Economic Prospects for Freshwater Crayfish (Yabby) in Western Australia

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Since the 1980s Western Australia has developed a significant commercial aquaculture industry, catering both to domestic and overseas markets. However, the limited scale of output, especially in the yabby industry, has been a major constraint on further expansion of sales. Currently, the industry is based on the cultivation of freshwater crayfish (yabby) in existing farm dams. There are about 100,000 farm dams in Western Australia but only about 6,000 are currently used for commercial yabby production. Thus one way to boost output is simply to persuade more farmers to utilise them for commercial yabby production. However, farm dams produce low yields and it is also necessary to investigate the potential for more intensive farming with purpose built dams. This paper examines the economic feasibility of yabby aquaculture using the internal rate of return. The main findings are that intensive farming is non-viable but semi-intensive farming and farming of existing dams is viable, although the former is only marginally so.

1. Introduction

The economics of aquaculture can be considered from several different perspectives: first, from the perspective of an individual enterprise; second, from the perspective of the industry as a whole and third, from the perspective of the national economy (Tisdell 1996). The individual enterprise is concerned with profitability and diversification while at the national level the focus is on net national benefit. For example, if an aquaculture operation has positive effects on local businesses, the profits of the enterprise may understate the social benefits of the industry.

Aquaculture is one of Australia's most rapidly growing primary industries. Between 1989-90 and 1994-95 aquaculture the value of production more than doubled in value to $419 million. Western Australia is the leading aquaculture producer, accounting for 39 per cent of the value of total output in 1994-95. However, about 98 per cent of Western Australia's output is accounted for by pearls; the cultivation of other aquaculture products including fish, mussels, marron and yabbies, is still in its infancy. Aquaculture shows great potential to generate employment and income in regional areas of Western Australia.

The aim of this paper is to investigate the potential for one species-yabbies (*Cherax albidus*) - and provide preliminary estimates of profitability for yabby farming in Western Australia. Figure 1 illustrates the growth of yabby production by volume and value between 1987-88 and 1995-96. Production of yabbies has grown from about two tonnes valued at $25,000 in 1987-88 to 112 tonnes valued at $1.23 million in 1995-96. In the past two years production has been reduced because of drought conditions in the wheatbelt so a more accurate indication of the potential size of the industry is the 1993-94 output of 289 tonnes valued at $2.6 million. Western Australia produces over 80 per cent of Australia's total output of yabbies; the balance coming from New South Wales, South Australia and Victoria. About two-thirds of sales go to overseas markets, one-fifth to the local market and the remainder to interstate markets. It has suggested that by the year 2000 the industry could be producing 1,500 tonnes of product (Thorn). However, this is probably unrealistic as extrapolation of existing trends suggests that the industry would be doing well to reach half this level of output.

In order to further develop both domestic and overseas markets the scale of output needs to be boosted. The easiest route is to increase the number of farm dams used for yabby production. However, a major problem is convincing farmers to undertake the time commitment required for successful management of an aquaculture operation especially at a time when prices of traditional rural crops are recovering.

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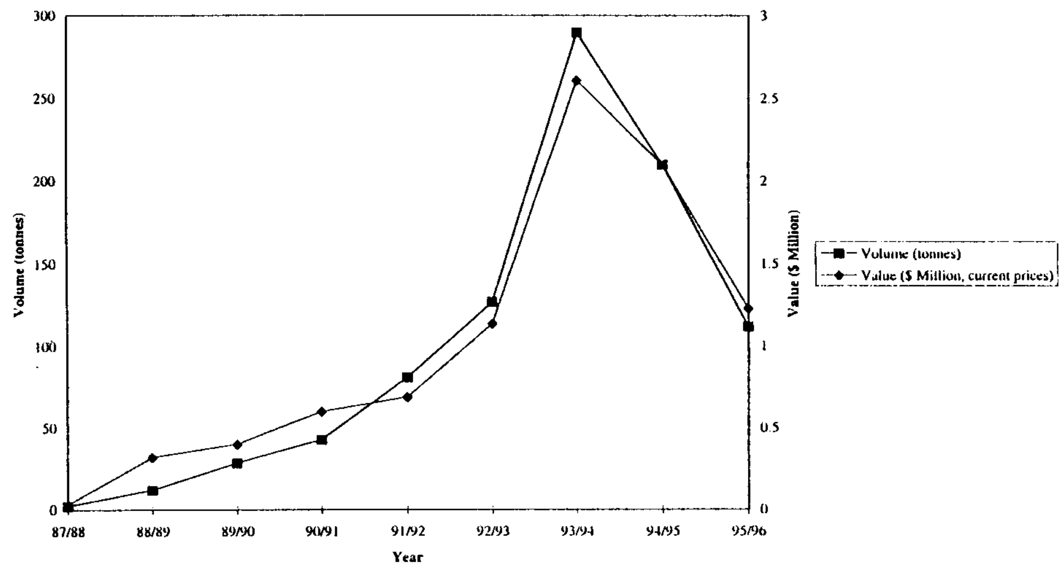
Figure 1: Yabby Production in Western Australia



