

Understanding Obesogenic Urban Environments from the perspective of Human Ecology

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ABSTRACT

The Human Ecology Program at the ANU takes a systems approach to understanding sustainability issues, such as those facing modern cities and their food production systems. Focussing on food consumption as part of normal everyday behaviour helps to get a diverse set of undergraduate students to understand the ecological consequences of their behaviour. Using metaphors mapped from the concept of 'metabolism' the students gain insights into how the urban form and the dominant beliefs and values of the inhabitants combine to induce major stresses on the city's hinterlands. The metabolic imbalances of modern affluent cities appear to make them 'obese'. Furthermore, these cities appear as 'obesogenic' environments (Egger and Swinburn, 1997) for a growing number of their inhabitants. Just as obesity is emerging as a primary health challenge in the Western world, so too the metabolism of cities is a primary threat to ecological health. At both the individual and urban scale these issues can be seen as 'normal' responses to a common systemic arrangement. Furthermore, the same kinds of intervention might lead to improvements at both scales. Once understood as problems which stem from a common core, students can see how they could take personally meaningful and achievable steps to contribute towards returning cities to equilibrium with their hinterlands. Although presented in relation to undergraduate teaching, the principles and approaches to enabling individual engagement, problem-identification, understanding and empowerment all have broader applicability.

INTRODUCTION

This paper explores whether the high material and energy intensity of modern urban environments, and the associated ecological load this demand places on agricultural hinterlands, can be usefully understood as caused by the same social structures of 'normal behaviour' that are driving the increasing levels of obesity in urban populations. The paper focuses on food production systems specifically, although the underlying principles being explored can be applied to commoditised consumerist material production systems more generally (following arguments from eg Hamilton, C. 2003; Hamilton, C. and Denniss, R. 2005).

Seeing these issues as common outcomes of the structured inter-relationships between social and environmental processes, when thought of as if they were a whole system, is one of the insights from Human Ecology. The issues that are discussed here have been found to be useful in a teaching context for helping students connect the principles of human ecology to the practice of their everyday life, and consequently to better understand and appreciate the value of the human ecological approach. The paper starts with a brief introduction to human ecology itself.

HUMAN ECOLOGY: A SYSTEMS APPROACH TO UNDERSTANDING SUSTAINABILITY ISSUES

For over 30 years, the ANU has undertaken teaching and research into the sustainability of human interactions with the environment, via a coherent intellectual program of study in Human Ecology. The program is characterised by:

- A commitment to the existence of a real world that constrains human behaviour, whilst recognizing that there are many ways in which that reality is understood and valued. From this perspective there is nothing to say that people *have* to value the environment in ways that are ultimately sustainable, but that there are real bio-physical consequences for them if they do not. It is acknowledged that often in sustainability issues one person or group's behaviour is not fed back to constrain them, but is felt by some other party.
- A focus on *how* a situation is understood, as prior to whether, and for whom, it is considered to be a 'problem' situation. Sustainability problems are then 'wicked problems', fitting Rittel and Webber's description; since 'problem understanding and problem are concomitant to each other ... the formulation of the wicked problem is the problem! The process of formulating the problem and conceiving the solution (or re-solution) are identical, since every specification of the problem is a specification of the direction in which a treatment is considered' (Rittel, H. and Webber, M., 1973, p161). In other words, how you understand a situation is a strong determinant of what is seen as a problem, and thus what kinds of actions might lead to solutions.
- An understanding that, whilst situations are real, in the terms discussed above, the aspects of those situations that they identify as systems-of-interest to them are constructed. 'Humans selectively identify systems of concern to them from myriad complex interrelations that form reality itself' (Dyball, R. et al. 2005: p43).
- A belief that when people strive to understand new situations, or old situations in new ways, they map concepts from source domains that they already understand. In other words, human understanding is fundamentally *metaphorical* (Lackoff, G. and Johnson, M. 1980; Lackoff, G. and Johnson, M 1999). The ability to draw from, or connect new ideas with, personal lived experience, makes a fundamentally important contribution to genuine understanding and learning.
- A belief that humans are accountable for their actions and choices and the affect these have on the environment. However, these choices and actions are constrained by dimensions of social power. In many parts of the world, this social power takes the form of oppression and coercion, and choices are limited by accesses to available resources. These constraints of force and lack are not of central concern here. Rather, the program focuses on the constraints that structures of normality place on why people do what they do, following Shove in arguing that, in addressing sustainability in the affluent West, 'shared understandings of "normality" matter more. This is so because notions of what it is to be a normal and acceptable member of society have far reaching environmental implications: they carry in their wake a trail of inescapable resource requirements ... I take normal practices to be those in which collective identities are anchored, which constitute a form of social glue, and which are, at any one point in time and in any one culture, seen to be obligatory, non-negotiable conditions of everyday life' (Shove, E. 2004, p. 77). That is, it is normal everyday behaviour, such as that of the students of the program, that accounts for the ecological signature of a society.

