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11. FOOD LANDSCAPES: A LANDSCAPE MODEL FOR INTENSIVE FARMING

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ABSTRACT

With rising meat consumption worldwide, particularly in developing countries, there is a need to explore new approaches in designing farms to assist with affordable meat production within a framework of improved environmental sustainability.

New Zealand (NZ) has a strong agricultural history. As world leaders in research and development, agriculture shaped our nation structurally and socially and will continue to do so into the future. To facilitate the continued supply of affordable meat, exploration of initiatives in design to support sustainable agriculture is required.

This paper presents a research project that has used landscape design methodology to anlayse and quantify existing intensive farming models for chicken meat production (broiler shed farms) and explores potential design interventions that can contribute to improved quadruple bottom line outcomes in intensive farming practice in NZ. System approaches such as industrial ecology, cradle to cradle, permaculture and zero energy buildings informed a design model that reduces the intensive farming footprint while improving the interconnections between the multiple inputs and outputs required for such farming practices, within the site and broader environment.

Comparison of quantitative data on aspects such as water, energy, biodiversity and waste between the existing intensive farm model and the proposed sustainable design model has shown that the inclusion of landscape architectural design methodology informing intensive farm development can improve sustainability in an economically viable way and contribute to a more appropriate approach to food production and land use.

INTRODUCTION

Intensive farming is a controversial topic worldwide. These farming types continue to expand throughout the world and in NZ as the demand for affordable meat continues to grow. The expansion of this farming method is due to their effectiveness in producing affordable meat. Affordability being a key driver for providing protein through meat to less affluent members of society. Although these farms are effective in producing affordable meat, they are highly debated as environmental and animal welfare issues accompany them. Technology within this industry is improving and changing, however, if these farms are not constructed, designed or maintained appropriately they can have detrimental impacts on the environment, affecting the health of the communities surrounding them.

NZ has a strong dependency on the agriculture sector economically, and our presence within the world of intensive farming is also prominent. In 2011 NZ produced 90 million chickens (Statistics NZ, 2010) and in 2007 we produced 760,000 pigs (Statistics NZ, 2010), this intensity of production highlights the need for such systems to achieve a more sustainable approach in order to facilitate continued supply of food within a more environmentally responsible landuse framework.

There are currently a number of disadvantages associated with intensive farming but their one very strong point is their confined use of land area. Unlike traditional sheep and cattle farming throughout New Zealand that requires large land footprints. However the full potential of intensive farms are not being realised. This paper illustrates that by utilising ecological services (eco- services) negative impacts of intensive farms can be eliminated and/or reduced and that they can contribute in a positive way to the environment and society.

According to a number of statistical surveys, world poultry has expanded 11 million tons to 63 million from 1965 to 1999 (Sheikh, 2012). In addition to this, ***the growth of super markets, alongside fast food retail outlets has also generated a major impact on poultry sales worldwide*** (Sheikh, 2012). The FAO (Food and Agriculture Organisation of United Nations) has also stated poultry is the second most consumed meat in the world, with 33% of meat consumption being chicken (FAO, 2013).

Throughout this research animal welfare had a strong influence. Landscape design methodology (in particular eco-services) and systems approaches have the ability to improve the environment not only outside the sheds but also within the sheds, thereby improving animal conditions within the buildings. Potential to improve efficiency of the farms themselves through design interventions that assist in reducing energy costs was also explored. With the incorporation of eco-services within this project, multiple benefits for farmers/owners, animals, end purchasers of the product and the environment were achieved. Food supply, animal welfare, environment and human health are intricately inter-linked through factory farming and the outcomes of this research show that landscape architects can contribute to addressing the current concerns linked to agricultural landscapes.

AIM

The aim for this research project was to develop a design model that improves the overall sustainability of broiler shed farms throughout New Zealand using existing broiler shed sites. The model encapsulates the cradle to cradle, industrial ecology, permaculture and ZEB's (Zero Energy Building) principles and decreases the demands intensive farming has on nonrenewable resources and results in a farm that produces very little waste. The model facilitates the continuation of affordable meat production, improved profitably for the farmers, and amelioration of the environmental conditions in and surrounding the farms while positively affecting the health of animals within the broiler sheds.