Source: Fisheries Department of WA, Annual Reports and unpublished data. Prior to 1991/92, production value is based on estimated prices.

2. Yabby Production

Yabbies, a species of freshwater crayfish, were introduced from western Victoria in the early 1930s. They have proved well suited to the high temperatures and low oxygen environments of the inland regions of Western Australia. By contrast, marron, a native species of crayfish, require a more oxygenated water supply and can be successfully cultivated only in the south-west of Western Australia. In order to protect native species such as marron, yabby cultivation south of Perth is restricted to the west of a boundary line defined by the inland margin of state forest. Research has confirmed that yabby production in inland farm dams is a feasible operation from a technical point of view (Morrissy; Lawrence). The capital costs are low as the yabbies are grown in existing dams built for watering of stock. However, the yield per unit area of water is low and the operations are best classified as harvesting or extensive aquaculture.

In principle, two other types of crayfish aquaculture are possible: first, semi-intensive, utilising purpose built ponds with regular inputs used to increase yields; second, intensive, 'battery culture', where the crayfish are housed separately in indoor tanks and all of the nutritional requirements are met from external sources. So far yabbies have not been successfully produced using intensive aquaculture; a few producers are experimenting with semi-intensive systems but such research is still in its early stages. For example, some producers are experimenting with purpose built dams as a way of increasing yields. The average farm dam is about 7-8 metres deep but yabbies live only in the top two metres where the water is oxygenated all year round. The purpose built dams are shallower (about 1.8 metres) but have a larger surface area and offer a more effective use of water area (*Countryman*, 29/6/1995). The Fisheries Department is currently undertaking research into ways of boosting yields from farm dams and the control of problems such as stunting of stocks (Aquainfo). One complication is that optimal management techniques appear to vary from locality to locality, suggesting that research into topics such as pond design and aeration needs to be done at the regional level.

One way of increasing efficiency is to undertake integrated aquaculture or polyculture. Polyculture is a traditional practice in Asia and refers to rearing compatible species in ponds so as to occupy all the ecological niches and 'obtain the maximum biomass of cultured species from a unit area or volume of water' (Pillay). However, while potentially attractive, there are a number of problems including overlapping feeding requirements and balancing the numbers of the respective species. There is clearly a need for more research on polyculture and potential target species such as silver perch.

3. Demand and Supply

The yabby industry is characterised by a large number of small producers, a fairly homogeneous product and freedom of entry and exit. According to Fisheries Department data in 1995, there were 35 producers in WA. There are no trade associations or government marketing boards affecting price by setting agreed prices for exports. Although economies of scale may exist for more intensive operations they are not likely to be significant with existing operations utilising farm dams.[1] Thus in economic terms the yabby producers are likely to be price takers, that is, no individual producer is able to influence the price received for yabbies. This suggests that what economists call the purely competitive model may throw some light on the production behaviour of yabby producers.[2] In competitive markets, price is determined by the quantity of product demanded and supplied.

3.1 Demand

In the longer run, demand for fish products will be influenced by a wide variety of factors including population size, income levels, the prices of substitutes, tastes and lifestyle factors. Rising per capita incomes in Asian countries are leading to increasing demands for high valued food products including specialist fish products. This has created considerable potential for Australia to meet the demand (East Asia Analytical Unit).

All sources of protein are substitutes to some degree. Fish products are very acceptable sources of protein and will need to compete with other products. One way for the aquaculture industry to increase sales is to place an emphasis on increasing production efficiency so as to reduce the *relative* price of aquaculture products.

