Kōura: a novel diversified product for a changing primary sector

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Abstract

Primary sector industries in New Zealand are under increasing pressure from community to produce products with lower environmental impacts, to both air and water. Contrasting these pressures is a growing world-wide demand for protein, which historically required increased intensification and associated negative environmental impacts. One area promoted for environmental mitigation is the fencing of riparian zones along waterways. The practicalities of this can create operational issues and large areas of land can essentially become non-productive for livestock and timber production. Novel solutions could provide commercial benefit from within these riparian zones. Ernslaw One Ltd. have created approximately 20 hectares of ponds along riparian edges in their Otago and Southland forests. These ponds are used to farm freshwater crayfish or kōura (*Paranephrops zealandicus)* in areas that would otherwise be unproductive as production forest can no longer be grown there for environmental reasons. Customers are increasingly looking for niche foods with unique provenance such as kōura. Currently the kōura industry is in its infancy but there are many groups with licence applications underway. Utilisation of these landscape units add scale and speed towards development of a viable industry with domestic and export potential. High-value novel products such as kōura demonstrate that revenue can be obtained with little environmental impact.

Keywords: kōura; aquaculture; diversification; sustainable; freshwater

Introduction

There is a growing world-wide demand for animal-based protein which will require further intensification and place greater pressure on the environment (Henchion et al. 2017). This is true in New Zealand with the increase in intensive agriculture having negative effects on water quality and quantity, despite innovation into better farming practices and technology (Gluckman 2017). The New Zealand Government's National Policy Statement on water (NPS) stated that by 2025 regional government must have in place a series of rules and standards which protect environmental values for water. The rapid intensification that agriculture has experienced has created, in some regions, waterways that are unlikely to meet potential future water-quality standards. This places agriculture in a difficult position, as increasingly tighter restrictions on environment impacts (MFE 2005) will make it challenging to meet the growing demand for protein.

Furthermore, consumers have traditionally purchased foods based on taste, price, and convenience, but this has changed to now include aspects such as nutrition, naturalness, and sustainability (MFE 2001; Deloitte 2016; Department of Agriculture and Water Resources 2019; MPI 2019a). The overarching theme of this purchasing behaviour is transparency, with consumers wanting to understand the origins and impacts of their food and to have certainty that the food they are eating can be trusted (MPI 2019a). This is important to New Zealand primary producers, who will be able to achieve product premiums if they are able to provide a product with the story that consumers want (MPI 2019a). For agriculture in New Zealand "business as usual" is unlikely to continue and the primary sector needs to quickly come up with solutions to mitigate negative impacts on waterways. Mitigation options such as riparian planting and fencing have been promoted (Collier 1995; Collins 2011; Maseyk et al. 2017) and while environmental benefits are likely to accrue for all of New Zealand, these will come at a direct economic cost to the landowner (Daigneult et al. 2017). The challenge to agriculturists is how economic value can be gained from waterways or other areas within their property retired or rehabilitated for environmental purposes, especially as the vegetation that develops in riparian zones can present new management challenges (e.g., become habitat for pest species such as broom (*Cytisus scoparius*) and gorse (*Ulex europaeus*)).

Riparian setbacks of 5 m or greater are required for the forestry industry (MPI 2019b). Ernslaw One Ltd. is using these setbacks to create ponds for the farming of an indigenous freshwater crayfish known as kōura (*Paranephrops zealandicus*) – a species endemic to New Zealand. Ernslaw One Ltd. markets their farmed kōura under the trade name KEEWAI.

Kōura Aquaculture in New Zealand

While aquaculture in New Zealand has a large profile, freshwater aquaculture is not often thought of in the New Zealand setting despite being undertaken in many other countries. This may be partly due to a lack of research funding into freshwater aquaculture in New Zealand (Hammond 2006; Lovett 2014; Hollows 2016). By comparison, Australia has invested heavily into freshwater aquaculture research with significant gains being made with crayfish species such as Redclaw and Marron (Jones 2000; Jones & Valverde 2020; Lawrence 2007; Rigg et al. 2020).

New Zealand kōura farming is in its infancy with around one tonne produced by two South Island farmers annually. Ernslaw One Ltd. is currently the largest farmer with around nine hectares of ponds in production and

another 11 hectares awaiting stocking. Kōura, as grown under the KEEWAI model, receive no artificial feeding or chemical use and provide a healthy natural product in a relatively low-input system, which is rare in aquaculture systems. It produces a product sought after by the market with minimal environmental impact. Additionally, it can have conservation and ecological benefits by restoring or creating wetland habitat of a type significantly reduced since European arrival in New Zealand (Robertson et al. 2019). The Ernslaw experience is that the combination of grass species and kōura ponds provide an effective catch mechanism for sediment and associated phosphate. Kōura are like "a canary at the bottom of the mine shaft" and if they are present in your ponds or streams, then typically you are having low environmental impacts on waterways.

At least three other companies have plans for around 100 hectares of ponds on non-forestry land in the North Island. This new development will provide the scale required to allow the kōura industry to achieve the critical mass required to enable development of overseas export market opportunities. Currently there are limited numbers of juveniles available to seed new ventures and an inability to shift stock for new farms between the North and South island. However, these constraints could be alleviated by the development of hatchery technology, where large numbers of juveniles are produced annually to seed new farms. Hatchery technology is being developed in countries such as Australia with reports of significant gains in juvenile production (Jones & Valverde 2020; Rigg et al. 2020).

