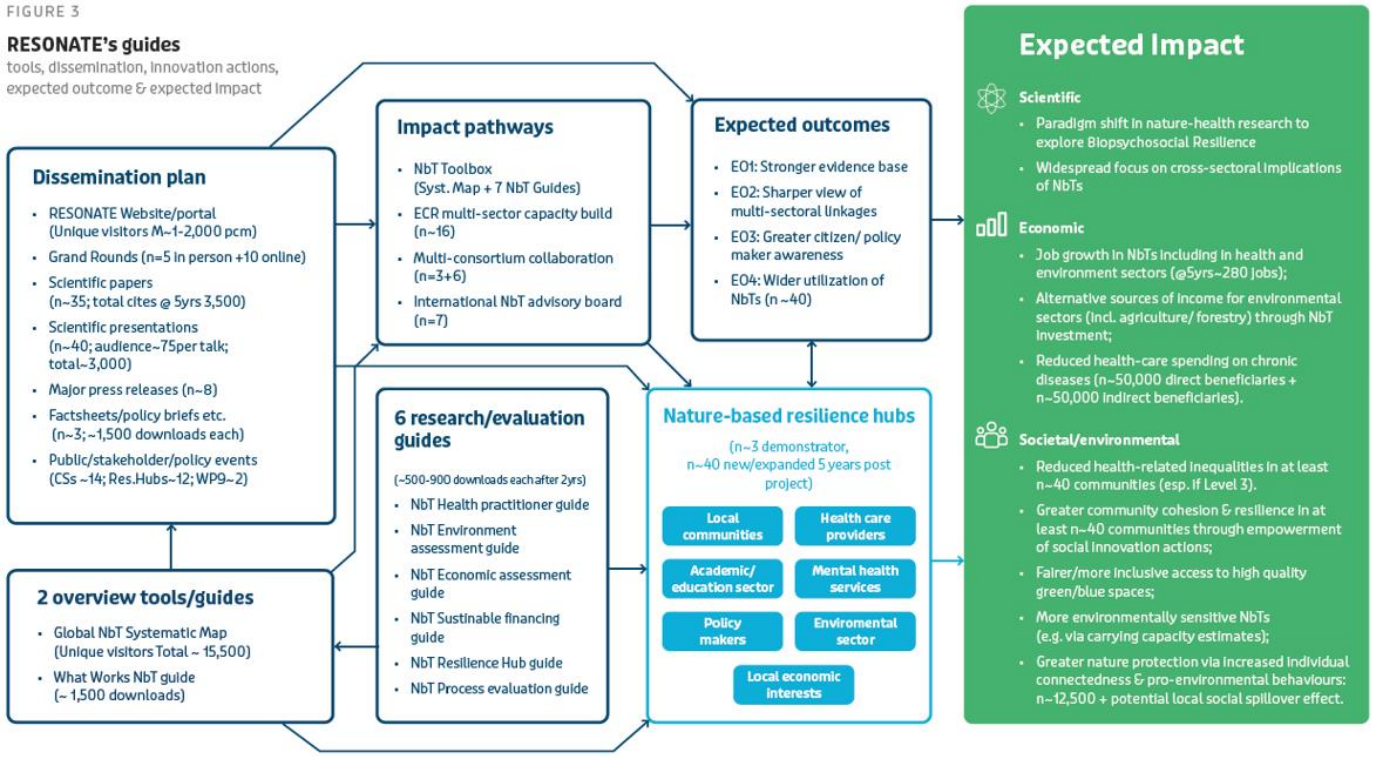
RESONATE will contribute to more ***resilient, inclusive, healthy, and green rural, coastal, and urban***

communities by focusing on the first expected impact in the destination: *Rural, coastal and urban areas are developed in a sustainable, balanced and inclusive manner thanks to a better understanding of the environmental, socio-economic, behavioural, cultural and demographic drivers of change as well as deployment of digital, nature-based, social and community-led innovations*. With a focus on mainstreaming cost-effective NbTs, and how these can be linked to the existing NbS infrastructure, the relationships between our results, outputs, dissemination plan, impact pathways, expected outcomes and impacts are summarised in Fig.3.

2.1 Project's pathways towards impact

Below we outline the impact we intend to have beyond the immediate scope and duration of the project and the pathways we will establish during the project to increase the probability these impacts will occur. Here, our general objectives (GOs) are mapped to the call's Expected Outcomes (EOs).

FIGURE 3



Scientific Impact. The high-quality evidence that will be produced by RESONATE's unique and complementary design will achieve lasting scientific impact by contributing to two key changes: 1) a ***paradigm shift in NbT research*** resulting in new knowledge and evidence of biopsychosocial resilience processes that can causally explain nature-health relationships; and 2) an evidence-based understanding of the ***cross-sectoral implications of NbTs*** beyond health including equity, environment, economy, and society.

Pathways: 1) A paradigm shift will be obtained through our broad set of complementary scientific studies, which will provide evidence on the interrelations between the social-ecological resilience potential of bringing nature closer to people (NbSs), and the biopsychosocial resilience potential of bringing people closer to nature (NbTs). By providing evidence on effectiveness and biopsychosocial resilience pathways, we will have significant impact on the academic community and a high potential for science to policy and practice translation of our results. By signing the Consortium Agreement, all members will agree to continuing to produce scientific and research outputs and communicate and disseminate project results after the project ends. Based on previous EU projects we expect, in addition to our original NBRT paper currently under review, a total of ***n~35 peer-reviewed papers***. In addition, we have costed for each institution to present at 2-3 ***international academic conferences (n~40)***. In Fig.3 this pathway (*Pathway 1*) is represented by the direct arrow from dissemination to EOs. Our academic outputs will also reach our EOs through our involvement in the proposed multi-consortium collaboration and by being disseminated globally by our IEAB through their ambassadorial role (*Pathway 2 – Impact Pathway Box, Fig. 3*). 2) To increase the knowledge and scientific focus on cross-sectoral implications of NbTs, we have three key mechanisms. First, the ***cross-sectoral scenario analysis*** (Ts 8.5, 8.6, 8.7) described under WP8 will provide researchers with a working template for how to conduct such complex data integration (**O4.1**). Second, our toolbox of resources for researchers, practitioners, and policy makers (**O4.2**) will provide clear step-by-step guidelines on how to support, monitor, and assess cross-sectoral integration in new and existing NbT programmes. Specifically, the Guides will contain details on NbT health equity

issues (**D4.1**), environmental impact assessment (**D5.1**), economic impact assessment (**D6.1**), sources and mechanisms for finance (**D6.2**) and process evaluation (**D8.1**), as well as laying out how the scientific community can help establish SIAs in the NbT field through supporting the co-creation and implementation of Resilience Hubs (**D7.2**), and an overarching generic 'What Works' guide (**D8.2**) detailing how all the pieces fit together (*Pathway 2 – Toolbox, Fig. 3*). Third, we will promote a cross-sectoral working legacy within the NbT field by supporting a well-funded (€40,000) programme of ***beneficiary lab-exchanges*** which will enable researchers from specific WPs to undertake visits to other RESONATE partner institutions with different backgrounds and skills sets (e.g. economic vs. process evaluation). These exchanges will help deliver optimally-integrated evaluation and assessment protocols to be applied across multiple Case Studies. Integrated understanding of the requirements of other partners and disciplines is a critical part of RESONATE's attempt to break down disciplinary silos. These funds are currently distributed equally (8k each) between the five WP partners that we envisage will benefit most from these cross-partner visit opportunities (UNIVIE, AZTI, UNIPD, NBSI, UNEXE) with the aim of funding up to four visits per partner (one per year). If the funds are not used by the currently allocated partner we will transfer them to another partner for these purposes in discussion with the Project Manager.

Targets/beneficiaries will primarily be the rapidly growing groups of scientists globally (including RESONATE's ECR community) researching nature-health relationships. A recent review highlighted the exponential growth in the field with the number of publications rising ten-fold between 2003 (~230 papers) and 2018 (~2300 papers) alongside a significant increase in the number of journals publishing these topics across various disciplines including e.g. epidemiology, public health, psychology, geography, urban planning, forestry, and environmental economics[17].

Scale/significance: Consortium members' track records means we have high potential to achieve extensive readership/citations; the consortium contains many of the most highly-cited authors in the nature-health and associated fields e.g. >25,000 cites (Hartig, Borja), >20,000 (Fleming), >15,000 (White), >10,000 (Konijnendijk, Van den Berg, Wheeler), >5,000 (Astell-Burt, Corbett, Pahl, Stigsdotter, Van den Bosch, Wells). Based on H2020 BlueHealth (see examples in Table 2.1), and using WP9's coordination, dissemination, and promotion package we estimate an average citation rate after 5 years of ~100 per paper, total ***~3,500 cites in the medium term***. With an estimated average audience of n~75 per scientific presentation (keynotes will be larger, symposia talks smaller), we conservatively predict a ***total academic presentation audience of n~3,000***. WP9 will help co-ordinate academic engagement, e.g. by helping organise conference symposia with several talks for greater project impact (T9.5).

Barriers/mitigation: An important barrier for academic reach is journal paywalls, which disproportionately limit access for certain sectors of the scientific community (e.g. those in lower income countries). To mitigate this issue, RESONATE adopts open-access approaches with partners including budgets for Gold Open Access publications (T1.9) and by adopting FAIR and open data management principles so that the academic community has access to the data generated during the project for subsequent use (T1.8).

Economic impact. RESONATE's economic/technological impact will depend largely on the number of new NbT programmes the project inspires to be successfully implemented and the number of existing programmes that are inspired to scale-up and/or scale-out their operations.

Pathways: We envisage two main pathways to achieving these impacts. 1) The ***Global NbT Systematic Map*** conducted by WP2 (**D2.2**) will collate existing peer-reviewed programmes in a single on-line interactive mapping tool, hosted on the RESONATE website from which those interested in starting new, or expanding existing, NbTs will have access to a global repository of best-practice projects from which to draw inspiration and learn about the enablers and barriers to sustained success. The Global NbT Systematic Map will be hosted on the RESONATE website at least 3 years after the project ends (*Pathway 2 – Toolbox Fig.3*). Drawing on previous projects (e.g. H2020 BlueHealth), we predict ***~2,000 unique visitors to the website per month*** from the second year on, of which ~25% will actively interact with the Systematic Map at least once. Between launch (Mth41) and 24 months post project, this would suggest n~15,500 unique visitors. Although hard to estimate how many of those engaging with the Systematic Map will be inspired to establish new or expand existing NbT programs, even if it were only ~0.25% that would still be n~40 new/expanded initiatives, which is a significant number, given that NbTs are still relatively uncommon. 2) WP6 is devoted to understanding the economic implications of NbTs and will produce two key guideline documents to help new/expanding initiatives better understand and fulfil their economic potential. First the '*NbT Economic Impact Assessment Guide'* ***(D6.1)*** will develop evidence-based scenarios about what a scaled-up/scaled-out offering of selected NbTs might look like including job creation and local economic impacts, which potential providers can use to create business cases when seeking funding. Second, the '*NbT Sustainable Financing Guide'* ***(D6.2)*** will build on the work of the Green4C project for the Green Care sector to conduct a market analysis of the supply and demand potential for NbTs in different sectors (green space management, rural development, and forestry) and analyse the public and private business case for NbTs, again offering practical support for new/existing NbTs to develop clear business cases and understanding of the funding networks and landscape that may be willing to support them. They will also identify financial mechanisms for Resilience Hubs to become permanent *(Pathway*

2 – Toolbox, Fig. 3).

Targets/beneficiaries: The main targets of these two pathways are: a) those wishing to set up new or expand existing NbTs; b) the public/private sector actors interested in supporting them financially; and c) those who may be willing to host them. The Systematic Map will offer those setting up NbTs inspiration and suggestions about what is possible and some of the financial challenges that need to be overcome, and the specific economic impact and sustainable financing guides will offer clear evidence and practical steps for how to fund such programmes. Potential funders may include public health bodies or health insurers who need to know that such programmes can be cost-effective, and NbT hosts including private land owners who need to estimate the returns from various activities on their land (e.g. harvesting forests vs. supporting NbTs) before offering support. Analysis of the UK's Green Gym programme using Social Return on Investment (SROI)[83] approaches, suggested that for every £1 invested, the social value in terms of health, environmental, economic, and social outcomes was £2.38[84], suggesting that significant returns can be realized if cross-sectoral actors appreciate the mutual co-benefits.

Scale/significance: If n~40 new/expanded initiatives are inspired by the Systematic Map and use the guides to help them set up or expand their projects this could still have significant economic impact. Using the Austrian Green Care sector as an example[85], there were 39 Green Care initiatives running in 2019/2020, each engaging n~250 users per year and employing n~7 staff. Assuming a similar scale in new NbTs and a doubling of capacity of existing ones this suggests that n~40 new/expanded projects might reach n~10,000 new individuals per year and employ 280 new people. Importantly, these jobs will not just be in the health and social care sectors, but will also extend to sectors such as agriculture and forestry given the expertise required to run NbTs on often "working landscapes"[86]. Over five years this would equal n~50,000 clients, resulting in potentially significant economic impact through ***reduced health-care spending on chronic diseases***. Once WP6 has conducted the cost-effectiveness analysis to be included in the '*NbT Economic Impact Assessment Guide*' (**D6.1**) we will also be able to quantify what these savings could look like. We believe our estimates are conservative because: a) they do not include the potential use of the Economic Guides by NbT practitioners looking to scale-up and scale-out existing programmes who have not engaged with the Systematic Map; and b) an assumption that existing programmes merely double in size may be underestimating the true expansion potential (e.g. CS7 aims to scale-out to multiple locations).

Barriers/mitigation: The first barrier to RESONATE's economic impact through these pathways is lack of awareness of the on-line NbT mapping tool and the NbT economic/financing guides. The communication, dissemination, and exploitation strategy is expanded in Section 2.2, but here we note that the mapping tool will be promoted via the five face-to-face and ten online Grand Rounds (T2.4), including ones supported by our IEAB in Canada, East and West USA, and Australia, which between them are estimated to reach n~3,000 researchers, practitioners, and stakeholders. More broadly, a lack of mid- to long-term financing is a barrier for existing NbTs[38], which is why our Guides will be designed to mitigate the concerns of potential investors, hosts and policy/decision makers by detailing issues such as cost-effectiveness and SROI, as part of outlining the market potential. We recognise that demonstrating cost-effectiveness is no guarantee that projects will be funded. Many Level 1 and Level 2 health promotion and disease prevention initiatives providing significant SROIs are consistently underfunded, in part because policy maker and societal focus tends to be on Level 3 disease treatments and therapies[87]. RESONATE will address this barrier by meeting GO3/EO3 and raising public and policy maker awareness about the economic and other benefits of NbTs in order to make them a more widely acceptable tool in the health and other sectors and stimulate demand among the public (T9.3, T9.4, see Section 2.2).

Societal/environmental Impact. Arguably, RESONATE's largest impacts will be societal and environmental. Most of these impacts will be achieved by RESONATE' capacity to make NbTs more widespread and mainstream, in part through greater awareness/acceptance across all sectors of society including health, environment, and finance.

Pathways: Some of the societal and environmental impacts will be achieved through the pathways discussed above i.e. the Toolbox incl. the Systematic Map and Guides and cross-sectoral silo-busting lab exchanges between partners. Of most direct relevance here are those Guides with most societal/environmental impact potential including those for health ***(D4.1)*** and the environment ***(D5.1)***, as well as the *Resilience Hub Guide* ***(D7.2)***, and the overarching *What Works Guide* ***(D8.2***). These Guides will together provide methods for monitoring and promoting: a) inclusivity and fairness in access to and use of NbTs for health promotion and disease prevention; b) the empowerment of local communities through the engagement, co-design, and co-creation activities embedded in the Resilience Hubs; and c) environmental sustainability and the need to "do no harm" to the environment or those directly affected by it. In order to achieve societal impact, the guides will need to be well advertised, easily accessible, and easy to follow/use, and RESONATE will adopt a plethora of measures (see 2.2) to ensure this happens (*Pathway 2 - Toolbox*). Lastly, on the local level, the Resilience Hubs (and their broader lessons) will feed directly into the EOs by leading to increased stakeholder engagement in identifying solutions for equitable, sustainable, financially viable and locally acceptable NbTs (*Pathway 3*, represented by the direct arrow from the Hubs to the EOs in Fig. 3). To support this process, we will be working with our demonstrator Hubs to draft Memoranda of Understanding concerning continuation of these

pilot projects beyond the official timeline of the project.

Targets/beneficiaries: There are at least four beneficiaries of these activities. 1) The most immediate beneficiaries will be practitioners establishing new, or scaling-up and/or scaling-out existing, NbTs through the provision of guides for assessing core societal (e.g. equity) and environmental (e.g. pro-environmental attitudes) goals, as well as a practical guide on how to establish the Resilience Hubs using local SIA approaches. When set alongside economic evidence to support the business case, stronger evidence of a given programme's broader societal and environmental co-benefits will help them secure more decision-maker support and sustainable funding from a broader set of parties. 2) Arguably the most important beneficiaries will be the NbT end-users themselves, especially those engaging with Level 2 programmes to reduce their risk of various Non-Communicable Diseases (NCD), and those with existing conditions engaging with Level 3 programmes to manage and/or reduce their symptoms and traditional health-care use (e.g. medication, doctor visits). As NbTs may be particularly beneficial for under-served members of society[12], they may help to reduce health inequalities, a key societal goal[88] to be explored and promoted in WP4. Finally, caring for ill relatives also has a toll on the well-being of family members[89], thus healthier end-users also have positive spillover potential for those closest to them. 3) A third societal beneficiary are members of the local communities where NbTs are hosted, especially those established using a Resilience Hub (or similar) approach. The Hubs are designed to empower local communities to engage with the process of NbT co-creation from the start, giving local actors and stakeholders a voice and promoting procedural justice, key elements of building more resilient local communities that are able to come together in times of challenge. By bringing together those looking to build local social-ecological resilience, e.g. through NbSs, with those looking to promote public health via NbTs, and giving voice to other local actors, the Resilience Hubs will provide a clear forum to promote lasting positive outcomes (for recent examples involving UNIVIE, UNEXE & ISGLOBAL consortium members see[90,91]). 4) The final beneficiary is the environment including other species and in turn people positively affected by environmental protection and/or improvement. WP5 will focus on assessing the environmental impacts of NbTs, both negative and positive, identifying ways to limit the former and promote the latter, with support from IEAB expertise on environmental ethics/justice (Poole[92]). Although CSs 4-8 focus primarily on deriving benefits from the environment, CS9 will also look at activities that potentially benefit the environment, and the broader review of the literature (T5.1) will also help identify potential environmental benefits from NbT programmes that directly benefit environmental goals, e.g. conservation activities[93]. Broader environmental benefits in terms of greater nature connectedness and more pro-environmental attitudes and behaviours will also be examined and quantified by WP5.

Scale/significance: Taking the potential n~40 new/expanded NbT projects inspired by the project as an example, carefully designed, inclusive NbTs may help to reduce health inequalities and promote local empowerment and community resilience in at least 40 communities in the medium term. Further, assuming each NbT end-user has at least one person indirectly positively affected by improvements in their health status, the overall impact of improved health from these 40 projects could reach >100,000 individuals in the first five years, with even greater benefits over a longer period, and with greater expansion of the NbT offering. Particular equity benefits might be achievable from the adoption of Level 3 NbTs like those in CSs 7-9 which already target under-served groups and have a "leave no one behind" agenda. Importantly, the scaling-out potential of these types of NbT are being explicitly explored in the project, for instance through CS7's extension of the ReST programme to new Swedish localities, through the monitoring of enablers and barriers to scaling-out potential explored using the process evaluations (Ts8.1-8.3), and through the scaling-up/out analyses conducted in T5.3, T6.4 and T8.7. Finally, if we assume that at least half of the new/extended NbTs use multiple locations (e.g. n~3 local woodland sites) to reduce adaptation and boredom of end-users, this would result in potentially n~80 (20x3 + 20x1) locations where, if carefully designed and managed, significant improvements in local environmental quality and biodiversity could be achieved. This would be especially the case for NbTs that co-design settings for both health promotion and environmental enhancement goals (e.g. CS8) and those which involve active environmental engagement (e.g. CS9). Although hard to quantify in absolute terms, even if only 25% of end-users developed stronger nature connectedness and more pro-environmental attitudes as a result of taking part in these NbTs, that would still result in improvements among some 12,500 individuals in the first five years. Moreover, given that social norms are powerful determinants of pro-environmental behaviours[94], simultaneous shifts in behaviour among significant numbers within a local community may also inspire others to act more sustainably even if they themselves have not directly been involved in the programme. Again, it is hard to estimate these effects here because the relevant data does not yet exist, but a key WP5 aim is to estimate such impacts.

Barriers/mitigation: A significant barrier may be the development of new and the scaling-up and/or scaling out of existing NbTs that do not take a cross-sectoral locally inclusive approach, but instead attempt to implement programmes with minimal local consultation/engagement and focus on specific sectoral goals. Local community resilience requires engagement and collaboration with multiple actors, stakeholders, and groups, and the resilience (i.e. long-term sustainability) of NbTs is no different. A recent systematic review of environmental, health, wellbeing, social and equity effects of urban green space interventions (UGS)[72] found that the most impactful ones were those

with a core co-creation, locally inclusive agenda, and argued that "the true potential of UGS has not been realised as studies have typically under-evaluated UGS interventions by not taking account of their multifunctional nature". Our cross-sectoral, community-focused Resilience Hubs are deliberately designed to meet this need, and by providing three demonstrator examples (CSs 4-6) and subsequent clear Guidelines on how to set up and manage such Hubs, NbT practitioners will be equipped to mitigate these risks themselves.

2.2 Measures to maximise impact - Communication, dissemination, and exploitation

To ensure maximisation of impacts, RESONATE dedicates a specific objective O3.1 to raising public, stakeholder and policy maker awareness (EO3). While recognising that communication, dissemination, and exploitation relate to all Os they are particularly relevant to EO3, which focuses on increasing public, stakeholder, and policy maker awareness of the potential health and well-being benefits of nature, especially through NbTs, via O3.1: Communication/Dissemination and O3.2: Multi-consortium collaboration, as well as O4.2: Exploitation via tools & guides. A full Dissemination and Exploitation Plan (DEP) will be delivered byMth6 (**D9.2**) explaining how communication will run throughout the whole project. This will be updated at Mth36 (**D9.3**) and Mth48 (**D9.4**). Dissemination will start as soon as results emerge, and exploitation will begin once actionable deliverables are ready. A summary of activities, linked to specific Tasks, across four overlapping stages, is presented in Table 2.1. We will build on our initial visual identity to produce a set of project templates and promotion materials, ensuring a unified style to all DEC activities. Interactive project brochures (e.g. with QR codes) in multiple languages will promote an inclusive approach to meeting GO3/EO3. Although WP9 is the dedicated WP, other WPs will contribute essential sector specific contributions as reflected by person-months allocation to WP9 (>10% of total). Activities will be overseen by a communications team led by WP9 with representatives from selected WPs that will meet twice a year to evaluate the success of project communication activities and adjust activities accordingly. With the signing of the Consortium Agreement all partners will agree to communicate and disseminate project outputs and results well after the project ends to ensure legacy.

Table 2.1. Dissemination, exploitation, and communication (DEC) activities by stage.

Activity	Outputs	Target audiences	Expected use and impact
Stage 1: Mth1~11			
Visual identity	Finalised RESONATE visual identity, logo, document & talk templates (+ funding source).	Internal project partners.	All partners use project 'brand' & house-style for their outputs and communication.
Website 1.0 (T9.1)	Website launched by Mth5 outlining project structure, aims, and goals. Password protected partner section and Resilience Hub platforms.	All target audiences incl. researchers, practitioners, sectoral stakeholders. Platforms for internal & Resilience Hub use.	N~500 unique visitors per month by Mth11, incl. local stakeholders involved in CSs & Resilience Hubs (~50 per CS/Hub incl. end-users).
DEC Plan (T9.2)	Delivered by Mth6; Living document, reviewed bi-annually by comms sub-group, and updated Mth36 & 48	Project partners, EU project officer.	Lay out DEC activities & partner expectations regarding comms. and protocols.
Resilience Hubs (T4.1, T5.1, T6.1, T7.2, T7.3, T8.1)	3 Resilience Hubs established and CSs 4-6 co-designed with cross-sectoral stakeholder interactive dialogue.	Local NbT stakeholders in Padua, Salzburg, & Barcelona + reps. of WPs3-8.	N~20 active stakeholders (incl. PPI) per Hub with Hub specific website pages for coordination/communication.
Scientific publications/ Presentations (T9.5)	Protocol paper submitted; Hub stakeholder briefs (in 3 languages) summarising approach.	Paper targeting scientific audience; Brief targeting NbT CS/Hub stakeholders.	Based on BlueHealth protocol paper[95]: n~ 12.5k reads; 160 cites @5 years. Brief read by ~100 local Hub actors.
NbT Network (T1.4)	Multi-project working network established with other funded NbT and related projects.	Potential NbT Network partners (n=2 + ~6 others).	Plan to coordinate joint DEC activities for maximum impact avoiding duplication (D1.1).
Stage 2: Mth12~48			
Website 2.0 (T9.1)	First refresh with expanded social media, blog, podcasts.	All target audiences.	N~1000 unique visitors per month (based on BlueHealth).
Grand Rounds (T2.4/T1.6)	5 face-to-face: 2 in Europe and 3 hosted in international partner countries (funded under T1.6) and 10 online webinars.	All target audiences directly/indirectly through streaming/ downloads.	Target N~50 per face-to-face meeting (Total~250); Via online webinars (N~200 each). Total reach n~2,250.