These characteristics underpin the program's teaching philosophy, which is to guide students' learning as they explore their personal inter-relationships with the ecosystems within which they are embedded in order that they might better understand the problem situations that they will encounter

in the future. Food, and its everyday acquisition, has proved a useful process to explore, as it resonates with many of the above points:

- the students do not *have* to feed themselves, but there is a significant bio-physical consequences for them if they do not
- how they understand their relationship to food is highly influential in whether they perceive modern production systems as problematic or not
- what aspects of the food production system they include as important variables determines the characteristic behaviour of the system they construct
- each has lived experience of food acquisition that can be drawn upon as part of the learning experience
- and for most eating behaviour is perfectly ‘normal’, within the structure and constraints of society, even though it can be easily shown to be, in its current form, a recent culturally phenomena.

Food production and consumption systems are also, arguably, the source of some of the major influences on levels of both individual and environmental health.

FOOD PRODUCTION AS A MAJOR ENVIRONMENTAL HEALTH ISSUE

One of the most pressing sustainability issues facing cities in the 21st century is how to feed and provide adequate clean water for their inhabitants. Global human population is trending towards 8 billion by 2020, of which more than half is urbanized – a percentage that is estimated to increase (UN Habitat, 2005). Current food production systems are struggling to match this increasing demand, despite large factors of increase in land area devoted to doing this, as shown in Table 1.

Table 1: Scale of environmental change, factors of increase 1890s to 1990s (Source: McNeill, J. 2005)

Freshwater use	9
Marine fish catch	35
Cropland	2
Irrigated area	5
Pasture	1.8
Forest	0.8 (20% reduction)
Cattle population	4
Goats	5
Pigs	9

Grain stock carryover is at an all time low of around 60 days (Earth Policy Institute, 2004) global tradable reserves are diminishing and world prices are increasing (Lees, B. 2005). Increasing output draws down soil resources, and where that output exceeds natural replenishment rates, the productive ‘capital’ of the soil is exceeded. Even in rich soils, over time, a rate of farm export of product that exceeds the rate of natural input must eventually exhaust the soil’s nutrient stocks. Some indicative outflows are shown by product type in Table 2.

Increases in output per unit area can be achieved with higher-yielding crops, including those that have been genetically modified, higher inputs of artificial fertilizers and other agricultural chemicals, and by increasing area of land under irrigation. However, the ability to sustain these higher yields is compromised by ecological stresses in the form of soil degradation, over-allocation of water, including salinity issues, and factors associated with exposure to a high dependency on fossil-fuel energy inputs.

Table 2: kg of Flows of Macro Nutrients Off Farm, per approximate typically yield by weight of different products per ha of farmland. (Source: Cox and Aitkens, 1979)

Commodity	kg N	kg P	kg K	kg S
Wheat (1 t)	21	5	5	1.5
Oats (1t)	16	3	4	2
Maize (1t)	16	3	4	2
Rape (1t)	27	6	4	2
Lucerne (1t)	24	2.4	18	2
Wool (25kg)	3	0.1	1.3	1
Meat (100kg)	2	0.5	0.25	1

