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Food and nutrition security in the Australia-New Zealand region: impact of climate change

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Food and nutrition security in the Australia-New Zealand region: impact of climate change

Abstract

Climate change is likely to have an effect on global food production but to examine effects on food and nutrition security, an appreciation of the dimensions of food security is required. The 1996 World Food Summit defined food security as 'when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active healthy life'. Thus food security is largely multi-factorial and defined by context. Australia and New Zealand both have substantial agricultural profiles and there is a significant production in meat and livestock, dairy and grains from the region. Both countries are islands, surrounded by oceans with extensive fisheries, bearing in mind that the local ecology will reflect the type of fish that are available. Meeting dietary needs and food preferences in this context would mean taking into account the health profiles of the population and how these relate to the food that is available now and in the future. Layering in the effects of climate change means that the high prevalence of lifestyle related disease (obesity, heart disease, diabetes) and the vulnerability of at risk groups, particularly in remote communities in Australia, will require additional consideration.

Disciplines

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Food and nutrition security in the Australia-New Zealand region: impact of climate change

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ABSTRACT

Climate change is likely to have an effect on global food production but to examine effects on food and nutrition security, an appreciation of the dimensions of food security is required. The 1996 World Food Summit defined food security as ‘when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active healthy life’. Thus food security is largely multi-factorial and defined by context. Australia and New Zealand both have substantial agricultural profiles and there is a significant production in meat and livestock, dairy and grains from the region. Both countries are islands, surrounded by oceans with extensive fisheries, bearing in mind that the local ecology will reflect the type of fish that are available. Meeting dietary needs and food preferences in this context would mean taking into account the health profiles of the population and how these relate to the food that is available now and in the future. Layering in the effects of climate change means that the high prevalence of lifestyle related disease (obesity, heart disease, diabetes) and the vulnerability of at risk groups, particularly in remote communities in Australia, will require additional consideration.

INTRODUCTION

Climate change is predicted to have an effect on most of the world's population in the near future, with substantial implications for health and wellbeing [1]. The rise in the earth's temperature and anticipated increased frequency of extreme weather events such as cyclones, floods and bushfires [2] have implications for ecological stability which in turn will affect the production and distribution of food as well as the ability of populations to reside in certain areas. There are many definitions of food security but the World Food Summit of 1996 described it as the ongoing physical and economic access to food for all that is safe, sufficient and nutritious, meeting the dietary needs and food preferences for an active and healthy life [3]. Recently, however, it has been argued that there is a need to expand the framing of food security to include not just the nutrition and social aspects of food but also its environmental dimensions, see [4, 5]. Thus the concept of food security has a number of facets relating to human health, environmental sustainability, and social equity. The expression of these factors is likely to vary substantially across the globe. For countries like Australia and New Zealand, health conditions such as obesity, cardiovascular disease and type 2 diabetes, which are associated with diets of excess, juxtaposed with lack of food and of nutritional vulnerability among socially disadvantaged populations deserve special attention.

Australia has a population of around 21.2 million people and covers an area of over 7 million km². New Zealand has a population of about 4.2 million people and consists of two islands covering just over 270,000 km² [6]. As Western societies they have a high prevalence of lifestyle related disease such as obesity, diabetes and cardiovascular disease, and their indigenous communities are particularly at risk. Both countries have a substantial agricultural production and are relatively self sustaining in terms of food supply. The connection in food is also reflected in the transnational food standards authority Food Standards Australia New Zealand (FSANZ) [7]. This authority has the responsibility of developing and administering the food standards code outlining requirements for foods including food safety. The enforcement of the code however is the responsibility of agencies and departments within the various states and territories. This means that the two countries are unique in sharing common food standards, so that a food product available in one country will be identical to that available in the other country. This paper reviews the food production profile of the two countries and examines possible effects of climate change on food production in Australia and how this might have an impact on food and nutrition security.