Resilience Hubs (T4.1, T5.1, T6.1, T7.2, T7.3, T8.1)	Ongoing two-way communications between Hub actors and project partners to successfully deliver CSs 4-6.	Local NbT stakeholders in Padua, Salzburg, & Barcelona + reps. of WPs3-8.	Provides inspiration to scale-up/out NbTs at CS sites, and provides examples for further dissemination (D7.2).
Social media activities (T9.3/T9.4)	Weekly summaries of major advances on social media posts incl. Twitter, Linkedin, Instagram, Facebook etc. with a project-specific hashtag.	All target audiences, with dedicated posts for specific audiences (e.g. health sector, forestry etc.) and CS localities.	Linkedin and Twitter pages have at least at least n~1000 followers by Mth18 & n~2000 followers by project end.
Blogs and podcasts (T9.3/T9.4)	20 blogs, 10 podcasts in total focusing on key project findings as well as on telling service user stories ('storytelling approach').	All project target audiences, with focus on policymakers, health professionals, wider public (service users).	Target audience for each blog/podcast n ~400. <u>*N.B. Social media/blogs/podcasts begin in Stage 1 & significant increase during stage 2.*</u>
Events (T1.4/T9.3/T9.4)	~14 CS linked events	Local/national audiences across all sectors e.g. Local Health Boards & Local Action Groups of the EU Rural Dev. Prog	> 100 attendees per event (+ online Ps) total n~3000. Aim to generate interest in NbTs as workable local/national cross-sectoral initiatives.
Events will continue into Stage 3 (not repeated below due to space)	12 Resilience Hub events (4 per Hub across the lifespan)	Local actors and stakeholders	~20-40 per event. Ongoing two-way dialogue.
	2 High-level events bringing all the pieces together (e.g. 'policy breakfasts') run by WP9 + *Multi-consortium events*	e.g.: WHO Europe, EUF, EUSTAFOR, USSE; World Urban Parks, EUPHA, NATURA2000	Clear evidence-based messages targeting policy-level shifts needed to make NbTs mainstream.
Scientific publications/ Presentations (T9.5)	Based on BlueHealth ~24/35 papers submitted. 3 x academic presentations per partner (total n~40).	Meetings incl.; EU Green Week; European Public Health Conf.; Healing Power of the Alps.	Based on 2017 BH paper[96] up to 350 cites per paper @5 years. Average presentation audience n~75 (total n~3,000).
Press releases and popular press stories (T9.3)	2-3 per year of major findings. Work in advance with national and local journalists to craft press stories.	General public but also high-level policy makers respond to press coverage.	Potential reach n >500,000 per story (multiple past papers of team ranked in AAAS top 50 annual Altmetric scores).
Stage 3: Mth36~48			
Website 3.0 (T9.1)	Second refresh with focus on Systematic Map and Toolbox Guides for direct download.	All target audiences, esp. cross-sectoral policymakers & funders.	N~2000 unique visitors per month (based on BlueHealth), higher after press releases.
Toolbox Guides (T4.4, T5.4, T6.4, T6.5, T7.3, T8.4, T8.8)	6 x sector specific and 1 x 360^{O} 'What Works' Guide of key findings, giving detailed guidance on how to measure sectoral parameters, identify finance, & set up Hubs.	All key project target audiences. Online Tutorials will help target audience optimise their use of the Guides	Based on BH and 'Nature on Prescription Guide'[97]: n~500-1500 downloads @ 2yrs post launch. Key resources for establishing & scaling-up/scaling out NbTs.
Press releases & stories (T9.3)	Final 2-3 press releases/media stories.	General public, High level policy makers.	Potential reach n >500,000 per story.
Factsheets and policy briefs (T9.3/T9.4)	~4 factsheets & ~4 policy briefs summarising ouputs and guides, public facing with primary dissemination online.	High level policy makers from different sectors, as well as e.g., land owners and managers.	Target reach n~500 per factsheet /policy brief based on consortium experience (e.g. EU level).
Stage 4: Mth45~≥108 (Legacy)			
Website 4.0 (T9.1)	Final refresh before official end but regular updating by UNIVIE for 5yrs post project.	All target audiences and potential Toolbox Guide users.	Gradual drop off over first 2yrs (~1000 pcm), yrs3-5 (~500 pcm).
Legacy plan (T9.1, T1.9)	Document outlining partner agreement to FAIR data management, Open Science, and comms. beyond project.	Internal project partners; All future potential users of the data, scientists, NGOs etc.	Partner commitments to project for at least 5yrs, e.g. data accessibility, talks, open access publications, etc.

Scientific publications/ Presentat. (T9.5)	Final ~10/35 papers submitted. Open access/conference fees paid for by partners after end.	Papers/talks targeting scientific audience; NbT stakeholders.	Total expected cites of all 35 papers @5 years n~3500. Total talk attendance n~3000.
NbT Task Force (T1.5)	Continued collaboration with other funded projects to keep NbT Task Force flourishing	NbT Task Force partners.	Avoid a "cliff-edge" @48Mths and maintain momentum for mainstreaming NbTs.
Funding	Commitment to seeking funding to extend Knowledge Exchange beyond project end.	Potential impact funders e.g. UK Impact Accelerator Accounts.	≥ 5 small-medium impact grants awarded to different partners by 2yrs post project.

O3.1: The role of the Website. The RESONATE website, delivered initially in Mth5 (**D9.1**), updated throughout, and with annual refreshes, will be key for maximising impact. It will be developed into a portal and one-stop-shop for evidence-based NbT's in Europe, with an important global dimension by hosting WP2's Systematic Map. The website will summarise the aims of the project, team members, activities, how to get involved, a repository of resources including the Toolbox of NbT Guides, factsheets, policy briefs, open access scientific publications, etc., and host the interactive Systematic Map, specific Resilience Hub information for helping to coordinate the three demonstrator projects, as well as talks, podcasts, and blogs summarising activities and progress. A password protected area will provide project partners a location to store and exchange documents not for public dissemination. A key innovation of the website will be the hosting of a Nature-based Therapy forum that helps develop a cross-sectoral NbT community in Europe. The work of other projects such as Green4C, RECETAS, and other forums such as the Togetherness Hub will inform its design. Live links to the project's social media streams will enhance the website's dynamic nature. The consortium, and WP9 lead (NBSI), have extensive experience developing highly-rated EU-funded project websites (e.g. https://bluehealth2020.eu/; https://www.greenforcare.eu/; https://recetasproject.eu/) and will ensure it is attractive, end-user focused, and contains an easy to navigate portal where all documents/papers/guides/tools etc. can be downloaded. Based on estimates from previous EU projects (e.g. BlueHealth) we estimate ***unique visitors per calendar month*** to be ~500pcm in Year 1, ~1,000 pcm in Yr2, ~2,000 pcm in Yrs3-4, ~1,000 pcm first year post and ~500pcm second year post, with peaks of ~4,000 after press releases.

O3.1: Media activities. Traditional tools will include highly-coordinated press releases of major findings (n=8). Consortium members have extensive experience of mass print/digital media (including radio/television), with many members being the "go to experts" on nature and health in their respective countries. Previous reach analysis suggests messages are potentially reaching ≥500,000 people per release. Major press releases entail considerable planning, including translation and coordination with journal editors and journalists before a paper/report is made public. Accordingly, and to avoid story-fatigue, we plan approximately one major release every six-months from months 12-48. Traditional media activities will be enriched and enhanced by developing a RESONATE social media identity which will feature regular updates from across the consortium, and podcasts and short 'video abstracts' of key activities and results for widespread accessibility. With consortium members already having several thousand followers on platforms such as Twitter between them, these activities will significantly contribute to both increasing awareness (GO3/EO3), and public/policy-maker justification for wider NBT implementation (GO4/EO4).

O3.2: Events and cross-project collaboration. In addition to the presentation of findings at academic conferences, regional meetings, and local and European policy maker events, RESONATE will host and support events that reach higher level policy makers and avoid the kind of "clash of messages" that can occur when three projects funded under the same call are all trying to communicate their specific findings with the same busy high-level targets. To this end, WP1 (Management) will establish close links with the other projects funded under this and related calls through ***joint activities, workshops, and integrated communication and dissemination activities***, both within the EU and beyond. Within the EU, we propose a multi-consortium collaboration of ~9 partners, including the three consortia funded under this call, three on-going NbS/NbT projects we lead/are involved in (i.e. Green4C, RECETAS, Go Green Routes), and at least three consortia from related calls (e.g. HORIZON-CL6: 2021-BIODIV-01-05; 2022-BIODIV-01-03; 2021-COMMUNITIES-01-06; and 2022-COMMUNITIES-01-05/02-01). In particular we envisage a collaboration similar to a Network Nature Task Force (https://networknature.eu/networknature/nature-based-solutions-task-forces) for NbTs. Realistically, impact will be greater if NbT and NbS projects collaborate and share insights, expertise, and comparative advantage, and coordinate interactions with busy high-level stakeholders/policy-makers (e.g. EU level 'policy breakfasts' n~2).

Following discussions with the two other projects funded under the 'Horizon-CL6-2022-COMMUNITIES-02-02: Developing nature-based therapy for health and well-being' call, i.e. NATURELAB and GreenMe, we can confirm at the Description of Action (DoA) stage that we will align our efforts in this regard. This will be facilitated by having no duplication of research site locations. Together we agreed to include the following text in each of our

DoAs: The coordinators of the three projects agree to coordinate their Communication and Dissemination strategies and stakeholder engagement plans to promote synergies and reduce potential conflicts (e.g. in terms of demands on specific stakeholder groups). To this end the coordinators will meet (in-person or virtually) after the projects have started and at least once annual for the duration of the projects, to update each other on activities and plans. Respective consortium team members with associated responsibilities will be in regular contact with those charged with similar tasks in the other two consortia. Project coordinators are welcome, but not required, to attend the yearly consortium meetings of the other projects, and will receive a timely invitation and respect all confidentiality issues associated with the meeting. Regardless of their presence at these meetings, each project coordinator agrees to provide a summary (video and/or PPT) of the project outcomes (or project outline, at the start) that will be shared at the consortium meetings, ensuring that all the three consortia are well informed and can better foresee and pursue joint initiatives. All events and other joint initiatives will be described in the periodic reports. We have set aside €6k to support these activities and will explore ways in which we, as a group, can fund support structures for NbT researchers and practitioners after the end of this cluster of projects. A report summarising all DEC activities will be submitted at the end of the project in Mth 45 (**D9.5**).

O4.2: The role of the Toolbox of NbT Guides + Online Tutorials. The Guides outlined in 2.1 are key deliverables for RESONATE and form an important part of its impact and potential exploitation. When combined into a toolbox they are designed to support interested parties set up new and/or scale-up and scale-out existing NbTs across Europe and beyond (GO4/EO4) and thus help to make NbTs a more mainstream part of health promotion/disease prevention. To support our target audiences use the Guides optimally, individual Tutorials will be produced to accompany each Guide's release following the approach developed by PMU in the EU funded Healing Alps (HEALPS) project. The tutorials will guide viewers through the key steps of the document using RESONATE CSs as worked examples. The Guides/Tutorials will come online between Mths 30-42. Given that website visits during this period are estimated to drop from ~2,000pcm to ~500pcm 2 years post-project we estimate the guides will be accessed by ~30,000 unique site visitors by two-years post project. Again, based on previous projects we expect an average ***download rate*** of ***5%*** for the high-level guides and factsheets (e.g. "What Works"), ***3%*** for moderate-level guides ("Resilience Hub"), and ***1.5%*** for more technical guides (e.g. "Environmental assessment"). This would equate to: n~1,500 downloads of the What Works Guide/Factsheets, and n~500-900 for the more technical guides. The former estimate is consistent with downloads of UNEXE's high-level 'Handbook for Nature on Prescription' after 2 years[97]. We would expect the majority of those downloading Guides to engage with the Tutorials.

International External Advisory Board (IEAB). More details on the members of the IEAB and the expertise they bring to the project are provided in Section 3.2. In addition to their advisory role, IEAB members have agreed to act as international ambassadors for the project and actively communicate, disseminate, and share projects insights and outputs globally among their networks. To ensure they are fully engaged with the project and can experience various aspects directly, and better act as project ambassadors we have set aside funds for them to fully engage with the project in two key ways. First, we will be able to fund each of the 7 members attend each of the four Annual General Meetings, at an approximate cost of €1k per EU-based member and €3k per Non-EU-based member (including travel, hotels, subsistence etc.) per AGM. Second, we have allocated funds for each of the four non-EU IEAB members to host a researcher from one of the EU Beneficiaries to support the running of a locality specific Grand Round (WP2, T2.5) and/or learn more about the successful NbTs run by/with our IEAB members. We envisage each trip/lab-visit will be approximately four weeks in duration (the minimal estimated time needed to organise a Grand Round and learn about an ongoing NbT in one of the host localities) with a cost of each trip of approximately €8k. These funds are currently distributed equally (€8k each) between the four WP partners that we envisage will benefit most from these IEAB visit opportunities (UNIVIE, ISGLOBAL, EHNet, ETIFOR). If the funds are not used by the currently allocated partner we will transfer them to another partner for this purpose in discussion with the Project Manager.

Intellectual property rights, knowledge management, and protection. Intellectual property rights will be defined in the Consortium Agreement (CA), jointly with procedures for data and knowledge management and protection. WPs 1 & 10 will coordinate these aspects of the project. The RESONATE consortium will share their own experience, innovation, and intellectual property rights to create new results that they would not be able to develop alone and in the same timeframe, without infringing any intellectual property rights belonging to individual participants. Knowledge management and Intellectual Property Rights (IPR) will be addressed in full compliance with the rules identified by the Horizon Europe Grant Agreement. A detailed description of the Intellectual Property Rights agreement (IPR) will be part of the Consortium Agreement (CA) signed by all project partners. Mechanisms will be implemented to ensure adequate communication with regard to IPR between the appropriate partners is in place. Background IP (pre-existing knowledge, e.g. the Sensory App. already developed as part of CS8) and sideground IP (knowledge produced by the partners but outside the realms of RESONATE) will remain the property

of the partners introducing it. The CA will be used to identify cases in which background and sideground IP can be made accessible for other partners (e.g., potential use of CS8's App with CS9 clients). Ownership, rights, and access to knowledge produced during the project (foreground IP) will be handled according to the partners' contributions. Examples here include the on-line interactive, Systematic Map (WP) and the concept of Resilience Hubs (WP7). Where several partners have jointly carried out work in which their respective share of the work cannot be ascertained, they will have joint ownership of such foreground IP. New knowledge created after the formal termination of the collaboration will be considered as postground IP. Dispute or conflicts arising from the handling or sharing of IP will be clarified internally by the RESONATE steering committee. Manuscripts, which aim to be open access, will be reviewed by partners to ensure that IP is not disseminated without appropriate protection. European legislation and privacy laws will be adhered to during all project activities, including by international partners. Where needed, additional national-level legislation and private laws will be respected.

Table 2.2 Key elements of the impact section

SPECIFIC NEEDS	EXPECTED RESULTS	D & E & C MEASURES
What are the specific needs that triggered this project?	What do you expect to generate by the end of the project?	What dissemination (D), exploitation (E), communication (C) measures will you apply to the results?
Despite growing interest in Nature-Based Therapies (NbTs) to improve health and well-being, they are yet to become mainstream due to ongoing uncertainties and knowledge gaps related to: 1. What counts as an NbT and what is their relationship to NbSs; 2. The perceived value/acceptability/linkages of NbTs by and among stakeholders including service users, health professionals, land-owners, managers, & stewards, potential funders, policy makers, and wider society; 3. Which types of NbT "work" in terms of providing sustainable improvements for people's physical and mental health (i.e. efficacy); 4. The mechanisms and processes behind why different NbTs might work; 5. Whether any potential benefits are equitable across different groups in society (i.e. equity); 6. How NbTs relate to other Social Prescribing practices including the referral process and appropriateness of any referrals; 7. How to ensure high standards of care/support across NbT provision; 8. The environmental impact of growing NbT provision; 9. How to sustainably finance NbTs; 10. How to bring together the multi-sectoral partners needed for sustainable adoption, implementation, and scaling-up & scaling-out.	RESONATE will provide evidence and significantly reduce uncertainty on all these issues by: 1. Better understanding of the synergies and differences between NbTs & NbSs, based on NBRT and the concept of biopsychosocial resilience 2. Providing extensive multi-sectoral feedback on NbT value/acceptability; 3. Providing robust, and accessible scientific evidence of which NbTs "work", through a Systematic Map and an online interactive tool for multi-stakeholder use; 4. Providing detailed evidence summarising 9 high-quality Case Studies, including information on effectiveness, mechanisms (e.g. biopsychosocial resilience), equity, cost-effectiveness (selected CSs), and environmental impact, including under different climate/societal scenarios (selected CSs); 5. Providing a multi-sectoral "Toolbox" of resources for establishing/scaling-up NbTs including specific Guides for: health professionals (incl. insights into social/green prescribing referral processes, link workers, and quality assurances); environmental stakeholders; the finance sector; and those wishing to conduct their own process/outcome evaluations; 6. Proving an overarching "What works" Guide summarising the overall messages/processes and user signposts to different elements of the "Toolbox". 7. A best-practice NbT Resilience Hub guide for establishing successful multi-sectoral NbT collaborations based on our three demonstrator NbT Resilience Hubs and exemplar Memoranda of Understanding to promote longer-term legacy.	Our results will be communicated/disseminated, and exploited in the following ways with estimates based on previous EU projects of comparable scale: *Communication/dissemination*: 1. Academic papers (n~35) & presentations (n~40 @75 per talk = total audience ~3,000); 2. RESONATE website will build up to ~2,000 unique visitors per month during the project; 3. Weekly social-media updates and re-tweets of twinned project messages, summary threads of key publications, and higher activity rate around key output releases; 4. An estimated ~15,500 unique visitors to the on-line Systematic Map; 5. An estimated download of ~1500 What Works Guides, ~900 Resilience Hub guides & ~500 for each practitioner Guide within 12 months of project end; 6. Major press releases n~8; and high-level policy-briefs/factsheets n~4 (approx. 1,500 downloads each); 7. Public stakeholder/policy events (n~16); *Exploitation*: 1. The Systematic Map will be exploited through the Grand Rounds n~15 which will use the online tool to engage key decision makers with the evidence base; 2. We will work closely with the other consortia funded by this call (n=2) and other related projects (n~6) to establish a Network Nature NbT Task Force able to produce greater, more coordinated, joined-up impact; 3. Our cross-beneficiary exchanges will help tackle disciplinary silos and improve understanding of research practices and needs within the consortium; 4. Our advisory board of international NbT leaders (n=7) will both inform EU practices and in turn spread lessons learned from RESONATE globally.

TARGET GROUPS		OUTCOMES	IMPACT
Who will use or further up-take the results of the project? Who will benefit from the results of the project?		*What change do you expect to see after successful dissemination and exploitation of project results to the target group(s)?*	*What are the expected wider scientific, economic and societal effects of the project contributing to the expected impacts outlined in the respective destination in the work programme?*
Mainstreaming of evidence-based NbTs will require the collaboration of four key sectors. Targets for our sector specific Guides plus the overarching What Works Guide will include: 1. *Health sector*: EU-wide medical associations e.g., Standing Committee of European Doctors; EPCF, WHO Healthy Cities Network; National Public Health Institutes, EUPHA, HEAL. 2. *Environmental sector*: Land owners/managers (e.g. European Landowners Organization, EUSTAFOR), planners (e.g. Urban Development Network, ISOCARP C40 Cities), landscape architects (e.g. IFLA Europe), Ecosystem Services Partnership, ALPARC, IUFRO. 3. *Finance opportunities*: e.g. Health Insurers (e.g. IPMI providers), Agricultural and forestry sectors e.g. (EFA, World Urban Parks), Sustainable Alpine Health Tourism (CIPRA); Natural Capital Project. 4. *Wider society/user groups*: Patient groups (e.g. European Patients Forum), community organisations (e.g. Euro. Ass. For Innovation in Local Development); wider public. In addition, we will be targeting: 5. *Existing NbT researchers and practitioners*: e.g. Intelligent Health; Green Gym etc. 6. *High level policymakers*: e.g. WHO (Europe), EEA, National Depts. for Health (e.g. DoH), and for Environment (e.g. DEFRA), European Marine Board, UN-Habit ICLEI.		The key changes/outcomes we expect to see are a direct result of us meeting our four Expected Outcomes (*we collapse EOs 3&5 in the call into EO4 due to overlap*). 1. Stronger evidence-base of the causal mechanisms linking equitable, environmentally sustainable NbTs with better health and well-being through greater appreciation of the biopsychosocial resilience processes involved (EO1); 2. A sharper view of the necessary cross-sectoral linkages among key stakeholders due to targeted communications about the processes and actors needed for successful NbTs, gathered via the Systematic Map, IEAB, and Resilience Hubs (EO2); 3. Greater awareness of the health, social justice, and environmental challenges, facilitators, co-benefits and market opportunities of NbTs, among policy makers, health professionals, land owners/managers/stewards, potential funders, and the wider public from our integrated cross-sectoral research programme using a systems-based approach (EO3); 4. Greater Europe-wide utilization of evidence-based equitable/environmentally/economically/socially sustainable NbTs, starting with the scaling-up and scaling-out of ~40 NbT projects within 5 years, ideally using a Resilience Hub based approach (EO4).	We envisage RESONATE will make a significant contribution to the following impacts: *Scientific*: 1. A paradigm shift in nature-health research with greater focus on Biopsychosocial Resilience processes; 2. NBT assessment moves beyond a focus on participant health, to also consider multi-sectoral outcomes (incl. equity/sustainability) and estimating future scenarios. *Economic*: n~40 new NbT projects could, over 5 years: 1. Significantly reduce health-care spending for n~50,000 people with common NCDs + benefits for 50,000 relatives; 2. Create n ~280 new jobs, especially in rural and coastal areas, across multiple sectors incl. health/environment; 3. Provide alternative sources of income for agricultural/forestry/marine etc. sectors. *Societal/environmental* 1. Reduced health-related inequalities in at least n~ 40 communities (esp. if Level 2/3 interventions). 2. Greater community n~40 cohesion through empowerment opportunities offered by the social innovation actions embodied by the Hub approach. 3. Fairer/more inclusive access to high quality green/blue spaces (esp. if Level 1 interventions); 2. More environmentally sensitive NbTs, e.g. via the systematic estimation of carrying capacity; 3. Greater nature protection, indirectly via increased nature connectedness of participants, and directly via pro-conservation activities: n~12,500 + potential local social spillover effect.

3. Quality and efficiency of the implementation

3.1 Work plan and resources

The 10 WPs are described in more detail in Part A. A schematic of how they are integrated is provided in Fig.4. Our starting resource philosophy was that each WP was of equal importance to the successful delivery of the project and therefore should receive equal resources. Since the costs of running WPs vary across country we then weighted the initial allocation of resources by the country's Purchasing Power Parity. The same starting principle was applied to CS budgets (within WP3) though these were set slightly higher than WPs due to the costs of primary data collection. As CSs 1&2 use secondary data they were allocated resources equivalent of one primary data CS. As the proposal developed, specific tasks emerged that required extra resources over and above this principle for specific WPs and CSs, e.g. the costs of developing and running the Resilience Hubs. These deviations from parity were agreed through consortium consensus. Three institutions (ISGLOBAL, UNEXE, and UNIPD) have higher budgets because they are running both WPs and CSs. UNIVIE's budget reflects the fact that it is running 2 WPs, and is covering all the costs of the seven IEAB members as well as the independent Ethics Advisor as required under WP10. (Table 3.1b). In terms of Person Months (PMs), all partners will be engaged with management/ethics (WPs1&10 ~9% of all PMs) and communications (WP9 ~11% PMs). A Gantt Chart showing the timetable for Tasks is presented in Fig.5.

FIGURE 4

RESONATE's Work Packages

Case Studies, and Social Innovation Actions

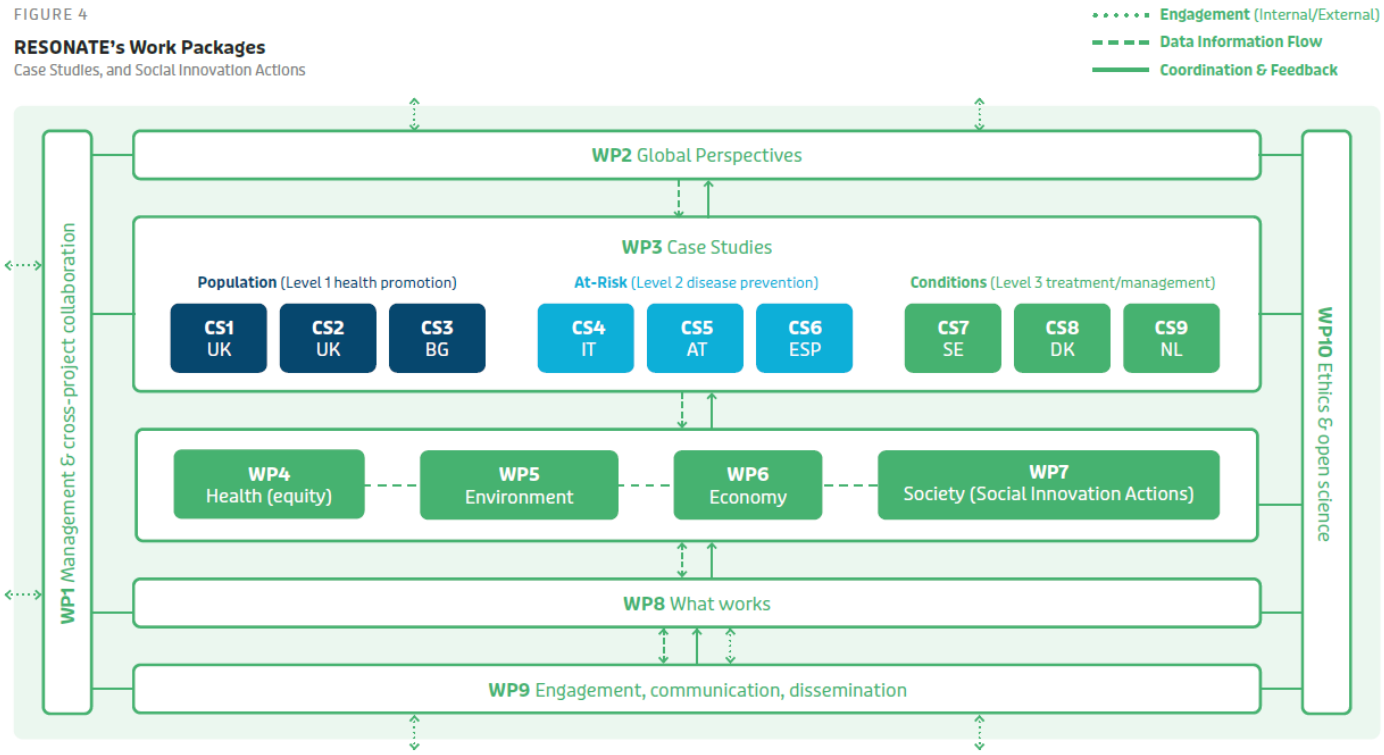


Figure 5: Gantt Chart of RESONATE Tasks

Note. WP10 Ethics and open science tasks will be overseen by WP1 (as T1.10 and T1.11) as agreed with the Project Officer.