FOOD CONSUMPTION AS A MAJOR INDIVIDUAL HEALTH ISSUE

One of the major human health issues arising in modern cities is obesity. Obesity is defined as an individual with a body mass index (BMI) of 30 or more. (BMI is the ratio of body weight in kilograms to height in meters squared.) A wide range of health disorders are associated with obesity, and to a lesser extent from being overweight more generally. These include hypertension, coronary heart disease, adult-onset diabetes, gallstone disease, breast, and endometrial and colon cancers, arthritis, and a range of psychological problems (McMichael, A. 2001, p234). Hardly detected as an issue for concern prior to the later half of the 20th century, obesity levels have greatly increased in recent decades. Estimates suggest that worldwide an additional 100 million adults became obese in the last decade, bringing totals to around 300 million. Health problems relating to obesity and overweight contribute to an estimated 17 million premature deaths a year. Although most prevalent in affluent nations, obesity and overweight related health issues affect many poorer nations, and is particularly concerning as a growing problem for children (UN Health Agency 2005). Estimated health costs in the United States alone are between \$10 and \$40 billion annually (Allison, D. and Zannolli, R. 1999). Seemingly paradoxically, on the one hand the major environmental health problem facing many cities in the 21st century is how to provide enough food for human consumption and on the other hand a major individual health problem is over consumption of food.

How to understand this paradox

Human ecology seeks to understand this apparent paradox by viewing both the 'size' or intensity of a city's demand upon its hinterland as the value of one variable, and the average fat balance of the city's population as the value of another variable. The former is often discussed via the metaphor of an 'urban metabolism', as discussed below – the latter in terms of population obesity levels. Both can be thought of more abstractly as two kinds of stocks. The only way that the level of a stock can change is by changing the net rate of inflows and outflows of that stock. Thus we are concerned here whether the rates of change in levels of both metabolism and obesity share a common constraint. This approach views these two variables as parts of a common system in which changes in the values of the respective variables can be seen as resulting from changing constraints on their net flows. In this approach, aspects of culture can also be thought of as a variable the value of which changes in some fundamental way, which in turn drives the values of the variables that concern us up or down, in the way that we observe. Here, the dominant constraining variable is indeed cultural, ultimately residing in the dominant worldview of the system. The suggestion then is that changing that dominant cultural driver such that the value of the key variable is reversed has the potential to reverse the value of those variables that concern us.

Systems-based approaches offer a powerful means of understanding the changes taking place in large complexes, such as a city. They are 'powerful' because they describe the behaviour in terms of a few simple yet generic archetypes (Newell, B. et al 2004).

OBESOGENIC ENVIRONMENTS

Egger and Swinburn’s concept of ‘obesogenic’ environments fits with this systems based approach. By ‘obesogenic’ they mean ‘the sum of the influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations’ (Egger, G. and Swinburn, B. 1997, p477). Egger and Swinburn’s model, illustrated in Figure 1, takes an individual or population obesity level as a ‘“settling point” – the net result of multiple influences which impact on fat mass by acting through the mediators of energy intake (especially energy dense food) and/or energy expenditure (especially physical activity)’ (Swinburn, B. and Egger, G.1999).