Irrespective of whether it is through organic or non-organic approaches, the food demands of the world require more intensive approaches to farming and this does not necessarily equate to non-sustainable approaches. Intensive farming will be required to feed the world and the real question to be answered is how can we make intensive farming a positive and sustainable contributor to the supply of food?

This research was driven by the question:

How can landscape design improve the overall sustainability of intensive farming in New Zealand, highlighting the contribution landscape architecture can make to agro-economics?

METHODOLOGY

This research project comprised three stages: research and analysis, design model development and then testing.

Research and analysis of the quadruple bottom line issues, systems approaches, case studies and existing broiler farming methods was undertaken to develop criteria for a design model of intensive broiler farms.

The development of the design model was undertaken using an existing site in Christchurch. The model was developed utilising landscape architectural design methodologies to create an intensive farm that achieves the goal of improving quadruple bottom line issues (environment, economics, animal welfare and social). This was then calculated, quantified and compared with the running costs of the sheds that already exist on the site. This determined that improvements could be made to the existing costs and ecology in and surrounding the site.

The design model was then tested on another site in South Head, Auckland to demonstrate how it can successfully be adapted to different site conditions/parameters while still achieving the desired improved quadruple bottom line outcomes.

NZ has a strong agricultural history that has shaped our nation structurally and socially helping form NZ into the nation that it is today (Cross, 1990). According to the Selwyn District Council about 90% of NZ insects, 80% of trees, ferns and flowering plants, 25% of bird species, all 60 reptile species, four remaining frogs and two species of bat, are found nowhere else on earth. This is remarkable internationally; Britain in contrast has only two endemic species, one plant and one animal. Although NZ is dependent on our agriculture sector, NZ has also become highly reliant on our tourism and filming industries for our pristine, unique, natural environment. If our farming methods continue to negatively impact our environment these economic sectors will be adversely affected. Farming needs to start ***"Working with intensification to identify environmental and social gains at the same time as capturing economic efficiencies as this is more likely to support biodiversity than simply attempting to stem or reverse intensification"*** (Moller et al, 2008).

RESULTS

Investigation into the background of farming and animal welfare identified four intricately linked aspects for improvement, these were the environment, economics, animal welfare and social (the Quadruple Bottom Line issues). Case studies including: the Ford Factory, Dearborne, Michigan, USA; Nick's Head Station, Poverty Bay, New Zealand; Zero Energy House, Pt Chev, Auckland, New Zealand; Kulundborg, Copenhagen, Denmark; Greening Waipara, Canterbury, New

Zealand; Pig City, Netherlands and Ashof Hen Unit, Rothenfluf, Switzerland along with analysis of quadruple bottom line issues, allowed development of a research analysis table of the positive and negative issues linked to existing broiler shed farm sites (fig.1).