FOOD PRODUCTION IN THE AUSTRALIA-NEW ZEALAND REGION: A SNAPSHOT

Agriculture is an important component of both the Australian and New Zealand economies though both are facing increased competition from the export market as well as the domestic markets. In New Zealand alone agriculture and horticulture account for over 50% of the export market. In Australia, agriculture is a significant employment opportunity with over 130 000 farms existing across the continent in 2005/06 [8]. With the expanse of land, also comes great variability in climatic, water and soil conditions though over 60% of the land does still remain dedicated to agriculture. The land is divided into sectors that farm primary products. High rainfall zones around the eastern and southern coastlines are the main areas for lamb or beef farming. This is also the main area for Australia's dairy industry. Slightly inland from this area, the wheat-sheep zone is where wheat cropping and grazing of sheep for wool occurs. The remaining inland areas are considered pastoral zones and largely used for grazing of beef cattle and sheep for mutton or lamb. Almost the same number of farms exists in the wheat-sheep zone as in the pastoral zone, despite the large differences in land areas [8]. Farming operations and harvesting areas are growing in size though overall this is only a small contributor (3%) to Australia's export market. Meat and dairy farming are seen to be the primary produce of New Zealand's agricultural sector though mainly in the lower ends of both the North and South islands [8].

The dairy sector is important to both countries [9]. Milk was the most frequently reported food item of the 1995 Australian National Nutrition Survey [10] and still the popularity of milk appears high [9]. Butter and yoghurt consumption have increased steadily since 2000 while cheese consumption has fluctuated. Despite increased production, Australia dairy farms are still faced with the increased pressures of climatic change and drought. Similarly, New Zealand has seen previously allocated pastoral land now used for dairy cattle resulting in an increased number of cows, and a decreased number but increased size of farms [8].

The grains sector includes wheat, barley, corn, oats, maize, sorghum and triticale and now also pulses, oilseeds and cereals [11]. Across Australia 67-81% of people in different age groups consume some form of cereal based product [10] and 1998/99 data indicates that on average Australians consume around 140kg of grains per annum [12]. Of the wheat that is not consumed by the domestic market, the remainder is used for export and world wheat consumption remains constant at around 619 million tones [13]. Other cereal-based products,

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as a group, are purchased more frequently and at a greater percentage of individual food budgets by lower income groups [12]. Good quality grain is rewarded in Australia to ensure growers are paid more accurately for the quality of grain that they produce [14].

Seafood is increasing as an animal protein source and global consumption of seafood is increasing annually [15]. Consumption of fishery products is seen to be primarily in a frozen form in developing countries while it is predominantly consumed fresh in developed countries. During the period 2003-2005, New Zealand produced double the amount of fishery products on average when compared with Australia, though of this, similar amounts were for non-food uses. Overall, despite the large differences in production figures, the supply per person appears similar at around 25 and 27kg/person annually for Australia and New Zealand respectively [15].

Further along the food supply chain, food distribution is managed by food companies including private label brands [16]. For example, in the New Zealand dairy food market there are three large cooperative companies and these have dominant market share– Fonterra (96%), Tatura (1%) and Westland (3%) [8]. These streamline the production, processing, distribution and marketing and protect smaller producers across the country [8]. In contrast to dairy foods, the grains supply chain is separated by manufacturers and distributors. In the domestic market, the states produce varying amounts, for example, the Victorian grains industry currently accounts for 15% of Australia's national grain production [17]. Of this, 50% represents wheat, and 30% barley and cereal [18]. Grain production in other states is still strong, especially in Western Australian and South Australia [19].

From a food trade perspective, Australia is ranked third, behind New Zealand for its dairy trade albeit only providing 2% of world milk production [8]. The majority of Australia's dairy production is used for the domestic market with the largest proportion of export products going to South-East Asia. The small domestic market of New Zealand sees 95% of its milk exported to overseas markets providing 33% of the world exports [8]. Australia produces 4% of the world's wheat output [8] and is the second largest wheat exporter in the world [9]. Barley remains a significant grain produced [8]. From a food production perspective then, climate change may well have an impact in the region. We now consider this from the Australian perspective.