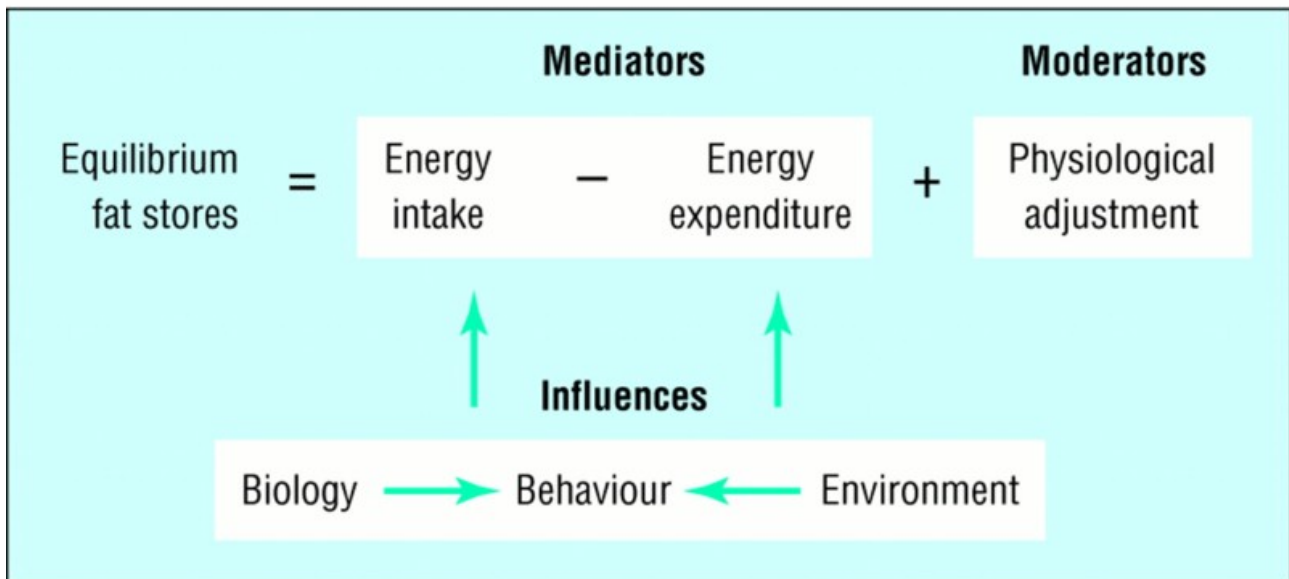


Fig 1: An Ecological model for understanding obesity (Source, Egger and Swinburn 1997, p316)

This places obesity in an ecological context, in which obesity is not a ‘pathology’, an individual’s metabolic or genetic defect, but is instead a ‘normal physiology within a pathological environment’ (Egger, G. and Swinburn B. 1997, p479). The switch of focus from the individual to the environment in which the individual is embedded is crucial. Viewing obesity in terms of ‘obesogenic’ environments allows the processes that result in obesity to be considered systemically, as variables in a dynamical system, as previously discussed. Levels of obesity can be considered as changes to the net value of a stock of energy, stored as body fat, caused by varying rates of inflows and outflows of energy, such as food and activity. This focuses attention on the factors that control those processes by which input and output rates are changed, and thus causing stocks of fat to accumulate or decline. These influences might be physical, such as the kind of food present in the environment or whether safe walking paths are present, or whether motorized transport systems exist. They also might be economic, relating to the affordability of those various physical things. They might be social, relating to social attitudes, values and peer pressure for eating customs, sporting activity and other behaviours.

URBAN METABOLISM METAPHORS

A city can likewise be thought of as if it were a system, acting to constrain the changes to the value of some key variable of interest, such as stocks of nutrients – or indeed any other material or resource. The physical, economic and social structure of the city will constrain the flows that cause critical stocks to increase, decrease or remain constant, with related affects in the hinterland from which these stocks are drawn.

The rate at which a city changes the inflows and outflows, and thus accumulations, of key resources has been expressed using the metaphor of an urban ‘metabolism’. It now becomes possible to see connections between an individual’s metabolic rate in a certain environment and the analogous metabolic rate of that environment itself as being connected in some way.

Marina Fisher-Kowalski has conducted a comprehensive review of the ‘metabolism’ metaphor, and its application to human dominated systems, revealing antecedents back as far as 1860 (1998; 1999). However, the concept of ‘metabolism’ that the Human Ecology program at the ANU uses is the one that was developed by the program’s founder, Stephen Boyden. Boyden originally developed his metabolism metaphors to describe the rate of energy and material exchange between human society and the biosphere as part of a human ecological analysis of the Hong Kong, in the 1970s (Boyden, S. Millar, S. et al. 1981).

