The Sustainable Carrying Capacity of New Zealand

the ROYAL SOCIETY of NEW ZEALAND
TE APĀRANGI

Sustainable carrying capacity has a simple definition from an ecological perspective - it is the number of a species that can be supported in a particular area indefinitely, given that area's endowment of water, food, and other necessities. However, for human beings in New Zealand, the expectations of being supported involves far more than mere survival, and through our food exports, the majority of the people we support are overseas. What then can be said about New Zealand's carrying capacity given our reliance on our environment to achieve human well-being? This paper explores the thinking around sustainability in a national context, and the implications when looking to build this concept into policy making.

Defining well-being, sustainability and carrying capacity

Well-being includes not just our biological needs or our psychological desires, but the opportunities and freedoms to address those desires in a secure and cohesive society.[1] It can be measured by, for instance, the United Nations' Human Development Index which includes income, life expectancy, and literacy.[2] More detailed measures should include environmental responsibility, economic efficiency, and social cohesion.[3,4]

For sustainability, the Brundtland Commission's statement "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" is now twenty-five years old and, as a definition, it appears to be durable. A recent attempt to define sustainable carrying capacity in a New Zealand local context resulted in: "The Human Carrying Capacity (HCC) is the measure of a specified area's ability to sustainably support human activity given aggregate lifestyle and development choices and the means used to achieve these, and is expressed in terms of number of people."[5] This statement does need the caveat that the needs of future generations will be different from our current needs so we should preserve the opportunities and choices that future generations may value more highly than us. Overall progress towards sustainability has been insufficient with the Royal Society of London, amongst others, calling for urgent action to radically transform unsustainable consumption.[6]

Much of the discussion around sustainable carrying capacity has come from dialogues between ecologists and economists with the aim of jointly developing approaches that deliver both economic and environmental goals. The overall concept provides a framework for discussing ecological resilience in the context of trade, economic growth, and changes in human behaviour and technologies. Its attractiveness may lie in the notion that a population or activity can be sustained at a stable and optimal level, avoiding crashes or over-exploitation. However, human societies are always changing and our current global wealth is characterised by ever-increasing rates of change in behaviour, technologies, and resource use. In this dynamic state, a quasi-equilibrium tool like sustainable carrying capacity is flawed, but it remains a useful conceptual tool for considering the scale and intensity of our relationship with the environment.[7]

New Zealand's current debate on our resource limits and constraints

New Zealand's prosperity for the foreseeable future is linked to the ongoing growth in our primary sector. This is placing increasing pressure on finite natural resources, as is the more general growth in economic wealth and resource use. Most economic activity depends directly or indirectly on environmental resources and services, which are subject to natural limitations of supply, renewability, quality and ability to deal with wastes. This is accentuated by the New Zealand economy being highly dependent on food exports and as such supports many more people overseas than domestically. Equally, New Zealand also imports most of the technological goods and cultural services that we use. A key challenge for the future will therefore be to identify what aspects of this scenario can be maintained environmentally, economically and socially.

Regulation and policy should be driven by discussions on the trade-offs to be made between resource use and conservation, between scarcity and substitution, between current use and future opportunities, and between narrow optimisation and wider resilience. Sir Peter Gluckman has called for a more nuanced and rigorous discussion of these trade-offs.[8] This paper is part of the Society's contribution to that debate.