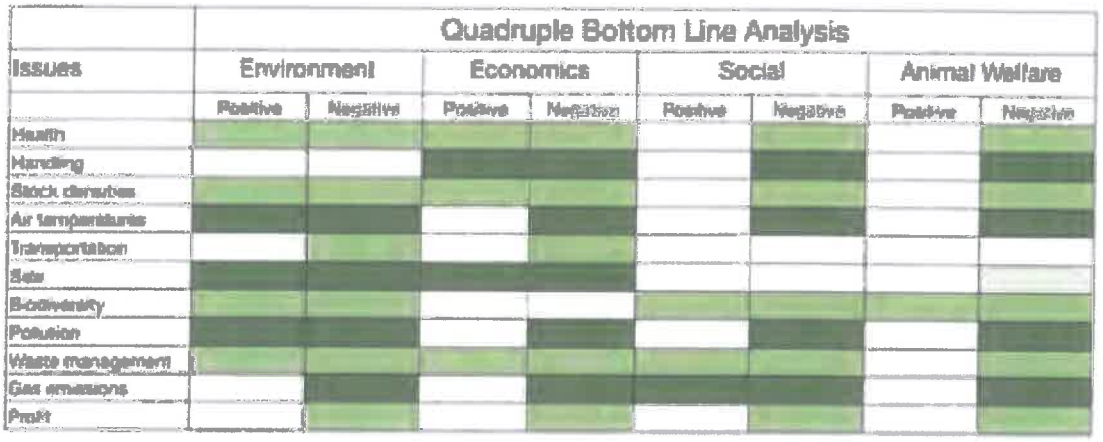

Fig. 1

This table provided an in-depth analysis of how quadruple bottom line issues impact on the main issues of intensive farming, those being health, handling, stock densities, air temperature, transportation, size, biodiversity, pollution, waste management, gas emissions and profit. The table allowed the analysis and comparison of these issues and established a comparative benchmark for testing the outcomes of the design model in shifting negatives to positive. The coloured boxes indicate whether the issue has a positive of negative impact on the quadruple bottom line issue.

Further development of this table identified landscape design interventions that could inform the design model to mitigate most, if not all negative aspects of intensive farming. They included livings roofs, swales/rain gardens/wetlands, vegetation, amenity, structural layout, micro-climates and eco-services. These landscape design interventions were then used as a tool to explore ways to address these negative aspects of intensive farming through the model case studies (fig.2).

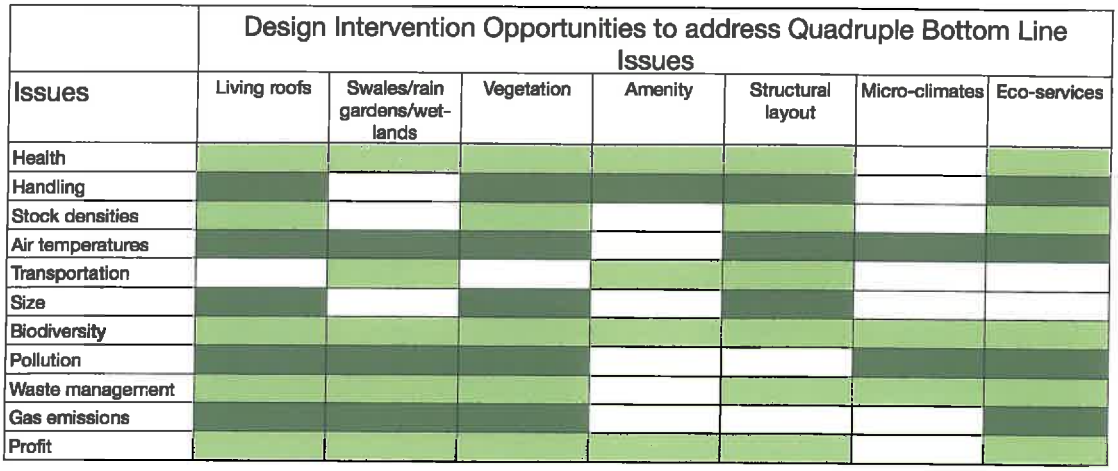

Fig.2

As a result of the September 2010 earthquakes, broiler shed farms in Christchurch were damaged and are currently being redesigned and reconstructed. This provided a key opportunity to explore particular sites and a site in the Waimakariri District was selected as a case study to test a design model. GIS analysis of the site and surrounding areas was carried out and highlighted the current conditions. There was a lack of vegetation, vast areas of agricultural farming land and the site contained friable soil conditions. GIS mapping highlighted the ecological context surrounding the site and confirmed the design model could and should contribute to ecological connections to the region.