Table 3.1a: 'Subcontracting costs' items

Partner	Cost (€)	Description of tasks and justification
NBSI	18,000	Commissioning of a web-design company for the website (+ refreshes).
MUP	80,000	Costs of commissioning a survey company to run the data collection for CS3's longitudinal prospective panel (n=1,500 participants at 1st wave) including incentives needed to maintain participation for the duration of the project. We envisage the survey to be conducted as a face-to face-interview at participant's home in the 1st wave, with the option for online or over the phone follow-up in waves 2 and 3. Based on recent experience of the MUP PI with a close in size but cross-sectional in design survey in Sofia, it is reasonable to expect that a survey company will initially require 20-25 interviewers to carry out the field work in wave 1. Preliminary quotes collected from several Bulgarian survey companies just prior to the project's beginning (in 2023) indicate that participant incentives (vouchers) could range from ~ €5-25 per participant at the end of the 3rd wave to ~ €12.5 per participant per wave. However, the choice of a survey company to conduct the field work and final logistics and voucher costs will ultimately be decided on a best cost-result ratio offer through a formal tendering process. The biological data for the sub-sample (n= 250 participants randomly selected out of those participants in the larger survey who during the 1st interview agree to be contacted for further testing at MUP twice between the survey waves) will be collected by 4-5 members of the MUP team (researchers and lab technicians the costs for whose work have been calculated in Direct personnel costs and purchase costs).
Total	98,000	

Details on sub-contracting cost details

NBSI Website: Within WP9 Task 9.1, a project website will be developed. This task will be commissioned to a qualified subcontractor with proven web design expertise. The total maximum cost for this service is €18,000. The budget includes: 1) initial design and building of the website; and 2) assistance with webpage refreshes especially towards the end of the project (for legacy purposes). NBSI will oversee this work but does not have the required specific web design and development expertise. NBSI will be in charge of regular website updates (e.g. news of events, publications etc.). A tender for work will be produced and at least three quotes sought. For selection of the sub-contract principles of best value of money will be applied, considering the quality of service, best price-quality ratio, and a proven track record of similar tasks. It will be ensured that there is no conflict of interest between the subcontractor and NBSI, nor with other consortium members.

MUP Longitudinal survey: Within WP3 T3.2 (data collection), MUP will subcontract a Bulgarian survey company to conduct a population-based interview survey among residents of Plovdiv. We will organize a formal competition for selecting a survey company and subcontract the one that wins the bid by providing the best price-quality ratio, according to predefined requirements on data collection quality. MUP is a medical university and research center that does not have the human resources and logistic capacity to carry out field interviews and collect the necessary data for CS3. Nevertheless, MUP will develop the survey sampling strategy, design the questionnaire, and all relevant procedures and monitoring protocol, which will then be applied by the survey company. The subcontracting costs declared by MUP (€80,000) should cover expenses made by the survey company for organizing and managing the field work, payment to interviewers who will be collecting the data, data validation and quality checks, survey software license, as well as participant incentives (vouchers). Given the anticipated response burden and need to keep participants with the project for 3 waves of data collection spread over 12 months, MUP has planned to provide them with incentives for every wave they take part in. The entire process of providing incentives to participants in the survey will be documented and proof requested from the survey company.

Table 3.1b: 'Purchase costs' items (travel and subsistence, equipment and other goods, works and services)

UNIVIE	Cost (€)	Justification
Travel & subsistence	96,012	2 staff for 3 x (non-Vienna) Annual Meetings x €850 = €5,100; PI/Project Manager site visits to all partners at least once during 48Mth project x 12

		(UNIPD/ETIFOR on same trip) x €850 = €10,200; 1 x 4 week visit to IEAB lab to learn about successful international NbT = €8,000; Europe-based IEAB Travel & Subsistence costs for 3 members (total = €3,839 per meeting) x 4 Annual Meetings = €15,356; Non-Europe based IEAB Travel & Subsistence costs for 4 members (total = €11,414 per meeting) x 4 Annual Meetings = €45,656; PI or PM to attend Annual Meetings of GreenMe/NATURELAB (6 meetings) - 1 staff 6 x €850 = €5,100; 6 conference travels x €1,100€ = €6,600€.
Equipment	0	No equipment costs ≥ €1,500
Other goods, services	55,907	Launch (1st) annual meeting costs (incl. all meals) n~40 participants = €5,600; IEAB Member Prop annual consultation fee 4 x €5,000 = €20,000; External ethics advisor 3 days (@ €700 per day) per report x 3 reports = €6,300; Conference registration fees 6 x €466,66 = €2,800; Open Access Publications costs 3 x €2,500 = €7,500; Consumables (incl.) post advertising costs (staff recruitment costs), translation of project materials (4 languages), software licenses (Qualtrics x 1, to produce surveys for other researchers in the field to support T1.4 & T1.5) = €4,464; CFS Audit costs = €9,243.
Total	151,919	
ISGlobal	**Cost (€)**	**Justification**
Travel & subsistence	24,800	2 staff for 3 x (non-Barcelona) Annual Meetings x €850 = €5,100; 6 conference travels x €1,100= €6,600; 1person Resilience Hub meeting travel €850 x 6 = €5,100; 1 x 4 week visit to IEAB lab to learn about successful international NbT = €8,000.
Equipment	0	No equipment costs ≥ €1,500
Other goods, services	61,549	Running the WP7-associated CS5 Resilience Hub (costs calculated by UNIPD), costs include collecting/preparing data for analysis from CS5 for the Resilience Hub and organization of one in-person 2.5-day workshop for relevant stakeholders n~10-15 (catering, room, consumables) and four half-day stakeholder workshops n~15/20 (venue, catering, speakers, moderation, promotion) = €26,667; Host 2nd Annual Meeting costs (incl. all meals) n~40 participants = €5,600; Open Access Publications costs 4 x €2,200 = €8,800; Software licences, e.g. EviAtlas and ESRI, for development of map application = €2,000; Technical support with developing the interactive online mapping tool = €3,900; Transport of saliva samples from Barcelona to Paracelsus Medical University laboratory facilities for cortisol analysis = €505; Conference Registration fees 6 x €466,66 = €2,800; Consumables including Saliva sampling kits, Blood pressure monitors, participant costs (e.g. travel reimbursement) n ~ 134, and software (NVIVO x 1) and survey (Qualtrics, x 1) licenses €7,677; CFS; Audit costs = €3,600.
Total	86,349	
AZTI	**Cost (€)**	**Justification**
Travel & subsistence	21,400	2persons x 4 annual meetings x €850 = €6,800; 6 conference travels x €1,100 = €6,600; 1-week knowledge exchange partner lab visits €2,000 x 4 = €8,000.
Equipment	0	No equipment costs ≥ €1,500
Other goods, services	22,100	Conference Registration fees 6 x €466,67 = €2,800; Open Access Publications costs 3 x €3,000 = €9,000; Consumables (incl.), translation (two languages, Italian/ German €1,700, Task 8.6) = €1,700; software licenses (1 x VENSIM Pro = €1,800p.a. x 2 = €3,600 Task 8.7); results communication videos (= €2,500 x2, Task 9.3) = €5,000.
Total	43,500	
ETIFOR	**Cost (€)**	**Justification**
Travel & subsistence	18,000	2 staff for 3 x (non-Padua) Annual Meetings x €833 = €5,000; 5 conference travels x €1,000 = €5,000; 1 x 4 week visit to IEAB lab to learn about successful international NbT = €8,000.
Equipment	0	No equipment costs ≥ €1,500

Other goods, services	23,770	NbT sustainable finance workshop n~15/20 participants- venue rental, catering, incidentals (branding, badges, name plates, promotion & dissemination, etc.) = €2,500; Conference Registration fees 5 x €466,66 = €2,333; Open Access Publications costs 3 x €2,200 = €6,600; Host 3nd Annual Meeting costs (incl. all meals) n~40 participants = €5,600; Organise National NbT meeting to dissemination findings nationally (n~100 participants) = €2,500; Consumables (incl.) translation, material printing = €4,237.
Total	41,770	
EHNet	**Cost (€)**	**Justification**
Travel & subsistence	27,200	2 persons x 4 annual meetings x €850 = €6,800; 6 conference travels x €1,100 = €6,600; Impact workshop travel 6 x €967 = €5,800; 1 x 4 week visit to IEAB lab to learn about successful international NbT = €8,000.
Equipment	0	No equipment costs ≥ €1,500
Other goods, services	25,200	Equity Impact Assessment workshops n~15/20 participants - venue rental, catering, incidentals (branding, badges, name plates, promotion & dissemination, etc.) €2,500 x 6 = €15,000; 4th annual meeting costs (incl. all meals) n~40 participants = €5,600; Conference Registration fees 6 x €466,66 = €2,800; Consumables (incl.) post advertising on social media to increase visibility (staff recruitment costs) = €180, Translations of background documents for Equity Impact Assessment Workshops: 5 of the 6 workshops will have translated documents in the local language, locations to be decided (5 x €300) = €1,500, software licence (Slido 'engage' plan) = €120.
Total	52,400	
UNIPD	**Cost (€)**	**Justification**
Travel & subsistence	58,790	2 staff for 3 x (non-Padua) Annual Meetings x €850 = €5,100; 3 persons x 8 project meetings, including those with other PPS to carry out project activities such as training to align data collection methodology in the 3 Resilience Hubs (2.5 days of full activity, minimum 3 nights/each training) x €708 = €17,000; 3 persons x 12 stakeholder workshops n~15/20 participants (local/regional) (average: 2 days, 1 night; €575/person/workshop = €20,690; 6 conferences travels x €1,333 = €8,000; 1-week knowledge exchange partner lab visits €2,000 x 4 = €8,000.
Equipment	2,520	New -20^{O}C refrigerator needed for saliva sample storage (purchase cost = €3,150; depreciation over 5yrs) = €2,520.
Other goods, services	63,967	Translation of 3 questionnaires into at least 4 languages, 12 x €900 = €10,800; Open Access Publications costs 4 x €2,400 = €9,600; English check by professional native speaker of 4 OA publications (€300/paper) = €1,200; Conference Registration fees 6 x €650 = €3,960; Service of coding expert for online surveys (e.g. conditional questions, filters, survey setting in multiple languages) (2 units, €4,300/unit) = €8,600 (we confirm this is an external service, like translation, not a sub-contract); Case study participant costs (e.g. travel reimbursement) n ~ 134; Software licenses for content analysis x 4 years (1x Nvivo pro, 2 x Nvivo) = €5,867; and support with survey (n ~ 3) programming = €8,850; Oxigen saturation measurement units (6 units, €50/unit) = €300; Pressure measurement units (6 units, €120/unit) = €720; Saliva samples (3 units, €370/unit) = €1,110; Saliva samples shipment from Padova to Paracelsus Medical University laboratory facilities for lab analysis (3 protected shipments for sending biological material) = €630; Consumables including graphical editing, user-friendly visualization, icons for material and WP7 outputs = €6,137; Audit costs = €6,253.
Total	125,277	
NBSI	**Cost (€)**	**Justification**
Travel & subsistence	18,000	2 persons x 4 annual meetings x €850 = €6,800; 3 conference travels x

		€1,067 = €3,200; 1-week knowledge exchange partner lab visits €2,000 x 4 = €8,000;
Equipment	0	No equipment costs ≥ €1,500
Other goods, services	29,850	Event organisation (venues, catering, speakers etc.) incl.; 2 x high-level events for European and other policy makers and key stakeholders aimed at communicating key project findings, e.g. in Brussels (@ €6,000 each) = €12,000; 2 x other project events (e.g., CS-related, Resilience Hubs) = €2,000; Translation support to partners for translating key products (project brochure, factsheets, policy briefs) = €4,000; Printing of key dissemination products, e.g.: project brochure = €1,500, 4 x factsheets = €3,500, 4 x policy briefs = €4,000, other publications = €1,000; Other consumables for dissemination activities, e.g., rent of studios/equipment for podcasts = €1,850.
Total	47,850	
MUP	**Cost (€)**	**Justification**
Travel & subsistence	10,000	2 persons x 4 annual meetings x €850 = €6,800; 3 conference travels x €1,067 = €3,200.
Equipment	0	No equipment costs ≥ €1,500
Other goods, services	53,500	Test kits/reagents/needles/containers etc. needed for biomarker assessment (e.g. Immunological/inflammation markers incl. TNF-α test kits, IL-6 test kits, IL-10 test kits IgG test kits, IgM test kits, IgA test kits, TBNK test kits, and Biochemical markers incl. Cholesterol kit OSR6116, Triglycerides kit OSR61118, C- Reactive protein (CRP) kit OSR6147, Creatinine kit OSR6178,) for the n~250 biometric sub-cohort at 2 time points = €42,000; Open Access Publications costs 3 x €3000 = €9000; Local dissemination events (venues, catering, speakers etc.) @ €1,250 each x 2 = €2,500.
Total	63,500	
PMU	**Cost (€)**	**Justification**
Travel & subsistence	10,000	2 persons x 4 annual meetings x €850 = €6,800; 3 conference travels x €1,067 = €3,200.
Equipment	4,000	Data warehousing and management computers = €4,000 (Purchase cost = €4,000, and depreciation over @ 4 years).
Other goods, services	72,333	Allostatic Load ELISA Kits and Immune-Multiplex Kits for all groups (measurement of stress hormones, pro- and anti-inflammatory cytokines, triglycerides and glucose) = €28,500; Lab disposable material (pipette tips, cryo tubes etc.) = €4,000; Blood and saliva collection tubes = €3,500; Stakeholder workshop costs for Hub activities n~15/20 (venue, catering, speakers, moderation, promotion) = €2,000 x 4= €8,000; Translation costs for instructions of how to collect the physiological data in the other two case study sites and to translate back into German any documentation accompanying the physiological metrics that are returned to PMU from the other two case study sites (two languages, Spanish and Italian); English-German translations for the local stakeholders of the resilience hubs. = €5,833; Dry-ice transport = €2,500; Heart rate wrist bands (for field recording of HR, HRV, BP etc.); these will also be used as incentives for study participants n ~ 134 (therefore "other costs" and not "equipment") = €10,000; Publication Costs (Open Access) 2 x €3,000 = €6,000; Software licences needed for Hub activities and project management (e.g. MIRO x 2 = €1,500, NVivo pro x 1 = €2,500) = €4,000.
Total	86,333	
UU	**Cost (€)**	**Justification**
Travel & subsistence	20,000	2 persons x 4 annual meetings x €850 = €6,800; 6 conference travels x €1,100 = €6,600; Site visits to roll-out locations = €1,200; Travel costs for ReST trainees to UU (6 people, 5 training days each) = €5,400.
Equipment	0	No equipment costs ≥ €1,500

Other goods, services	59,000	Case study participant costs (e.g. gift certificates) for longitudinal participation (Reimbursement (in gift certificates) = €12 per hour spent with needed assessments. Interventions including follow-ups involve 5.6 hours assessment/participant: (12*5.6)*260 = €17,472. An N = 100 subset also complete a fatigue induction and restoration procedure before and after intervention, total 3.45 hours: (12*3.45)*100 = €4,140. Another N=30 subset complete a 1-hour follow-up interview: 12*30=€360. Finally, all 260 complete an arranged voluntary donation task, gifting up to €25 of earned reimbursements for which they are subsequently compensated up to €25: 50*260=€13 000) = €35,000; Locality specific costs (e.g. venue costs for 4 sites x 5 sessions x 2 intervention types ReST & CMT) = €15,000. Open Access Publications costs 3 x €3,000 = €9,000.
Total	79,000	
UCPH	**Cost (€)**	**Justification**
Travel & subsistence	15,000	2 persons x 4 annual meetings x €850 = €6,800; 6 conference travels x €1,100 = €6,600; Regular site visits costs = €1,600.
Equipment	0	No equipment costs ≥ €1,500
Other goods, services	63,000	Biometric data capture: Electroencephalogram/Brain waves (4 x EEG Kit - NeuroElectrics Enobio 8) = €25,000; Heart-rate variability (4 x HRV Kit - Shimmer3 EMG) = €10,000; Eye-tracking (5 x Tobii Pro Glasses 2 kit) = €6,500; Software licences: 1 x iMotions Modules – CORE, EEG, ECG, Analysis-Only; 1 x Kubios HRV for scientific research = €11,000; Open Access Publications costs 3 x €2,500 = €7,500; Questionnaire survey costs = €2,000; Ethics application = €1,000.
Total	78,000	
NVM	**Cost (€)**	**Justification**
Travel & subsistence	8,000	1person x 4 annual meetings x €850 = €3,400; 2 conference travels x €1,300 = €2,600; Travel to care farms €83 x 24 = €2,000.
Equipment	0	No equipment costs ≥ €1,500
Other goods, services	29,400	Venue hire and meeting costs for 6 x CoP meetings €1,500 each = €9,000; Compensation of Care Farm Branch Organisation SZZ (for collecting data for Case Study 9) for extra work of their support staff at a rate of 480 euro per day including: selection and recruitment of n = 24 matched farms in their network for participation in the research = 24 * 2 hours = €2,880; planning and organisation of 6 x CoP meetings 6 days = €2,880; Development and implementation of online survey for Case Study 9 clients and family to monitor and evaluate clients' progress 5 days = €2,400; costs for attending meetings with research team and CoP meetings including travel = €1,840; Open Access Publications costs 2 x €3,000 = €6,000; Consumables (incl.) farm recruitment promotion materials = €4,400.
Total	37,400	
UNTWE	**Cost (€)**	**Justification**
Travel & subsistence	4,000	1person x 4 annual meetings x €750 = €3,000; 1 conference travels = €1,000.
Equipment	0	No equipment costs ≥ €1,500
Other goods, services	4,900	Conference Registration fees x 1 = €400; Open Access Publication x 1 = €2,500; Consumables (incl.) compensations for material costs to support the interventions designed in the CoPs by care farms (e.g., materials to build a shelter where elderly people can stay and do garden work in winter times and during bad weather) = €2,000.
Total	8,900	

Table 3.1c: Other cost categories (e.g. internally invoiced goods/services)

Partner	Cost (€)	Description of tasks and justification

UU	10,000	Facilities access beyond standard OH provisions @UU: Room hire €60 x 65 sessions (5 waves, 13 sessions per wave) = €3,900; Data collection waves; Consultation services beyond standard OH provisions @UU: Setup anonymous participant database = €2,100; Data management support = €2,000; Statistical consultation = €2,000.
Total	10,000	

Other sources of financing

The project involves one associated partner [UNEXE]. The total estimated costs of the associated partners to implement the project tasks amounts to €750,217.50. These are broken down into Personnel costs = €532,420; Purchase Costs (Travel & Subsistence) = €24,575; Purchase Costs (Other goods and services) = €43,179; and Indirect costs = €150,043.50. The costs of AP UNEXE will be financed from UKRI funding.

3.2 Capacity of participants and consortium as a whole

Below we outline how the consortium is perfectly constructed to meet the call's Expected Outcomes (EO).

EO1 Stronger evidence base. Successful collaboration is already evident from the development of NBRT by consortium members during Stage 1. Although significantly enriched by having leading theorists on nature-based resilience (e.g. Hartig, Razani, Van den Berg, Wells), representatives from all partners and several of the IEAB made significant contributions to the theory's development and are co-authors on the paper (currently in revision). The result is a clear, project-wide, shared vision that has brought partners together with each perfectly understanding their role. Partners also have all the required experience, skills, and networks to deliver the CSs (O1.2). Wheeler (UNEXE) and White (UNIVIE) have published four papers exploring longitudinal nature-health relationships using UKHLS's forerunner (CS1) with >2,000 total cites. Corbett (UNEXE) is the PI for the PROTECT panel and thus ideally placed to lead CS2. Dzhambov (MUP) is a leader in understanding how to investigate and test mediation processes in nature-health relationships, and will apply these skills to exploring the potential multiple and interconnected roles of various biopsychosocial resilience processes applying statistical mediation techniques in the nature-health field and the MUP team are qualified to collect the biological samples from a sub-set of the Plovdiv cohort (CS3). The seed ideas for CSs 4-6 were developed by NbT researchers at UNIPD/ETIFOR (forest bathing: Secco, Doimo), PMU (alpine health tourism: Hartl, Pichler), and ISGLOBAL (nature-based social prescriptions: Litt, van den Bosch) based on previous/current programmes (e.g. H2020 - RECETAS; INTERREG - HEALPS), with particular expertise in biological resilience (PMU), psychological resilience (UNIPD), and social resilience (ISGLOBAL). CSs 7-9 are extensions of on-going programmes. Lymeus & Hartig (UU) have developed/refined the ReST programme over several years and it is ripe for scaling-up/out (CS7). Stigsdotter (UCPH) and team have co-created the Move Green garden and associated App to improve access and inclusivity and now is the ideal time to test these infrastructural initiatives (CS8). Finally, van den Berg (NVM) wrote about the "challenges and opportunities of green prescriptions" as early as 2017[18], and has a long relationship with the Care Farm body where CS9 will take place. She is perfectly positioned to identify how NbT practices could be more integrated with support from Van Rompey (UNTWE).

EO2 Sharper view of cross-sectoral linkages. The online interactive Systematic Map will be based on a systematic review of existing NbTs and their cross-sectoral operations. WP2 lead Van den Bosch (ISGLOBAL) is a world lead on nature-health reviews both in the academic literature, including a 2017 review of reviews (> 500 cites)[98], and high-level policy documents such as WHO Europe's 2016 'Urban green spaces and health: A review of evidence'. The online Systematic Map tool builds upon a similar exercise led by Pahl (UNIVIE) for the United Nations Environmental Programme, which produced an interactive map of global initiatives for marine litter reduction, and will be supported by expertise in GIS-based online interactive tools at UCPH (Karlsson Nyed). RESONATE team members are also perfectly placed to explore cross-sectoral linkages through WPs4-7, and three of the four WP lead organisations are non-academic institutions and thus have closer ties to practitioners, policy makers, and a broad range of societal actors aiding pathways to impact. EHNet is the EU's leading partnership on health promotion, disease prevention, and health equity with partners across Europe including regional health authorities, research institutions, and policy and practice organisations. Their ability to develop our understanding of the European medical profession's attitudes towards NbTs, and their potential to reduce health inequalities (WP4), is unparalleled. AZTI is an independent scientific and technology centre focusing on supporting a healthy, sustainable, and fair society, with a focus on assessing ecosystem services, human impact on the environment, and human-marine interactions, and is thus ideally placed to lead WP5. Given the enormous potential of "blue therapies" (e.g. CS6), expertise in marine settings is critical in ensuring the needs of coastal communities are understood within the project. ETIFOR are an international consultancy supporting public and private organizations adopt innovative NbSs to improve the socio-economic and environmental performance of policies, projects, and investments. As leads

of the Green4C project with its focus on private-public partnerships to provide cost-effective NbSs to growing health issues, they are the ideal partner to lead WP6 with its focus on economic issues and NbT financing. Finally, with multiple backgrounds including forestry, agriculture, and rural development and as partners in the EU's H2020 Social Innovation in Marginalised Rural Areas project, UNIPD are ideally placed to lead WP7's focus on societal awareness and acceptance, with a focus on often neglected rural communities. The UNIPD team developed the idea of the NbT Resilience Hubs specifically for this project based on previous best-practice SIA approaches.

EO3 Greater citizen & policy-maker awareness. RESONATE is designed to communicate, disseminate, and exploit its findings and work with related projects to produce symbiotic messages that support each other rather than compete for attention. Our efforts will be led by NBSI (WP9), an institute founded to communicate the science and support city greening to promote human and environmental health. Their innovative 3-30-300 rule (i.e. everyone should be able to see 3 trees from home, live in a neighbourhood with at least 30% vegetation cover, and be no more than 300 meters from the nearest green space) is an example of the public facing message development they excel in. Several partners also have outstanding track-records in relevant fields, with EHNet, for instance, having over two decades of experience communicating to, and raising awareness of health-related policy makers at national and EU levels. This expertise will be supported by consortium members' ability to conduct research that gains public/policy attention and interest. PI White, for instance, has published articles that were ranked 7th & 38th in the Altmetric Top 100, an annual summary of the 100 articles across all scientific disciplines that received the most public attention and societal engagement. Although led by WP1, the multi-consortium co-ordination of efforts will involve all partners who between them are already involved in several of the most relevant EU projects and have extensive networks.

EO4 Wider NbT utilisation. NbT mainstreaming will depend on policy-maker and funders' beliefs that they can be safely/sustainably scaled-up/scaled-out to reach sufficient numbers of people to be worth investment. Estimating these effects depends on understanding the interplay between multiple societal/environmental drivers and the barriers, enablers, and potential unintended side-effects. Both AZTI and ETIFOR are experienced in conducting the required cross-sectoral scenario analyses using tools such as Bayesian Network Analysis and VENSIM and will lead the work on integrating social, environmental, and economic parameters, including future projections, for selected CSs to demonstrate how the necessary scaling-up/scaling-out forecasts can be produced (O4.1). In addition, UNEXE has a track record in investigating the barriers/enablers for nature-based social prescribing[97], and is currently working on several projects with UK Ministries of health and environment to support scaling-up processes (see Part A). Although the barriers and enablers for expansion may vary across countries, many of the lessons learned from the UK will be explored in our CSs across Europe through UNEXE's expertise in conducting process evaluations of complex health interventions. The public/policy-maker facing guides will benefit from the expertise of all partners who have a considerable track record of producing such documents targeting audiences beyond the academic sphere.