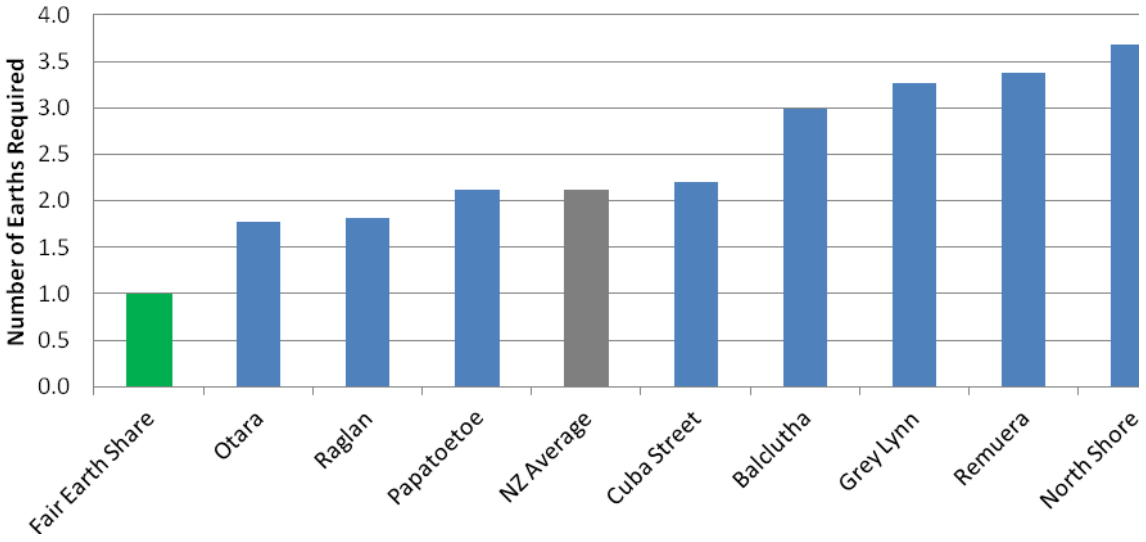

Figure 1 Resource over-use and the number of Earths required to sustain New Zealand lifestyles. The North Shore lifestyle is characterised by preferences for high levels of consumption, travel, and large houses. Conversely, people with a Raglan lifestyle prefer self-sufficiency, simpler consumption, working from home, and have a lower income on average.[16]

Environmental limits: boundaries, scarcities, and constraints

For the environmental resources that make up New Zealand's natural capital, some biophysical changes, such as the extinction of species or the eutrophication of waterways, have clear, drastic and often irreversible impacts upon flows of benefits from those resources.[9,10] However, most resource limits are not manifest as sharp boundaries in that manner. Instead, they show up as socially constructed constraints within bounding biophysical scarcities, which vary in scale, response time, and consequences of use. Depletion of underlying resources rarely results in a sudden halt to the flow of benefits from that resource but increasing scarcity is associated with soaring costs. When constraints are not hard limits, then the policy questions that informed by these scientific concerns are answered by trading-off between the varying goals found at a range of spatial scales from local to global and over timescales from immediate to generational. For example, climate change is a global constraint where acceptable levels of risk are set, as they are for other constraints, by "political, economic, cultural and moral tradeoffs", rather than the need to avoid biophysical thresholds.[11] These trade-offs must take into account the marginal impacts versus the benefits of changes in flows. When marginal impacts are irreversible or comprise sharp thresholds, then this should feed into each trade-off analysis. On top of this, asymmetries between well-known benefits and less well-known impacts, and insufficient knowledge of underlying stocks, flow of benefits, and the results of trade-offs must all feature in this decision-making.

Our range of responses to the connection between biophysical scarcities and socio-cultural constraints includes denial, acceptance, short-term races to capture finite benefits, reduction in resource use, optimisation of use, and substitution of one resource for another. Water resources provide an example. We have reached a point where the biophysical limits to extraction and use are obvious although those limits are not well defined and vary over time and catchment. Within these circumstances, there is the question of how we decide to use the resource, whilst accommodating the clash of values and valuations around different uses and implementing that decision through regulatory, financial, and behavioural changes. The Land & Water Forum is showing that more progress can be made through collaborative approaches than adversarial approaches. For such approaches to be successful, then decisions should be developed using processes that are transparent, inclusive, consistent, efficient, equitable, and informed by relevant scientific knowledge.