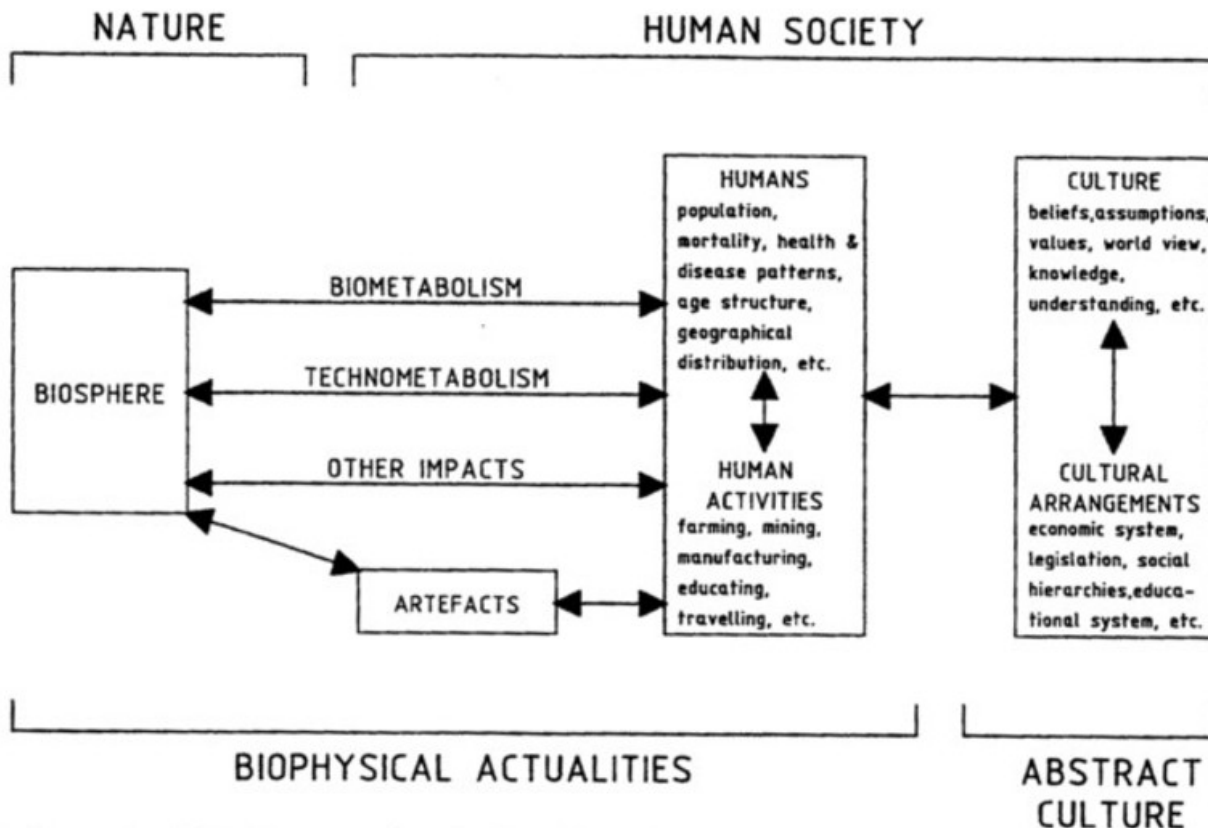


Figure 2: Boyden’s metabolism model, (Boyden, S. 2004).

The Hong Kong project treated the city as an ecosystem, describing the overall material and energy exchanges of the system as a whole. Then the specific material and energy fluxes caused by the behaviour of a particular species – human beings – was identified¹. The project team used the term *biometabolism* as ‘the inputs, internal uses and outputs of material and energy involved in the biological processes within living organisms [notably, humans]’ and used the term *technometabolism* to refer to the ‘inputs, uses and outputs of energy and materials resulting from technological processes and taking place outside of human bodies’ (Boyden, S. 2004, pp181 & 184). The relationship between these two kinds of metabolic processes, and the cultural values that ultimately drive them, are captured in Figure 2.

PRINCIPLES OF PERMANENCE

¹ In ecological terms the former is *synecology* and the focus on a particular species is *autoecology*.

At both individual and city scales, different social arrangements, such as result from different decisions or different institutional structures, will change the rate of material and energy flows and so alter the levels of stocks. By assessing these inflows and outflows of materials, and their energy 'cost', different arrangements might be compared and judged. This includes the unavoidable energy and material flow profiles of alternatives that are suggested as being 'more sustainable'. Ultimately, this judgment will rest on the values held by the person or group doing the judging. However, we can say that there are certain fundamental principles that mean that certain material fluxes are not sustainable over the longer term.

Bill Clarke originally suggested these principles in *The Structure of Permanence* (Clarke 1977), arguing that, whether humans value certain processes or not, ecological reality constrains a system's ability to endure over the long term. These constraints mean that any human system is ultimately unsustainable if it;

- draws more energy or material from its hinterlands than ecological processes can replenish *after* they have maintained themselves;
- exports more material than ecological processes can absorb;
- concentrates materials within the system boundary at levels that are self-poisoning or otherwise morbidly harmful.