UK partner. We have been advised that the status of our UK partner (UNEXE) will change from full beneficiary, at the time of submission, to 'associated partner' at the time of the signing of the Grant Agreement. We will work with the Project Officer to manage any issues arising. UNEXE are key partners because the UKHLS and PROTECT panels (CSs1&2) are the world's largest household and prospective dementia-related panels respectively, and provide unique opportunities to explore intersectionality (analysing the intersections of gender, age, ethnicity etc. requires very large samples). Further, UNEXE's experience of working closely with the UK's nature-based social prescription programme gives them unique insight into policy makers' attitudes and beliefs about NbTs as well as insights into the structural barriers that need to be overcome, such as a lack of trained link-workers who have the knowledge and skills to support doctors' direct patients to the most appropriate opportunities for their needs[38].

International Expert Advisory Board (IEAB). The following EU/international experts in NbTs have agreed to be on our IEAB: Prof. Thomas **Astell-Burt**, Founding Co-Director of the Population Wellbeing and Environment Research Lab, a focal point for NbT research in **Australia**; Dr Melissa **Lem**, director of the **Canadian PaRx** (Prescription for Nature) NbT program; Nicole **Prop**, Managing Director of the long-standing nationwide '**Green Care Austria'** program; Prof. Nooshin **Razani**, director of The Center for Nature and Health (CNH) which has pioneered park prescription programs for childhood resilience in **California**; and Prof. Nancy **Wells**, Cornell University expert on **nature-based resilience**. Between them they are already running some of the most high-profile NbT programmes in Australia, Europe, and North America, and will thus be able to offer extensive insights not only on the global NbT picture (WP2) but also the cross-sectoral collaboration needed for successful, inclusive, sustainable NbTs (WPs3-8). The board is further enriched by: Dr. Kath **Maguire,** an expert in **Patient Public Involvement** and current facilitator of service user workshops on nature based social prescribing in the UK; and Prof. Alexandria **Poole**, an applied **environmental ethicist** who focuses on urban sustainability and developing avenues for social and environmental justice within education, public discourse, and empowering community engagement through applications in policy and technology for socio-ecological well-being. These board members will support us to ensure public, patient, and broader environmental needs and concerns are at the forefront of all project activities. The

locations of each of the annual meetings will be Vienna, Barcelona, Padua & Brussels, with this last one deliberately designed to be close to the high-level policy makers we want to target towards the end of the project.

Closing statement: RESONATE will support multiple Horizon Europe goals by contributing to the creation of more resilient, inclusive, and just societies that leave no one behind, whilst ensuring that healthcare "not only benefits people", but also the planet and society more generally[13]. By working with multi-sectoral stakeholders, practitioners, and innovators across the EU and internationally, we will achieve a shift in the way NbTs are perceived and utilised, with benefits to individual and community resilience that will resonate for decades to come.

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4. RESONATE Ethics Self-Assessment

Ethical dimension of the objectives, methodology, and likely impact:

1. Human Participants

Involvement of human participants within RESONATE is vital to: 1) build a stronger causal evidence-base regarding the relationships between nature and human health/well-being; and, 2) evaluate the efficacy of NbTs for health promotion/disease prevention. Participants involved in RESONATE activities will largely be volunteers engaged in: non-medical social and behavioural science research (interviews, surveys), complex interventions (Randomised Controlled Trails), or Community of Practice (CoP) interventions. To evaluate NbTs across the three levels of health promotion/disease prevention (primary: Level 1; secondary: Level 2; tertiary: Level 3), some studies involve participants with existing medical conditions (e.g. metabolic syndrome, physical disabilities), as well as vulnerable groups (e.g. adults with dementia and developmental challenges). Inclusion/exclusion criteria and sampling methods for each Case Study have already been defined to meet specific RESONATE objectives (See Annex: 'Essential Information for Clinical Studies in Horizon Europe). The proposed methodologies are not expected to result in discriminatory practices or unfair treatment.

1.1 Methodologies

- Secondary analysis of longitudinal datasets will be used to track large samples of general populations over time in order to monitor the links between nature contact, biopsychosocial resilience, mental health/well-being and stressful life events. Data pertaining to these participants have already been captured, with consent for secondary use obtained at the time of original data collection. There is little potential for adverse impacts of these activities, since only analyses of cleaned, anonymised data will be conducted in these studies. Approximate geolocations of participants will be linked to map data providing measures of neighbourhood-level exposure to natural environments. To avoid any risk of disclosure, mapping to geographical data will be undertaken either within the UK Data Service SecureLab digital environment (Case Study 1, UKHLS), or by supplying the data provider with neighbourhood-level nature metrics for secure data linkage who will, in turn, remove personally identifiable information/geographical identifiers from the returned dataset (Case Study 2, PROTECT).
- A primary panel survey will be conducted to assess whether nature contact mitigates the adverse impacts of everyday and environmental stressors on mental health/wellbeing, via high biopsychosocial resilience (Case Study 3). Participants will be recruited and administered by a professional subcontractor complying with EU and national rules. The company will approach a random sample of the Plovdiv residents, excluding minors, in-patients, institutionalized individuals, and those incapable of fully understanding the conditions and implications of their participation in the study. Survey data will be linked to environmental exposures, measured with geographic information systems, after which the working dataset will be pseudonymised with participant identifiers stored separately. The potential for adverse impacts is low, however as with any questionnaire survey, minor psychological distress may be caused by answering personal questions. To mitigate this, information sheets will include the contact details of relevant support organisations. Participants will also have the option to choose not to answer such questions or to discontinue the interview at any point.
- Laboratory testing (see Section 2. Human cells): to provide precise and objective measurements of biological resilience, a randomly drawn sub-sample of survey participants from Case Study 3 will be invited to take part in a subsequent laboratory testing for metabolic, immune, and hormonal biomarkers in blood (and possibly urine; see section 2 for more details).
- Randomised Controlled Trials of NbTs will develop a stronger causal evidence-base and further knowledge of the biopsychosocial mechanisms underlying nature-health associations. Interventions proposed for Case Studies 4-8 are non-invasive and considered to pose little risk to participant safety. NbTs consist of low-intensity physical activity within natural environments and are based upon well-established programmes/protocols (e.g., mindful nature immersion; Restoration skills training, ReST, MoveGreen). Control conditions vary between studies, but constitute low-risk activities (e.g. waiting list control, conventional mindfulness training). Detailed risk assessments for each intervention will be conducted prior to study initiation and interventions will only be delivered by individuals with the appropriate training and qualifications. Data collected across these case studies will include: collection of questionnaire data, non-invasive physiological data (e.g. saliva samples; see Section 2. Human Cells) and semi-structured interviews. Questionnaires will include validated measures of mental health/wellbeing (e.g., SF-12 general health questionnaire), and biopsychosocial resilience metrics (e.g., Brief Resilience Scale) that have been widely used in prior research.
- Community of Practice interventions: a collaborative action approach will be used explore how to integrate biopsychosocial resilience building processes into stakeholders' existing nature-based practices (Case Study 9). Consent for the recording of co-creation meetings and the use of such data (e.g., Chatham House rules) will be

agreed between all parties. After obtaining informed assent (see Section 1.3 Informed consent), the impacts of the interventions will be measured by means of researcher observations of clients with dementia or other cognitive issues participating in co-designed activities, as well as caregivers' completion of questionnaires. Specific consideration will be given to inclusivity, power-dynamics between researchers and stakeholders, and equity within all activities

- Semi-structured interviews: qualitative interviews will be used across Work Packages to obtain in-depth accounts of perceptions of NbTs from key stakeholders (e.g., healthcare professionals, land managers) and case study participants. The potential for adverse impacts is low, however as with any interview, minor psychological distress may be caused by answering some questions, thus appropriate support structures will be put into place prior to data collection. Confidentiality will be addressed by the removal of identifier components, biographical detail amendments, and pseudonyms (applicable to names of individuals, places and organizations, where appropriate).

1.2 Ethical approval: the overarching principle of RESONATE is that the interests and welfare of human beings shall prevail over the sole interest of society or science, therefore, where appropriate: 1) detailed risk assessments will be conducted; 2) specific insurance/indemnity arrangements will be implemented; and 3) research protocols will be submitted for consideration, comment, guidance, and approval to Research Ethics Authorities or other national competent authorities in each of the participating countries before any individual study begins.

1.3 Informed consent*:* individuals asked to participate in the project are entitled to choose whether or not to take part. Their decision is voluntary and they should be competent to understand what is involved. Information will be given in both oral (where applicable) and written form, in the native language, by an authorised professional. Information sheets will include details on: 1) the aims, methods and implications of the study; 2) the nature of the participation and any benefits, risks, or discomfort that might ensue; 3) details of how biological samples and data will be collected, protected during the project and whether they will be destroyed or reused afterwards; 4) the voluntary nature of the study (including their right to withdraw participation, samples or data); and, 5) whom they should contact for answers to any questions they may have in relation to the study or to request removal of their data after participation. Prior to participating in a study, all participants will be required to provide written informed consent. Informed consent forms will be developed in accordance with common practice and standard examples, as well as local ethics regulations. In the case of individuals with diminished mental capacity (Case Study 9) assent will be obtained and one of their legal representatives will be required to sign the informed consent form and any observable reluctance or hesitancy by the client themselves (which CS9 staff are trained to notice) will be taken as a lack of consent regardless of consent from legal representatives.

1.4 Incidental findings: a policy for incidental findings will be developed, with a particular focus on mental health and physiological measures of resilience (i.e. cardiovascular and metabolic function for CSs 4-6). This will ensure that appropriate measures (e.g. referring the participants to their primary care provider) are taken when necessary. Participants will be informed on how potential incidental findings will be managed during the informed consent process.

2. Human Cells

The inclusion of physiological data to measure the biological component of biopsychosocial resilience will contribute to precise and objective measures of intervention effects. This will provide unprecedented knowledge on nature-based interventions' potential to improve health and prevent disease within general populations, as well as high-risk populations (i.e. individuals with metabolic syndrome). To achieve this, metabolic, immune, and hormonal biomarkers will be assessed saliva and blood samples.

- Saliva samples (Case Studies 4-6). The collection of saliva will be conducted using an unstimulated passive drooling method in salivary tubes (SalivaBio Collection Aid, Salimetrics). This method is easy and non-invasive, improving compliance with testing. From the saliva samples we will assess: 1) Neuroendocrine function by analysing cortisol. Since the cortisol value will be incorporated in the full AL-index, we will not need to take diurnal rhythm into account in these studies, but only one sample per occasion is required; 2) Immune function by analysing: saliva immunoglobulin A (sIgA), interleukin 1 and 6 (IL1 and IL6), and C-reactive protein (CRP). Saliva samples will be stored securely in freezers (-20°C) until transport to collaborating partners in Austria. Samples will be analysed at the Paracelsus Medizinische Privatuniversität Salzburg (PMU), Salzburg, Austria to ensure synchronised procedures across the three harmonised case studies. This will prevent any variances occurring due to differences in laboratory protocols. The Salzburg laboratory has longstanding expertise and experience of these kinds of analyses. All samples will be destroyed after completion of the study.

Blood samples (Case Studies 3 & 5). Blood samples will be collected by trained team members at the two Medical

Universities involved in Case Studies 3 & 5 (Meditcinsky Universitet-Plovdiv, MUP; PMU), to test for metabolic (e.g., CBC, Triglycerides, blood glucose, cholesterol), immune (e.g., interleukins, NKTB cells), and hormonal (e.g., cortisol) biomarkers. These tests will be carried out according to the Declaration of Helsinki and other clinical standards, in research-grade, accredited medical facilities, and only after obtaining informed consent. Collection of these bio-samples will require invasive procedures (i.e. the drawing of blood - likely from median cubital vein), which may cause local bruising and pain as with any venepuncture. However, this procedure will be conducted by experienced clinical physicians and lab technicians, and participants will be monitored before, during, and shortly after the procedure, and provided first aid if necessary. All samples will be destroyed after completion of the study. Both the MUP and PMU Principle Investigators, as well as clinical physicians on their teams, have experience and expertise in these procedures.

3. Data Protection

Examination of relationships between nature and human health/wellbeing, as well as evaluations regarding the efficacy of NbTs, require the collection and analyses of some personal/sensitive data, including: geolocation (Case Studies 1-3); validated measures of health/wellbeing (Case Studies 1-9) and biological samples (Case Studies 3-6). Adequate measures to ensure personal data protection and confidentiality will be taken, according to the Regulation (EU) 2016/679 and national/local regulations.

The following principles will be applied: lawfulness, fairness, and transparency; purpose limitation; data minimisation (necessary and proportionate for the research objective); accuracy; storage limitation, and integrity and confidentiality.

General procedures across Case Studies/Work Packages include:

- Written consent will include a specific clause on personal data protection informing the participants how their data is treated and stored, the research purpose, the Data Protection Officer (DPO) contact and their rights.
- Pseudonymisation will be implemented as a general standard, meaning that all material obtained in the framework of the project (questionnaires, interviews, saliva samples) will be identified through a code; the name and/or other personal data that could allow the identification of the participant will never be indicated. This unique identifier will link all basic data required for the research. The master key file linking the centre's study numbers with personal identifiers will be maintained in a password protected file with limited access. Whenever possible, anonymisation will be applied.
- Files containing personal data will be stored in encrypted and password-locked files, with limited access to authorised project personnel.
- In the case of tracking participants by geo-localization techniques, the geo-localization data will be stored separately from the other participant's data (health, etc.).
- If applicable, transfers will be done according to current legislation.
- Reported study results will pertain to analyses of aggregate data. No individual's name will be associated with any published or unpublished report. Visualization of participants' residential location will be rendered at a resolution/aspect ratio that does not allow for identification of specific locations.
- Project personnel will be trained on this topic and required to sign a confidentiality agreement.

The partners will assess with the corresponding DPO, whether a Data Protection Impact Assessment is required (Art. 35GDPR), to evaluate the risks and implement mitigation measures. The first Data Management Plan will be delivered within 6 months of project start by WP1 with support of all Partners. As the studies proceed, more elaborated versions will be delivered to the International Expert Advisory Board (IEAB). Fine-tuning of the plan will occur, at least by the mid-term and final review of the project, in order to update it in accordance with the data generated from the studies and potential changes to the initially expected data production and use. Whenever any important changes to the studies occur, a new version of the plan will be created.

4. Non-EU Countries

Case Studies 1 and 2, as well as Work Package 8 will be led by partners in the United Kingdom (UK). The ethical standards and guidelines of Horizon Europe will be rigorously applied, regardless of the country in which the research is carried out.

The process evaluation proposed in Work Package 8 will involve the transfer of de-identified personal data from the EU partners responsible for Case Studies (Bulgaria, Italy, Austria, Spain, Sweden, Denmark, Netherlands) to partners at the University of Exeter in the United Kingdom. Given the equivalence of the UK's 2018 Data Protection Act and the EU's GDPR, we foresee no issues that would prohibit the sharing of data. However, we will ensure that data transfer is conducted securely and is compliant with EU rules on international data transfers (https://ec.europa.eu/info/law/law-topic/data-protection/international-dimension-data-protection/rules-international-

data-transfers_en). The data received will be de-identified, so that no individual will be personally identifiable. Participant codes will allow the link of quantitative and qualitative process evaluation data of individuals, required for Work Package 8 tasks, but this alone would not allow UK partners to personally identify any individual.

Compliance with ethical principles and relevant legislations:

Research studies in the countries participating in the project will be conducted according to international and national legal and ethical rules and requirements. The consortium is aware and will conform to the International, European, and National legislations in all the various aspects of the research as detailed below. The ethical standards of guidelines of Horizon Europe will be rigorously applied, regardless of the country in which the research is carried out. The partners will adhere to the highest standards of research integrity as described in the European Code of Conduct for Research Integrity.

The consortium partners are aware of further relevant guidance, codes, and regulations, including:

- The Nuremberg Code (1946) addressing volunteer consent and proper acting;
- The Revised Declaration of Helsinki in its last version of 2013
- The convention for the protection of human rights and dignity of human being with regard to the application of biology and medicine called the "Convention on Human Rights and Biomedicine" (Council of Europe, 1997) and, the additional protocol on the prohibition of cloning human beings (1998); and its additional protocol on biomedical research (2005)
- Recommendation CM/Rec (2016)6 on research on biological materials of human origin was adopted by the Committee of Ministers of the Council of Europe
- Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data.
- UN Convention on the Rights of the Child (1990);
- The Royal Decree that establishes the basic requirements for the authorisation and functioning of biobanks with biomedical research purpose and for the processing of human samples and regulating the functioning and organisation of the National Register of Biobanks for Biomedical Research (1716/2011, of 18th November).
- EU Guidelines for Ethics in Social Sciences and Humanities (http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020_ethics-soc-science-humanities_en.pdf)
- Ethical and governance guidelines for conducting evaluations of complex interventions e.g. https://arc-w.nihr.ac.uk/training-and-capacity-building/evaluation-best-practice-and-guidelines/).

We have reviewed the guidance available on the web (http://ec.europa.eu/research/participants/docs/h2020-funding-guide/cross-cutting-issues/ethics_en.htm ; https://ec.europa.eu/research/swafs/index.cfm?pg=policy&lib=ethics

Ethics committees and approval: relevant approvals/authorisations from the national/local Ethics Committees for the research with humans will be obtained prior to any intervention. Relevant documents (e.g., ethical approvals, information sheets, informed consent) will be kept on file and will be provided upon request. The ethical, legal, and social aspects will be closely monitored by Work Package 10, and overseen by an Independent Ethics Advisor to be appointed by end Mth1. The partners involved will monitor that all relevant approvals and certificates are obtained. Where any new substantial ethical issues are raised, e.g. by the Independent Ethics Expert in their Ethics Summary reports or elsewhere across the project, the associated Beneficiaries and Coordinator will inform the granting authority, and will continue to rigorously follow the guidance provided by the European Commission Ethics Self-Assessment Guidelines.

Security: beyond the involvement of non-EU partners (UK), RESONATE will not involve activities or results raising security issues, nor will it use EU-classified information as background material or as results.

ETHICS ANNEX. Essential information for clinical studies in Horizon Europe

1 Description of the clinical study

1.1 Title, acronym, unique identifier (e.g. EudraCT Number, or identifier from ISCRTN, ClinicalTrials.gov if available) of the clinical study

Case Study 1. UKHLS Representative Longitudinal Study: Does Nature Contact Mitigate the Impact of Stressful Life Events on Mental and Physical Health via Enhanced Psychosocial Resilience?

Case Study 2. PROTECT Cohort Study: Does Nature Contact Mitigate the Impact of Stressful Societal Level Events on Mental and Physical Health via Enhanced Psychosocial Resilience?

Case Study 3. RESONATE Longitudinal Panel Study: Does Nature Contact Mitigate the Impact of Everyday and Environmental Stressors on Mental and Physical Health via Enhanced Biopsychosocial Resilience?

Case Study 4. Randomised Controlled Trial Examining the Efficacy of an Urban/Peri-Urban Nature-Based Therapy for Increased Biopsychosocial Resilience Amongst Sedentary Individuals with Metabolic Syndrome**.**

Case Study 5. Randomised Controlled Trial Examining the Efficacy of a Rural Nature-Based Therapy for Increased Biopsychosocial Resilience Amongst Sedentary Individuals with Metabolic Syndrome**.**

Case Study 6. Randomised Controlled Trial Examining the Efficacy of an Urban Coastal Nature-Based Therapy for Increased Biopsychosocial Resilience Amongst Sedentary Individuals with Metabolic Syndrome.

Case Study 7. Randomised Controlled Trial Combining Environmental and Skill-Based Approaches to Promoting Psychological Resilience Amongst Individuals with Clinically Elevated Psychological Symptoms.

Case Study 8. Randomised Controlled Trial of a Technology Enhanced Nature Immersion for Promoting Biopsychosocial Resilience and Mental Health for People with Mobility Issues.

Case Study 9. Feasibility Trial of Enhanced Nature-Based Care in Care Farms for Promoting Psychological Resilience and Well-Being Amongst Clients of Care Farms with Dementia or Other Cognitive and Functional Impairments.

*No unique identifiers currently available. All Case Studies will be registered at the start of the project.

Please note. *Full detailed protocols will be developed during the project and submitted to the relevant ethics committees for approval. Case Studies 1-3 use either secondary data or non-intervention data, thus several sections for this template are not applicable. Case Studies 4-6 and 9 involve important co-creation aspects with local stakeholders, service providers, and service users. Therefore, exact information cannot be provided for some sections at this time, but we instead provide generic principles and examples that may be subject to change. More detailed information is provided for Case Studies 7-8 as these are extensions to established nature-based therapy programmes. In short, the length of answers to some sections varies as a function of the type and stage of case study development*.

1.2 Study rationale

Please provide the overall rationale for conducting the proposed study.

Overview: the proposed Case Studies are embedded within the wider RESONATE proposal, which brings together a global consortium of researchers specialising in Nature-based Therapy (NbT) research. The proposed Case Studies span eight countries; urban, rural, and coastal settings; primary (Level 1), secondary (Level 2), and tertiary (Level 3) level health promotion/disease prevention. Using longitudinal cohort designs and Randomised Controlled Trails (RCTs) and Community of Practice (CoP) interventions, the combined results of the RESONATE Case Studies will: 1) provide further insight into the resilience-building functions of nature contact for health/well-being; 2) strengthen the causal evidence base; 3) increase public/policy makers' and health care professionals' awareness and acceptance of these benefits; 4) help build more resilient individuals, communities, and ecological systems in urban, rural, and coastal settings; and 5) ensure wider utilization of cost-effective nature-based therapies as a form of preventive medicine.

Case Study 1. This case study will investigate whether the availability of neighbourhood nature promotes better psychological (i.e. more adaptive coping appraisals) and social resilience (i.e. better relational resources and social

cohesion), which in turn attenuates negative impacts of stressful life events (e.g., divorce, unemployment, bereavement) on health in adulthood. The study will link secondary data from the United Kingdom Household Longitudinal Study (UKHLS) to environmental data surrounding individual's homes (i.e. green/blue space indicators), for the period 2010 to 2019 (current available data with new Waves expected before analysis). Key measures of emotional and social resilience were collected in (Waves 3-6). Analyses will explore individuals either side of these years to explore the relationships between nature exposure and emotional and social resilience prior to Waves 3/6 and then subsequently the associations between stressful events and health/well-being during/after Waves 3/6. Broadly, our hypothesis is that greater nature exposure at T1 will, ceteris paribus, be associated with higher resilience at T2, which in turn moderates the relationship between stressful events at T3 and health/well-being outcomes at T4.

Case Study 2. This case study will investigate whether the availability of neighbourhood nature and engagement with natural environments more widely promotes better psychological (i.e. better cognitive functioning) and social resilience (i.e. less loneliness) to stressors, attenuating negative impacts of socially stressful events on health/well-being in older adults. Stressful life events considered will include individual (e.g. bereavement, serious illness) and collective (such as 2022 UK cost of living crisis) experiences. The study will link data from the PROTECT cohort to environmental data (i.e. green/blue space indicators) from 2015 (baseline) and will retrospectively link earlier environmental exposures through collection of residential address histories. We will also work with the PROTECT team to collect additional data via an online survey to establish participants' frequency and characteristics of visits to natural environments. The basic hypothesis is similar to CS1 in terms of the exploration of longitudinal patterns.

Case Study 3. This case study will use a bespoke prospective longitudinal cohort drawn from a random sample of residents of the city of Plovdiv, Bulgaria to investigate the contributions of different types of nature contact to biopsychosocial resilience and, through that, physical and mental health. More specifically, the study will examine the potential of nature contact to buffer the impact on health/well-being of harmful physical exposures (e.g., noise, air pollution) and stressful everyday hassles.

Case Studies 4-6. The proposed studies will examine the effects of NbTs based on the mindful immersion in nature on the biopsychosocial resilience of individuals who are sedentary, low-nature users, and with metabolic syndrome (a combination of at least 3 of 5 risk factors: large waistline, high blood pressure, abnormal blood lipid levels, low HDL cholesterol, and high blood sugar) (secondary prevention) in urban/peri-urban (Case Study 4), rural (Case Study 5) and urban coastal settings (Case Study 6). Thus, the studies will contribute to building a stronger body of evidence regarding target group specific NbTs and will also deliver relevant impact through the explicit development of nature-based, and community-led innovations that will inform guidelines on how to best co-create locally relevant resilience building NbTs.

Case Study 7. This study compares nature-based, mindfulness-based, and integrated approaches to promoting resilience in a large, factorial RCT that will disentangle the relative and additive contributions of the environmental and skill-building components to resilience-related processes and outcomes.

Case Study 8. People with mobility issues (e.g. those using assistive devices such as walkers or wheelchairs) face significant barriers in terms of accessing nature and have been largely overlooked in the research field of nature and human health relationships. The 'Leave no one behind' agenda and Sustainable Development Goal 11.7 explicitly draw attention to the need for improved equitable fair access to urban green spaces for people with physical disabilities in an attempt to reduce existing inequalities. This group is also of particular interest to the current call because, they face many additional stressors in their everyday lives as evidenced by generally poorer health-related quality of life compared to the able-bodied population. To the extent that supportive nature contact can help build biopsychosocial resilience, the benefits may therefore be particularly pertinent for this group. The specific aim of Case Study 8 to test the potential benefits to biopsychosocial resilience and mental health for people with mobility issues of spending time in a bespoke outdoor environment research laboratory 'Move Green Lab.' located within Denmark's largest arboretum and designed to aid nature access for people with mobility issues using the Evidence-Based Health Design in Landscape architecture process model (EBHDL-process model). Specifically, we will explore whether regular visits to the Move Green Lab. (urban forest) using smartphone App designed to guide and support people's sensory experiences enhances mental health and biopsychosocial resilience outcomes for people with mobility issues.

