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Semi-Intensive Production of Red Swamp Crawfish in Earthen Ponds without Planted Forage

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Traditional culture

Traditional pond culture of crawfish (*Procambarus clarkii* and *P. zonangulus*) is extensive, with little energy input and no feed directly provided. Crawfish are produced in an annual cycle with an agronomic crop, commonly rice. Rice fields are planted and then gradually flooded to a depth of 0.3 to 0.7 m. After flooding, crawfish emerge from their burrows. The farmer may choose to harvest both rice and crawfish or only crawfish. If the rice is harvested, regrowth, called ratoon, occurs. After harvest and as air temperatures decrease to freezing, the ratoon or the unharvested rice dies and begins to decompose. Bacteria and algae that grow on decomposing plant material are consumed by organisms that, in turn, are food for the crawfish. Crawfish can be harvested with traps as early as November, but are usually harvested from January through May. Harvest may end before May in response to a successful harvest from the capture fisheries or the need to plant a new crop. For a more detailed description of these production practices, refer to SRAC publications 240, 241 and 242.

Limitations of traditional culture

Culturing crawfish with planted forage has helped to satisfy the increasing consumer demand for crawfish and to prolong the season when crawfish are available. However, when the harvest from the capture fisheries is abundant, prices often fall below the level at which the culture fisheries can realize a profit. Traditional crawfish farming has other limitations. The decay of vegetation in shallow water can produce critically low dissolved oxygen concentrations, particularly when water temperature is high. Also, food resources are sometimes depleted by mid-March or early April, when the population of crawfish is largest. As a result, crawfish cease to grow, or become stunted, and many of them remain below market size.

Trapping is the only harvesting method that can be used in shallow water that contains vegetation. Seining is not possible when vegetation is present. Planted forage also limits the growth and harvest period. The pond must be drained and the crop allowed to grow before the pond can be reflooded. If flooding occurs when water is warm, accelerated rates of decay will cause the dissolved oxygen in the water to decrease to levels that are stressful or even lethal. If flooding happens when water is cool, water quality is not as likely to be a problem but the cooler water is not conducive to rapid growth of the red swamp crawfish.

An alternative culture

Growing crawfish in deeper ponds without planted forage has several advantages over traditional crawfish culture. The growing and harvest seasons are longer; there are fewer problems with low levels of dissolved oxygen; and deeper ponds without forage can be seined to rapidly remove excess crawfish and prevent stunted growth.

Management practices

Pond design and water supply

Ponds should have an average depth of about 4 feet, range in size from 1 to 5 surface acres of water, and have a 3:1 slope from the top of the levee to the pond

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bottom. Long, narrow, rectangular ponds are more suitable than wide, square ponds because they make it easier to distribute feed or organic fertilizer over the entire surface area of the pond. There is also more space for crawfish to burrow along the perimeter of long, rectangular ponds. Narrow ponds also have a larger area of shallow water that presumably serves as a nursery or sanctuary for juveniles.

Either surface or ground water can be used to fill ponds. The lower cost of using surface water must be weighed against having a reliable quality and quantity of water. Surface water can contain predatory fish that compete with crawfish for the natural food in the pond. Once ponds are filled, additional water is needed only to replace what is lost from evaporation. Ponds are generally not drained unless they become contaminated with fish.

Initial stocking

After the pond is prepared and filled, it is stocked with broodstock obtained from commercial capture or culture fisheries. Stocking can be done from May to July. Broodstock generally consists of an equal number of males and females. Stocking density should be 75 to 100 pounds per acre (84 to 112 kg / hectare). Be sure to stock only crawfish harvested within the previous 24 hours. Crawfish held for longer periods of time are subject to stress and may have significant post-stocking mortality. Broodstock should be transported in mesh sacks and packed densely enough to minimize movement. The transported crawfish should be kept cool and moist, but not have direct contact with ice. If sound management practices that ensure good survival are followed, crawfish should not have to be restocked annually. The unharvested population remaining in the pond should be sufficient to sustain consistent levels of production from year to year. Restocking is recommended when annual production in a pond is significantly lower than in all other ponds or when it decreases by 25 to 30 percent over time. Broodstock should be restocked at a rate proportional to the decrease in production.