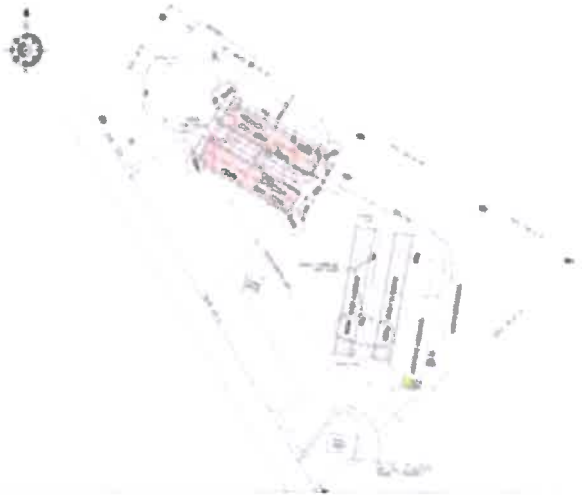

Fig.3

The main issue with existing standard broiler shed farm design is the disorganized and sporadic layout as seen in fig. 3. The sheds are also highly visible within the environment and they consume a majority of the site, making them the dominant feature.

A majority of these sites not only produce chickens they also have livestock like sheep, cows, horses, pigs and goats in a small-holding style. As such, permaculture systems approach was seen as a beneficial option as it could build on the desire of landowners to become self-sufficient and the land holding as a whole to become more environmentally sustainable.

Other influences in the design model included the catchment of natural energies like sunlight and warm winds to heat buildings in winter and deflection of hot summer sun and winds. Site analysis was carried out to determine the location of the sheds to maximize natural energy catchment whilst allowing the continued use of the site as a lifestyle block. It allowed the site to be divided into zones that addressed the quadruple bottom line issues of intensive farming by acknowledging the economic, social, environmental and cultural aspects of the site.

Fig. 4 illustrates the completed design model that:

- Utilizes rain gardens between the sheds to collect and filter water from the washout of the sheds.
- Combines living roofs and solar panels to maximize catchment of the sun's energy for power.The solar power system will be connected to the grid so the farm can export excess electricity to the national grid and be credited for the same rate they pay for power. Through calculations it was determined this farm would require 110 solar panels in order to create a zero energy farm.
- Collects water from the living roofs to irrigate plants in the warmer months.

Fig.4

- The friable soils allowed for permeable asphalt. It is located at the ends of sheds to provide access for heavy vehicles when removing or delivering wood chips and birds. The remainder of the drives are to be constructed with compacted lose metal.
- Utilises skylights within living roofs to provide natural lighting for the chickens.
- Employs deciduous planting to protect the broiler sheds, orchards, the house and livestock from the hot summer sun and winds whilst letting the warm winds and sun through in winter.
- Places intensive horticulture, livestock and orchards within close proximity of both dwellings.
- Provides easy access for larger vehicles throughout the site and an alternative entrance for the trucks to reduce interruptions for the residents.
- Removes the nonrenewable LPG heating for renewable biomass heating facilities. It was essential to change the current heating systems to biomass heating as it utilizes woodchips, a renewable organic matter that also doubles as waste from another industry (timber).
- Vegetation increases the amenity value of the site whilst improving the biodiversity within the site and region.
- Changes the currently common green coloured walls to white mimicking the polar icecaps and the way they reflect sunlight back into space

Visualisation shows the improved aesthetics possible for these intensive farms and the positive impacts it would therefore have on the quadruple bottom line issues – in particular the social and environmental issues.

Fig. 5

A visualization (fig.5) showing the improved aesthetics possible for intensive farms.

Shade analysis was undertaken to determine the height of the deciduous trees in order to protect the sheds on the northern boundary. This height was calculated at a maximum of 10m. The trees need to maintain this height, if they exceed this they will impact on the catchment of solar energy from solar panels. As New Zealand's native deciduous trees don't suit these requirements and the site conditions, exotic deciduous species were selected based on the following guidelines.

- Prevent monocultural farm landscapes by selecting deciduous plant species that are not commonly used in the Canterbury Plains farming regions.
- If other intensive farms in this region were to utilize this same model, it is important that plant species are not repeated on mass as the aim of this design is to create heterogeneous landscapes that increase biodiversity.