Case Study 9. This study will explore how nature-based biopsychosocial resilience building processes can be integrated into the existing practices of a region-wide care farming program in the Netherlands. The main aim is to improve the use of the natural environment for building resilience by means of staff training. This training will be

carried out as a participatory trajectory (or Community of Practice) in which staff of different farms will exchange their knowledge and will collaborate with researchers and other experts to develop, test, and evaluate nature-based daytime activities that are optimally geared towards building the clients' biopsychosocial resilience. For this study, we will focus on care farms offering daytime activities for older people with various forms of dementia in different stages and other cognitive and functional impairments. There is currently no cure available for this condition, but the activities at the farm can help the clients and their caregivers to live well with the condition and as such become more resilient against its negative impacts.

1.2.1 Extent and evaluation of current knowledge directly linked to the scientific question(s) to be answered by the clinical study

Case Studies 1-3. Epidemiological evidence suggests that different types of contact, with various forms of nature, is good for a range of health and well-being outcomes (Frumkin et al., 2017; Hartig et al., 2014; Twohig-Bennett & Jones, 2018). Yet, the current evidence base is limited by its largely cross-sectional approach. Although analysis of data from UKHLS's predecessor The British Household Panel Survey (BHPS) by members of the RESONATE consortium showed that relocations to greener, more natural, or coastal locations, are associated with improved mental health and wellbeing (White, et al., 2013a; 2013b, Alcock, White et al., 2014; 2015; see also Annerstedt (Van den Bosch) et al., 2015), they were unable to explain the mechanisms underlying these associations (Frumkin et al., 2017). Case Studies 1-3 build on this earlier work to use longitudinal cohort designs and several validated measures of resilience to: 1) strengthen the causal evidence base; and, 2) examine a range of biopsychosocial mechanisms with the potential to mediate nature-health associations.

Case Studies 4-6. Current evidence suggests that NbTs can have a beneficial impact on mental health and wellbeing (Britton et al., 2020; Lovell et al., 2015). However, high-quality evidence, based on well-controlled trials, is lacking (Annerstedt & Währborg, 2011; Corazon et al., 2019) and the biopsychosocial mechanisms are again insufficiently understood (Frumkin et al., 2017). Furthermore, heterogeneity in terms of intervention protocols and outcomes between studies make it difficult to synthesise and compare causal evidence on the efficacy of NbTs (Hartig et al., 2014; Annerstedt & Währborg, 2011). Using comparable high-quality Randomised Controlled Trial (RCT) designs, Case Studies 4-6 will provide essential knowledge regarding the efficiency of NbTs in a high-risk population group suffering from Metabolic Syndrome (MtS). The rationale behind choosing a population with MtS is that this is a group of individuals with a high risk of developing various non-communicable diseases (NCDs), such as coronary heart disease and stroke, and are likely to benefit from improved biopsychosocial resilience. MtS is characterised by a cluster of conditions that occur together, such as being overweight, and having high blood pressure, and blood glucose levels. All the parameters may hypothetically be improved by NbT, which could promote physical activity and reduce stress. The results are expected to be beneficial for implementation of nature-based interventions as a preventive approach in a high-risk population, with significant health gains.

Case Study 7. NbTs often combine an environmental intervention with more conventionally "psychological", individual-level methods (e.g., talk therapy, skills training) to promote biopsychosocial resilience. Mindfulness training is one such individual-level method that, building on tradition, experience, and emerging theory is being combined with nature exposure to achieve synergies and added benefits in NbT's (Djernis et al., 2019; Kotera et al., 2022). Arguments for the feasibility of such a combination have been put forth by researchers in environmental psychology (Macaulay et al., 2022; Schutte & Malouff, 2018), meditation science (Tang & Posner, 2009; Van Gordon et al., 2018), and NbT fields (Corazon et al., 2012; Lymeus et al., 2017). Yet, it is still poorly understood how integration of the two approaches may facilitate relevant processes and outcomes beyond those that can be achieved through either component alone (Geiger et al., 2019; Lymeus, 2022b). The restoration skills training (ReST) course was systematically developed based on current insights in the respective fields (Lymeus, 2019) and has withstood empirical testing in terms of several theoretical assumptions and resilience-related outcomes (Lymeus et al., 2018, 2022). The ReST course and surrounding research framework gives unique opportunity to factor out the relative and additive contributions of the setting and skill-building components involved by comparing five weeks of ReST training to formally matched conventional mindfulness-based training conducted indoors, nature contact without mindfulness training in a Nature on Prescription program, and to a passive control condition. This will allow firm conclusions regarding how these components contribute to mechanisms of change and to outcomes directly relevant for the biopsychosocial resilience model.

Case Study 8. Despite the many possible health benefits of nature exposure, not all population groups have equal access to them, as illustrated in a review of health inequalities in a British context (Shanahan et al., 2014). One aspect of accessibility addressed by the British review is the distance to the nearest green space, which has been shown to be related to the frequency of visits (e.g., Neuvonen et al., 2007; Schipperijn et al., 2010) and health (Stigsdotter et

al., 2010). Another aspect to consider is the accessibility of the space in relation to the individual's abilities (WHO, 2011). Both the distance to and the accessibility of green spaces may involve potential constraints that might exclude individuals from visiting them. A national Danish survey found that people with mobility disabilities visit green spaces much less frequently than the able-bodied population (Stigsdotter, Corazon & Ekholm 2017). These findings are in line with a nation-wide survey on the use of outdoor environments for leisure conducted in the United States (Williams, Vogelsong & Cordell 2004). Furthermore, people restricted by physical disability generally have greater mental and physical health problems than the able-bodied population (WHO 2011). One may, therefore, assume that the potential health benefits of contact with green spaces could be an important health resource for this population group. However, little is known about what factors lead to the generally low participation of people with mobility disabilities in green space activities. Studies have found that this group has the same preference for green spaces as the able-bodied reference group, shares the same environmental attitudes (Brown, Kaplan & Quaderer 1999; Lovelock, 2010; Moore, Dattilo & Devine 1996), and gains the same health benefits (Zhang et al. 2017). To provide equal access for all and to meet the requirements of the United Nation's Convention on the Equal Rights of Persons with Disabilities (UN, 2006), it is important to explore the constraints this population group experiences when visiting green spaces and how they can be overcome, but perhaps foremost also to provide guidance on how to use green spaces for a 'new' group of nature visitors.

Case Study 9. The concept of care farming provides an innovative approach to dementia care that is being implemented in an increasing number of countries. Several research projects have been carried out that address a wide range of issues related to dementia care provision at care farms with various research methods (e.g. De Boer, Verbeek, Zwakhalen, & Hamers, 2019; De Bruin et al., 2017; Ibsen et al., 2020). Results indicate that contact with nature and animals and time spent outdoors is an important and highly valued element of care farming, in addition to other elements such as (physical) activities, structure, social interactions, healthy eating, and a sense of meaning in life. Participants and their family caregivers experience less stigmatisation because of dementia, since the care farm environment is non-institutional. Instead, people with dementia consider themselves a volunteer or employee rather than a patient with cognitive and functional impairments. Clients feel recognized, understood, and seen as people who can deliver a meaningful contribution. Based on these studies, it can be concluded that care farms have a wide range of resilience-building benefits that promote the health and wellbeing of people with dementia and their family caregivers (De Bruin et al., 2020). It is however, not as yet well understood how the natural outdoor environment of the farms can be optimally used to support these beneficial impacts.

1.2.1.1 Outcomes (efficacy, safety) of completed and number of ongoing clinical studies utilising the same intervention in the same indication (including review of public registers)

Case Studies 1- 3. Not applicable. The proposed studies use observational designs examining the associations between respondents' existing contact with nature (e.g. residential access, recreational visits), stressful life events, biopsychosocial resilience measures, and mental health outcomes.

Case Studies 4-6. There are currently no ongoing clinical studies using the same intervention in the same indication. The efficacy and safety of similar interventions (i.e. NbTs with a focus on moderate exercise in natural environments, though not participants with MtS) have, however, been shown in a range of completed studies that were conducted by researchers within the RESONATE consortium (e.g. Arnulf Hartl: ISRCTN88277657 – Effects of Winter Exercise and the Healing Climate of Caves on people with Allergies and Asthma; ISRCTN43292449 – Mountain Hiking *vs.* Nature Connection Therapy Based in Algund as Climate Therapy for Couples).

Case Study 7. Mindfulness training is well-established as a health and well-being intervention for several clinical groups and healthy participants, most prominently exemplified in research and practice by the Mindfulness-Based Stress Reduction course (MBSR; see Crane et al., 2017). A multitude of evidence reviews have affirmed that conventional mindfulness training promotes several aspects of psychological functioning and health (Cásedas et al., 2020; Khoury et al., 2013; Sedlmeier et al., 2018; Tang et al., 2015). Studies that have assessed undesired experiences and potential harm in connection with conventional mindfulness training have broadly concluded that the training may be challenging for some but not attended by any serious risks when applied appropriately (Aizik-Reebs et al., 2021; Baer et al., 2019, 2021). Members of the consortium have previously compared a five-week conventional mindfulness training course based on the MBSR approach to a formally matched mindfulness- and nature-based ReST course. The studies affirmed that ReST teaches skills relevant for protective resilience (general attention performance) and recovery resilience (cognitive and emotional restoration) while conventional mindfulness training only generated indications of the former (Lymeus et al., 2018). ReST also had lower drop-out and steadier compliance rates than conventional mindfulness training, which was explained by interactions between experiences of setting characteristics and meditation depth during class meetings (Lymeus et al., 2019). In addition to being more restorative

(i.e., less effortful) and appealing, random assignment to the ReST course was, on average, attended by lasting benefits for general aspects of psychological functioning that were not inferior to those of conventional mindfulness training, and was not attended by any elevated or concerning risk of deteriorated psychological functioning (Lymeus et al., 2020, 2022). This case study compares ReST, conventional mindfulness training building on MBSR, and a Nature on Prescription intervention that involves regular nature visits without any particular training. Nature on Prescription is currently being established as a health and wellbeing intervention in several countries, and members of the consortium have contributed to the development of a comprehensive handbook for successful and safe implementation of such interventions (Fullam et al., 2021). The guidelines put forth in the handbook served as a foundation for development of a preliminary Nature on Prescription intervention that was tested in a pilot study. Evaluations of the pilot study (Palm & Stjernberg, 2022; Tóth, 2022) concluded that the intervention is broadly promising and that participant's reports did not indicate any major discomforts or undesired outcomes. Experience and data resulting from the pilot study, together with expertise shared within the consortium, will guide further improvements of the Nature on Prescription intervention in preparation for this study.

Case Study 8. Although no ongoing or previous studies have utilised the same App. enhanced intervention, a previous RCT study supports the clinical efficacy of the nature-based therapy programme that underpins the rationale for the App (Stigsdotter et al., 2018; Corazon et al., 2018).

Case Study 9. No ongoing or previous studies have utilised this intervention in a care-farm setting for clients with dementia. However, a recent study by our research group has examined the impacts of a participatory staff training to increase the use of the outdoor natural area at nature-based day-care centres (for young children aged 0-4). The training aimed at stimulating staff's interaction skills using the concept of 'attentive presence'. Following this concept, caregivers were stimulated to be fully present on what is happening in the moment, accept what is happening as it is, and have an eye for how the child is captured and guided by affordances in the environment, and support the child in doing so. This study (under review with the Journal of Outdoor and Environmental Education) showed that children at centres that participated in the training program, as compared to centres that did not, showed lower stress levels (including hair cortisol measurements), and increased levels of well-being, involvement, physical activity, and creative play behaviour while in the outdoor area. Although the target population of this study (very young children) is very different from the target population of the current study (older adults with dementia), a key similarity between the two populations is that they have limited capacity for verbal exchanges and thus are unable to answer questionnaires or other self-report measures. Both populations require data-collection to be carried out through in-situ observations, for which we have developed systematic field observation procedures.

1.2.2 Level of evidence related to the mechanism of action of the intervention in the planned clinical study population

Case Studies 1-3. Epidemiological studies indicate that residential access to green/blue spaces, as well as recreational nature visits are associated with better health and well-being outcomes (White et al., 2021; Martin et al., 2020). However, to date, population-level investigations of these associations have predominantly used a cross-sectional approach, and consideration of the biopsychosocial mechanisms potentially underlying nature-health associations tends to be fragmented and lack a coherent joined-up framework (White et al., 2022, *under review* – i.e. the paper describing the theory developed by consortium members for this proposal). The proposed studies address these limitations by using longitudinal/cohort designs to examine: 1) whether higher levels of nature contact mitigate the adverse impacts of stressors on mental and physical health; and 2) whether/how various biopsychosocial resilience pathways underly these associations.

Case Studies 4-6. Preliminary studies suggest a beneficial impact of NbTs on physical health (e.g., chronic-low back pain, allergy and asthma, osteoporosis prevention), improved mental health and well-being (e.g., unipolar depression, stress related disorders, positive emotions), and stress (e.g., cortisol, Bonham-Corcoran et al., 2022). However, the evidence level is limited and no previous studies have analysed the impact of these kind of NbTs on biopsychosocial resilience and health in individuals with MtS in urban/peri-urban (Case Study 4), rural (Case Study 5) and urban coastal (Case Study 6) settings in a coordinated and community co-created fashion.

Case Study 7. Much research in environmental psychology has demonstrated that certain spontaneous, transactional qualities in how people tend to relate to natural environmental features (Hartig et al., 1997; Kaplan, 1995) contribute to relatively high preferences and short-term emotional benefits (e.g., Marselle et al., 2016; White et al., 2010), as well as longer-term health benefits of nature contacts (e.g. Hipp et al., 2015). Hence, the restoration processes known to commonly take place in nature settings presumably proceed even without any conscious decision or particular investment by the individual (von Lindern et al., 2022) and nature-based interventions have been reported to

particularly benefit people with low cognitive/emotional resources (e.g., Hartig & Staats, 2006; Wheeler et al., 2015). In contrast, mainstream theories in meditation science hold that mindfulness training for beginners improves psychological resilience by gradually training neural and cognitive-behavioural self-regulation capabilities in regular focused-attention meditation exercises (Chiesa et al., 2011; Fox et al., 2016; Lutz et al., 2008). However, such training requires determination and an investment of cognitive effort (Hasenkamp et al., 2012; Lutz et al., 2015; Malinowski, 2013). Accordingly, people who have weak self-regulation capabilities to begin with – to whom mindfulness training is frequently recommended as a remedy – tend to practice less, drop out more, and benefit less (Banerjee et al., 2018; Crane & Williams, 2010; Lymeus et al., 2017). The outcomes reported under 1.2.1.1 give indications that ReST, which integrates mindfulness training with nature contact, is less effortful and more appealing than conventional mindfulness training because it supports psychological restoration during practice sessions, which in turn promotes deeper meditative experiences and higher initial and long-term commitment to the practice. Given the attrition problems commonly seen with conventional mindfulness training, consortium members compared the relationship between initial cognitive functioning, practice compliance, and achieved cognitive improvements among participants in a conventional mindfulness course versus ReST (Lymeus, 2022a). Participants with more pronounced cognitive problems practiced more if they had been randomly assigned to ReST, which in turn contributed substantially to explaining their improvement in cognitive functioning. Hence, ReST better helped those participants who needed it most. The lower effort required with the ReST approach (Lymeus et al., 2018) and the restoration processes promoted by the natural setting (Lymeus et al., 2019) presumably constitute key mechanisms behind this difference in compliance and outcome patterns compared with conventional mindfulness training. Former ReST participants were also more likely than former participants in the conventional course to keep using the skills they had learned over the following six months (Lymeus et al., 2022).

Case Study 8. The results reported under 1.2.1.1 give indications that nature exposure could be beneficial for the mental health issues that people with mobility disability face. However, the evidence level is limited and no previous studies have analysed impact of visits with an App with sensory awareness exercises tailored to a particular nature environment that is specifically designed to be accessible and health promoting for people with mobility disabilities.

Case Study 9. In general, there is substantial support for the beneficial effects of contact with nature for older adults with dementia and other cognitive and functional impairments (Uwajeh, Polay, & Iyendo, 2018; Whear et al., 2014). The effectiveness of Communities of Practices as a co-creative participatory approach to stimulate innovation in healthcare and public health and other domains (eg., education, community building) is also well-established (Li et al., 2009; Wenger, 1998). However, the combination of these two approaches for optimizing the beneficial effects of contact with nature at care-farms is new and innovative, thus has not been empirically studied.

1.3 Objective(s) of the clinical study
Please differentiate between primary and secondary objective(s)

Case Study 1. The primary objective is to investigate whether residential and occupational exposure to natural environments attenuates adverse mental and physical health trajectories associated with personally stressful life events. The secondary objective is to examine whether these associations are mediated by higher psychological and/or social resilience, specifically higher self-efficacy and neighbourhood cohesion (the most relevant metrics that already exist in this secondary dataset following preliminary data availability screening).

Case Study 2. The primary objective is to investigate whether exposure to natural environments (incl. residential exposure, recreational nature visits) attenuates adverse mental and physical health trajectories associated with societal level stressors (e.g. Covid-19 lockdowns, cost of living challenges) on an older population. The secondary objective is to examine whether these associations are mediated by better psychological and/or social resilience, specifically higher executive function and lower loneliness (again the most relevant metrics existing in this secondary dataset following preliminary data availability screening).

Case Study 3. The primary research questions to be answered include: 1) the frequency, duration, and form of habitual exposure to green/blue spaces and, in general, contact with nature; 2) the contribution of nature contact to different types of biopsychosocial resilience and, through that, mental/physical health. In addition, the underlying pathways linking nature contact, resilience, and mental health, including the potential of nature contact to buffer the impact on mental health of harmful physical exposures (e.g., noise, air pollution) and stressful everyday events and hassles will be explored.

Case Studies 4-6. The primary objective of these clinical studies is to analyse the impact of a series of short, initially staff guided, and then outdoor-activity-mapping-App-supported, self-directed mindful immersions in nature on

biopsychosocial resilience in a sedentary population with MtS and low nature use prior to the study. Primary outcomes to measure biopsychosocial resilience include: 1) quality of life (incl. SF-12), and 2) chronic stress. The secondary objective is to provide data on environmental, social, and economical aspects of the intervention to contribute to Social Innovation Actions and to establish NbTs as secondary prevention measures in health care. Of note we are not creating a new technology App. support system here but will use off the shelf products that can already be used to map out routes in advance and which can be uploaded for participants to route follow e.g. https://www.outdooractive.com/.

Case Study 7. Restoration skills training (ReST), which integrates mindfulness training with restorative nature experience, is promising as an appealing and accessible health intervention. However, it needs to be studied with high quality RCT methods that explore its scaling-out potential and roll out fidelity, in order to gain wider acceptance. We seek to determine whether the integrated method yields broader and stronger outcomes than each component intervention alone, and can be disseminated as an intervention to enhance resilience.

Case Study 8. The primary objective is to examine the impact of regular visits to the Move Green Lab., supported by a nature-based App, on the biopsychosocial resilience and mental health of participants with mobility disabilities/issues. The secondary objectives are to: 1) analyse and investigate if the App. is supporting the nature experiences by using eye-tracking technology with a sub-sample of willing participants; 2) analyse the possibility of the landscape by using landscape analyses, systematic observations, qualitative interviews with participants, and eye-tracking technology in order to gain insight into how to improve future designs for these groups concerning nature accessibility.

Case Study 9. The primary objective is to evaluate the impacts of a participatory staff training program aimed at strengthening the use of the natural outdoor areas at care-farms for improving clients' well-being while engaging in nature-based activities. The secondary objective is to compare the nature-based biopsychosocial resilience (as measured by the validated outcome measures of the RESONATE program) of clients at farms who participated in the program to clients who did not, and to identify factors that may moderate the impacts of the training, such as the characteristics of the outdoor area, quality of the interaction between care givers and care clients, etc.

1.4 Characteristics of the study population (size, age group, sex distribution, inclusion and exclusion criteria; all items with justification)

Case Study 1. The UK Household Longitudinal survey (UKHLS) is a nationally representative annual longitudinal panel survey, based on a clustered-stratified probability sample of 40,000 UK households. Data is currently available from 2009 to 2019 (Waves 1-10) with possible further waves released before analysis will begin. With measures pertaining to emotional and social processes included in different survey waves, we will analyse these two potential mediators separately, over somewhat different time-frames. Analyses for emotional resilience will be restricted to participants over the age of 18, who completed the General Self-Efficacy Scale (GSF) in 2013/14 (Wave 5) (N = 37,112). Analyses for social resilience will be restricted to participants who completed the two social items of interest (i.e. number of close friends and neighbourhood social cohesion scale) in 2014/15 (Wave 6) (N = 36,000). Should data on the two proposed mediators become available for later survey waves this will also be analysed. Intersectionality will be explored thorough interaction terms across multiple socio-demographics, including gender, age, ethnicity, and socio-economic status, and stratified where appropriate.

Case Study 2. PROTECT included ~14,000 UK participants at baseline (2015); by April 2020 there were 24,030 enrolled members of the cohort. Inclusion criteria for PROTECT enrolment were: 1) living in the UK; 2) age 40+; 3) regular access to a computer and the Internet; and 4) no pre-existing diagnosis of dementia. Overall the PROTECT cohort has an average age of approximately 62 years, and around 70% of participants are female (Huntley et al., 2018). As with CS 1, intersectionality will be explored thorough interaction terms across multiple socio-demographics, including gender, age, ethnicity, and socio-economic status, and stratified where appropriate.

Case Study 3. The sample will comprise 1,500 residents of Plovdiv, Bulgaria at baseline. The gender and ethnic profile of the sample will closely resemble that of the general population of Plovdiv. Eligible participants will include non-institutionalized adults (18-65 years) resident in Plovdiv or Plovdiv province for a minimum of 1 year, who are fluent in Bulgarian, mobile enough to be able to leave their home independently, and capable of understanding the study objectives and conditions and voluntarily choose to take part in the study. To be included, participants will also have to indicate their intention to stay with the cohort during follow-up, for which they will receive financial incentives. We will exclude minors and those over the age of 65 years, in-patients, institutionalized individuals, those not using their dwelling as a main residence in the past 1 year, and those incapable of fully understanding the

conditions and implications of their participation in the study or people unable to give informed consent. Excluding children and elderly individuals is expected to ensure relative homogeneity in the opportunities for nature use, mobility patterns, and health status not severely contaminated by co-morbidities.

Case Studies 4-6. Based on preliminary power analysis and attrition rates from the most comparable previous study (Pichler et al., 2022) the studies will each include 134 participants (N = 67 intervention group; N =67 waitlist control group). We will include people with MtS to analyse the effect of NbTs in a Level 2 disease prevention context. Age group: 40-65yrs, the highest working age risk group for MtS. Sex distribution: We will use stratification in the randomisation procedure to obtain gender balance to better understand potential gender-related effect differences. Inclusion criteria: 1) clinically diagnosed with MtS (ICD-10: E88.81) according to abnormal values for 3/5 of the following factors: waist circumference , blood pressure, triglyceride levels , HDL-cholesterol, fasting glucose; 2) aged 40-65; 3) sedentary behaviour (assessed with the International Physical Activity Questionnaire – Short Form IPAQ-SF); 4) ability to participate in moderate hiking tours (assessed via Physical Activity Readiness Questionnaire, PAR-Q); 5) low nature users; 6) ownership of a smartphone. Exclusion criteria will be finalised during the Hub development phase but are likely to include: an already highly active lifestyle, uncontrolled metabolic disease and/or hypertension, immunologically mediated chronic conditions or immunodeficiency, severe respiratory diseases, acute or untreated psychiatric disorders, orthopaedic contraindications for hiking, and moderate to severe allergies that can be triggered in nature visits (that could cause discomfort or hamper benefits).

Case Study 7. Participants will be drawn from the general population of university students: a group designated by the Public Health Agency of Sweden (2018) as a vulnerable occupational group where existing preventive and treatment options are insufficient and whose uncertain completion of a higher education jeopardizes the major personal and societal investments made in hope of a bright and sustainable future. We will recruit through posters on university campuses and relevant social media platforms as well as through collaboration with the student health services and primary care providers and stratify the incoming eligible sample by psychological health status (based on established cut-off scores on the clinically validated Depression Anxiety Stress Scales (Alfonsson et al., 2017; Lovibond & Lovibond, 1995). Thus, the sample will comprise 50% individuals with clinical-level symptoms of psychological distress and 50% individuals with mild or no symptoms. We will also seek balanced gender representation by oversampling males from the female-dominated population. The sample will be stratified by health status and gender before they are randomly and equally distributed between the intervention conditions. **Inclusion criteria:** Being enrolled in courses for at least 75% of full time during the study period and being <40 years old (i.e., representing typical university students); not having any major health issues beside psychological distress as assessed at enrolment, nor having any ongoing treatments (i.e., personal factors that could interfere with participation and outcomes); being motivated to participate in a health intervention and able to plan for participating in accordance with the given intervention schedule (i.e., able and likely to engage properly with the interventions). **Exclusion criteria:** Current severe mental illness, suicidal ideation or self-harm, or any current or previous symptoms of psychosis or bipolarity (i.e., in need of other treatment; see Baer et al., 2019); moderate to severe allergies that can be triggered in nature visits (that could cause discomfort or hamper benefits); recently (<3 months) started taking any new medication or adjusted an ongoing medication regimen that could reasonably affect their psychological health (because it could introduce extraneous variation in the data); previous participation in mindfulness training courses or a nature on prescription intervention (because it could limit potential effects; minor experience in similar practices such as yoga or using mindfulness apps is acceptable); known scheduling conflicts that will cause them to miss more than one of the scheduled intervention meetings.

Case Study 8. 110 adults (+18yrs, all adult groups relevant) will be recruited (N = 55 intervention condition visit with App; N = 55 waiting controls) to achieve sufficient power (Cohen, 1988). Sex distribution: All genders are included, but the distribution will be random (non-gender specific intervention). Inclusion criteria: ICF 2017: d4500 (walking short distances; walking for less than a kilometre, such as walking around rooms or hallways, within a building or for short distances outside); All educational levels, all religious affiliations, all types of marital status, all types of households, all types of employment and income (general inclusion of participants). Exclusion criteria: Do not understand Danish (App in Danish); Cognitive limitations (must be able to communicate with the participants); Drug or alcohol abuse (may bias the results); Participation in mindfulness program or similar during time of intervention (may bias the results).