Within the 'metabolism' analogy the city is an 'organism' that can kill itself by exceeding its local ecosystem's carrying capacity or by becoming morbidly obese. Following the metaphor, such obese urban environments can be seen as 'normal', as in characteristic, responses to an obesogenic system, within which they can be seen as embedded.

The global food production systems that feed modern cities clearly violate Clarke's principles. The imbalance in energy input output ratio is well illustrated by the 'typical' loaf of white bread (figures presented here are based on those originally calculated by Leach (1976), subsequently updated by Dumaresq (2002) and using figures from Smil (1999). A 1kg of commercial white bread has a food energy value of about 12Mj – around the typical demand for an average active human. However, the energy required to grow, process, package and distribute the bread is almost twice this figure, at around 21Mj – the energy equivalent of about half a litre of oil. Of this, less than 20% is incurred on-farm. This applies to energy intensive agricultural farming systems, including the energy required to manufacture, distribute and apply modern agricultural inputs, such as fertilizers and herbicides. Over 75% of the balance is incurred post farm-gate, in transport, primary processing and reprocessing and packaging. These estimates of the energy required to deliver the loaf to the shop exclude the energy cost of the individual's shopping habits. If the individual chose to walk to the store, assumed to be a 5km round trip, they would burn around 1 to 1.5Mj of somatic energy – nearly 10% of the energy they 'capture' in the loaf. If, on the other hand, they drove the same trip they would burn very little somatic energy, but their vehicle would consume another 25Mj (assuming a relatively small car with a city cycle of 9 km to the litre). Exercising the latter option sees the energy value of the measures to acquire the food approximate four times the energy value of the food itself

Ultimately, if we are concerned with the rate at which society's metabolism is operating, then we must engage with the cultural drivers behind humans and the behaviours that they normalize. Culture both produces and rests upon specific cultural arrangements, including the legal, governmental and institutional frameworks within which the economy, with its patterns of material and energy flows, operates. These structures give different individuals and groups differential access to certain resources and goods produced by society. If, at either the whole-of-society level, or at the level of individuals, metabolic distortions are evident, then it suggests that the ultimate cause of these distortions stem from dominant cultural settings. This is evident in the example of the physical and cultural structures that make driving to buy a loaf of bread perfectly normal behaviour,

whilst walking for this purpose is now unusual. It can be observed that this change in 'normal mode of transport' has occurred in the last twenty to fifty years.

EXTENDING THE 'OBESOGENIC' CONCEPT TO THE 'TECHNOMETABOLISM' METAPHOR?

Within the models used in the Human Ecology program, 'over consumption' can be seen to affect the health of the system, when considered either at the level of the city and its environment or at the level of individuals and their immediate surrounds. The imbalances manifest at different levels, but are usefully viewed as being part of the same system. In considering the material and energy demand of a city, Human Ecology students would be asked to consider how the same level of contentment or purpose satisfaction might be achieved, but at a lower level of material flows or accumulation. A similar question might be asked of individuals and their eating habits and their daily energy expenditure through transport and other human labour saving devices.

However, it has been stressed throughout that, while the immediate cause of over consumption might be individual human behaviour, it is limited, and at times unfair, to hold people responsible for that behaviour in isolation from the social structures within which they are embedded. Rather, we need to look to the systems level behaviour. If, as Egger and Swinburn's model suggests, within an obesogenic environment an individuals' size is a 'normal' response to a pathological environment, then perhaps there is an analogous relationship between normal everyday behaviour and the 'size' of a city's technometabolism?

One means of exploring this relationship is by applying the 'soft systems' approach suggested by Peter Checkland (for example Checkland 1985; 2000). Checkland suggests that we view processes as 'human purposeful activities', which are *for* transforming something into something else. When viewed in this way, as Lockie and Pritchard remark, the primary purpose of the food production system seems to be the smooth running of the food supply chain itself, in order to more efficiently turn commodity into economic return. To this primary purpose, issues such as human and environmental health are merely secondary outcomes (Lockie and Pritchard 2001).

