SUPPORTING DOCUMENT

A Five Capitals Model approach –

Building a business case for investment in nature for health

Natural Capital Case Studies

Green space quality enhancements, improving wellbeing

B 16 | Health benefits from coastal wetland ecosystems

Summary: Sutton-Grier & Sandifer (2019) discuss several critical ecosystem services provided by wetlands, including disaster risk reduction, with an emphasis on benefits to human health and well-being. Through a disaster risk reduction lens, the authors show how coastal wetlands can be effective nature-based solutions, minimizing the impacts of disasters by buffering coastal communities from storms and erosion and absorbing flood waters.

Metric: Critical review of ecosystem services

Results: Highlighted are ecosystem services arising from biodiversity in coastal and marine ecosystems such as marshes and seagrass meadows, and include fish nursery habitat, water purification, flood risk reduction, climate modulation, and nutrient cycling. Lesser known cultural ecosystem services from wetlands are also described, namely recreation and leisure, aesthetic, spiritual, cultural heritage and identity, educational, inspirational, sense of place, social, scientific, and existence. There is fragmentary but encouraging evidence to support further development and testing of the links between wetland biodiversity (and specifically wetland microbial biodiversity) and health protective benefits for humans, from infectious and inflammatory-based diseases. In addition, mental and physical health benefits of experiencing healthy wetlands could offset some stress and disease encounters related to disasters. For example, mental and physical stress after a disaster could be alleviated by providing opportunities for at-risk individuals to experience increased exposure to healthy natural and biodiverse environments, including saltmarshes and other wetlands.

Application of findings: Coastal wetlands could be incorporated into strategies for reducing risks posed by disasters and facilitating recovery. Disaster planning authorities could consider the roles that healthy coastal wetlands play in promoting community resilience and human health as part of pre-disaster planning. The roles of wetlands in support of human health and well-being could also be incorporated into coastal resilience and restoration activities undertaken by those military services that frequently interact with these environments. Wetland-based activities could also be developed for referral of individuals and groups from social prescribing services.

B 17 | Impact of type of environment on psychological and physiological responses

Summary: Gidlow et al. (2016) undertook a randomised, cross-over, field-based trial that compared psychological and physiological responses of unstressed individuals to self-paced 30-minute walks in three pleasant but different environments: residential (urban), natural (green), and natural with water (blue). Changes from baseline (T1) to end of 30-min walk (T2), and 30 minutes after leaving environment (T3), were measured in terms of mood, cognitive function, restoration experiences, salivary cortisol, and heart rate variability (HRV).

Metrics: i) Self-reported health using the Short-Form 12 (SF12v2 used to determine Physical and Mental Component Scores), ii) Perceived Stress Scale (PSS), iii) NR-6 Nature-relatedness scale, iv) Total Mood Disturbance (TMD) was assessed, v) Restoration experience was measured through an abbreviated six-item version of the Restoration Outcome Scale, vi) Salivary cortisol was measured as a physiological marker of stress, vii) Ambulatory Heart Rate (HR) and HRV data were collected as an objective measure of exercise intensity, and viii) Rate of Perceived Exertion (RPE) was measured during the walks using the Borg Scale to provide a measure of participant-rated exercise intensity.

Results: Mood and cortisol improved at T2 and T3 in all environments. Green and blue environments were associated with greater restoration experiences, and cognitive function improvements that persisted at T3. Stress reduction (mood and cortisol changes) was observed in all environments suggesting salutogenic effects of walking, but natural environments gave additional cognitive benefits lasting at least 30 min after leaving the environment.

Application of findings: Confirmation of the benefit of such activities in good quality natural environments will be of interest to public health professionals. The additional physical health benefits arising from walking activities in natural green and blue spaces could help justify the continued or increased use of natural resources for such programmes offered by, for example, park authorities.