EFFECTS OF CLIMATE CHANGE ON FOOD PRODUCTION IN AUSTRALIA

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The continent of Australia largely comprises desert, and the agricultural industry routinely deals with problems of drought and lack of water. A recent review on climate change for the Australian continent, however, found that crop yields may be affected in a number of ways [20]. The Garnaut report commissioned by the Australian government noted that climate change may reduce crop yields by a number of means that would affect food production in the country. The picture painted by this scenario was concerning. This included reduced growing seasons and increased grain sterility. Effects on the marine ecosystems due to rising seawater temperatures would see major shifts in migration and thereby changes in fish stocks and 'mortality events'. There would be shifts in rainfall patterns and this could disrupt the flows in rivers that may have been used for irrigation. There may be an acceleration of erosion and desertification resulting in reduced yields from crops and livestock. Once fertile coastal land would become unusable from rising sea levels and severe weather presenting itself with increasing intensity and frequency would severely disrupt agriculture. These aspects are consistent with more general perspectives on the impact of climate change on agriculture across the globe [21]. Nevertheless, a 2009 report from the Australian Bureau of Agricultural and Resource Economics (ABARE) noted there was no immediate threat to food security but there were challenges related to climate change, water, soil degradation, labour shortages and declining productivity [22].

For the Australian agricultural sector, the Garnaut report [20] noted that greenhouse gas emissions were greatest from beef cattle (58.1%), then sheep (22%) and dairy cattle (11.6%). Emissions from pigs and poultry were relatively low (1.8% and 1.0% respectively), and lower for that noted for grains (2.5%). Methane emission could be mitigated by increased productivity and nutritional management (for example by adding monensin to feeds and manipulating dietary fats) but these effects were yet to be realised on a major scale. This position concurred with that of others that technological strategies involving for example improved livestock farming efficiency and improved manure management, would not be sufficient, bearing in mind that global demand for animal source foods is growing but that reducing consumption must not compromise nutritional requirements [5].

Climate change may also affect the macro-nutrient composition of certain foods. For example, Bloom et al report that increasing atmospheric carbon dioxide levels could reduce crops' protein content by 20% as plants lose the ability to take up nitrate from agricultural soils. Indeed, the challenge of feeding the global population is seen to need a 'multi-faceted and linked global strategy' to ensure efficient and equitable food distribution in this changing

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environment [23]in [24]. This has implications for food production in the Australia-New Zealand region as anywhere else.

AUSTRALIAN POPULATION AND HEALTH TRENDS

The Australian government's Intergenerational report 2010, reports that the Australian population is projected to reach 35 million people by 2050 [25]. This projection represents an unprecedented rate and absolute increase in the national population and inevitably this will place significant challenges on the carrying capacity of the food system to achieve food security. Cardiovascular disease, cancer and respiratory diseases remain the highest cause of mortality in Australia though diabetes has more than doubled in the past two decades [26] and obesity continues to rise (54% in 2005) [27]. Although the death rates among young people has halved, three in every 10 young persons is either overweight or obese. One eighth of all deaths in the 25-64 year old age group are related to coronary heart disease while heart disease, stroke or cancer is the primary cause of mortality in those over 65. The Australian population has now been predicted to live to 78yrs for males and 86yrs for females, though unfortunately predictions for the indigenous population remain significantly lower [26, 28]. In some age groups, the difference in mortality rates can be up to nine times higher with a 16.7 year gap seen for males and 19.0 year gap for females from 1996-2000 [28]. Indigenous groups also have a higher incidence of chronic disease with one study showing approximately 40% suffering from diabetes at age 50 and above [29]. Obesity has increased most significantly in males aged 35-44yrs seeing an increase from 12 to 23% between 1995-2004/05. During this same period, females increased from 12 to 20% [27]. Like many countries around the globe, Australia has developed dietary guidelines to address lifestyle related disease and at the same time highlight the importance of consuming a variety of foods each day to achieve a diet adequate in all nutrients [30]. Dietary guidelines along with food guides provide a standard for assessing food security at the population level. In Australia's latest dietary guideline and food guide review environmental considerations have been addressed as a core theme [31]. (fig.1)