Feeds and feeding strategies

Existing ponds do not need to have a food source added before stocking because natural foods should be sufficient to sustain the population until the first young of the year (those hatched during successive spawnings of a calendar year) are produced in mid-fall. However, new ponds should be organically fertilized (with cracked corn, cotton seed meal, or distillers dried grains) before and after stocking to ensure sufficient natural food. Once the initial young of the year have hatched, a formulated feed (a combination of organic fertilizer and feed, or just a fertilizer) must be added to the pond to enhance the production of pond organisms. Both a pelleted, 32% crude protein, sinking catfish feed and a comparably priced extruded, 28 to 30% crude protein, sinking diet have been successfully used in experimental trials. The food breaks up rapidly—before it is consumed—so it mainly acts as a fertilizer and a source of nutrition for microorganisms that, in turn, are food for those organisms crawfish eat. For direct consumption by crawfish, it is best to use a highly water-stable, extruded, formulated feed.

If the price of feed becomes cost-prohibitive, alternative methods of fertilization will be necessary. For example, two-thirds of the amount of a sinking catfish feed might be replaced with alfalfa or range pellets. Or, commercial feed could be supplemented with or replaced by an organic fertilizer such as corn, alfalfa hay, cottonseed meal, or soybeans. In recent research, a combination of rejected soybeans and alfalfa hay (composite level of crude protein = 28%) was substituted for formulated feed with no significant differences in production.

The recommended feeding (fertilization) rates for each month are presented in Table 1. These amounts translate into daily feeding (fertilization) rates of 5.6 to 31.5 pounds per acre (6.3 to 35.3 kg / hectare). These are estimates based upon the biomass (total weight) of the pond population and the water temperature. Crawfish eat less as water temperature decreases and eventually stop eating at temperatures less than 50 °F (less than 10 °C), within

Table 1. Recommended daily and monthly feeding rates and percent of total feed fed for each month in semi-intensive crawfish ponds in northeast Mississippi.

Month	Pounds/acre/day	Pounds/acre/month	Percent
Jan	0.0	0	0.0
Feb	0.0	0	0.0
Mar	12.9	400	7.1
Apr	25.0	750	13.4
May	31.5	975	17.4
Jun	30.8	925	16.5
Jul	22.6	700	12.5
Aug	14.5	450	8.1
Sep	13.3	400	7.1
Oct	14.5	450	8.1
Nov	12.5	375	6.7
Dec	5.7	175	3.1
Total		**5,600**	**100**

its range of tolerance. Crawfish feed and forage most actively during the evening. However, because feeding is essentially a pond fertilization process, it should be done in mid-afternoon when the level of dissolved oxygen is comparatively high. Whether feeding (fertilization) needs to be done every day has yet to be established.

There are many fertilizers, in a range of prices, that could be used. Pelleted feed is easier to distribute than feedstuffs. Pelleted organic fertilizers include corn gluten, rice bran, alfalfa pellets and range pellets. Organic fertilizer should be used with care, however, particularly if the temperature of the water is high, because it can dramatically reduce dissolved oxygen.

Water quality

Red swamp crawfish can tolerate poorer water quality conditions than many species of fish and crustaceans. They can tolerate levels of dissolved oxygen as low as 0.5 mg/L, but chronically low levels are not conducive to maximum growth. If levels fall, or are anticipated to fall, below 3 mg/L, ponds should be aerated using PTO-driven paddlewheels or floating electrical aerators at a rate of 1.5 hp/acre (0.6 ha).

Most problems with low concentrations of dissolved oxygen occur from May through August when water temperatures are highest and crawfish populations are largest. The more crawfish there are, the higher the oxygen demand. The concentration of dissolved oxygen near the pond bottom should be monitored daily using an oxygen meter or some type of analytical test kit. The best time to monitor is just before sunrise when levels are generally lowest. If the oxygen level is chronically low, monitor more often to be certain it does not fall to a lethal level. At times the pond may become stratified, causing the bottom layer to be depleted of oxygen. This can be prevented by mixing the water in the pond.