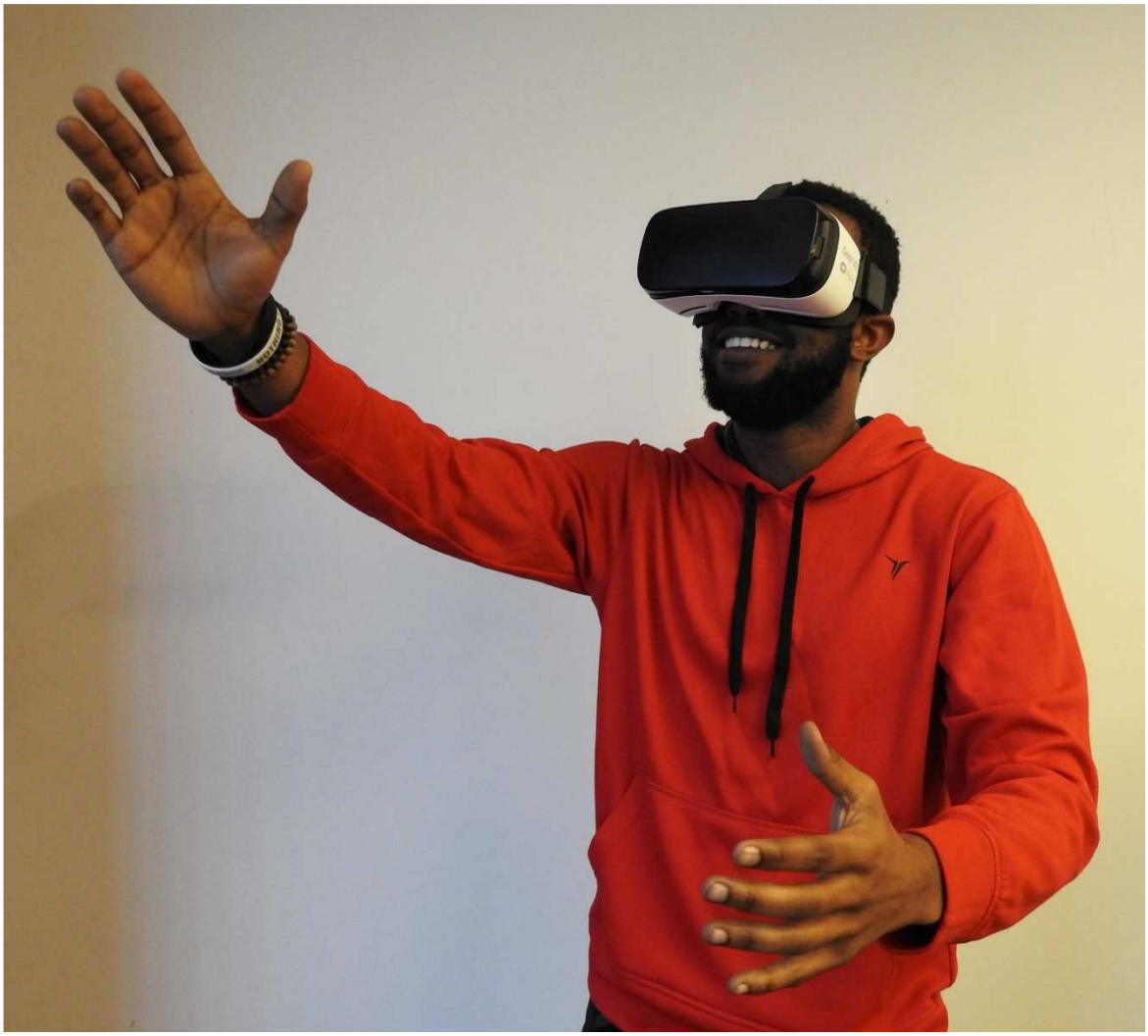
B 18 | Virtual Reality Technology has potential to improve wellbeing

Summary: White et al (2018) reviewed previous use of virtual reality (VR) nature in health and care settings to consider the potential use of this technology in future. They wanted to assess whether engaging with virtual nature can contribute to enhanced physical and emotional well- being in housebound or mobility-constrained individuals. Examples of application of exposure to VR in nature include provision of distraction from pain; reducing negative emotions, pain, and anxiety in patients during chemotherapy treatments; and reducing heart rates of patients with dementia.

Metric: Critical review of actual and potential applications of VR

Results: VR use can be an alternative to real-world nature in cases when in vivo contact with nature is not possible. A range of possible applications exist for the use of VR technology in psychiatric and medical care, although outcomes need to be measured in a scientifically valid manner. Use by individuals with limited mobility experiencing virtual nature walks or ocean explorations in combination with virtual meetings with friends or family members can improve social capital.