Consumption of fish products is low in Australia compared with Asian countries. In 1988-90, per capita consumption of fish in Australia averaged 18.8kg compared with Japan (72kg per capita), Republic of Korea (47.6kg per capita) and Hong Kong (53.5kg per capita). If consumers can be persuaded to view fish products as part of the meat protein complex, there is room for substantial increases in consumption of wild capture fish species and aquaculture products such as yabbies as specialist fish products.

Due to competition from other fish products, the demand for yabbies is likely to be price elastic. However, many Australian consumers have not eaten yabbies and are unfamiliar with their taste and this limits their willingness to substitute yabbies for other fish products. Therefore, there may be a good case for a marketing campaign to expand the market and/or cause a shift in tastes.

The yabby industry consists of many small producers with no influence over price: therefore, as far as the individual producer is concerned, the price received will not change if the level of production changes. But if a producer differentiates his/her product in some way, for example, by using advertising to create a brand name image for a specialist product, then the price elasticity of demand is different, and higher prices might be generated.

Yabbies are in competition with other specialist fish products, hence there is a need to differentiate each product and develop market niches for each product. Marron, for example, grow much larger, command a higher price, and are likely to continue to be the preferred gourmet product. The Japanese reputedly prefer the stronger flavour of the marine species and are not familiar with freshwater crustaceans (*Age*, 2/5/91). The advantages of yabbies include relatively high growth rates, low losses in transit and lower prices compared to marron.

3.2 Supply

In the long run, the supply of yabbies will be influenced by factors such as technological change and the price of inputs. Technical improvements can range from sophisticated advances in bio-engineering to relatively simple improvements in dam design. Government subsides for inputs and research can also affect operational efficiency. Although the Australian Tax Office generally treats aquaculture businesses as primary producers, some forms of rural assistance which are available to farmers, such as for water supply, are not currently available to aquaculture producers.

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[1] Treadwell suggests economies of scale exist in Redclaw aquaculture. The average IRR for a six hectare farm is 9.3 per cent, compared to 19.4 per cent for a 15 hectare farm (Treadwell, *et al.*, 1991, p.62).

[2] The other key assumption is perfect information, that is, all participants are well informed about available products and prices. See, for example, Baumol, W. J., Blinder, A. S., Gunther, A. W., and Hicks, J. R. L., 1992.

In the absence of collective marketing arrangements, it is not feasible to maintain differential prices for exports and home consumption; exports will sell at world prices and, in the long run, competition between producers will cause prices in the home market to reach parity with export prices (less freight and other handling costs). Some producers tend to emphasise the physical aspects of aquaculture production and neglect these economic aspects.

4. Marketing

With new specialist fish products, commercial development is slow; 'a species has the potential for commercial development only if there is a ready market for it at prices that provide a reasonable profit and if the marketing infrastructures and channels are adequate for and efficient in handling increased production' (Shang, p.94).

In the modern world, marketing infrastructures must provide for storage, refrigeration, quality control and hygiene. Producers may by-pass these requirements and sell directly to consumers but with specialised fish products such a practice increases the risks of inadequate product handling and variations in quality. The establishment of receiving depots and export processing operations requires specialised capital investment and new producers are probably best advised to work through an established marketing network with high standards of quality control. Currently, in Western Australia there are five processor/distributors.

From a marketing point of view, aquaculture offers some advantages over wild capture fisheries. These include improved predictability in amounts delivered; better quality control (e.g. producing product of a more uniform size) and greater control over the safety aspect. In particular, the ability to produce a high quality standardised product will be attractive to restaurants and supermarket outlets. The fact that Australia enjoys access to relatively unpolluted water supplies is a distinct marketing advantage over many Asian competitors (Batt, 1994a).

Since the 1960s, the European crayfish industry has been devastated by a fungal disease called *Aphanomyces astaci*, but Australian crayfish are free of this disease, which gives another marketing advantage (*Age*, 19/4/90). However, the world-wide growth of the aquaculture industry has led to increased trade in live fish, larvae, milt and eggs, increasing the risk of the introduction of infectious diseases to Australia. The development of more intensive forms of aquaculture culture also increases the threat of disease and resultant financial losses. Furthermore, there are disease risks associated with the movement of aquaculture species within Australia.