Case Study 9. This study takes a two-step approach: first, staff of care farms (as the primary target group) will follow a training programme to potentially enhance their interaction skills with clients in the natural environment, and develop and test new activities to practice these skills. Second, the impacts of the training program on the adult clients with dementia and other cognitive and functional disabilities (the target study population) will be measured by means of observations and questionnaires (supported by caregivers). It is not possible beforehand to specify the

characteristics of the target study population, as this will depend on the characteristics of the farms that will sign up for participation, and the presence of clients on the days of observation. As noted by De Bruin et al. (2020), care farms in the Netherlands do not intend to attract a distinctive client group. Compared to people with dementia attending adult day services centres affiliated to residential homes or nursing homes, clients of care farms are relatively young (on average about 71rs vs. 85yrs) and more often male. It can be expected that this client composition will be reflected in the study population. In general, all clients at farms participating in the study who are able to go out and participate in nature activities will be eligible for inclusion, there are no exclusion criteria except for not being able to participate in these activities. In a similar vein, all staff members of care farms that sign up for the training programme are eligible for participation in the study.

1.4.1 Details on sample size and power calculation

Case Study 1. Non-applicable – this study involves the analysis of a secondary dataset. Common heuristics to determine sufficient sample size for structural Equation Models indicate that: sample size should exceed 200 (Loehlin, 1992); there should be at least 15 cases per measured variable or predictor (Stevens, 2002; Siddiqui, 2013) and a minimum of 5 cases per parameter estimate (Bentler & Chu, 1987). Thus, with an analytical sample of approximately 36,000+ respondents we anticipate no issues with a lack of power.

Case Study 2. Non-applicable – this study involves the analysis of a secondary dataset. Common heuristics to determine sufficient sample size for structural Equation Models indicate that: sample size should exceed 200 (Loehlin, 1992); there should be at least 15 cases per measured variable or predictor (Stevens, 2002; Siddiqui, 2013) and a minimum of 5 cases per parameter estimate (Bentler & Chu, 1987). Thus, with an analytical sample of approximately 14,000+ respondents we anticipate that the study will be sufficiently powered.

Case Study 3. The total sample will comprise 1,500 residents of Plovdiv recruited at baseline, with the intent to keep as many of the initial sample in the cohort by the end of follow-up (in 12 months) by providing incentives. Conventional rules of thumb based on anticipated model parameters typically suggest that up to 1,000 subjects are required for estimating the parameters and detecting misspecifications of a structural equation model with bootstrap generated standard errors for indirect effects and continuous data (Kyriazos, 2018). Furthermore, a preliminary simulation based on anticipated small effect (0.1), statistical power of .8, alpha level of .05, 3 latent variables, and 25 observed variables, taken as a ballpark of the structural equation model complexity in this study, indicated a minimum sample size of 823 for model structure and minimum sample size of 1,258 to detect effect (Soper, 2022, Westland, 2010). Another Monte Carlo simulation including one exposure, one outcome, and either two serial or three parallel mediator observed variables, and assuming small correlations (0.1) between these variables, suggested that with 1,500 participants, statistical power for the regression path parameters would exceed .8 (Schoemann, Boulton & Short, 2017). Thus, with an analytical sample size of about 1,500 respondents for the main analysis we anticipate that the study will be sufficiently powered. Moreover, that sample size is expected to ensure sufficient variability in the data to enable complex tests of associations between various forms of exposure to nature and self-reported and measured health parameters. A subsample of 250 participants will undergo laboratory testing for biomarkers of resilience. These participants will be randomly drawn from all participants who at the time of the first interview consent to have their blood (and possibly urine) samples collected. With a sample size of 250, simpler mediation analysis with no latent constructs /only observed scores/ also appears justified according to heuristic and preliminary simulation results for single mediation models with repeated measurements (Kyriazos, 2018; Schoemann, Boulton & Short, 2017).

Case Studies 4-6. The number of participants was defined as calculated sample size + 25 % (calculated drop out and loss-to-follow-up). The sample size was calculated with data from a previous study conducted by project partner 10 (Paracelsus Medical University Salzburg, Institute of Ecomedicine - ISRCTN43292449). The study compared two types of nature-based therapies (mountain hiking vs. forest therapy) in a population presenting the following demographics: age 50–60rs, body mass index ≥25–≤30, sedentary lifestyle (International Physical Activity Questionnaire Short Form <3.00 METmin/week) and the ability to participate in moderate hiking tours (Physical Activity Readiness Questionnaire). Sample size was calculated with a bootstrap simulation (using the R-GNU software environment, General Public License, R Foundation for Statistical Computing); F1-LD-F1 models from the nparLD package (Nonparametric Longitudinal Data Analysis) were applied. The initial seed for the variate generator was set at 1 and the re-sampling process was fixed to 1000 repetitions for each sample size. The percentage of significant results was used as an estimator of power. Following the results, we expect a power of 0.87 with a sample size of 50 per study arm. With an assumed drop out and loss-to-follow up of 25%, recruitment rate is set to 67 per study arm, i.e. in total 134 study subjects.

Case Study 7. Building on previous studies comparing ReST to conventional mindfulness training and on a pilot study completed during spring 2022 comparing ReST to Nature on Prescription, we consider that the study should be powered (given (1-β) >.80, and α <.05) to detect effects of f ≈ .175 (ηp2 ≈ .03) in two-factor interactions (e.g., intervention type x health status, intervention type x gender) in ANCOVA analyses targeting the primary outcome (psychological distress, assessed with DASS-21) and secondary outcomes. This will be achieved by a total intention-to-treat sample of 260 individuals (i.e., 130 per health status category, 65 per intervention condition including the passive control condition). A random subset of 100 participants will also be asked to complete a fatigue induction and restoration paradigm before and after the interventions. The size of the subset sample was determined based on analyses with mixed ANOVA for four groups and six measurement points (before fatigue induction, after fatigue induction, after restoration; repeated before and after intervention), assumptions of relatively high correlations (.70) among repeated measures (as observed in pilot studies using similar methods), and small effects (f ≈ .10). This yields power of (1-β) >.80 at α <.05.

Case Study 8. Building on a previous study (Stigsdotter *et al.* 2018) and a power analysis we propose to recruit 110 individuals in a two-arm RCT with a 6-month follow-up (assuming a 30% attenuation rate). The power analysis relates to a repeated measures ANOVA (based on (1-β) >.80, and α <.05) with an effect size of f=0.25. The intervention group (n = 55) will be supported by an enabler to visit the Move Green lab for at least 2hrs a week for five consecutive weeks (plus baseline measures one week before intervention starts), vs. waiting-control.

Case Study 9. We aim to include 24 farms. Staff of 12 farms will participate in the training. After the training, the well-being of their clients while being outdoors will be observed with the 19-item Greater Cincinnati Chapter Well-Being Observation Tool (GCCWB, Kinney & Rentz, 2005) as the main outcome measure. Scores on this measure will be compared to clients of 12 matched farms whose staff did not participate in the training programme. Based on previous research, we expect to be able to observe about 8 clients per farm, which would result in 96 clients per condition. An a-priori power analysis indicates that 30 clients per condition would be sufficient to detect a significant difference of 16 points in observed wellbeing on the GCCWB with a standard deviation of 22, with α = .05 and a power of 80%. Thus, we anticipate that this study will be sufficiently powered.

1.5 Design of the clinical study (controlled / uncontrolled; randomised; open / blinded; parallel group / cross over / other; please justify the appropriateness of the selected design)

Case Study 1. The analysis is a moderated mediation analysis of nationally representative longitudinal panel survey data. Data on exposure to the natural environment (e.g. neighbourhood greenspace, coastal proximity), stressful life events (e.g. divorce), and mental health outcomes (General Health Questionnaire, life satisfaction) are available at different time points for the same individuals. Regression and/or Structural Equation Models will be used to examine whether individuals' nature exposure attenuates the impact of stressful life events on mental health trajectories, and whether these associations are mediated by psychological and social resilience.

Case Study 2. The analysis is a moderated mediation analysis of nationally representative longitudinal panel survey data. Data on exposure to the natural environment (e.g. residential, recreational nature visits), socially stressful events (e.g. Covid-19 lockdowns, cost of living crisis), and mental health outcomes (depression, anxiety) are available at different time points for the same individuals. Regression and/or Structural Equation Models will be used to examine whether individuals' nature exposure attenuates the impact of socially stressful events on mental health trajectories, and whether these associations are mediated by psychological and social resilience.

Case Study 3. The study will use a prospective panel design. We will define different neighbourhood typologies based on distances to green spaces and major traffic lines, and will then draw a random sample of residents from each, to ensure sufficient sub-samples for different urban exposures. Survey data on residential environment, stressors, and mental/physical health will be collected at 3 time points, six months apart. Biophysical resilience markers, will be collected at two time points from a sub-set of participants (months 14-17 and 20-23, respectively).

Case Studies 4-6. Stratified randomised controlled waiting-list trials. We will follow established methods and protocols for conducting RCTs. The randomisation is done to measure marginal difference in outcomes between the groups and to balance known and unknown factors, efficiently reducing the risk of confounding and eliminating observer bias and selection effects. This will improve causal inference, which will contribute to strengthened evidence level. The waiting-list control group serves as an untreated comparison to determine if the treatment had any effect. A waiting-list control group was selected for these Case Studies primarily because the intervention arms will already vary to some extent as a function of the co-creation processes that will take place in each setting, and thus we did not want to add additional heterogeneity to the design by also having different co-created control groups

which would render case study synthesis even harder. CS7, which is further advanced in terms of societal readiness is able to explore multiple control conditions and thus, to some extent, tease out issues such as is nature mindfulness better than nature alone or mindfulness alone.

Case Study 7. The study is a controlled (factorial 4-armed), randomized, open, parallel group trial. The 4 intervention conditions cover the 4 possible combinations of nature contact vs. no nature contact and mindfulness training vs. no mindfulness training and hence involves 3 active conditions (ReST, Nature on Prescription, conventional mindfulness training) and one passive condition (wait-list control). The interventions and other aspects of study participation will be given in addition to any ongoing care that participants take part in and so will not replace any regular treatment. Participants will be randomly assigned with stratification by health status (moderate vs. mild to none) and gender (female vs. male) to one of the four interventions. These design aspects will ensure the ability to disentangle effects of the environment and the training in mindfulness skills, as well as allowing us to explore emerging trends by health status and gender where appropriate. The design will be non-blinded, which is common in psychological RCT's where participant blinding is normally impossible and assessor-blinding difficult to achieve. However, the interventions will be delivered by hired and trained instructors without previous affiliation to the project or knowledge of the hypotheses. Data collection and interventions will be done in four waves where all participants will complete interventions over the course of 12 months. Primary and several secondary outcomes will be assessed shortly before and after the five-week interventions, one month after the interventions, and six months after the interventions. A random subset of 100 participants will also be asked to go through a fatigue induction and restoration paradigm with assessments of physiological and psychological indices of stress before and after the interventions, in order to evaluate the effects of the interventions on protective (i.e., resistance to fatigue induction) and recovery resilience (i.e., restoration efficiency).

Case Study 8. A randomised controlled two-armed trial with waiting-control group. Several options for the control group were discussed (e.g. visits without the enhancing App) but a waiting-control was selected for several reasons. First, since the App has not previously been used systematically, there was no data upon which to base power calculations about the relative potential benefits of visits with and without the App. The present study will begin to provide such data by producing results that can be compared to previous trials in the same location without the App, which can then be used at a later stage to design an adequately powered study to compare visits with and without the App. Further, we also have to recognise the practicalities involved in working with this target population. Based on previous studies between two to four individuals will be involved in supporting and testing each visiting individual for each visit. Attempting to support two groups of people with physical limitations at the site over the same time period would be extremely logistically challenging within the time frame and budget. The waiting control group will still be monitored at the same time points, but not on-site, and receive access to the visit enhancing App. and instructions after the end of the intervention period if there is evidence that the experiences were positive.

Case Study 9. This is a comparative study with a matched design. Farms and clients will not be randomly allocated, and staff will not be blind to the intervention (as they will themselves be involved in co-creation). Matching of the farms will be done in a very careful manner, based on environmental and organizational characteristics, which will be collected before the start of the training program through a questionnaire sent out to the farms. Additionally, researchers will evaluate the farms' characteristics using pre-defined checklists to further establish the comparability of the farms in the two conditions.

1.6 Type of intervention (medicinal product / advanced therapy medicinal product / medical device / in vitro diagnostic medical device / surgical or other invasive procedure / other medical intervention, including, e.g., counselling)

Case Study 1. The 'intervention' in this study will be respondents' residential exposure to green and blue spaces (i.e. the proportion of private and public greenspace within their immediate neighbourhood i.e. their Lower Layer Super Output Area (LSOA), and proximity to the coast based on population-weighted LSOA centroids). Geographical measures of neighbourhood green/blue space will be linked to existing UKHLS data using GIS within the UK Data Service's SecureLab.

Case Study 2. The 'intervention' in this study will be respondents' residential exposure to green and blue spaces (as for CS1) and self-report recreational nature visits (based on items used for the England wide People and Nature Survey (PANS). Geographical measures will be supplied to the PROTECT team to be linked anonymously with the PROTECT data. To prevent identification of individuals, geographical identifiers (i.e. LSOA codes) will be removed from the returned dataset.

Case Study 3. Data on the 'intervention' (i.e. residential environment, objective greenspace quantity/quality and experienced recreational nature use), as well as data pertaining everyday stressors (e.g. financial, relationship, job worries, traffic noise/air pollution), and mental/physical health (e.g. PHQ-9; GAD-7) will be collected in a field survey.

Case Studies 4-6. These studies constitute complex interventions and will be standardised as much as possible to enable comparisons between study sites (i.e. urban/peri-urban settings [Case Study 4]; rural mountainous settings [Case Study 5]; urban coastal settings [Case Study 6]). The intervention is a five week long mindful immersion in nature treatment. Based on previous studies by the teams, but depending on co-creation results, the intervention will involve approximately three semi-structured 40-minute walks per week, 15 sessions in total. The initial sessions will be led by a guide, with later sessions supported through established on-line Apps that help people navigate selected nature routes (e.g. https://www.outdooractive.com/), with the final decision on the number of in-person vs. self-directed walks determined through the co-creation processes in each location. Walk locations will be determined through the co-creation, but for each case study it will be centrally located and accessible by public transport. Trainers will support participants during the first few walks (number to be determined during the co-creation process) and for the remaining sessions the treatment will be self-guided using a set of newly mapped out walks (designed for this study) added to existing nature walk mobile phone applications (e.g. https://www.outdooractive.com/) with a range of different walks offered to avoid repetitiveness and provide a sense of self agency. The intervention on each walk consists of five subsequent stages: (1) a 10 minute walk along a nature path/trail; (2) an aural/olfactory mindfulness procedure (being still with eyes closed and remain alert to sounds/smells); (3) 10 minutes continued walk along the path/trail; (4) five minutes' tactile mindfulness procedure (touching natural elements along the path, such as plants, water, sand, stones); (5) a 10 minute walk back to the start point. Again, these will be the seed ideas to discuss in the Social Innovation Action Nature-based Therapy Resilience Hubs in each location so may be adjusted depending on local conditions and norms, to avoid asking people to do something that would make them feel uncomfortable etc.

Case Study 7. Each of the active interventions spans five weeks and build on existing protocols. The interventions will be led by qualified and specifically trained instructors without any direct knowledge of the study hypotheses or affiliation with the research project (to explore scaling up/out potential). The interventions and other aspects of study participation will be given in addition to any ongoing care that participants take part in and so will not replace any regular treatment. The ReST condition involves one 90-minute group meeting every week, with <12 participants and an instructor present. These meetings take place in an accessible natural setting and involve motivational and educational talks and conversations, practical training in guided exercises that serve to direct and cultivate mindfulness in relation to the setting, and personalized advice on how to establish a regular meditation habit consisting of 20-minute daily practice with given exercises. The Conventional Mindfulness Training condition, like ReST, involves weekly 90-minute group meetings with <12 participants and an instructor present. The meetings take place indoors and involve similar contents as ReST but with talks, conversations, guided exercises and personalized advice that build on views and practices represented in the established Mindfulness-Based Stress Reduction program. As in ReST, the participants will be advised to practice 20-minutes daily with conventional mindfulness exercises. Nature on Prescription participants will attend weekly online meetings with <12 participants and an instructor. These meetings will be 30 minutes long and participants will be advised to participate via their mobile phones from a natural location. As in ReST and Conventional Mindfulness Training, the meetings will involve motivational and educational talks and conversations and personalized advice on how to establish a regular habit of visiting nature. Following the meeting, participants will be instructed to spend an additional 60 minutes in nature, engaging in calm activities according to their own preference. They will also be asked to spend 20 minutes daily in natural settings. Participants who are randomly assigned to the waiting list control condition will not be informed that other participants commence with interventions immediately. Instead, they will be informed that they can choose any of the three interventions (ReST, Conventional Mindfulness Training, Nature on Prescription) freely once they have completed a five-week baseline assessment period and, after that, another month's hiatus. Hence, they will commence with the intervention once they, and the participants in the active conditions, have completed the 1-month follow-up. A separate analysis will be conducted on these choice preferences to see which treatment is a priori most popular among different types of individuals, with implications for future offerings.

Case Study 8. The intervention consists of spending time in a specifically design mobility inclusive nature garden supported by a mobile phone App designed to enhance the experience. The Move Green Lab. consists of an accessible trail leading the participant to a variety of nature experiences with the App tailored to specific places and experiences along the trail and consisting of sound files with five sensory awareness exercises focusing on five senses (Presence in body and mind, Sight and sense of hearing, Sense of feeling, Body and balance sense and sense of smell).

Case Study 9. This intervention can be classified as a 'non-medical intervention among a clinical population'. Staff

at the care farms will be inspired by researchers and other experts to become more 'attentively present' during their interactions with clients in the outdoor environment. In this way staff can support clients' intrinsic motivation to seek out and connect with the natural world through the affordances it offers e.g. being captured by natural sounds, textures, smells, animals etc. As such, the study aligns with Case Studies 4-8 which also contain elements of supporting people be more mindful of nature. The major difference is that whereas other Case Studies attempt to guide people directly to attend more to nature, here our aim is to encourage staff to support clients to become immersed in the nature attentive activities that they spontaneously engage in, and let them have time and space to do this freely, but safely. In doing so, the project builds on previous work of our group with pre-school children who were also stimulated by staff to spontaneously engage with nature in a mindful fashion. The precise way in which staff bring this into practice involves a process of co-creation in is in a Community of Practice intervention, and thus in a sense staff of care farms are the target group of this intervention. However, clients of the farms will participate in the activities designed by their staff throughout (and after) the six-month intervention period. Ultimately, the intervention from the client's perspective is standard care *vs.* care that is designed to give them more support for spontaneously occurring mindfulness of the natural world.

1.7 Description and timing of study procedures

Please provide an overview, preferably in a tabular format, about the schedule of study procedures. Please give a simple statement on how long individual patients or healthy volunteers participate in the clinical study.

Case Study 1. This not a typical clinical study: the secondary data we are analysing is derived solely from the UKHLS. There is no schedule of study procedures that affects participants, since their data have all been collected, anonymised, and published prior to beginning the study. The UKHLS has been conducted since 2009 and is still ongoing. Participants of that (much larger) household panel survey typically participate for several years. Some participants have been merged into the UKHLS from the British Household Panel Survey (BHPS), which was conducted between 1991 and 2008. Participants are free to leave the UKHLS at any time, but approximately 95% of participants continue to participate from one wave to the next. The aim of UKHLS—as with any household survey—is to retain participants over a long period of time, giving a long-term perspective on the lives of people in the UK. The focus on surveying entire households means that in 2019 UKHLS including over 18,500 two-generation and 2,700 three-generation families taking part in the Study.

Case Study 2. This is not a typical clinical study: the secondary data we are analysing is derived solely from the PROTECT cohort, augmented with additional data to be collected by the PROTECT team in collaboration with the UNEXE research team regarding residential nature exposure from neighbourhood data. There is no schedule of study procedures that affects participants, since data have primarily been collected, anonymised, and published prior to beginning the study. Additional data to be collected for the purposes of this study will be added to the main PROTECT datasets. Participants are free to withdraw from the cohort at any time, but most are involved for a period of several years.

Case Study 3. Participants will stay with the study for about 12 months. The study timeline is outlined in Table 1.

Table 1. Timeline for Case Study 3.

Procedures	Month
Development of conceptual models, Development of questionnaire, sampling framework, participant records, and training for sampling and field work	M 1-6
Ethics documentation preparation, submission, and approval	M 5-10
Tender process for survey company and biomarkers kits/reagents	M 1-8
Questionnaire survey Wave 1 - data collection, validation, and curation	M 11-13
First Biomarker tests in subsample – bio-samples collection, analysis, data curation	M 14-17
Questionnaire survey Wave 2 - data collection, validation and curation	M 17-19
Second Biomarker tests in subsample – bio-samples collection, analysis, data curation	M 20-23
Questionnaire survey Wave 3 - data collection, validation, and curation	M 23-25
Creating GIS datasets and linkage to survey data	M 13-28
Data curation, analysis, and interpretation	M 14-36

Case Studies 4-6. No recruitment or other aspects of the study will be initiated until ethical approval is obtained. We will collect outcome data in both the treatment and the wait-list control group at baseline, post-intervention, and five

weeks after intervention to evaluate long-term effects. For ethical reasons, the waiting-list control group will receive the same intervention following conclusion of the active treatment group trial and a reduced set of outcome measurements will be obtained for their benefit. Baseline data, including demographic information (e.g. date of birth, gender, ethnicity) will be documented at Eligibility screen 2 (t-1, see table 2). Data on potential confounders will be collected (e.g. diet, living environment, household income, pets, activities, smoking, health status, and medication). If significant baseline differences between the groups occur in spite of the randomisation, these variables will be included in subsequent models for sensitivity analyses. To assess results of the interventions in terms of biopsychosocial resilience, a broad set of outcome data will be collected through self-reports, anthropometric measures, and saliva sampling, necessary to evaluate biopsychosocial resilience processes (see Table 2 and Fig.1 for proposed seed design to be discussed in the local Resilience Hubs). Our primary outcomes are health-related quality of life and allostatic load. Secondary outcomes relate to nature connectedness, self-satisfaction, cardiorespiratory fitness, and physical activity. The proposed self-report tests cover diverse dimensions of psychosocial resilience, meet key psychometric standards, provide normative data, and are sensitive to measuring change over time. The proposed metrics will be discussed as part of the Resilience Hub exercise in each location and possible changes to the secondary outcome set may occur, e.g. where local stakeholders think an alternative more locally relevant one is available, though we will require the primary outcomes to remain the same across study to ensure later synthesis. Metabolic indicators of triglycerides and fasting glucose will only be measured in CS5 (Salzburg) given the expertise needed to collect and analyse these data. All data will be collected by trained assistants.

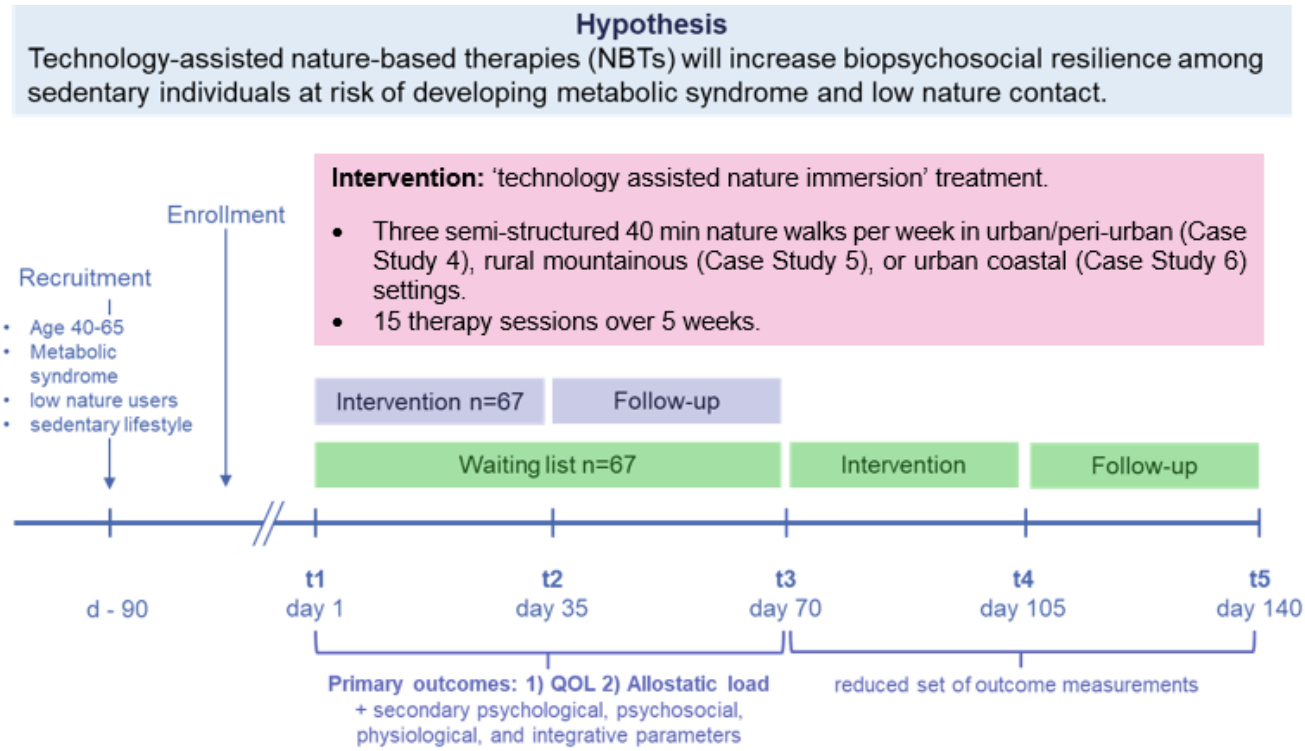
Table 2: Proposed participant timeline for CSs 4-6 showing time schedule of enrolment, interventions, and assessments of participants to be discussed at the local Hub events.