Application of findings: The use of immersive technology has many possible applications in health care; for example, more studies are needed to investigate the effects of exposure to virtual nature for individuals with depression and for cognitive rehabilitation. Commercially, there are numerous tax benefits available to many VR/AR companies who are involved in research, development and intellectual property creation (Digital Catapult, n.d.), hence the potential identified in this paper might be of interest to VR/AR companies in relation to potential markets for content development.



B 19 | Blue health interventions particularly beneficial for mental health

Summary: Britton et al. (2020) aimed to address the gap in understanding the health benefits of blue space within existing interventions. They reviewed studies that have examined the design, structure, benefits and outcomes, if any, of blue care for attaining or restoring psychological and/or physical health and wellbeing.

Metric: Systematic review synthesis

Results: There was some evidence for greater social connectedness during and after interventions, but results were inconsistent and mixed across studies with very few findings for physical health. Overall, positive outcomes were identified for health and wellbeing, especially mental health and psycho- social wellbeing in the short term. Some interpersonal as well as individual effects were evident with a number of studies placing strong emphasis on social connection, sense of belonging, and interaction with others who have shared life experiences, as well as the connective properties of water environments.

Application of findings: The findings suggest how activities in blue space, rather than particular qualities of blue space, might contribute to rehabilitation and health promotion. Groups of people with mental health issues should be targeted more by providers of blue space given the evidence for added benefits from these environments.

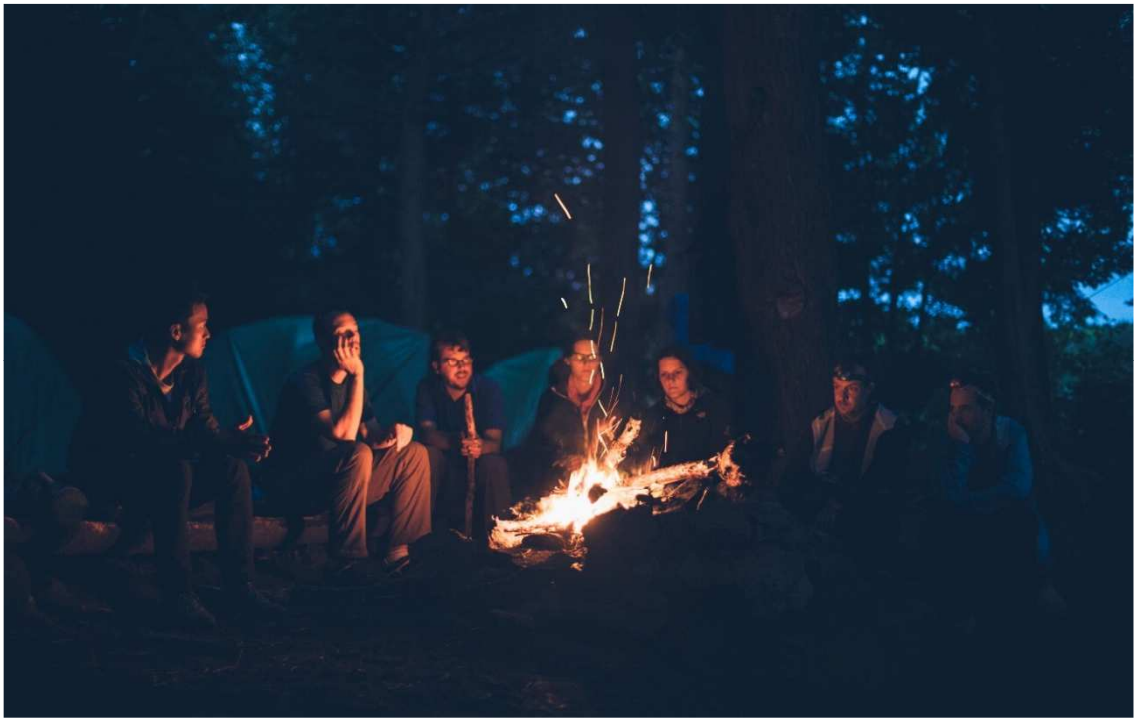
B 20 | Potential for self-paying social prescribing services through reduced healthcare costs

Summary: Maughan et al. (2016) assessed the effects of a social prescribing service development on healthcare use and the subsequent economic and environmental costs. The Connect project was operated by Carlisle Eden Mind from October 2011 to March 2014 and involved non-healthcare staff referring patients to local projects, using 'Asset Mapping' to identify available services across third, public and private sectors, self-help, self-management resources, educational, leisure and recreational facilities and fitness-, health- and exercise-related activities. Mean economic impacts were compared between a group of patients with a common mental health condition that spent between 6 and 18 months in the Connect project and a control group with similar conditions but not part of the project. As well as service outcome measures, the financial and environmental impacts were calculated for each outcome using national averages or accepted conversion factors.