The Australian Quarantine and Inspection Service (AQIS) has concluded that if *Aphanomyces astaci* is introduced into the wild crayfish population, apart from reducing crayfish numbers, it could alter the food chain and cause serious ecological damage (Humphrey). Tasmanian salmon farmers are concerned about the risks associated with the import of uncooked, wild, ocean-caught Pacific salmon produce from the USA and Canada. The AQIS report recommends that because of the risks and the difficulties of detecting latent infections all living crustaceans imports should be regarded as high risk species and should be subject to the same rules as living finfish. These rules include consideration on a case by case basis, the development of protocols for quarantine and licensing and approval of import premises (Humphey). New Zealand has already relaxed its controls on imports of Pacific salmon.

There is some concern that the implementation of the Hilmer Committee's report on competition policy may impede the ability of state governments to restrict inter-state trade in aquaculture products on quarantine and other grounds. The arbitrary boundary line which restricts yabby farming south of Perth in order to protect marron and other native species could also be questioned on similar grounds.

In the past, aquaculture products have suffered from inconsistency of supply, poor quality of product, and inadequate transport to markets (O'Sullivan). The domestic market is as yet relatively undeveloped, and yabbies compete with other seafood products such as prawns, marron, and marine crayfish. Overseas demand is for fresh rather than frozen yabbies so access to reliable air transport will be needed (O'Sullivan).

There are a number of other barriers to the further development of export markets for WA production (Batt, 1994b); the major ones appear to be the limited scale of production and the difficulty of maintaining a continuous supply of product. Supply tends to be seasonal due to biological, climatic and social factors. It has been observed, for example, that output from farm dams tends to increase during school holidays when extra hands are available. Distributors need to establish holding systems to maintain year-round supplies and encourage the spread of the industry to warmer northern areas to overcome the lack of production from southern areas during the winter months.

There is a need to educate consumers, both domestic and foreign, about the advantages of the fish. Given the infant status of the industry, a co-operative approach, based on generic advertising, is appropriate. Another area where co-operation is essential is the standardisation of the product and quality control. These practices can be introduced either by a private or government body. A Code of Practice is currently being developed for the industry. Generally speaking, cooperative marketing arrangements can offer significant advantages to producers, that is, monopolistic power for selling and monopsonistic advantages for purchasing inputs. Unfortunately, according to one informed observer 'there is no primary industry within which I can identify such a degree of disunity as the WA yabby industry' (Thorn). The WA Fisheries Department is putting considerable resources into the development of the industry including the provision of a number of Aquaculture Development Officers at strategic locations around the state.

Commercial aquaculture passes through a typical product cycle after its establishment (Tisdell, 1996). In the early stage, a few pioneers dominate the industry, production techniques evolve through 'learning by doing', markets are undeveloped and profits uncertain. As ineffective techniques are gradually discarded and marketing improves, high profits may be earned. However, the high profitability attracts new entrants into the industry and profit levels are gradually reduced to the average level in the economy appropriate to the degree of riskiness of the industry. In Western Australia, the cultivation of yabbies is still in the pioneer stage, but it has potential in some circumstances.

5. Investment Appraisal

Investment appraisal involves identifying the circumstances in which fish investment will take place and the expected rate of return on capital that can be obtained. Generally speaking, farmers in WA are not likely to switch from producing sheep to yabbies, but are likely to engage in fish farming as a part-time activity. It is more likely that smaller land owners particularly could see advantages in diversifying into yabby production. Diversification of production is a well recognised strategy for reducing risk (Tisdell, 1996). In some circumstances, yabby farming could be part of a diversified operation producing wildflowers, honey or some other product.

Given that aquaculture investments are mainly undertaken by small businesses, information on production conditions and outcomes is very limited. The fact that aquaculture products are produced in an aquatic medium plus the fact that it is a relatively young industry suggests it is a high risk activity (Pillay). The risks of failure include the effects of diseases, droughts and poaching. The limited information available also makes it hard to quantify the risks at this stage of development.