IMPACT OF CLIMATE CHANGE ON FOOD AND NUTRITION SECURITY

In a general review of health and climate change, [32] it was noted that agricultural food production contributes substantially to greenhouse gas emissions – a major cause of rising global temperatures. Arguing for the potential added benefits to the nutritional health of the

population, the authors of this review suggested technical improvements in agriculture plus a reduction in livestock production to contribute to the effort to reduce greenhouse gas emissions. A forthcoming paper using Australia as a case study describes the modelled effects of a theoretical reduction in ruminant red meat consumption on colorectal cancer incidence in Australian adults and on greenhouse gas emissions from on-farm activities in the livestock sector [33]. Under a scenario of 50g/person/day red meat consumption, [34] the estimated preventable proportion for colorectal cancer incidence among males was 10.7% (771 cases in 2005), while reducing annual emissions from livestock by 13.3 MtCO₂-e (approximately 22% of emissions). Debate has ensued in the regional scientific literature as to how best to address this issue, both in terms of measurement of environmental effects and the relative impact from dietary consumption patterns [35, 36]. Either way evidence is accumulating on the current and expected impacts of climate change on food system sustainability [37] [38] and the impacts of climate change on human health [39, 40]. The food system contributes to climate change and is increasingly affected by it [34]. The drought-prone and long-term drying conditions emerging in Australia and other sub-tropical regions around the world, higher temperatures, rising sea levels, increasing frequency of flooding, and acidification of oceans are now contributing to reduced quantity, quality and affordability of food in many countries [34, 41, 42].

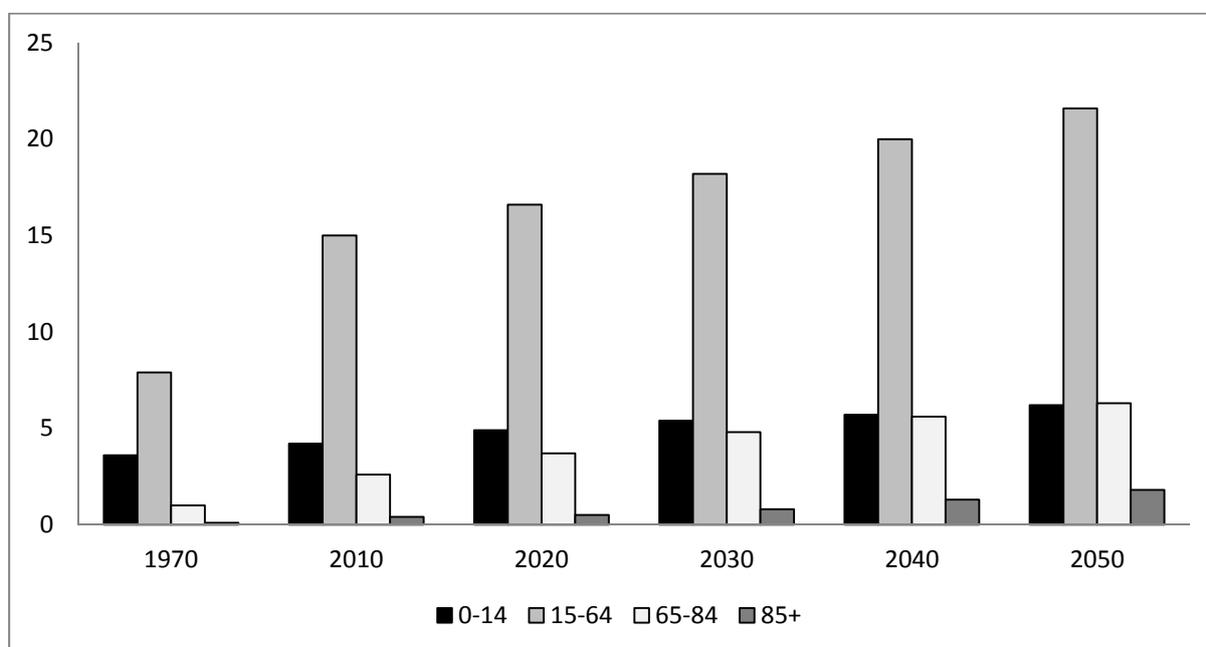


Figure 1: Australian historical and future population numbers (per millions of people)

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Climate change is likely to affect the common pillars of food security, notably availability, access and utilisation [43]. The immediate concern for effects of climate change may be on the ability to produce enough food for the population (availability), but for this reason a focus on the less apparent and perhaps more insidious effects on the latter two pillars warrant consideration. 'Access' can be considered in terms of physical, economic and social access to an adequate food supply, whereas 'utilisation' raises important considerations regarding the nutritional quality of the food and the ability of the population to benefit in terms of physical health. If climate change limits productivity, the subsequent effects on access and utilisation may be amplified.