If the pH of the soil of the pond bottom is less than 7.0, lime should be added until the pH is at least 7.0. The ideal pH of water used to raise crawfish is 7.0 to 9.0. The total hardness and total alkalinity of the water should range from 50 to 250 ppm as calcium carbonate. If primary productivity is high and water has a high alkalinity and low total hardness, the pH will tend to be too high. High pH can be managed by applying either agricultural gypsum ($CaSO_4$) or alum ($AlSO_4$). Alum applied at a rate of 1 mg/L of water gives almost immediate results to prevent mortality, but the effect is only temporary if primary productivity remains high. Agricultural gypsum is a good source of calcium that will reduce high levels of carbonate through its precipitation as calcium carbonate. Applying gypsum to achieve a total harness equivalent to total alkalinity will lower pH to an acceptable level.

Harvest

Harvest generally begins in late March or early April of the year following initial stocking. Trapping is the principal harvest method, but seining can be done when conditions warrant. In deep ponds, boats are needed for efficient trapping. Boats should be able to maneuver among substrate (see section on substrate). Commonly used traps are pyramidal in shape, with a $^3/_4$-inch hexagonal mesh and three openings around the base (Fig. 1). Almost all new traps have a $^3/_4$-inch square mesh that retains smaller crawfish. The neck of the trap extends above the water and is equipped with a PVC collar to prevent crawfish from escaping. Traps can be held upright by inserting a rebar vertically through the trap. Using 20 to 25 traps per acre (49 to 62 per hectare) is recommended.

The schedule for baiting and harvesting traps is based on water temperature. There are many brands of formulated bait made for use in traps. Formulated bait is most effective when the crawfish are most active, generally at water temperatures of 66 to 86 °F (19 to 30 °C). Below 66 °F (19 °C), harvest is not significantly different whether formulated bait is used or not. This may be because at lower temperatures crawfish seek refuge in traps. When water temperature falls below 66 °F, traps can be set without bait and harvested once per week. A cost-effective catch without bait at temperatures below 66 °F might be achieved by using more traps.

At water temperatures higher than 66 °F (19 °C), baited traps are harvested three or four times per week, depending on the time of year. The interval between baiting and harvest is generally 24 or 48 hours. Several examples are shown in Table 2. For example, if traps are harvested four times per week, there would be one 24-hour

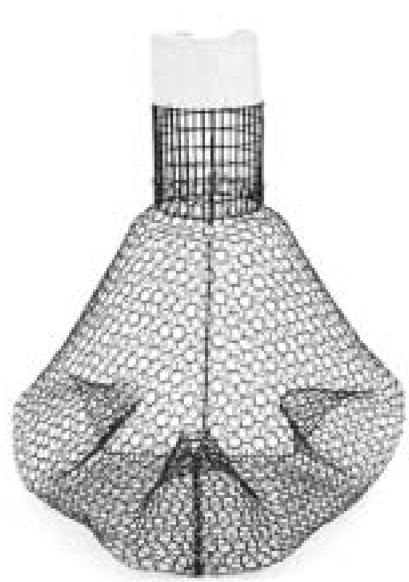

Figure 1. A pyramid trap with three funnel openings used to harvest crawfish in semi-intensive production ponds. Traps are positioned vertically on the bottom of the pond. About one-third of the upper portion of the trap extends beyond the surface of the water. Because semi-intensive production ponds are deeper, the trap neck is longer than depicted.

Table 2. Typical weekly trap harvest schedules. Each X represents a day when traps are harvested and baited.

	Day						
Frequency	1	2	3	4	5	6	7
3x	X		X		X		
4x	X	X		X	X		
4x	X	X		X		X	

and three 48-hour intervals. If traps are harvested three times per week, there would be two 48-hour and one 72-hour intervals. The harvest schedule should maximize catch. Variables that affect catch per trap per day (i.e., catch per unit effort or CPUE) include water temperature, water quality, moon phase, weather patterns, and population density. Trap harvest should be suspended when water temperature falls below 59 °F. Trap harvest should be suspended for at least 1 week when the average weekly CPUE falls below 0.5 pounds per trap per day. The CPUE begins to decline about August 15 when the peak period of mating and spawning occurs. Trap harvest may need to be suspended periodically after that date. This period in the harvest season may vary with the latitude of the production ponds. Trap harvest may resume again in late September or early October. Basing harvest on temperature and CPUE generally results in 75 to 90 harvest days per year, or 20 to 30 weeks per year. These recommended harvest practices optimize CPUE by reducing labor costs and may help increase the average individual size (weight) of harvested crawfish.