A number of aquaculture operations have either failed to get off the ground or gone into liquidation in WA and elsewhere. For example, Marine Industries Ltd went into voluntary liquidation in 1991 when its fish farming activities in Victoria and Western Australia collapsed (*Australian Financial Review*, 1/7/91). A 1990 Prospectus for the Blue Cray Project in New South Wales warned investors that the project 'is a pioneering venture. Sale prices will depend on the ability of the farm manager to develop markets. It is possible that projected production levels may not be achieved in the anticipated time frames' (Newman). Not surprisingly, investors were deterred and it never got off the ground. In 1994 the Prospectus for Midwest Hatcheries (W.A.) Limited which was designed to raise capital for a fish farming venture at Jurien Bay warned of the 'inherent risks associated with the breeding, growing and harvesting of fingerlings which relate principally to disease, market changes and fluctuation in foreign exchange rates' (Midwest Hatcheries WA Ltd). It is difficult to attract venture capital into aquaculture, increasing the need for careful economic appraisal of potential aquaculture diversification projects.

There are three major methods of measuring the economic feasibility of an investment project: the net present value technique, the benefit-cost ratio and the internal rate of return (IRR). The advantages and disadvantages of the three approaches are discussed in the literature and will not be reviewed here (Tisdell 1972; Shang; Treadwell *et al.*, 1991). In order to facilitate comparisons with other research this paper utilises the IRR approach. The real rate of interest used for comparisons is the monetary or nominal rate adjusted for the rate of inflation. The real rate of interest is currently (September 1996) about 5-6 per cent (based on an inflation rate of 3.1 per cent and bond rates of 8-9 per cent).

The paper investigates three farm models: model 1, a semi-intensive farm with full start-up costs; model 2, a semi-intensive farm with complimentary or free start-up costs (land and some other inputs already supplied); model 3, an extensive farm (using existing farm dams). Due to space limitations the detailed assumptions for each model are not listed here but are available from the author. The general assumptions include:

- Returns are estimated over a 10 year period.
- The calculations are based on private cost and benefits and are on a pre-tax basis.
- In the case of the full start-up and complimentary cost start-up models it is assumed that there is no production in the first year, 50 per cent production in the second year and full production from the third year onwards. In the case of the farm dam model, it is assumed that there is 25 per cent production in the first year, 50 per cent production in the second year and full production from the third year onwards.
- It is assumed that a suitable site with access to water exists.
- Farm sizes -
  - model 1-10 hectares pond area
  - model 2-10 hectares pond area
  - model 3-4 hectares pond area
- Prices -
  - model 1 - $9.50 per kg
  - model 2 - $9.50 per kg
  - model 3 - $6.50 per kg (lower than for models 1 and 2 because the yabbies are unpurged).
- Yields -
  - model 1 - 1500kg/ha/yr
  - model 2 - 1500kg/ha/yr
  - model 3 - 500kg/ha/yr (less than models 1 and 2 due to the lower productivity of farm dams).
- All of the calculations include a return to labour.

The results are given in Table 1 which also includes some earlier estimates by other researchers. The calculations provide IRRs of -10.0 per cent for model 1 (the full start-up case), 7.0 per cent for model 2 (the complimentary cost start-up case) and 18.5 per cent for model 3 (the extensive case). The estimate for model 1 suggests that full start-up yabby farming is non-viable when judged by economic criteria. By contrast, the complimentary cost start-up operation is viable but only marginally so, and the farm dam operation is viable. Appendix Tables 1 and 2 show the cash flow pattern for model 1 (the full start-up case); details for the other models are available on request from the author.

In order to estimate the sensitivity of results, it is assumed that an IRR of 15 per cent represents a minimum target rate of return allowing for the risk involved. Table 1 illustrates how an IRR of 15 per cent can be achieved in the cases of models 1 and 2 by varying yields and prices. It is assumed that other inputs costs do not vary. For example, in the case of model 2 (complimentary cost start-up) if price is unchanged but yields can be increased from 1500 to 1778kg/ha/yr then an IRR of 15 per cent is achieved; alternatively, if yield is unchanged but price increases from $9.50 to $11.23 per kg an IRR of 15 per cent is achieved. Therefore either an increase in yield of about 19 per cent or an increase of price of about 18 per cent will achieve the target IRR. In the case of model 1 (full start-up) the required increases to achieve an IRR of 15 per cent are 68 per cent and 67 per cent respectively. While it is possible for technical changes to improve yields, *it is highly unlikely that increases of the magnitude required to make model 1 viable are possible in the foreseeable future.* As far as prices are concerned, given the competitive nature of the industry and the strong competition from other fish products such as marron, redclaw and prawns, *it is unrealistic to expect significant price increases* in the medium term.