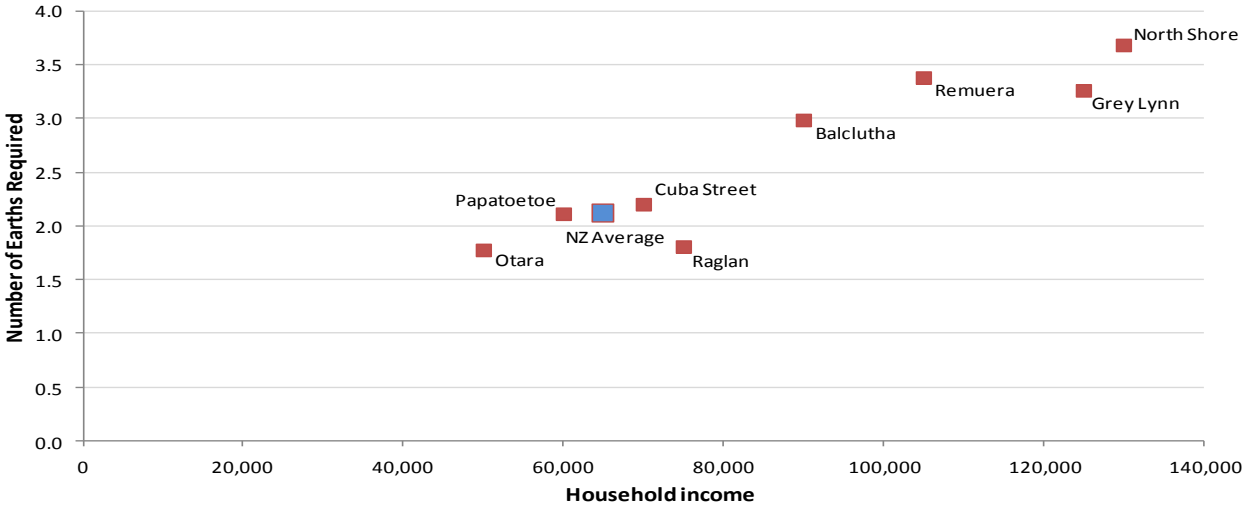

Figure 2 Household income and ecological footprint. The environmental impact of most households in New Zealand depends strongly upon income, with few effects due to lifestyle differences. However, the variation within each lifestyle group is high. Data from Lawton[16]

Connecting well-being with resource constraints for New Zealanders

One approach to assessing sustainability is the ecological footprint – an indicator that attempts to measure the resource use of a person (for food, goods, mobility, services and shelter) in terms of how much biologically productive land (globally averaged) is needed to meet that use. Estimates for New Zealanders have included eight[12] and five global hectares per person[13]. In comparison, distributing the world's productive land to the world population would result in a 'Fair Earth Share' of 1.7 hectares per person.[14]

Footprint varies with lifestyle, wealth, and consumption decisions but little research has explored this connection in New Zealand.[15] Wealthier New Zealanders tend to prefer larger houses and more discretionary travel such as overseas holidays, thereby increasing their footprint. Rural New Zealanders grow more of their own food but travel further to work and shops. Urban New Zealanders share infrastructure, have smaller dwellings, and less necessary travel, reducing their footprint. One of the few available breakdowns of New Zealand lifestyles, the 8 Tribes analysis, was used to explore how ecological footprint varied with lifestyle decisions. **Figure 1** shows the results - a doubling of average footprint from the lowest to the highest lifestyle. However, even the groups with the smallest footprint are still well above the 'Fair Earth Share'.[16]

Personal footprints are connected with lifestyle choices and one study comparing Wellington in 1956 and 2006 showed a 45% increase in ecological footprint and an improved quality of life.[17]However, there is little research that explores the link between lifestyles, well-being, wealth, and social values. Within nations, wealth generally increases health and happiness, up to a certain level of wealth but data across nations strongly suggest that social development and economic development are two separate matters.[2] Numerous factors that increase footprint are only weakly connected with well-being. For example, older people generally have higher quality of life, higher income and thus higher footprint, but it may be that both higher quality of life and higher income are due to life experience, rather than higher quality of life resulting from higher income.[18] Equally, ecological footprint increases with household income in New Zealand (as seen in **Figure 2**), but there is little evidence to say that well-being follows.[16]

Carrying capacity depends upon resource use and, despite the poor connection between resource use and well-being, lifestyles are changing to become more resource-demanding at both national and global levels.[19] The potential impact of this change is large, for example the increase in meat consumption as people across the globe become wealthier is expected to increase by more than 60%[20] and possibly double demands for meat and dairy from 2000 to 2050.[21] New Zealand currently produces enough calories for 20 million people and enough protein for 45 million people[22], but these numbers depend upon the changing diets of those people and their future consumption of meat.

Constraints on well-being are socially constructed on top of biophysical scarcities

The complicated nature of human well-being, the rate of change of technologies used to deliver well-being, and the difficulty in determining sustainability all mean that defining an upper human population density for New Zealand's sustainable carrying capacity with any precision is not possible, although it must be considered in analyses of the ecological future of New Zealand.

New Zealand faces a set of constraints on its ability to provide well-being. These constraints are complex, varying in timescale, physical scale, impact, risk profile, and pushing against or overshooting those constraints has varied consequences. Individual constraints are explored in the Society's paper *Constraints to New Zealand's Sustainable Well-being*, which considers the following aspects:

- Climate change
- Land use
- Water use
- Native biodiversity
- Imported nutrients and liquid fuels
- Wild fisheries

New Zealand's discussion around these constraints would benefit from more comprehensive measures of well-being and, in particular, a stronger understanding of the connections between well-being, consumption, and environmental impact[6] along with better data about the state of, trends of, and limits on our natural capital.

Further reading:

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[19] Steffan, "The Anthropocene: conceptual and historical perspectives", 2011
[20] FAO "World agriculture: towards 2030/2050 Interim Report", 2006
[21] Boland, "The future supply of animal-derived protein for human consumption", 2012
[22] Riddet Institute, "A Call to Arms", 2012