The objective of this design model was to improve ecological connections and biodiversity throughout farming regions. Because of this the following criteria was created to select plant species for the remainder of the site:

- Toleration of site conditions (including rain gardens, swales, living roofs and wetlands).

- Introduce invertebrates and insects onto the site.
- Select plants from the ecological district of the site to improve landscape ecology.
- Provide habitats.
- Enhance aesthetics and amenity.

By following these criteria the design model contributed almost half of the site (3 hectares) in native vegetation to the region. If this design model were to be applied to other intensive farms throughout the area surrounding the site it would contribute 31 hectares of native vegetation to a region that is currently predominantly un-vegetated farmland.

This exposed one of the potentials of intensive farms. It condenses land area use allowing more land to be returned to nature, thus contributing to biodiversity improvements.

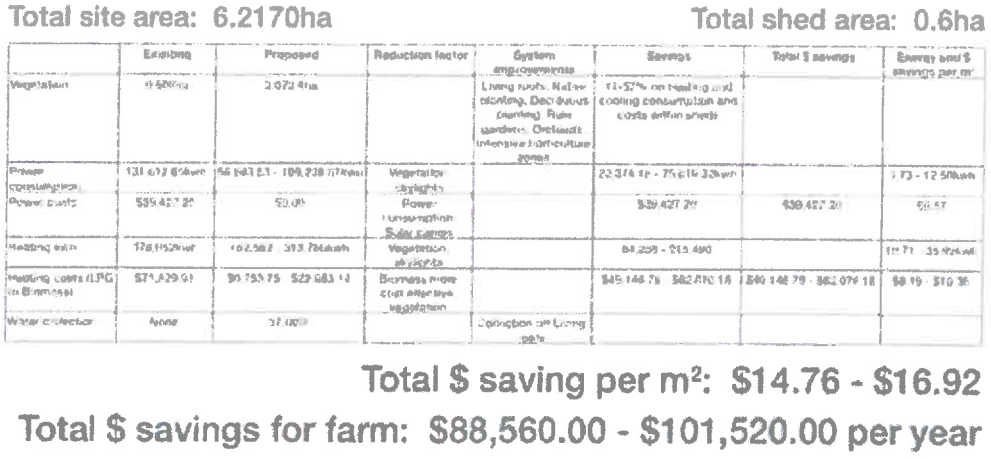

Fig.6

Running cost information was supplied from a current broiler shed farm in Christchurch. Currently on average throughout New Zealand it takes 22.23kwh or $6.57 per m² per year to power; and 63.83kwh or $11.97 per m² per year to heat using LPG. Figure 6 reveals the design model has the potential to save this farm considerable costs.

Comparison of metabolisms (fig.7) on existing broiler-shed sites and the design model was undertaken. This highlighted the lineal metabolism, of existing farms when compared with the design model's metabolism that reduces the inputs and outputs and metabolism footprint of the farm site. The design model achieved a major shift to inputs and outputs being retained within the site and shed zones, thus creating a system that works within the site rather than relying on significant external influences.