Metric: CONNECT social prescribing service outcomes - included the number of GP appointments, prescriptions of psychotropic medications and the number of secondary care referrals (SCR).

Results: No statistically significant differences between the financial and environmental costs of healthcare use between groups. There were larger reductions in healthcare use in the Connect group compared with the control group, although not statistically significant. The Connect project was associated with increased overall financial savings, mainly due to a reduction of SCRs. There were larger reductions in financial cost per patient for SCRs in the Connect group over 18 months (mean diff = £147). There was little difference between groups regarding costs of medication (mean diff = £1) and GP appointments (mean diff = £6) after 18 months. The reductions in financial costs for the Connect group due to reduced healthcare use remained larger than the control group even after service costs were included.

Application of findings: Although this study highlights the difficulty in measuring the financial and environmental impacts of social prescribing services, it nevertheless demonstrates that social prescribing services are potentially able to pay for themselves through reducing future healthcare costs. It will therefore be of interest to funders and managers of social prescribing schemes involving community-based referral mechanisms.



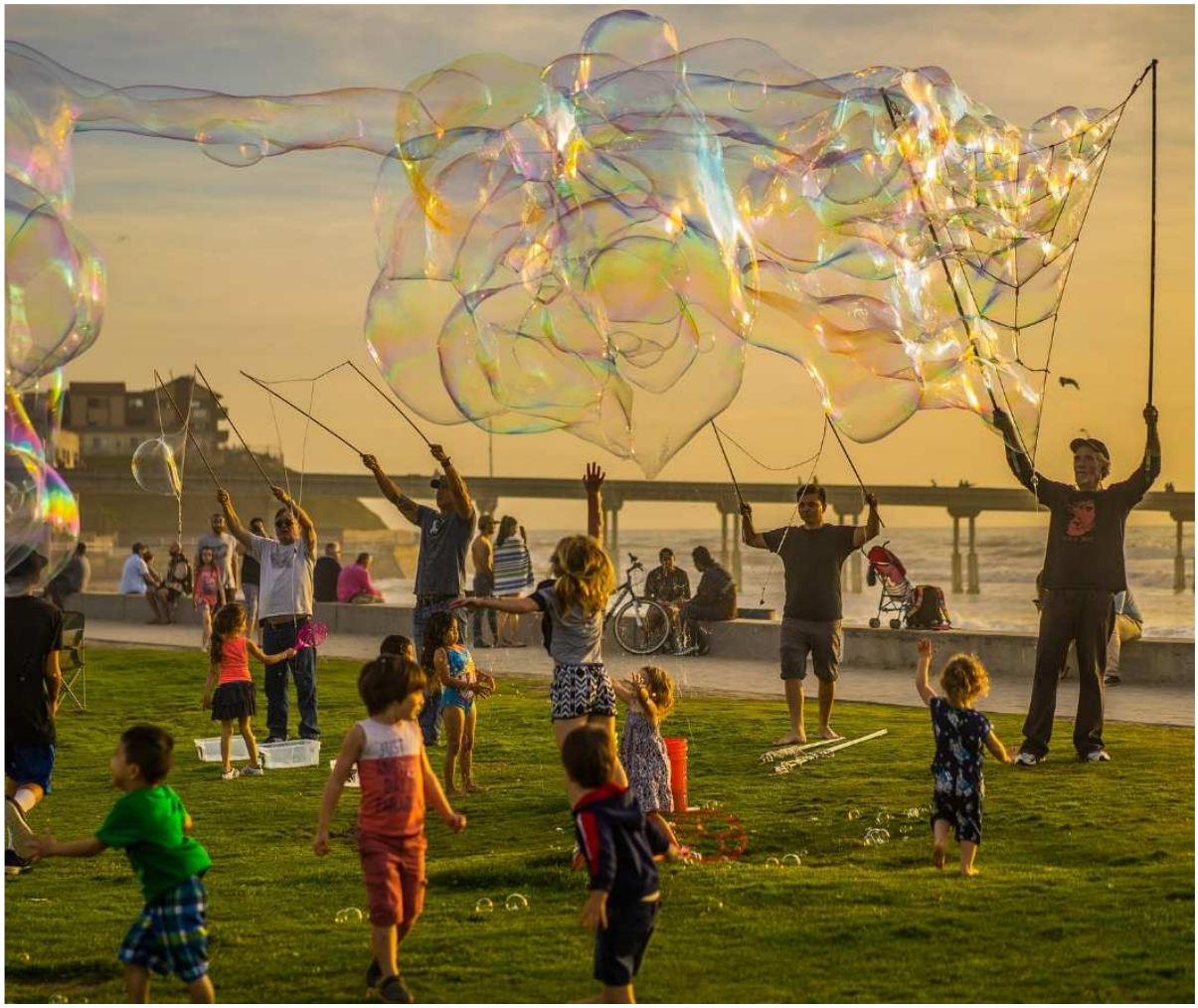
B 21 | Positive relationship between nature-dose and mental and social health