It is useful to compare these results with previous research. Table 1 shows that Staniford and Kuznecovs estimated a IRR of 23.7 per cent, while Treadwell, McKelvie and Maguire estimated a range of IRRs from 2.1 per cent to 17.0 per cent, with an average of 9.3 per cent (Treadwell *et al.*, 1991). The range of the latter IRR values reflects the impact of risk and uncertainty which was estimated on the basis of a probability distribution. Unfortunately, it appears that the favourable results of Staniford and Kuznecovs are due to the use of unrealistically high yields in their calculations.

Table 1: Comparative Results - Profitability of Yabby Farming

	Staniford & Kuznecovs (1988)	Treadwell, McKelvie & Maguire (1991)	Tull		
			Model 1	Model 2	Model 3
Farm Size	10ha	15ha	10ha	10ha	4ha
Yield	3,300kg/ha/yr	1,000-2,500kg/ha/yr	1,500kg/ha/yr	1,500/kg/ha/yr	500kg/ha/yr
Price	$10kg	$10-$16kg (domestic) $14-$21kg (export)	$9.50kg	$9.50kg	$6.50kg (unpurged)
Return on Capital	27.4%	3.0% (domestic sales only)* 19.1% (export sales only)*	6.0%	20.9%	381.3%
Internal Rate of Return	23.7%	2.1%-17%	-10.0%	7.0%	18.5%
Breakeven yield	1,953kg/ha/yr		1,839kg/ha/yr	1,290kg/ha/yr	433kg/ha/yr
Breakeven price	$7.00 (approx)		$11.60	$8.19	$5.65
15% return criteria	$10kg/ 2,691kg/ha/yr $7kg / 3,8887/kg/ha/yr $13kg/ 2,058kg/ha/yr		$9.50kg / 2,517kg/ha/yr $15.82kg/ 1,500kg/ha/yr	$9.50kg / 1,778kg/ha/yr $11.23kg/ 1,500kg/ha/yr	$6.50kg / 486kg/ha/yr $6.32kg / 500kg/ha/yr

* Estimate only based on available data.

Source: Treadwell, R., McKelvie, L. & Maguire, G.B. (1991). Profitability of selected aquaculture species. ABARE Discussion Paper 91.11, 55-62.
Staniford, A.J., Kuzneocovs, J. (1988), Aquaculture of the yabbie, Cherax Destructor Clark (Decapoda: Parastacidae): an economic evaluation. Aquaculture and Fisheries Management, 19, 325-340.

The estimates support the conclusion that there is a considerable degree of risk involved in *intensive* yabby farming. On a more positive note, it is clear that the harvesting of *existing* farm dams can make a positive addition to household income with minimal outlays and risks.

Yabby crayfish aquaculture can utilise spare labour time in the farm household and is becoming an increasingly popular part-time activity, especially for women (O'Sullivan). One farmer's wife has successfully value-added by marketing pickled yabbies in jars (*West Australian*, 1/4/96). In the last two decades there have been substantial increases in the financial contribution of women to the farm business through both on and off farm employment (Lewis).

The private profitability or otherwise of an aquaculture enterprise does not indicate its value from society's point of view. This is because the operations of an aquaculture enterprise can impose costs and benefits on other firms and individuals. Costs that may be imposed include water pollution and habitat destruction; benefits that other firms may reap include increased business by local traders because of the increased employment and income generated in a specific region by the aquaculture operations. It should be stressed that the presence of negative externalities such as pollution does not mean that an industry should be discouraged. There are well established policy measures, such as taxes on pollutants, which can be used to ensure that business enterprises take significant externalities into account (Tisdell 1972). It is, of course, possible that aquaculture itself can be constrained by externalities caused by other economic activities. If there is a net external benefit from yabby farming in a region, market-failure theory provides some support for government assistance to the industry, for example, helping producers introduce new technologies which can improve production efficiency and create a regional benefit where none existed previously.