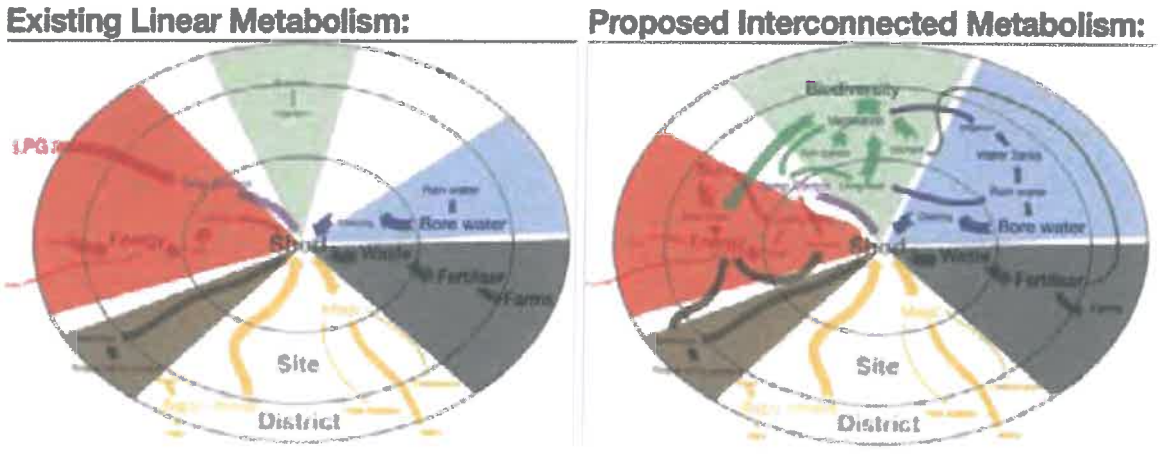

Fig.7

The design model established a set of guiding principles which were then developed for intensive broiler shed farms.

- Change existing district plans and RMA objectives for farming by creating practical and achievable guidelines for the improvement of intensive farms.

- Minimize the impact of existing intensive farming.
- In-depth site analysis to capture natural energies.
- Improve shed environment for the chickens by optimizing and improving the environment outside the sheds.
- Increasing vegetation on these small footprint farms to improve ecological connections.
- Decrease the demands intensive farming has on power and nonrenewable resources by utilizing eco-services and renewable energies.
- Improve site interconnections and shift to maximize on site systems.
- A design model that can be implemented within a realistic budget that continues to yield profits for property owners.
- Maintain and enhance the typical land use of properties, a lifestyle block or smallholding.
- Provide a rich soft-engineered landscape that is attractive to the public and local community whilst increasing land value for the property owners.
- Achievable design interventions using current best practice and accessible technology.
- Continue the supply of affordable meat to the world by minimizing the costs of running intensive farms through use of renewable resources and eco-services.

To test the applicability of these principles the design of another site in South Head, Auckland was undertaken with significantly different environmental influences and site conditions.

GIS mapping proved it was better ecologically connected, hydrology is dominant feature with a femoral stream and swampland surrounding the northern end of the site boundary, and the soils are less permeable than Waimakariri. The same design interventions were then applied to this broiler shed farm, however there were other landscape characteristics that needed to be addressed like topography and water.

Analysis of this site defined the northern end of the site as being suitable for the location of the sheds as the gradient was less and the catchment of natural energies was higher. Another issue for this site was the proposed six sheds, although this scenario is more economical for the site it impacted highly on the other 3 quadruple bottom line issues, so it was more appropriate to limit the site to 4 sheds.

As seen in fig 7 the design on the South Head broiler site achieves the same outcomes as the Waimakariri site with a few differences because of the site conditions. They included utilization of lower regions for wetlands and three collection ponds to cleanse water before entering the femoral stream and swampland; retiring steep slopes into native vegetation; location of concrete pads at the ends of sheds as permeable asphalt is not suited to this region; livestock areas located in the remaining leveled areas of the site; limiting the access to one route because of site constraints; changing existing contours to maximize catchment or renewable energies; selections of deciduous plants on the north and northwest boundaries that tolerate wet feet.

The same calculations were applied to this site and determined that if this design model was applied to this site it could potentially save the owners $127,238.40 per year. Although the site constraints of this region were very different to the site in Waimakariri, it was discovered that the design model could be implemented within other locations in New Zealand. Each design model needs to be retrofitted to the region in which the site is located. Irrespective of location, the principles and their implementation still have the potential to improve the quadruple bottom line issues associated with intensive broiler shed farming.

CONCLUSION

New Zealand has a high dependence on Agriculture for employment and exports and landscape architects have had minimal or no input into the design of intensive farms.

In depth discussions with poultry industry members confirmed that they too realise the impacts their unsustainable meat production is having on the environment; and the importance of continued supply of affordable meat to the growing world population.

There are complex issues surrounding intensive farms with animal welfare being one of the main issues. This highlights the importance of implementing landscape design interventions in a systematic manner to achieve a design model that improves quadruple bottom line issues.