Summary: Cox et al. (2017) carried out an urban neighbourhood study in southern England. They used an online survey to collect socio-demographic and lifestyle variables together with health response variables to demonstrate that nearby nature is beneficial to population health.

Metric: The authors used a nature dose-response framework to determine relationships between nature dose type, (frequency and time spent in private green space), intensity (quantity of neighbourhood vegetation cover) of nature exposure and health outcomes (mental, physical and social health, physical behaviour) and nature. They modelled dose-response relationships between dose type and self-reported depression and demonstrated positive relationships between nature dose and mental and social health, increased physical activity and nature orientation.

Results: Health outcomes improved with increasing frequency and duration of exposure to nearby nature. Participants who spent relatively less time out of doors were more likely to have depression and to have worse physical behaviour. The authors found vegetation cover and afternoon bird abundance (but not species richness) were positively associated with lower depression, anxiety, and stress among people that actually encountered these nature metrics.

Application of findings: The authors concluded that if efforts were made to ensure minimal levels of neighbourhood vegetation cover (20%), there is potential for an annual national saving of up to £0.5 - £2.6 billion per year for depression and anxiety alone (based on estimated costs of these disorders to the English economy).



B 22 | Nature-based therapy can assist in treatments of disorders

Summary: Corazon et al 2018 investigated the use of nature based therapy in the form of a forest garden in the treatment of binge eating disorder. Based on acceptance and commitment therapy (ACT) and cognitive behavioural therapy (CBT) this nature-based therapy (NBT) involved guided body and mind awareness exercises in a beautiful park in Denmark. Participants experienced stimuli such as scents and sounds, walking awareness exercises, body scanning and stretching exercises.

Metrics: The study made use of both quantitative and qualitative methods. The authors used Rosenberg's Self-Esteem Scale (RSES) to measure the participants' sense of self-esteem and the Psychological General Well-Being Index (PGWBI) questionnaire, to measure psychological general well-being: this included anxiety, depressed mood, positive well-being, self-control, general mental health, and vitality. Participants also participated in Eating Disorder Examination interviews.

Results: The positive outcomes from the study included decreases in binge eating episodes and increases in general psychological well-being and self-esteem. There were indications that the NBT context made the psychotherapeutic content more accessible to the participants and further helped them transfer the therapeutic gains to daily life after completing treatment.

Application of Findings: The results provide initial support for the feasibility of implementing an ACT-based NBT in the treatment of binge eating disorder.

B 23 | Economic value of protected areas

Summary: Buckley et al. (2019) evaluated methods to calculate the economic value of protected areas based on the improved mental health of visitors, and compared these to values arising from ecosystem services, biodiversity prospecting, and tourism.

The authors measured Quality of Life for visitors at the trailheads of two Australian subtropical national parks, using a Personal Wellbeing Index (PWI). Visitor PWI was compared against national statistics to estimate per capita differentials (ΔPWI). Published estimates of $/QALY were used to convert ΔPWI to $/visitor. The total annual value of visits for Australia was obtained by multiplying this rate by protected area visitation rates. An online survey sample was used to collect data on protected-area and non-park green-space use over a 12 month period (QOL, measured as PWI; and socioeconomic, demographic, and physical health parameters).

Metrics: Personal Wellbeing Index (PWI), QALYs.