		STUDY PERIOD							
		Enrolment		**Allo-catio n**	**Post-allocation**				
TIMEPOINT		**T_{-2}**	**T_{-1}**	**T0**	**T_1 Day 1**	**T_2 Day 35**	**T_3 Day 70**	**T_4 Day 105**	**T_5 Day 140**
ENROLMENT									
Eligibility screen—step 1 • Recruitment via established contacts with health care centres and clinics for MtS patients etc. ○ Doctor's diagnosed Metabolic Syndrome (MtS) ○ Sedentary lifestyle ○ Age 40-65 ○ Low nature users (< 30 min/week)		X							
Eligibility screen—step 2 • Medical history • Patient Health Questionnaire (PHQ-9) • Physical Activity (IPAQ-SF) • Physical Activity Readiness Questionnaire (PAR-Q) • Baseline data			X						
Informed consent			X						
Group allocation				X					
INTERVENTION									
Nature immersion therapy **(IG)**					● →				
Waiting-list control group **(CG)**								● →	
ASSESSMENTS									
<u>Primary Outcome 1</u> **Quality of life (QOL)**	**IG**				X	X	X		

• Short Form Health Survey (SF-12) [1] • Euro Quality of Life Questionnaire (EQ-5D) [2]	**CG**				X	X	X	X	X
Primary Outcome 2 **Allostatic Load Index** [3]	**IG**				X	X	X		
	CG				X	X	X		
Secondary Outcomes • PHQ-9[4] • Positive and negative experiences (SPANE)[5] • Nature Relatedness (NRS)[6] • Satisfaction with Life Scale (SWLS)[7] • Physical activity (IPAQ-SF)[8] • Cardiorespiratory fitness[9]	**IG**				X	X	X		
	CG				X	X	X	X	X
Integrative Outcomes[10]	**IG**				X	X			
	CG				X	X	X	X	X

Note. [1] The SF12 covers health-related quality of life across the two main dimensions of physical and mental health, as well as a total score (Wirtz et al., 2018); [2] The EQ5D consists of two parts—a descriptive self-assessment in five dimensions, resulting in a health profile index (EQ-5DIndex), and a visual analog scale (EQ-5D-VAS) on which the respondent estimates their current state of health in a range of 0 (worst possible health status) to 100 (best possible health status) (Ludwig et al., 2018); [3] Allostatic load index: (a) neuroendocrine; (b) immune; (c) cardiovascular; and (d) metabolic systems. In C6 following parameters will be measured: a) neuroendocrine [Cortisol from Saliva (Adrenal glucocorticoid and indicator of HPA-axis activity) – from saliva and DHEA-S from Saliva (Adrenal hormone and functional HPA-axis antagonist) – from saliva]; b immune: [IL-17 (Proinflammatory cytokine associated with chronic stress, endothelial dysfunction and hypertension) – from saliva; IL-6 (Proinflammatory cytokine related to sleep disorders, low-grade chronic inflammation, psychosocial factors and stress) – from saliva; IL-10 from Saliva (Antiinflammatory Cytokine, Induced by physical exercise and exposure to microbial biodiversity in nature) – from saliva; CRP from Saliva (Marker of Microinflammation and general cardiovascular health) – from saliva]; cardiovascular: [Heart rate, Heart rate variability, Blood pressure] and d) metabolic [Anthropometric: waist circumference, height & weight; Triglycerides – from blood; cholesterol (HDL, LDL) – from blood; Fasting Glucose – from blood]. The results of the measurements will be combined into an AL-index in accordance with standard methods; [4]The PHQ-9 is a self-administered version of the PRIME-MD diagnostic instrument for common mental disorders which scores each of the nine DSM-IV criteria for depression as "0" (not at all) to "3" (nearly every day) (Kroenke et al. 2001); [5] The Scale of Positive and Negative Experience (SPANE) is an instrument that assesses subjective feelings of well-being and ill-being (Corno et al., 2016); [6] Nature Relatedness Scale 6: The NRS6 assesses closeness to nature over 6 items, which are rated on a scale of 1 = "do not agree" up to 5 = "agree fully", with higher values indicating a higher closeness to nature (Nisbett et al., 2009); [7] Satisfaction with Life Scale (SLWS): The SLWS is a one-dimensional questionnaire for recording life satisfaction. It consists of five items, which are answered on a seven-level Likert scale, with total scores ranging from 5 (lowest satisfaction) to 35 (highest satisfaction).[8] The International Physical Activity Questionnaire Short Form (IPAQ-SF) (Lee et al., 2011b) is a cost-effective method to assess physical activity; [9] Cardiorespiratory fitness will be assessed by the "Chester step test". During Chester step test, participants are asked to step on and off a low step at a defined rate, which is set by a metronome. Every two minutes, the heart rate and exertion level are recorded. The test continues until the participant reaches 80% of her/his maximum predicted heart rate (Buckley et al., 2004); [10] Integrative outcomes will be defined by a co-design process with WP4 (health), WP5 (environmental), WP6 (economy), and WP7 (society). The timeline for collection of these data will be identified during the course of the project. Some suggestions for tools to use are Health Equity Audit (HEA), Health Equity Impact Assessment (HEIA), Social Acceptance Survey (SAS), Environmental Impact Assessment (EIA), and Quality-adjusted life year (QALY, derived from the EQ5D/SF-12) for economic assessments.

Figure 1: "Seed" schedule for Case Studies 4-6 to be discussed during Resilience Hubs



Case Study 7. An overview of the study timeline is outlined in Table 3. Participants in the active conditions will complete the intervention during 5 weeks, with assessments of outcomes shortly before and after, and then participate in follow-up assessments one month and six months after the end of the intervention. Participants in the waitlist control condition will complete assessments on three occasions: before and after a 5-week period corresponding to the intervention time and then again one month later.

Table 3. Overview of study procedure for Case Study 7.

Procedures	Month
Preparations: trial registration, recruitment and training of instructors, any needed addendums to existing ethical approval, initiate participant recruitment	M 1-6
Continuous participant recruitment	M 7-18
Wave 1 (N ≈ 65) and 2 (N ≈ 65): initiate data collection and complete interventions	M 7-12
Wave 3 (N ≈ 65) and 4 (N ≈ 65): initiate data collection and complete interventions Wave 1 and 2 complete final follow-up assessments	M 13-18
Wave 3 and 4 complete final follow-up assessments	M 18-24
Data curation, analysis, and interpretation	M 18-30
Publication, dissemination, implementation	M 31-48

Case Study 8. The overall structure of the intervention is presented in Table 4. Intervention participants will visit the Move Green Lab, for five 2 hour visits, once a week for a period of five weeks. The data collection for the control group will follow the same timelines as those outlined for the intervention group.

Table 4. Overview of study procedure for Case Study 8.

Procedures	Month
Preparations: ethics applications, protocols, trial registration, staff training, technical equipment, questionnaires, interviews and observations	M 1-6
Participant recruitment	M 6-10
Intervention vs. control	M 7-18
Follow up	M 9-24
Data curation, analysis, and interpretation	M 19-30
Publication, dissemination, implementation	M 31-48

Case Study 9. A timeline of procedures are outlined in Table 5.

Table 5. Overview of procedures for Case Study 9.

Procedures	Month
Development of protocols and procedures for the training, including scientific and practical details such as hiring the venues and inviting experts to give a talk	M 1-3
Recruitment of matched intervention and control farms for participation in the study, including the development of brochures and other information	M 3-7
Kick-off meetings to inform farms participating in the CoP program	M 7-11
CoP-1 meetings	M 11-15
Staff experimenting with the activities in practice	M 12-16
CoP-2 meetings	M 16-20
Staff experimenting with the activities in practice	M 17-21
Visits of researchers to care farms in the experimental groups to do observations of the clients and collect in-situ data of the environmental and process quality of the farms	M 21-26
Collection of post-intervention data on resilience of clients at intervention and control farms, through staff surveys and questionnaires for caregivers administered through the standard quality monitoring system of the care farm organisation	M 8-26
Data curation, analysis, and interpretation	M 26-M30
Publication, dissemination, implementation	M 31-M48

2 Preparedness status

2.1 Development of the clinical study protocol

Please describe how the below aspects have been or will be addressed in developing the clinical study protocol (if applicable):

2.1.1 Scientific advice from regulatory and health technology assessment bodies

Case Studies 1-9. See Section 2.2.2 for details about the IEAB that will oversee and support this.

Clinical efficacy, safety, and methodological guidelines (including guidelines on statistics)

All Case Studies will be pre-registered and reporting will adhere to the CONSORT-statement, including CONSORT flow chart (CONSORT, 2019).

Case studies 1-2. Clinical efficacy and safety are not applicable, as these studies involve the analysis of secondary datasets. Detailed study protocols, pertaining to linkage of secondary data to the environmental variables and the planned analyses will be pre-registered on an open access domain (e.g. Open Science Framework). Descriptive statistics will include Means and Standard Deviations for each mental health outcome for specific survey waves, as a function of green/blue space indicators and stressful life events. A series of multi-level regressions models will be used to estimate the associations between nature contact measures (e.g. neighbourhood greenspace, proximity to coast) and mental health outcomes. Models will be stratified according to the presence/absence of stressful life events. Using a stepwise procedure, time, nature contact indicators and their interaction terms will be specified as fixed effects; and time, nested within people, will be added as a random effect. In order to examine potential mediation effects, proposed mediators (i.e. measures of psychosocial resilience) will be entered into the multi-level models within the final step. If the inclusion of these variables reduces the strength of nature-welling associations, mediation effects will be formally tested using multi-level Structural Equation Modelling. We recognise the need to ensure that all outputs from the analyses are non-disclosive. The majority of outputs from the work, whether internal reports or publications, will involve summary statistics (means, standard deviations), regression coefficients. These are generally non-disclosive by their nature. Tabulation of frequencies (especially cross-tabulation of 2+ variables) presents a greater risk of disclosure. To mitigate the risk of disclosure, any frequency tabulations would be constrained to the total sample. Tabulations that result in cell values ≤5 will be re-categorised, or values will be suppressed.

Case Study 3. The study protocol will be reviewed by the Institutional Ethics Committee at the Medical University of Plovdiv, Bulgaria, and only after receiving an approval will we initiate data collection. Survey participants will be recruited by a professional survey company complying with GDPR, applicable international, and local regulations.

Participants' personal data (socio-demographics, self-reported health status, psychological self-assessments, residential and workplace locations) will be obtained and used according to international, EU, and national data protection laws, and the raw data allowing identification of subjects will not leave the local team. After linking these survey data to environmental exposures, measured with geographic information systems, the working dataset will be pseudonymised and participant identifiers will be stored separately. The pseudonymized data itself will be stored securely by the research team and will only be reported in scientific publications and events in an aggregated format, precluding identification of subjects. Visualization of participants' residential location will be rendered in scientific publications at a resolution/aspect ratio that does not allow for identification of specific locations. Bio-sample collection and handling will be carried out according to the Declaration of Helsinki and other clinical standards, in research-grade, accredited medical facilities, and only after obtaining informed consent.

Case Studies 4-6. Clinical efficacy will be determined by appropriate power and statistical testing. Trialling three matched studies helps support efficacy assessment across setting. Safety will be ensured by extensive evaluation of the site and no intervention will start until ethical approval has been obtained. Design: Stratified randomised, controlled waiting-list trial. Randomisation: The randomisation of participants to treatment or control will be done to measure marginal difference in outcomes between the groups and to balance known and unknown factors. The randomisation method will be detailed in a User's Reference Manual. A randomisation list will be generated, including participant ID codes, random assignments, and participants will be allocated based on randomisation codes. The randomisation of participants to the treatment and control groups will be performed independently within gender category strata. Information of the randomisation codes will be locked in a database until interim or final analyses are required (to be revealed only to the PIs and associated statisticians). An RCT design is rare in this field and will offer a unique potential for unbiased results and for drawing credible causal conclusions. Statistical analyses: A detailed statistical analysis plan will be drafted for the protocol. We will test group differences in pre-versus post-intervention outcomes following an intention-to-treat (ITT) principle, comparing pre-post changes of the treatment and control groups. ITT analyses attempt to include all participants according to the group to which they were randomly allocated including those who do not complete all aspects of the study, as long as they can at least be contacted at the trial end. ITT analysis is a cornerstone of RCT analysis strategies, though missing data and high attrition can complicate statistical approaches. As well as in-house statisticians in all institutions we have additional statistical expertise at UNIVIE (Voracek) to support these potentially complex analytical issues. Standard descriptive statistics will be used to analyse baseline values and to compare before-after factors in both arms. Summary statistics, will be produced to assess normality and potential need for data transformation. Associations and typical model assumptions will be examined and correlations between the various outcome data will be tested with linear mixed-effect models. We will adjust for multiple testing, e.g. Benjamini-Hochberg. Tests of the group differences in pre-versus post-intervention temporal change for continuous, count, or binary (or ordinal) outcomes will be made using random effects, linear, log-linear, or logistic models, respectively. Models will include random effects for temporal and spatial correlations and fixed effects for: (1) intervention group; (2) time effects characterizing changes between pre- and post-intervention; and (3) interaction between the intervention group and the pre- and post-intervention temporal effects, representing the group contrast. This will identify if the intervention has had an effect or not. If any baseline variables are significantly different between the groups, secondary analysis will be conducted including these variables to adjust for any residual confounding not prevented by the randomisation. Missing data sensitivity analyses will be conducted as appropriate.

Case Study 7. Clinical efficacy will be determined by appropriate power and statistical testing. Safety will be ensured by providing participants with any needed information and guidance about how to carry out study procedures without unnecessary discomfort or risk. Safety will further be considered in terms of undesired outcomes as part of the evaluation. Design: Controlled (factorial 4-armed), randomized, open, parallel group trial. Interventions and data collection will be conducted in four consecutive waves. Randomisation: Eligible participants who provide informed consent will be stratified by gender (2 levels) and symptom severity classification (2 levels) and assigned a participant ID code. Participant codes within each stratum will be evenly split between the four conditions using a random list generator. Participants will then receive a detailed schedule for when and where to appear for intervention and measurement procedures. Information of the randomisation codes will be stored on a password-protected server by the UU PI. A detailed statistical analysis plan will be drafted for the protocol. Analyses: The basic purpose is to compare outcomes achieved over time between intervention conditions, depending on participant's initial symptom severity classifications and their experiences of and compliance with the given intervention. We will test group differences in pre-versus post-intervention temporal change following ITT approaches, comparing pre- to post- and pre- to follow-up-changes of the conditions. Data will be screened with regard to statistical properties and, where appropriate, curated and transformed before analysis (Tabachnick & Fidell, 2007). Where appropriate, missing data issues will be handled with multiple imputation. Main outcome evaluations will apply ANOVA family approaches,

variously targeting repeated assessments (e.g., before, directly after, and one month after intervention) and summary variables (e.g., deltas representing change) and controlling for possible initial group differences where appropriate (Clifton & Clifton, 2019; Vickers & Altman, 2001). Group-level analyses of average outcomes will be complemented with analyses of individual-level change using logistic regression or simple Chi-square methods to compare categorical classifications building on a reliable change index (Christensen & Mendoza, 1986; Jacobson & Truax, 1991). The reliable change index builds on statistical procedures for inference regarding the confidence with which a given participant can be assumed to have experienced true change in a measured construct, weighing in their observed change in scores and the reliability of the assessment method. This approach serves to identify what proportions of participants in different groups actually improved or deteriorated substantively in the respective outcomes. Hypothesised mechanisms of change (e.g., compliance patterns) will be evaluated with conditional process analyses (Hayes et al., 2017) that yield robust statistical inferences concerning complex causal patterns using bootstrapping methods.

Case Study 8. The study protocol will be reviewed and approved by the Danish National Committee on Health Research Ethics. The study design, methods and statistical considerations have been based on discussions within the research group, who have completed several projects and pilot studies with similar interventions and assessment methods, and with experienced colleagues within and outside of the consortium. Our 'a priori' assumptions regarding clinical efficacy and safety of the interventions are well founded in previous results obtained by the research group (Stigsdotter et al, 2017; 2018a; 2018b; Corazon et al., 2018). The interventions and other aspects of study participation will be given in addition to ongoing regular care that participants take part in. Completion of the project will yield further data on these matters that are integral to the motivations for conducting the study.

Case Study 9. This study will follow the safety and other guidelines as provided by the quality framework of the Dutch national care farm organisation. These guidelines include adherence to Dutch law and regulations, such as the Care Complaints and Disputes Act (Wkkgz), the health and safety law, the General Data Protection Regulation (GDPR), and the Employee Participation of Healthcare Institutions Act (Wmcz). Only farms that follow these guidelines will be included. The data from this study follow a hierarchical structure, with clients nested in care farms, and therefore will be analysed with mixed model techniques. Differences between control and intervention farms in observational and other post-intervention data will be analysed with client characteristics (age, gender, and other relevant variables) as covariates, and with separate two-way analyses to test for moderating effects of these characteristics. If relevant, location characteristics (such as size or naturalness) will also be included as covariates to increase comparability of the control and intervention locations. In addition to these quantitative analyses, qualitative data on client functioning collected as part of the training will be analysed using content analysis and grounded theory techniques. In analysing the results, we will follow APA guidelines.

2.1.2 Involvement of citizens / patients, carers in drawing up the clinical study protocol

Case Studies 1-3. Not applicable.

Case Studies 4-6. Each study involves co-creation aspects with local stakeholders, service providers, and service users.

Case Study 7. The ReST intervention has been developed iteratively over 10 years building on clinical experience, quantitative outcome assessments, and quantitative and verbal feedback obtained from >60 individuals who have completed the course (see Lymeus, 2019). The conventional mindfulness training intervention will build on the established and widely used Mindfulness-Based Stress Reduction program that has been previously used in studies by the research group and that has been extensively researched with regard to clinical efficacy as well as safety in the wider research community (see Baer et al., 2019; Sedlmeier et al., 2018). A preliminary version of the Nature on Prescription intervention was developed building on existing best practice guidelines for such interventions and tested with 17 individuals in a pilot study completed in spring 2022 (Palm & Stjernberg, 2022; Tóth, 2022). Quantitative and verbal feedback from these participants will be used to further improve the Nature on Prescription intervention during the preparations for the project.

Case Study 8. In addition to many years spent developing the crucial intervention site at the Move Green lab. the App is based on over 13 years experiences of developing nature-based health promoting interventions/therapy programmes. The researcher/psychologist responsible for the development of the App has developed several nature-based therapy programs and activity manuals for different patient groups for several research projects and for municipalities. Over the years we have had an active dialogue with the practitioners and taken their experiences into account for developing the App. An RCT study has confirmed the clinical efficacy of the nature-based therapy

programme that underpins the rationale for the App (Stigsdotter et al., 2018; Corazon et al., 2018).

Case Study 9. The staff training program involves a co-creation process with staff of care farms, researchers, experts, and other stakeholders. As such co-creation is an integral part of the study. The protocol for the intervention will be developed in close collaboration with the regional branch organisation of the care farms who will facilitate this research project and ensure that it is supported by caregivers, local municipalities, and the Dutch national care farm organisation. There are direct lines of communication between the researchers and all the stakeholders involved in this study, and there is strong support from all parties to facilitate and support this study.

Regulatory intelligence to ensure timely regulatory approval and ethics clearance of the clinical study in all jurisdictions where its implementation is planned

Please provide information on the following regulatory and ethics aspects:

2.1.3 How the consortium will ensure access to regulatory expertise necessary to get advice on, and management of, regulatory affairs activities in all concerned jurisdictions?

Case Studies 1-9. The RESONATE consortium has significant experience running similar case studies and are well informed regarding the relevant regulatory frameworks, recommendations, and ethical guidelines that are applicable within the jurisdictions covered. Where appropriate: 1) detailed risk assessments will be conducted; 2) specific insurance/indemnity arrangements will be implemented; and 3) research protocols will be submitted for consideration, comment, guidance, and approval to Research Ethics Authorities or other national competent authorities in each participating country before any individual study begins. See Section 2.2.2 for details about the IEAB that will oversee and support this.

2.1.4 How the consortium will ensure access to ethics expertise necessary to get advice on current proceedings and documentation requirements of all concerned ethics committees?

All Case Studies are aware of and will conform to the International, European, and National legislations in all the various aspects of the research. The ethical standards of guidelines of Horizon Europe will be rigorously applied

Case Study 1. A single ethics application will be made to the University of Exeter Medical School Research Ethics Committee. Applications for similar analyses have been made successfully by the researchers leading this work previously.

Case Study 2. A single ethics application will be made to the University of Exeter Medical School Research Ethics Committee. Applications for similar analyses have been made successfully by the researchers leading this work previously.

Case Study 3. A single ethics application will be made to Meditcinsky Universitet, Plovdiv.

Case Study 4. The Ethics Committee of Psychology of Padua (http://ethos.psy.unipd.it/it/) is a well-established committee which give recommendations and approve the projects upon verifying that everything is in accordance with the national and international ethical and data protection regulations. The Padua Ethics Committee will follow the implementation of the study by giving its approval to each protocol (including Participant Information Sheet and Consent Form) that will be developed through the study.

Case Study 5. The study protocol will be submitted to the Ethics Committee of the Federal State of Salzburg www.salzburg.gv.at/ethikkommission. This ethics committee is well established and will approve, if the study protocol is in accordance with national and international ethical and data protection regulations. The Salzburg Ethics Committee will follow the implementation of the study by giving its approval to every protocol (including patient information sheet and informed consent form). Furthermore, the study protocol will be presented to the ethics committee of the Paracelsus Medical University (Ethikkommission pmu.ac.at), that will additionally assess, if all aspects of the study follow national and international regulations (in particular: Declaration of Helsinki, ICH-GDP Guideline for Good Clinical Practice, University regulations, data protection). Registration to an international trial register will then be carried out prospectively based on the local ethics committee vote.

Case Study 6. ISGlobal- Campus Mar is bond to the PS-Mar Ethics Committee (Clinical Research Ethics Committee of the Municipal Health Care Service), created and accredited for the first time on November 11th, 1993 by the General Direction of Health Resources of the Department of Health of the Government of Catalonia, in accordance with the Order of 26 October 1992. According to the new Spanish legislation, the committee has been accredited as a Drug Research Ethics Committee in February 2018. The PS-Mar CEIC evaluates all research protocols in humans

conducted by ISGlobal-Campus Mar researchers. According to Spanish regulations, our local Ethics Committee will follow the implementation of the study by giving its approval to every protocol (including Participant Information Sheet and Consent Form) that will be developed through the study. All ISGlobal researchers are self-regulated by the Code of Good Scientific Practice (http://www.prbb.org/system/uploads/ attachment/file/3/en/eng_a4.pdf). Research studies in Spain are regulated by both international and national legal and ethical rules and all national legal and ethical requirements will be fulfilled.

Case Study 7. In accordance with the UU team's practice, ethical approval has already been obtained from the Swedish Ethical Review Authority for the basic design of this study during the Stage 1 submission process (Diary number: 2021-06675-01, January 2022). The study does not, however, currently have another source of funding, and will not processed unless RESONATE is successful. Any modifications to the approved study protocol, as necessitated in further stages of project preparations, will be subject to ethical review as addendums to the already approved application.

Case Study 8. Ethical approval will be sought from the Danish National Committee on Health Research Ethics. CPHU brings expertise in data management to the RESONATE project through Dr. Karlsson Nyed a named researcher on the grant.

Case Study 9. Ethical approval will be handled by the University of Twente (BMS Ethics Committee). The committee will decide whether this study will need medical-ethical approval (or a waiver to get such approval), or whether an ethical review of non-medical research is applicable. Depending on their professional assessment, we will apply for the necessary ethical approvals. Based on previous experience, we expect this study will not require medical-ethical approval, because it does not involve a medical intervention, and the clients and farms are not randomly assigned to the intervention. In cases of medical research, The University of Twente cooperates with the accredited MREC Research Ethics Committee in the region Arnhem-Nijmegen (CMO A/N) and facilitates and supports researchers to submit there. This procedure can also be used for advice on WMO applicability.

2.2 How the scientific and operational governance of the clinical study will be ensured?

2.2.1 Please give details about the sponsor(s) (name, type of entity, seat or country of residence).

Case Studies 1-9. European Commission's Horizon Europe programme, no other sponsors involved.

2.2.2 Please describe the composition, the role and the functioning of the planned board(s), governing bodies.

Case Studies 1-9. RESONATE's scientific International Expert Advisory Board (IEAB) includes several of the most high-profile NbT researchers and practitioners globally. The EAB consists of Prof. Thomas Astell-Burt, Founding Co-Director of the Population Wellbeing and Environment Research Lab, a focal point for NBT research in Australia; Dr Melissa Lem, director of the Canadian PaRx (Prescription for Nature) NBT program; Nicole Prop, Managing Director of the nationwide 'Green Care Austria' program; Prof. Nooshin Razani, director of The Center for Nature and Health (CNH), which has pioneered park prescription programs for childhood resilience in California; Prof. Nancy Wells, Cornell University expert on nature-based resilience; Dr Kath Maguire, who has specific expertise in Public Patient Involvement for complex interventions, including nature-based social prescribing; and environmental ethics expert Dr Alexandria Poole.

Operational feasibility

2.3 Please describe how the availability of the intervention(s) (including comparators) is secured throughout the entire implementation phase (give details on manufacturing, packaging / labelling operations, storage, logistical, import/export issues, etc.)

Case Studies 1-3. Not applicable.

Case Studies 4-6. These interventions are expected to largely take place on public space. However, precise locations will be determined through planned co-creation activities (e.g. Resilience Hubs) in consultation with local land owners/managers.

Case Study 7. The interventions will be provided by independent instructors who will be hired and trained to deliver interventions as part of the project. Having already trained 10 licensed clinical psychologists to deliver ReST and 3 to deliver Nature on Prescription, we have reason to expect that sufficient numbers of instructors cannot be recruited for the project. Regarding conventional mindfulness training, we have connections with several licensed psychologists with relevant training and so expect recruitment of such instructors will be fully manageable.