Perhaps to better view this interdependency, a 'food in health security' (FIHS) platform was recently proposed for the Asia-Pacific region where both global and human health were considered in the context of environmental, community and household, cultural, care and behavioural inputs on the one hand, and infrastructural, economic, technical and biological inputs on the other [44]. Thus the concept of food security is complex and can be appreciated from a number of perspectives related to human health, not least of which is the impact of social and cultural effects. A consideration of these aspects are pertinent in the context of food security in the Australia- New Zealand region given the relatively lower risk to provide the required volume of food but with a high prevalence of lifestyle related disease and the need to meet the needs of at risk sub-groups in the population.

The 1995 National Nutrition Survey estimated the prevalence of food insecurity in Australia as 5.2% [10]. This was based on a single-item question: "In the last 12 months, were there times when you ran out of food and couldn't afford to buy more". It is likely that this single-item question was not able to capture the true prevalence of food security, and focussed on the affordability issue, without consideration to other aspects of food security, such as availability and utilisation.

The FIHS review acknowledged that there were a number of underlying social causes of food and health insecurity. The nature of the global and Australian food systems - from the underlying conditions of governance and trade, issues of agricultural production, food procurement and distribution, consumer price of food, excessive marketing of energy-dense, nutrient-poor foods and food waste – affects food security and health risk through matters of food availability, nutritional quality and affordability [45]. Like most other risk factors for chronic diseases in Australia, food insecurity is more prevalent among socially disadvantaged

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groups. Having enough money to buy food; being able to travel to retail outlets selling the range of commodities desired in contemporary societies; having food storage and cooking facilities; enjoying a choice of cuisines and food practices appropriate to one's cultural identity, and having the personal skills and knowledge to prepare nutritionally balanced meals, influence the social distribution of food and nutrition security and thereby chronic disease risk. [46-48].

It is noted that cognitive factors including a sense of personal control over food intakes, and their lives in general are associated with food security. This may relate to a person's social access to food which may have substantial health implications. The following examples of our own research indicate how social access is an important parameter in food security for three groups with higher health risks: the overweight population, indigenous Australians in remote communities and older Australians.

Overweight urban populations: In our own clinical trials research we have found that making dietary changes to improve health (food utility) has been subject to barriers that relate to family and social circumstances. In a recent study we interviewed 117 trial participants in a healthy lifestyle intervention and found improving wellness and wellbeing to achieve a better quality of life was the driving force to engage in health behavioural change for weight loss [49]. A combination of psychosocial factors identified inter-related themes of lack of available time and responsibilities to family/significant others and work demands as heavily influencing the individuals' perception about their capacity to achieve change in food choice for health, wellness and wellbeing. Many participants identified aspects of accountability linked to the obligation to ensure the success of the study (social responsibility), improved physical appearance (social acceptability), and beliefs about direct and longer term impact of these behaviours on health and wellbeing (capacity building) as motivating factors in prioritising personal healthy food choice. Thus to enable individuals to improve food patterns strategies within this complex personal environment there is a need to articulate the benefits of better food choice in the context of these broader influences and beliefs [50].

Fundamentally to stimulate individuals to be more globally aware of the impact of the eating behaviour there is a need to develop strategies that move beyond addressing individuals primary needs for physiological and social requirements as articulated by Maslow's well known basic hierarchy of needs. That is, to achieve their higher order aspirations for optimal health and wellbeing we need to assist them in identifying the broader implications of poor food choices in the social context for both personal and community health and attainment.