Results: The pilot studies, for visitors on-site, found ΔPWI= 2.4–3.4%. Using ΔPWI= 2.5%, a $/QALY value of US $200,000, and an Australian adult population of 20M, the annual health services value of Australia's national parks is ~US$100 billion, approx. 7.5% of Australia's GDP, 1.6X the entire annual turnover of Australia's tourism industry. Scaling up, a conservative global estimate using QALYs is US$6 trillion p.a, representing approx. 4% of global ecosystem services value.

Application of findings: Health service values will be of interest to policymakers and health service providers; methods will be of interest to site managers, researchers and evaluators at local and national scales. (Note the large variation used within studies, even in these case study examples, of the economic value per QALY).

B 24 | Green infrastructure investment is cost-effective while improving quality of life

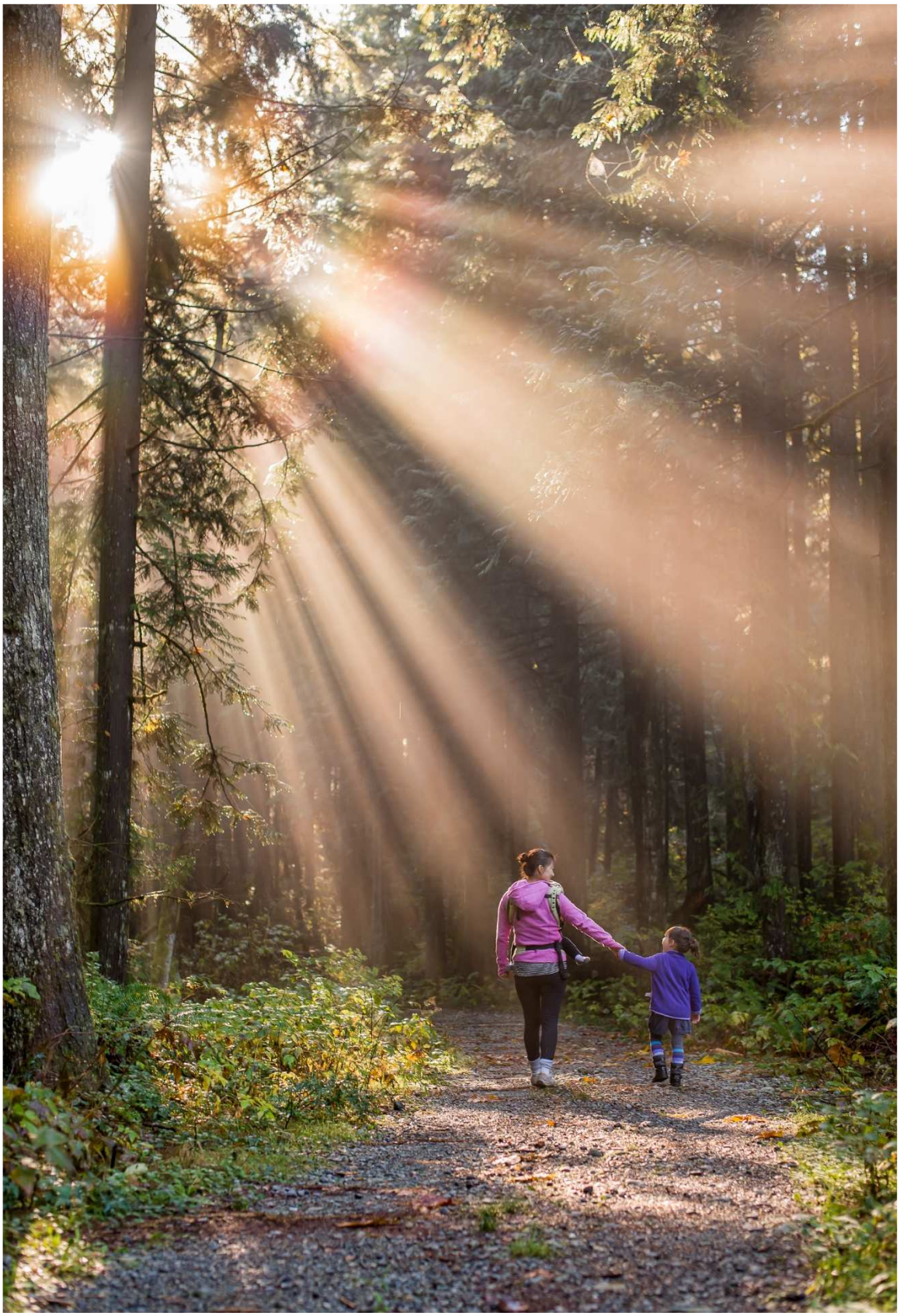
Summary: Thompson et al. (2019) evaluated whether the implementation of a programme designed to improve the quality of, and access to, local woodlands in deprived communities in Scotland, UK, was associated with lower perceived stress or other health-related outcomes. They assessed a physical intervention and combined social and physical intervention as part of the Forestry Commission Scotland's Woods In and Around Towns (WIAT) programme. Physical intervention included new or resurfaced and drained footpaths, signage, and entrance features undertaken over a period of eight months. Social interventions consisted of a programme of community-level activities and events, e.g., guided walks, 'family fun' days, 'scavenger hunts', and woodland based classes for schoolchildren. Repeated, cross-sectional surveys of intervention and control communities were undertaken in three waves, across three sites. A cost-consequences analysis (CCA) was used to present the total cost of the interventions in relation to the primary and secondary outcomes of the interventions. An exploratory cost-utility analysis (CUA) was also conducted from the EQ-5D responses for the WIAT interventions over the timescale of the study.