Case Study 8. Each intervention day a minimum of 2 researchers and a maximum of 4 are present, to make sure the intervention runs as planned. We will purchase some cell phones where the App. is already uploaded, and use as back up if the participants' phones do not work. At the first meeting (indoors), researchers will assist the participants to upload the App. and they will present the App. and how it works. The intervention will take place on public space co-designed by the team for specific use of these groups in an inclusive fashion and will be freely available.

Case Study 9. This intervention will be carried out by the principal researchers together with hired assistants with whom we have worked with before and who will be trained to deliver the intervention according to detailed instructions. We will develop protocols for all aspects of the intervention including data handling to support future replication/scaling-out etc..

2.4 Please describe how the study population will be recruited
Please give details on the recruitment strategy, monitoring of progress and potential mitigation measures

Case Study 1. Not applicable – the study population has already been recruited as part of the UKHLS, based on a clustered-stratified probability sample of 40,000 UK households. This research only uses secondary data that was already collected as part of an extensive and long-running nationwide survey (UKHLS). Participants were selected based on their address (residential households). Households were selected using a random stratified sampling strategy in an effort to ensure representativeness of the UK population. Specifically, the sample from which data will be obtained for the purposes of this research is the Understanding Society General Population Sample, which is a stratified, clustered, equal probability sample of residential addresses drawn to a uniform design throughout the whole of the UK. The Northern Ireland sample is not clustered. Householders were informed of their selection by letter and invited to respond by providing their consent. If one householder consented, other members of the household could refuse to participate. Once selected, questionnaires were administered by trained interviewers at the households in question.

Case Study 2. Not applicable– the study population has already been recruited as part of the PROTECT study (see Huntley et al., 2018).

Case Study 3. The sample will consist of randomly selected, non-institutionalized adult volunteers from Plovdiv province, Bulgaria, who will give informed consent to take part in the study and for their personal data to be used for scientific research. We do not plan to deliberately involve vulnerable populations. Participants will be recruited by a professional survey company complying with GDPR, applicable international, and local regulations. Participants will be invited to take part in the survey voluntarily and will receive information sheets before giving their consent in informed consent forms. The company will approach a random sample of the residents of Plovdiv, Bulgaria, living in pre-specified neighbourhood types, primarily defined by access (distance) to urban green spaces. In the first wave of the survey, participants will be recruited at their home address, while for waves 2 and 3, there will be an option to follow them up with online or phone interviews. The research team will request that the survey company use tablets to collect the data, so that we can monitor in real time the progress on data collection. We will also ask for quality control checks (e.g., double checking 10% of the work of each interviewer and 20% of the entire sample).

Case study 4. The Resilience Hub stakeholder group will be key in actively recruiting participants from local public and private health centres, companies, and public bodies, as well as university employees etc. and recognised social media channels of the research group. Recruitment will be supported by an online screening process with previously defined successful methodology that follows a two-stage process: 1) Screen for Doctor diagnosed MtS, Sedentary lifestyle, Age 40-65yrs; and if still eligible 2) Screen for Medical history, Patient Health Questionnaire (PHQ-9), Physical Activity (IPAQ-SF), Physical Activity Readiness Questionnaire (PAR-Q) and Low nature users (< 30 min/week). Recruitment will continue until a sufficient sample size is achieved (134 participants (67 intervention group; 67 wait-list control), with an assumed attrition rate of 25%. Every eligible individual will be offered to participate. Randomisation of participants to treatment or wait-list control will follow recruitment of eligible participants.

Case Study 5. The study population will be recruited within the patient pool of the Paracelsus 10,000 study, an epidemiological study with 10,000 participants in an age range of 40-69 years investigating the state of health of the Salzburg population. In parallel, the recruitment will utilize the established "Study participants wanted" WWW and Social Media channels of the University Clinics. Recruitment stages and targets are the same as for CS4.

Case Study 6. Recruitment strategies are planned in collaboration with project managers at ISGlobal with experience of recruitment of clinical populations. We will contact a number of public and private health care centres, including general practices and hospitals, and a specialised Endocrinology clinic (Hospital Clínic Endocrinología,

https://www.clinicbarcelona.org/servicio/endocrinologia-y-nutricion/escribenos), across Barcelona. We will also address centres for nutrition and diets to distribute the survey among their clients (e.g. NaturHouse https://centros.naturhouse.es/listado-centros?provincia=BARCELONA). We will use tools such as EUSurvey https://ec.europa.eu/eusurvey/home/welcome) for a standardised approach to recruit participants that fulfil all inclusion criteria. In addition, we will post the survey on researcher linked social media channels to optimise recruitment. Recruitment stages and targets are the same as for CS4.

Case Study 7. We will sample university students in two or more Swedish cities, feasible locations including Uppsala, Örebro, Västerås/Enköping, Gävle, and Stockholm, depending on the availability of suitable intervention providers in the respective areas. Recruitment will use flyers posted in campus buildings, health care providers (including student health services), and other relevant locations as well as on relevant social media pages. The flyers will advertise a study that involves taking part in a five-week health intervention. They will also describe in general terms the inclusion and exclusion criteria. People who express interest in the study will be sent detailed participant information via email. If they remain interested, they can sign up for an online enrolment interview. The enrolment interview will involve verbal information about the study and opportunity to receive responses to any questions and a diagnostic survey (DSM-5 Self-Rated Level 1 Cross-Cutting Symptom Measure, Adult; American Psychiatric Association, 2013) through which individuals who are unsuitable for participation due to health reasons can be excluded and guided to contact an appropriate health service. Following the checks on eligibility, presumptive participants who provide written informed consent will be randomly assigned to a condition and provided with a separate information sheet to remind them of when and how they are meant to participate in the given intervention. Every week during the five-week intervention period and then in connection with every follow-up assessment, participants will be asked to indicate how they have been feeling in the last week ("much worse", "a bit worse", "about the same", "a bit better", "much better") compared to the week before. This serves to monitor their development and will, on indication of "much worse" or two occasions of responding "a bit worse", prompt a researcher to contact them personally and discuss whether they have a need for professional help outside the scope of the study. If so, contact information and suitable advice will be given.

Case Study 8. We have access to the Disabled People's Organisations Denmark's (DPOD) members' e-mail addresses. DPOD is an umbrella organisation consisting of 35-member organisations and have a total of 340,000 members. We have positive experience of inviting (by e-mail) the members to information meetings, where we can explain the project in more detail and answer questions. Further, The Danish association of Youth With Disabilities (SUMH) which is an umbrella organization led by and working for young people with disabilities strongly support participating in research projects. If necessary, we can also recruit participants by advertising in relevant papers (those advertisements must be approved by the National Committee on Health Research Ethics before being published). During the five-week intervention period each participant has a designated researcher that meets them at each intervention day and sends them reminders for the next intervention day. Participants are included in the project due to their physical functional limitations, not any mental diagnosis and therefore monitoring their progress is not necessary.

Case Study 9. Recruitment strategies are planned in collaboration with Stichting Zorgboeren Zuid (SZZ), the regional care farm organization in the province of Brabant. The principal researcher also has a direct connection with the national federation of care farms. This would offer additional opportunities for recruiting in other regions. A key challenge lies in recruiting (matching) farms for the control group, who will not participate in the training. However, there is much commitment of the farms in participating in scientific research that will provide evidence-based data on their effectiveness

2.4.1 How many clinical sites will contribute to the recruitment of the study population in which countries? Are these clinical sites part of an established clinical trial network? Please also describe the selection criteria of the clinical sites.

Case Studies 1-3. Not applicable – no clinical sites will contribute to recruitment.

Case Studies 4-6. The number of clinics to approach will be determined during the final development of the study protocol.

Case Study 7. One clinical site (the research group at Uppsala University, Sweden) will be involved in the recruitment of participants and collection of data. Interventions will be delivered by instructors and within facilities and locations selected and monitored by the research group, as determined by the availability of suitable instructors. Feasible university cities other than Uppsala include Örebro, Västerås/Enköping, Gävle, and Stockholm.

Case Study 8. One clinical site (the Nature, Health & Design research group at University of Copenhagen, Denmark) will be involved in the recruitment of participants and collection of data. The App. has been developed by psychologists of the research group, and they (and others like physiotherapists) will be present at the site during intervention. The Move Green Lab. has been designed by landscape architects within the research group.

Case Study 9. The sample will include 24 care farms in the Netherlands who are not yet part of an established clinical network. We will follow a stepwise approach, in which, first we will select the intervention farms willing to invest time and effort in this study (for a small financial compensation to staff members for their participation). Then, after selecting these farms, we will create a control group of farms that match the intervention farms in terms of size, population, vision etc. as best as possible.

2.4.2 Will recruitment of the study population be of a competitive nature between the clinical sites? (Please describe how underperformance of individual clinical sites in recruitment will be managed.)

Case Studies 1-3. Not applicable

Case Studies 4-9. No

2.4.3 What evidence supports the ability of the individual clinical sites to recruit the required number of study participants within the planned timeline (e.g. documented performance in previous clinical studies of similar complexity targeting very similar study population)?

Case Studies 1-3. Not applicable

Case Studies 4-6. Previous successful collaborations and NbT studies.

Case Study 7. The research group has worked with very similar intervention studies in the same organizational contexts for 10 years. Our experience is that recruitment efforts in connection with waves of data collection for such studies generally attract initial interest from 50-120 individuals within one month. Circa 50-80% of these have been interviewed and circa 25% excluded based on the interview. In this project, we expect the inflow of expressions of interest to be fully sufficient given that recruitment will be continuous during months 7-18 of the project and will involve health care providers (rather than only campus and online flyers as in our previous studies), that we will have ample resources for conducting interviews, and that exclusion for mental health reasons will only affect severely ill individuals (rather than moderately to severely ill as in our previous studies). We have also built extensive experience in efficient recruitment procedures and so will be able to take appropriate and timely measures to boost incoming expressions of interest if needed.

Case Study 8. The research group has previously worked with a pilot project for the Move Green project targeting the same type of participants. Our experience is that the e-mails sent to the DPOD's members list resulted in a large number of potential participants showed up at our meetings, where most of the participants were recruited. Today we also have an active network with many of DPOD's under organisations.

Case Study 9. Long-term collaboration with the care-farming organisation in the Netherlands, e.g. by the principal researcher giving advice and keynote speeches at symposia of the organisation, and preliminary discussions with the overarching organisation, for this proposal, suggests we will have no issues with recruiting 12 intervention and 12 control farms.

2.5 Please describe what additional supply (e.g. an electronic device for remote data capture, a specific instrument for administering the investigational product, etc.) is necessary to carry out the required study procedures and how this supply will be made available to the clinical sites

Case Studies 1-2. Not applicable

Case Study 3. Facilities and equipment for the collection and analyses of blood samples are already available to the research group.

Case Studies 4-6. The interventions will not take place at any clinical sites. We will use an existing smartphone application (e.g. https://www.outdooractive.com/) to help people navigate a set route, installed on the participants' private smartphones. The required clinical equipment (Sphygmomanometers, Pulsoxymeters, optical HR/HRV sensors) is available at all study sites. The Saliva samples for these Case Studies are analysed together in the immunological laboratory of the Paracelsus Medical University to ensure maximum comparability of the molecular

parameters of the allostatic load. Although both PMU and ISGlobal already have ready access to a -20^{O} C freezer to keep the saliva samples in until ready to send/analyse, there are no such facilities in or near the buildings used by the UNIPD team who have therefore the purchase of one to their equipment budget.

Case Study 7. We have all technical equipment that is necessary readily available within the research group. In addition to technical platforms for online data capture (i.e., access and relevant program code for data capture using the online service PsyToolKit in combination with video monitoring), a subset of 100 participants will also be asked to complete a fatigue induction and restoration paradigm on-site. This procedure involves continuous test performance and ambulatory heart rate monitoring using existing equipment (weather proof laptop computers, Bittium Faros 180 devices).

Case Study 8. The following technical equipment; eye-tracking, portable EEG and ECG, will be purchased from IMOTION. Further, computer (for eye-tracking) and cell phones will be purchased through the university. The researchers attending the intervention will bring it to the site.

Case Study 9. No additional supplies are necessary.

2.6 Please provide plans on data management aspects (data standards, type of data capture, verification of data, central data collection, cleaning, analysis, reporting, security)

Case Study 1. Secondary data have already been collected and cleaned. There is no way to identify any individuals in the dataset, or their address. In order to prevent data being misused in such a way that anonymity might be compromised, the named applicant has formally agreed to follow all relevant procedures to safeguard against such disclosure.

Case Study 2. Most data have already been collected and cleaned. Additional data will be collected and managed by the PROTECT study team in a manner consistent with existing data collection. Access to Personal Identifying Information will not be provided to the RESONATE research team, with postcode-level linkage to environmental data carried out through an anonymised process. In order to prevent data being misused in such a way that anonymity might be compromised, the named applicant has formally agreed to follow all relevant procedures to safeguard against such disclosure.

Case Study 3. Storage, processing, and exchange of personal data by the local team will be done in a secure environment, with limited access only by the PI and analysts directly responsible for processing the data. In case residential geolocation data has to be exchanged with other partners in the consortium (e.g., for enrichment with geographic data), the geocodes will be anonymized (e.g., via data scrambling) to prevent participant identification. The data may be stored beyond the life of the project conditional on obtaining informed consent from the study participants. After linking these survey data to environmental exposures, measured with geographic information systems, the working dataset will be pseudonymised and participant identifiers will be stored separately. The pseudonymized data itself will be stored securely by the research team.

Case Studies 4-6. Trained assistants will be responsible for rigorous data collection procedures. We will develop proper anonymization procedures, which will include removal of personal data from outcome data and secure storage of encrypted data. Adequate measures to ensure personal data protection and confidentiality will be taken, according to the Regulation (EU) 2016/679 on the protection of persons with regard to the processing of personal data and on the free movement of such data. National regulations on personal data protection will be implemented to guarantee the highest standards in personal data management. The following principles will be applied when processing personal data: lawfulness, fairness, and transparency; purpose limitation; data minimization (necessary and proportionate for the research objective); accuracy; storage limitation, and integrity and confidentiality (overseen by WP10). General procedures in the research protocol to safeguard the privacy of study participants include: 1) Written consent will be obtained from all the participants in the study to use their personal data; 2) Consent forms include a specific clause on personal data protection informing the study participants how their data is going to be treated and stored, the research purpose, the DPO contact and their rights; 3) Pseudonymization will be implemented as a general standard, meaning that all material obtained in the framework of the project (questionnaires, physical measurements, and saliva) will be identified through a code, the name and/or other personal data that could allow the identification of the participant will never be indicated. This unique identifier will link all basic data required for the study. The master key file linking the centre's study numbers with personal identifiers will be maintained in a password protected file with limited access; 4) All files containing personal data will be stored in encrypted and password-locked files. Access to these files will be limited to authorized project personnel; 5) Only researchers linked to the project will have access to personal data; and, 6) Personal data will not be transferred, except in cases considered by law. If it is

necessary to transfer personal data, participants will be properly informed in the consent form and measures to ensure personal data protection will be implemented. Transfer will be done according to the current legislation. All project personnel will be trained in the importance of confidentiality of individual records and required to sign a confidentiality agreement. Every person involved in the study implementation (hiking guides, co-workers involved etc.) will sign a non-disclosure agreement before the start of the study, which is countersigned by the Case Study's PI. Confidentiality relates to all circumstances that become known through the participation in the study, in particular information about study participants, employees and other cooperation partners regarding economic, operational, technical, tax, and personal circumstances, as well as about internal matters of any kind. Saliva probes from these case studies will be sent for analysis to the Paracelsus Medical University. The probes will only be labelled with identification numbers (ID), so the analysis will be completely anonymous. PMU is used to such sample transfers and will support and guide the UNIPD and ISGlobal teams on how best to do this.

Case Study 7. A detailed data management plan will be completed within the preparation phase of the project (Month1-6). All data will be obtained, stored and analysed under pseudonym code. All data handling procedures will be done in accordance with the guidelines and using the physical and virtual infrastructure provided by UU, which in turn comply with the applicable national and EU regulations. Any data that can be made anonymously available to the wider research community will be made available in the time and form suitable for the given data type, reflecting FAIR principles. Representatives of the Swedish National Data Service will be consulted as needed regarding data security and availability issues.

Case study 8. A detailed data management plan will be completed within the preparation phase of the project (month1-4). All data will be obtained, stored, and analysed under pseudonym code. All data handling procedures will be done in accordance with the guidelines and using the physical and virtual infrastructure provided by the University of Copenhagen, which in turn comply with the applicable national and EU regulations. Any data that can be made anonymously available to the wider research community will be made available in the time and form suitable for the given data type, reflecting FAIR principles, and as long as a written contract has been signed.

Case Study 9. A detailed data management plan will be completed within the preparation phase of the project (Month1-6). The primary researcher will carry out the data collection with trained assistants. We will develop proper anonymization procedures, which will include removal of personal data from outcome data and secure storage of encrypted data. Written consent will be obtained from all the participants in the study to use their personal data. Consent forms include a specific clause on personal data protection informing the study participants how their data is going to be treated and stored, the research purpose, the DPO contact, and their rights. All files containing personal data will be stored in encrypted and password-locked files. Access to these files will be limited to authorized project personnel. Only researchers linked to the project will have access to personal data, and these data will not be transferred, except in the cases considered by law. If it is necessary to transfer personal data, this information will be included in the information sheet/consent form and measures to ensure personal data protection will be implemented. Transfer will be done according to the current legislation.

2.7 Please give details on how reporting obligations (regarding study initiation, safety of study participants, ethical concerns, quality issues, integrity of data, study results) to regulatory bodies/ethics committees will be met.

Case Study 1. We will apply all appropriate methods and standards specified in the Microdata Handling and Security Guide to Good Practice and ONS Statistical Disclosure Control in all tables and summaries produced from the data requested in this application. All conditions specified in the End User Licenses pertaining to the data will be adhered to. Given the high degree of aggregation at which we would present summaries of the data and the large numbers of individuals included in our analyses, risk of any kind of disclosure is very low. In any case, methods described in the ONS Statistical Disclosure Control documentation will be adhered to in ensuring that outputs in no way compromise anonymity of participants. In the unlikely event that an "unsafe" geographical cell were identified in preparation of summary tables, appropriate combination, suppression, or re-aggregation methods would be applied to ensure that confidentiality is protected. All members of the research team working on these data are experienced in working with confidential data sets and in ensuring that no outputs are in any way disclosive using the means described in ONS guidance. We consider the protection of survey participant responses paramount. In order that total confidentiality of the data is assured, all data will be stored and analysed on a secure server. No data containing individual respondent details will be stored or manipulated locally on laptop or desktop machines, and only aggregated (and hence anonymised and checked for potential low cell counts etc.) data will be transferred to such machines for the preparation of summaries for journal articles etc. The Understanding Society study itself is conducted in accordance with the Data Protection Act. This means that personal information (as defined by the Data Protection Act) are kept strictly confidential by the UK Data Service and will not be included in any data set obtained by the researchers

leading this analysis.

Case Study 2. We will apply all appropriate methods and standards specified in the Microdata Handling and Security Guide to Good Practice and ONS Statistical Disclosure Control in all tables and summaries produced from the data requested in this application. All conditions specified by the PROTECT study team pertaining to analysis of the data will be adhered to. Given the high degree of aggregation at which we would present summaries of the data and the large numbers of individuals included in our analyses, risk of any kind of disclosure is very low. In any case, methods described in the ONS Statistical Disclosure Control documentation will be adhered to in ensuring that outputs in no way compromise anonymity of participants. In the unlikely event that an "unsafe" geographical cell were identified in preparation of summary tables, appropriate combination, suppression or re-aggregation methods would be applied so as to ensure that confidentiality is protected. All members of the research team working on these data are experienced in working with confidential data sets and in ensuring that no outputs are in any way disclosive using the means described in ONS guidance. We consider the protection of survey participant responses paramount. Even though data to be analysed will be de-identified, in order that total confidentiality of the data is assured, all data will be stored and analysed on a secure server. No data containing individual respondent details will be stored or manipulated locally on laptop or desktop machines, and only aggregated (and hence anonymised and checked for potential low cell counts etc.) data will be transferred to such machines for the preparation of summaries for journal articles etc.

Case Study 3. Data will only be reported in scientific publications and events in an aggregated format, precluding identification of subjects. Visualization of participants' residential location will be rendered in scientific publications at a resolution/aspect ratio that does not allow for identification of specific locations.

Case Studies 4-6. Reported study results will pertain to analyses of aggregate data. No individual's name will be associated with any published or unpublished report of this study. For further details, please see section 2.6.

Case Study 7. The project will be completed in accordance with the protocol and schedule already approved by the Swedish Ethical Review Authority (Diary number: 2021-06675-01, January 2022). The Authority will be consulted without delay in case of any substantive changes to the protocol or interventions or any unforeseen concerns regarding the safety or integrity of the interventions or data collection and management procedures. The Swedish National Data Service and the Uppsala University representative for data security will be consulted as needed regarding any arising concerns in the management of data.

Case Study 8. The project will be completed in accordance with the protocol which is to be sent and approved by the National Committee on Health Research Ethics. The committee will be consulted without delay in case of any substantive changes to the protocol or interventions or any unforeseen concerns regarding the safety or integrity of the interventions or data collection and management procedures. The representative for data security at the University of Copenhagen will be consulted as needed regarding any arising concerns in the management of data.

Case Study 9. See section 2.6

2.8 Please list all items of the sponsor's responsibilities (e.g. monitoring clinical sites, meeting regulatory obligations, data management, etc.) that will be supported by entities that are not part of the sponsor's organisation. Please describe how the sponsor will ensure oversight of these activities.

Case Studies 1-9. As of regulations by the European Commission, no other sponsors are involved.

2.9 What are the plans for major study milestones and what evidence supports its feasibility?
Please describe a realistic plan (based on prior experience) detailing the time necessary for (i) compiling the required regulatory and ethics submission package, (ii) receipt of regulatory and ethics approval, (iii) initiation of clinical site(s), (iv) completion of recruitment of the study population, (v) final assessment of all study participants, (vi) analysis/ reporting of study results.

Case Study 1. Key study milestones include: (i) Two weeks for preparing the ethics submission package and getting it peer-reviewed; (ii) two months for ethics approval; (iii-v) all participants are already recruited and data collected, cleaned etc; and (vi) two years for analysis and reporting.

Case Study 2. Study milestones include: (i) Two weeks for preparing the ethics submission package and getting it peer-reviewed; (ii) two months for ethics approval; (iii-v) 3 months for additional data collection and cleaning; and (vi) two years for analysis and reporting.

Case Study 3. Key milestones are outlined in Table 7.

Table 7. Key milestones for Case Study 3

Procedures	Month
Development of conceptual models, Development of questionnaire, sampling framework, participant records and training for sampling and field work	M 1-6
Ethics documentation preparation, submission and approval	M 5-10
Tender process for survey company and biomarkers kits/reagents	M 1-8
Questionnaire survey Wave 1 - data collection, validation and curation	M 11-13
First Biomarker tests in subsample - biosamples collection, analysis and data curation	M 14-17
Questionnaire survey Wave 2 - data collection, validation and curation	M 17-19
Second Biomarker tests in subsample - biosamples collection, analysis and data curation	M 20-23
Questionnaire survey Wave 3 - data collection, validation and curation	M 23-25
Creating GIS datasets and linkage to survey data	M 13-25
Data curation, analysis, and interpretation	M 14-30
Publication, dissemination, implementation	M 31-48

Case Studies 4-6. Key milestones are presented in Table 8.

Table 8. Key milestones for Case Studies 4, 5 & 6.

Procedures	Month
Study co-creation and ethics documentation preparation, submission, and approval	M 1-12
Participant recruitment and screening for incl. and excl. criteria	M 12-15
Randomisation and set-up of data management	M 12-15
Pilot testing of intervention and data collection	M 16-18
Intervention and data collection and storage	M 18-24
Shipping and analysis of saliva samples in Austrian laboratory	M 19-24
Data curation, analysis, and interpretation	M 25-33
Publication, dissemination, implementation	M 33-48

Case Study 7. Key milestones are provided in Table 9.

Table 9. Key milestones for Case Study 7.

Procedures	Month
Development of study protocol and intervention protocols, securing ethical approval	Completed during 2022
Trial registration and any needed addendum to ethical approval	M 1-6
Recruitment and training of instructors	M 1-6
Recruitment of participants (continuous) and completion of interventions (in 4 waves)	M 7-18
Data collection in connection with intervention waves and subsequent follow-up	M 7-24
Last wave of interventions completed	M 18
6-month follow-up of last study wave completed	M 24
Data curation, analysis, and interpretation	M 18-30
Publication, dissemination, implementation	M 31-48

Case Study 8. Key milestones are outlined in Table 10.

Table 10. Key milestones for Case Study 8.

Procedures	Month
Ethics documentation preparation, protocol, submission, and approval	M 1-4
Trial registration and any needed addendum to ethical approval obtained	M 6
Participant recruitment and screening for incl. and excl. criteria	M 6-10
Intervention completed (visitors with vs. without App.)	M 18
Follow-ups completed	M 24

Data curation, analyses and interpretation	M 30
Publication, dissemination, implementation	M 36

Case Study 9. Key milestones are given in Table 11.

Table 11. Key milestones for Case Study 8.

Procedures	Month
Development of protocols and procedures for the training, including scientific and practical details such as hiring the venues and inviting experts to give a talk	M 1-6
Recruitment of matched intervention and control farms for participation in the study, including the development of brochures and other information.	M 2-8
Kick-off meeting to inform farms participating in the CoP program	M 9
CoP-1 meetings	M 10-13
Staff experimenting with the activities in practice	M 10-15
CoP-2 meetings	M 12-15
Staff experimenting with the activities in practice	M 12-17
CoP- 3 meetings	M 14-17
Staff experimenting with the activities in practice	M 14-19
Closing meetings with staff evaluations	M 16-19
Visits of researchers to care farms to do observations of the clients and collect in-situ data of the environmental and process quality of the farms	M 17-22
Collection of post-intervention data on resilience of clients at intervention and control farms, through staff surveys and questionnaires for caregivers administered through the standard quality monitoring system of the care farm organisation	M 17-22
Data analysis and write-up	M 23-30
Publication, dissemination, implementation	M 31-48

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