Improvements in the design model could achieve interconnections and profitability of the intensive farming sites at the same time successfully mitigating the on-site issues of intensive broiler shed farming, could also produce positive impacts on the surrounding communities and biodiversity.

Intensive farming is a complex web of functions and services that contribute to the final meat product. Within the poultry meat industry there are breeder sheds, hatcheries, broiler sheds, processing plants and the food supply for all poultry. This design model is a model that deals with individual sites and has the potential to be implemented within other sectors of poultry farming or even other intensive farming sectors (i.e. pig farming). By implementing this model throughout all sites that are involved within the intensive farming process, landscape architects could contribute to the improved sustainability of these farms. This could lead to a better public perception of the contribution that intensive farming can make to sustainable agricultural approaches.

Currently the government is initiating the National Science Challenge. This is a movement that seeks to utilise sciences to intensifying agriculture to earn more money off the land. Although sciences play an important role in agriculture, by employing aholistic landscape systems approach into intensive farming we could achieve even more beneficial improvements to the quadruple bottom line issues of intensive farming.

Helen Clark recently attended the Rio + 20 conference and foresees a future for New Zealand in sustainable environmental management. It is our history and expertise in land based production that could lead the world into sustainable food production. She believes ***"you can't deal with the environment if the people are poor and the world is inequitable...you have to deal with these things together"*** (McNicholas, 2012).

The development of this design model values the farmers and industry's perspective and ensures continuation of economically viable farms. It creates employment opportunities, improves quadruple bottom line issues whilst assuring the continued supply of affordable meat to the world.

Intensive farming is not the only solution to the world food crisis, but it is here to stay for the foreseeable future. This model highlights that through incorporation of design methodology improvements to the sustainability of intensive farms in New Zealand can be achieved.

New Zealanders alone consume over 70 million chickens every year, so improved approaches to the production

of this meat resource is required. As landscape architects we can play a much larger role in working with design of agricultural landscapes to achieve positive contributions to sustainability and improved production outcomes. This is a design model for Food Landscapes: it encapsulates a smart, profitable design model for improved sustainability in intensive farming.

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12. REARTICULATING THE VERNACULAR PATTERNS OF A COASTAL LANDSCAPE

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ABSTRACT

This research proposes a response to the ingrained ideas of landscape architecture in coastal environments of privileging the unmodified environment and focusing on ecological concerns. This response is developed through the study of vernacular environments in coastal locations and seeks to incorporate these patterns within spatial design.

A coastal definition is sought specifically in relation to the Kaikoura coastline which has qualities that set it apart from the rest of New Zealand. It could be suggested that there is a vernacular pattern to Kaikoura or the New Zealand coast in general; this research argues that the vernacular environment is more specific than this. It is proposed that within Kaikoura, the individual bays and settlements have conditions that distinguish them. The importance of context is affirmed through fieldwork study that unveils these specific vernacular qualities. Rearticulating the built traditions found in these coastal environments suggests ways in which innovation can strengthen and reassert this relationship, between vernacular landscape and designed landscape.

Three coastal environments are the focus of the fieldwork. Despite sharing a common regional context, the influences of the coast affects these sites in specific ways and therefore they display unique landscape qualities.

This research explores how these observed vernacular patterns may be tested in a design project. Design could be used to determine whether these environments are as unique as this proposal suggests. Testing through design will measure how effective these vernacular references may be, and aim to answer whether such design can produce landscape architecture that has a legible relationship with the vernacular environment.

BACKGROUND

Coastal environments are highly valued in New Zealand. The coast was the first part of New Zealand to be charted, and the first part to be settled. Today it plays a large part in the New Zealand way of life, both in terms of livelihood and identity.

The coastal environment itself is complex, it is the result of an accumulation of influences, both natural and cultural. Within the field of landscape architecture there is a tendency to prioritise the natural values of coastal environments. Ecology is a similarly key motivator in landscape architecture. This natural and ecological focus values unspoilt coastal