Name of measures: Perceived Stress Scale (PSS), quality of life EQ-5D, physical activity measured using the International Physical Activity Questionnaire, connectedness with nature measured using the Inclusion of Nature in Self Scale, Social cohesion measured based on three items from the English Citizenship Survey, QALYs.

Results: The average cost per person for the physical intervention was £7.68, (95% CI £7.67–£7.69) and £11.80, (95% CI £11.79–£11.82) for both physical and social interventions. The CUA compared the incremental expected cost of the physical intervention and both the physical and social interventions per individual in the eligible population with estimated QALYs gained from the intervention, based on the adjusted difference of the health-related quality of life (HRQoL) utilities of the EQ-5D.

The CUA suggested that for the physical intervention the cost per QALY was £935, (95% CI £399) while for the combined physical and social interventions the cost per QALY was £662, (95% CI £206). Assuming a societal willingness to pay of at least £10,000 per QALY, the interventions would only have to generate lifetime QALYs of 0.0012 on average for the interventions to be cost-effective.

Application of findings: These findings will be of interest to those required to undertake assessments of natural environment interventions. The inform government policymakers, landowners, stewardship communities, practitioners and NGOs engaged in supporting community health and wellbeing.



Exploring the literature – Five Capitals Themes and Objectives

'These tables and descriptions of the five capitals highlight further examples of themes that relate to each capital, as well as the kind of business objectives these could inform. These examples are drawn from academic literature[1] that highlight cases where the Five Capitals Model has been applied within real environmental contexts.

We hope these will help you identify themes relevant to your own work, generate new ideas, and support your understanding of how particular themes, issues, programmes, activities and even structures within your organisation align with the five capitals and might best be positioned within the model.

Manufactured Capital

Most interactions between natural and human capital are not direct, but are facilitated by manufactured capital in the form of industrial production facilities, communication devices, and built infrastructure. This capital comprises, for example, buildings, transport systems, energy, water, waste infrastructure and all durable production and consumer goods, including machinery and information technology. There is a need to consider the trade-off between manufactured capital providing essential goods, services, and shelter for human well-being, and its potential to impact negatively on natural capital. Solutions will need to find a balance between the natural and manufactured capital.

There is less detail on this capital within environmental and sustainability literature, but some examples include:

Examples of **themes** that relate to manufactured capital
The availability and suitability of renewable energy infrastructure, public transport and flood protection infrastructure
Physical resources, such as transport infrastructure (i.e. roads, bridges, tunnels), transport vessels, flood dykes, farms, domestic water supply systems
Equipment – in a local planning context, for example, might include tools and machinery that contribute to the provision of services, rather than being part of the output itself
Technological solutions i.e. communication mechanisms
Local neighbourhood indicators of various SDGs include: Road density as a proxy indicator for air quality among buildings in a neighbourhood
Energy consumption rates of households and buildings as an indicator of clean energy
Proximity of communities to solid waste recycling points as an indicator for responsible consumption and production

Examples of **objectives** that relate to manufactured capital
• Provide suitable housing that meets the needs of the population and maximise affordable housing
• Improve energy efficiency and use of sustainable construction materials
• Make public transport, walking and cycling easier and more attractive
• Make public transport, walking and cycling easier and more attractive

[1] Sources include ACE (2020); Hooper et al. (2020); Hooper & Austen (2020); Nguyen (2018); Maack & Davidsdottir (2015); Makino et al. (2016); Subramanian et al. (2021), and Weisz et al. (2015).