Habitat Requirements

Kōura farming can be integrated into most primary sector landscapes - in particular, riparian zones along waterways. The key ingredients are water with a lack of ecotoxic chemicals, particularly insecticides and herbicides, and a riparian buffer which traps and reduces sediment. Kōura can be farmed in static ponds (ones with no flowing water in or out) and, having no-consumptive water use, are an option in areas where water availability is limited or seasonally restricted. Permanently damp (i.e., boggy) areas can easily be developed or rehabilitated into open-water wetlands where kōura can be grown.

Minimum pond size of around 100 m^2, approximately 1.2 m deep, and ideally rectangular in shape is recommended (Hollows 2016). A series of small ponds this size along a waterway or gully can be easily managed and treated as one production area (Fig. 1). Larger reservoirs such as livestock water dams, irrigation dams and duck ponds are places where kōura can be successfully farmed under most conditions. Smaller ponds (~60 m^2) which rely on water from seeps or rain can successfully produce kōura in dry areas with annual precipitation as low as 500 mm. Kōura are typically associated with the bank areas of ponds and streams where these solid edges provide refuge for them to lodge, hide and shelter in. A pond with a large refuge to total surface area will generally offer the highest levels of production. The area of refuge can easily be increased by the addition of coarse rocks, woody vegetation or other artificial refugia placed away from the banks.

Figure 1 Ponds created in stream riparian area where trees are unable to be grown for environmental reasons.

Food Sources

Kōura feed at all trophic levels and can maintain or improve water quality by consuming material such as algae, bacteria, fungi, water plants or any other organic material that may degrade water quality as it decomposes (Hollows 1998). Plants such as *Carex* grasses and watercress (*Nasturtium* species) in the riparian areas provide habitat as well as a food source since kōura will eat the plants and smaller invertebrates that live on them. A commercial kōura dietary supplement is not readily available in New Zealand, but salmon pellets are a suitable feed. These are readily eaten by kōura and typically contain an appropriate balance of nutrients and minerals required for growth. In extensive koura aquaculture operations, such as those currently operated by Ernslaw One Ltd., the existing ecosystems provides all the food required, and, while supplementary feeding is possible and would increase production, it has associated increased input costs (including labour).

Sales and Marketing

Kōura are a unique food-product with a sweet-tasting, delicate flesh. When cooked, the carapace (shells) turn bright red making them particularly desirable within the restaurant trade, especially for Asian markets. They are a product that can be sustainably grown without artificial inputs and can co-exist within most current primary industry operations. The limited New Zealand production relative to domestic and global consumer demand suggests that kōura will remain a niche high-value product. Kōura maintain product quality when transported in chilli-boxes packed with wood-shavings and ice packs. They have a shelf life of up to 10 days, which finds favour with restaurants and overseas markets. In the five years Ernslaw One Ltd. have been selling KEEWAI, there has been no fish mortality transporting product to market (New Zealand, Asia, or Canada). In addition, there may be an alternative market for kōura as aquarium pets, as there is strong demand from Asia. This has yet to be explored by KEEWAI but there is

a flourishing world-wide market for freshwater crayfish for the aquarium trade (Faulks 2015).

Current productive outputs

Kōura farms are largely extensive at present and the maximum yield is difficult to define. Water temperature and refuge are key factors determining how fast kōura can achieve a market weight (~70 to 100 grams) but two to three years is the norm in Otago and Southland. Further north in New Zealand you would expect faster growth rates, and therefore, better production due to the warmer climate. Productive yields of up to five saleable kōura per m^2 have been achieved in ponds with mixed age classes by Ernslaw One Ltd. while up to eight per m^2 have been recorded in ponds initially stocked with males, all of a similar live weight, by New Zealand Clearwater Crayfish (Hollows 2016). Labour requirement is low; once ponds are developed and stocked it can require as little as a two visits per pond annually to harvest stock for market through to a few hours per week for larger or more intensive farms.

Regulatory considerations

A fish-farm licence from the Ministry of Primary Industries (MPI) is required to commercially farm kōura in New Zealand. As part of the fish-farm application, resource consents from territorial authorities may be required for activities such as land-use consents, and consents to take, use, and discharge to water. This will help reduce the time and cost to obtain the necessary formal permits and consents. Water availability needs thorough investigation with relevant government agencies and other water users early in the aquaculture planning process (e.g., neighbours or irrigation companies). Consultation with affected parties is another component of the licensing process. These parties include local Iwi, the Department of Conservation (DoC), Regional and Territorial authorities and Fish & Game New Zealand. In addition, you may need to discuss your plans with other groups such as adjacent landowners and/or other water users depending on the size and location of your farm.

Figure 2 Annual kōura harvest from an Otago forest pond, 2019.

Identifying a source of kōura is critical, as farmed stocks are limited, and a permit from DoC to transfer kōura into the ponds may also be required. Currently there are four fish-farms with kōura for sale to seed new farms. Alternatively, a permit for wild capture can be applied for from MPI. To sell kōura for human consumption requires a facility to purge the fish prior to sale (this does not apply to sales between fish farms or for the aquarium trade). An animal material depot (AMD) certificate will be required from MPI prior to selling any stock to ensure relevant food safety standards are met. MPI have a good understanding of what is involved with kōura farming and getting the necessary approvals is now much less onerous than it was when KEEWAI was established. Aside from the land and water resource the equipment required is essentially only nets, bait, buckets, a shed, water tanks and a system for keeping water cool, alongside some recording of stocking and production data. A guide to getting started with kōura aquaculture has been produced and provides some good information around regulatory requirements, as well as practical considerations (Hollows 2016).

Conclusions

Kōura are a unique product as, along with commercial value, there are positive environmental and conservation aspects associated with their production. They are a new opportunity for primary production from land unable to be farmed in traditional or intensive methods. In the current environment, do we need to think outside the square and look at new regulatory requirements around the environment as opportunities for diversification rather than as another nail in the coffin to industry?

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