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Indigenous populations in remote communities: Indigenous Australians living in remote communities experience high levels of chronic illness part of which is the result of poor diet reflected in a high prevalence of obesity and type 2 diabetes [29]. Remote stores are typically the only source of food. In our study we examined trends in purchasing patterns of sugar sweetened water based beverages in a remote Aboriginal community store. A review of the objectives and strategies of a community nutrition store policy and purchasing trends analysis showed the withdrawal of the three highest selling sugar sweetened water based beverages did not affect the total volume of all beverages sold. However, we did find a shift in purchasing trends towards beverages with lower or zero sugar content. In contrast to the effects of families on individual social food access, this research showed that the effect of community support in creating better social access to healthy food for the population. [51]

Older people: In a cohort of older Australians (n=2937), aged 50 years and over, living in the Blue Mountains, West of Sydney, we found 12.7% people reported some level of food insecurity [52]. Preliminary analyses have indicated that this level of food insecurity also had an impact on diet quality, in particular women who reported food insecurity consumed smaller quantities of fruit ($p<0.05$). In the same cohort we have observed several changes over ten years of tracking their dietary intakes, with people tending to consume greater quantities of packaged foods with a longer shelf-life, such as canned fruit and canned fish [53]. We are currently conducting further research into these factors and we are interested to investigate whether such dietary changes reflect difficulties with shopping regularly, which may be affecting food security via access, and / or may be related to other health issues, such as decline in dental health or walking ability.

Thus, while climate change itself remains a major concern, as these vignettes show, there remains a need to remain cognisant of how social factors influence food and nutrition security, and the very real possibility that the impact of these factors may be greater under conditions of an environmentally stressed food supply.

CONCLUSIONS

There are many dimensions to food and nutrition security but climate change is likely to have an impact across the board. In the case of the Australia-New Zealand region this may well be reflected in food production systems but food and nutrition security relate to much more than food production. In 2009 the Public Health Association of Australia (PHAA) launched an

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advocacy report [54] calling for an overhaul of government food policy in Australia in order to address more effectively the issues of prevention of chronic disease, social inequality and climate change. This report argued that there were problems with the nutritional quality of the food supply, families at risk of food insecurity and an inadequate understanding in the community of the effect of food choice on the environment. To address these problems, an integrated national food policy with a whole of government framework was called for.

For a country as vast as Australia, one could argue that a number of different perspectives can emerge when balancing concepts of the health of the planet with that of the health of the human population. These relate to the management of waste, regional changes in the production and manufacturing mix, distribution and storage systems, the import/export mix and changing food consumption profiles. Already we have seen the development of a National Climate Change Adaptation Research Network (ARN) for Human Health that builds on the National Adaptation Research Plan (NARP) [40]. It may also be worthwhile to review the recently released US National Institute of Health white paper. This reports on a comprehensive analysis of health consequences, including those that are nutrition-related, that are occurring or will occur as a result of climate change, with a view to recommending a research agenda to identify who will be most vulnerable, and what efforts will be most beneficial [55]. We will need data on food production, intake and health outcomes as well as knowledge of the resilience of food system components. Activities such as scenario mapping activities may be helpful in anticipating unknown consequences.

It is recognised that climate change will place increasing stresses on the capacity of the food system to provide a secure food supply for the Australian and New Zealand populations throughout the 21st century. Assessment of climate change impacts on the amount, diversity and quality of food available into the future is a complex activity. Data will be required to inform decision-making and modelling projections will be necessarily based on many assumptions and database constraints. Nutritionally at risk groups are likely to remain particularly vulnerable, bearing in mind that, in the context of obesity and lifestyle related disease, not all food consumption necessarily promotes health. The extent of impacts and risk of food insecurity will depend largely on mitigation efforts and the implementation of adaptation response shifts in current practices that are possible at both micro and macro level. As relatively wealthy countries, Australia and New Zealand have the luxury of being able to manage a degree of food insecurity by importing additional food from other countries. However, significant issues emerge in an interconnected global food marketplace. There is an

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urgent need for a greater investment in research in Australia and New Zealand to assess climate change and population projections, the implications for food production and for health outcomes, and the relationships among these variables.

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