Natural Capital

Human health can be directly or indirectly affected by a wide range of ecosystem services. For example, the crop pollination and food production, the availability of fresh water and clean air, and carbon sequestration for climate regulation. Key themes identified in the literature that relate to natural capital include: biodiversity; air quality; land quality; water quality; climate change, sustainability; and protected area management.

Examples within environmental and sustainability literature include:

Examples of **themes** that relate to natural capital
The ability of the environment to sequester carbon and to protect infrastructure from flooding and erosion
Ecosystem services and benefits i.e. water quality, maintenance of populations and habitats, erosion control, flood protection, climate regulation
Habitats as assets within an ecosystem
Asset registers i.e. for marine environments - geology, rock, sediment, saltmarsh, mussel beds, commercial finfish and crustaceans, wetland birds, marine mammals
Natural resources, such as groundwater, gardens, land for crops, plant types, shellfish species, forests, solar energy, soil fertility etc
Green area density as indicators of potential habitat for life, and effect on microclimate

Examples of **objectives** that relate to natural capital
• Protection and enhancement of biodiversity and important wildlife habitats
• Protection and enhancement of the countryside, natural landscape and townscape
• Maintenance and enhancement of heritage assets and their settings
• Maintenance and enhancement of air quality
• Protection of high-grade soils
• Reduced disturbance to water birds, sea birds and marine mammals
• Designated bathing waters reach guideline standards
• Estuarine and coastal water bodies reach appropriate standards under the Water Framework Directive
• Reduced disturbance of intertidal mudflats in estuaries from recreational bait collection
• Reduced quantity of plastic waste and litter on beaches
• Connections to a water supply

Human Capital

Human capital can be evidenced through the wellbeing, skills and education benefits that individuals gain, both from helping to set up, and participate in, programmes, projects and activities that deliver positive health and wellbeing outcomes.

Examples from literature include:

Examples of **themes** that relate to human capital
The required skills, employment opportunities and need to encourage behaviour change around, for example, transport use
Health, wellbeing and happiness
Leisure
Mobility
Knowledge, from education and training
Identity
Self-respect

Examples of **objectives** that relate to human capital
• Provide access to learning, training, skills and knowledge for everyone
• Diversify the range of local employment opportunities
• Improve health of population and reduce health inequalities
• Strengthen research, technology and innovation
• Improve access to health services

Social Capital

This is a set of shared values and structures that allows individuals to work together in a group to effectively achieve a common purpose. Key themes within this capital include community engagement, public services (for example, community-based social prescription programmes) and equality.

Examples from literature include:

Examples of **themes** that relate to social capital
The opportunity for community-led energy projects
Social cohesion
Community networks with shared norms, values and understanding
Degree of neighbourliness and kinship arising from particular actions or decisions
Knowledge, skills and capabilities
Connections between people, and between people and systems
Extent and type of civil engagement in voluntary actions
Extent of political participation

Examples of **objectives** that relate to social capital
• Reduce crime and the fear of crime
• Promote development which supports community wellbeing and cohesion, especially in those areas facing multiple deprivations
• Use information technology to promote and facilitate opportunities within the community planning process including buildings and services which can be utilised by the community, using business networks to provide opportunities for new enterprise
• Contribute to a diverse and growing population with a balanced demographic structure
• Fully engage with and positively involve the local community and other interested parties at all stages of the planning process
• Effective transmission of information about public services

Financial Capital

Themes within this capital include returns on investment, cost-benefit analyses, project financing mechanisms and economic measures of health and wellbeing.

Examples from literature include:

Examples of **themes** that relate to financial capital
Mechanisms to encourage related inward investment (climate change)
Cash, loans, bank savings, credits and insurance
Social return on investment
Conversion of health and wellbeing metrics to economic values
Household income

Examples of **objectives** that relate to financial capital
• Foster sustainable economic growth
• Contribute to a private sector that is a high-level economic contributor
• Provide export opportunities
• Become a location of choice for start-up businesses
• Ability to invest in better water quality

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