Tim Lang and Michael Heasman describe the worldview currently dominating food systems as 'productivist'. Within this worldview the dominant drivers are to raise output and monetary gains through intensification. The key food sector that is employed is commodity markets, which link high input agriculture via mass processing to mass markets, within a general industry approach of creating homogenous products in pursuit of quantity (measured as the rate of throughput) over quality. Ultimately the consumer focus is on cheapness of product, in which the appearance and apparent convenience of food dominates – a belief constantly reinforced by marketing. Underpinning the production process are environmental assumptions resting on cheap energy for inputs and transport, presuming limitless natural resources and the uncoded externalization of pollutants and other environmental harm. Consideration of health, if present at all, operates within externally imposed regulatory minimums, with the adequacy of the rate of supply as the prime health related issue to which food production can contribute (Lang, T. and Heasman, M. 2004). While such a worldview dominates food production systems it is likely that unhealthy and unsustainable processes will characterise all aspects of industrialized agricultural production, through manufacture and distribution to final consumption. Increasing obesity and decreasing agroecological health and increasing rates of urban metabolism and decreasing rates of human energy expenditure are all thus interlinked and driven by common attitudes to commoditised food production and consumption of food.

CONCLUSION: SUSTAINABLE CONSUMPTION AND HEALTHY DIETS

The recent CSIRO report into the sustainability of the Australian economy *Balancing Act* makes a number of recommendations that relate to this discussion. Suggestions that they make to move towards a more sustainable economy include:

- Constraining the linear flow of the ‘grand elements’, such as carbon, nitrogen, and phosphorus and of water.
- Basing the economy on ‘flows’ of resources that do not draw down stocks
- Shortening energy-intense the supply chains by reduce transportation and processing
- Engineer society for durability and resilience (Foran, B et al, 2005)

Moving away from a ‘productivist’ dominated food system would help further all of these objectives. In so doing, it is likely that many of the processes influencing obesity would be addressed as well. The implication would be to base diet on locally grown, seasonal produce, to eat less highly processed foods, that economics would send a price signal that related unfavourably to highly manufactured food products, and that a greater diversity of food would be eaten².

Obesity affects individuals within the city – it is not a phenomenon ‘out there’ somewhere remote. Perhaps above all, as alarm grows about children and the health, psychological and economic cost of a system that is making obesity so prevalent, then a ‘tipping point’ of concern may be reached. At the 2005 British Labour party conference in Brighton, England, Ruth Kelly, the education secretary announced bans on foods high in fats, sugar and salts from school meals and vending machines. The move is just the most recent manifestation of rising concern in Britain about the health affects of the British diet, and in particular about the diet of younger people. This outcome has been widely seen as the consequence of efforts by the popular ‘TV Chef’ personality, Jamie Oliver who has campaigned to expose the dangerously imbalanced diet offered by many school dinners and tuck-shops. Perhaps this suggests a growing level of community awareness of, and disquiet for, aspects of the modern industrialized food production systems.

A major reason for emphasising the linkages between sustainability issues, such as manifest as degraded agricultural hinterlands, and individual health, such as obesity, is the ‘care factor’. It is difficult for urban dwellers to get signals that link their consumption to ecosystem processes. For many, consuming more is a good thing – although some surveys suggest we are not as wedded to high levels of consumption as might appear (Hamilton, C. 2003 and 2005). It is certainly the case that eventually urban dwellers will be reminded about their ecological embeddedness, but by then it may be too late.

A human ecological perspective suggests that degrading agricultural hinterlands and obesity are both symptoms of the same system. Both involve variables whose values are changing in response to common core system drivers. Both are ‘normal’ in the sense that they are characteristic responses the way that the system is currently structured. This suggests that steps to address one might address the other. City dwellers may understandably feel more concern for the health of their children than for the health of some distant farmland. However, their willingness to encourage action to address the former could be extended to address the latter, if the connections between the two are recognized. By addressing root problems in the attitudes held within the productivist worldview a more enduring solution is likely to be found than would be obtained by only addressing the proximate causes of obesity. A human ecological perspective suggests that these issues arise from common origins in the dominant worldview and that enduring resolutions to both need be taken at this deeper level.

² Wahlqvist and Specht make this connection between food variety, biodiversity and ‘resilience’ (Wahlqvist, M. and Specht, R. 1998).

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