6. Conclusions

Yabby crayfish aquaculture is still a pioneer industry without a track record of profitability in WA. Evaluation of its economic feasibility suggests that intensive yabby farming is currently non-viable and consequently for investors it must be classified as a high risk activity. However, semi-intensive and extensive yabby farming is viable, although the former is only marginally so. For farm households with spare labour time, harvesting existing dams can yield a positive addition to farm income with minimal outlays. A continuous time commitment is required to ensure continuity of supplies. Regional development will be enhanced if it can be demonstrated that aquaculture offers other benefits, for example, by aiding water and soil conservation. In addition, there may be significant external benefits and costs from the development of yabby farming in regional areas but further research is needed before an adequate assessment can be made of these. Although these findings are based on Western Australian data, it is likely that, provided climatic and other conditions are suitable, yabby aquaculture can also be a valuable diversification activity for primary enterprises in other parts of Australia.

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Appendix

Table 1: Semi Intensive Yabbie Farm (Cherax albidus) Full Start Up

Characteristics

Total Farm Area	40 ha
Total Pond Area	10 ha
Pond Size	2,000 m^2
Number of Ponds	50
Type of Ponds	mixed and sexed
Water Supply	runoff and storage dam
Yield	1,500 kg/ha/year
IRR	**-9.95%**

Annual Income

Income	
Yield	15,000
Price	$9.50
Gross Income	$142,500

Set Up Costs

		$
Land		40,000
Ponds	Cost per pond = $3,500 Inc. excavation/piping predator control/shelters	175,000
	Monitoring and pond transfer equipment	1,000
	Aerators	none
Feeding Equip		Manual
Water Supply	Storage Dam	75,000
Office & Storage Shed	Building	25,000
	Office equip and shelving (inc. PC)	7,000
Transport Equip	4 wd ute + trailer	25,000
Harvesting Equip	Traps (100 @ $40)	4,000
Processing Equip	Holding equipment	10,000
	Purge tanks x 2	7,000
Stock	Juveniles 20kg per dam @ $3.5	3,500
Energy	Electricity Connection	10,000
Total		**382,500**

Annual Operating Costs

		$
Depreciation	See schedule	14,050
Repairs & Maintenance	(5% set up costs excl. land/stock)	16,950
Labour	Farm Managers (owner)	40,000
	Farm Hand	26,000
Feed	Lupins only 8kg/week/1,000m^2	8,320
Energy	Power - electricity	5,000
	Fuel ($60/week)	3,000
Packaging	Polystyrene + ice 1,500 ctns @ 10kg capacity @ $3.5 (assume cartons used twice)	2,625
Bait & Consumables		1,000
Water	Mains water usage	500
Administration	Govt. charges/insurance accounting	2,000
Total		**119,445**

Depreciation Schedule - Full Start Up

	Rate	Amount p.a.
Ponds	2.5%	4,375
Storage Dam	2.5%	1,875
Monitoring & Pond Transfer Equipment	15%	150
Office and Storage Shed Building	3%	750
Office Equip and Shelving	15%	1,050
Transport Equip	15%	3,750
Harvesting Equip	10%	400
Processing Equip	10%	1,700
Total		**14,050**

Table 2: Cashflow: Full Start Up Model

Year	1	2	3	4	5	6	7	8	9	10
Set Up Costs	382,500								Salvage Value	76,500
Operating Costs										
Depreciation	14,050	14,050	14,050	14,050	14,050	14,050	14,050	14,050	14,050	14,050
Repairs & Maintenance	0	16,950	16,950	16,950	16,950	16,950	16,950	16,950	16,950	16,950
Labour	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000	66,000
Feed	8,320	8,320	8,320	8,320	8,320	8,320	8,320	8,320	8,320	8,320
Energy	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
Packaging	0	1,312.5	2,625	2,625	2,625	2,625	2,625	2,625	2,625	2,625
Bait & Consumables	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Water	500	500	500	500	500	500	500	500	500	500
Administration	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Sub total	99,870	118,132.5	119,445	119,445	119,445	119,445	119,445	119,445	119,445	119,445
Total Costs	482,370	118,132.5	119,445	119,445	119,445	119,445	119,445	119,445	119,445	42,945
Total Income	0	71,250	142,500	142,500	142,500	142,500	142,500	142,500	142,500	142,500
Cashflow	-482,370	-46,882.5	23,055	23,055	23,055	23,055	23,055	23,055	23,055	99,555
IRR	-9.95%									
Rate of Return on Capital	6.0%									