Approximately 70 percent of the total trapping days occurs from April through August in northeast Mississippi (Table 3). The duration of the trap harvest season and the number of trap days are influenced by latitude. Monthly yields are based upon the number of trap days per month. Daily yield is highest from March through July, rang ing from about 25 to about 40 pounds per acre per day (28 to 45 kg / hectare / day). When conditions from August through February are favorable for harvest, the daily yield decreases by approximately 50 percent and ranges from 10 to 25 pounds per acre per day (11 to 28 kg / hectare / day). The number of trap days in March, April and May can be reduced and offset by trapping more days during August, September and October without lowering the total biomass harvested annually. The increase in labor might be offset by higher prices obtained during this period when ponds with planted forage are drained. It might be possible to get higher daily yields for the latter months, when water temperature usually declines below 66 °F (19 °C), by using a "cold water" formulated bait rather than unbaited traps. Fish make good cold water bait in traditional forage-based farming; however, using fish can cause problems related to labor, availability, storage and the introduction of disease.

Crawfish can be harvested by seining when the water temperature is below 66 °F (19 °C). However, there is little difference in total weekly yield between seining once per week and harvesting unbaited traps several times per week. Seining will capture recently molted or soft-shell crawfish that do not enter traps (although seining can damage their delicate shells). Soft-shell animals are a value-added product and usually command a much higher price. Soft-shell crawfish must be separated from other crawfish and processed rapidly to preserve the soft-shell condition.

Expected annual yields

Annual yields in small experimental ponds have consistently been 1,800 to 2,300 pounds per acre (2,017 to 2,578 kg / hectare), although some lower and higher yields have been recorded. Recent results from large commercial ponds verify that these yields can be expected. The monthly proportional distribution of annual yield is presented in Table 3. Individual

Table 3. Estimated harvest days/month, daily and monthly harvest yields, and monthly harvest yields expressed as a percent of the total annual yield.

Month	Harvest days/month	Pounds/ acre/day	Pounds/acre/ month	Percent
Jan	1	20.0	20	0.9
Feb	1	25.0	25	1.1
Mar	4	26.25	105	4.8
Apr	10	31.5	315	14.3
May	14	41.1	575	26.1
Jun	13	38.5	500	22.7
Jul	13	26.2	340	15.5
Aug	7	10.0	70	3.2
Sep	7	12.9	90	4.1
Oct	5	20.0	100	4.6
Nov	4	15.0	60	2.7
Dec	0	0.0	0	0.0
Total	**79**		**2,200**	**100.0**

harvest weight is highest from September through April, ranging from about 1.0 ounce (28 g), 16-count, to 0.8 ounce (22.4 g), 20-count. When the number of crawfish in the pond is highest (usually May through mid-August), the harvest weight decreases slightly to about 0.67 ounce (18.8 g), 24-count. Using 3/4-inch square mesh traps will probably result in lower mean weight and higher yield.

Processing

Crawfish harvested from semi-intensive systems are processed in the same manner as those harvested from forage-based ponds. The crop can be marketed as whole (live or frozen) or as peeled tail meat, depending upon demand and ultimate destination. Live crawfish are generally packed into open mesh vegetable sacks and kept moist under refrigerated storage (usually for no more than 3 days) until eventual transport and distribution. Sometimes live crawfish are held in tanks filled with water for 12 to 24 hours to allow “purging” of any partially digested food from the intestinal tract before they are placed in refrigerated storage or frozen. Purging makes the product more attractive to the consumer by removing mud from the gill chambers and the shell. Some crawfish may be lost during the purging procedure, but this is offset by the higher price of a value-added product. Live crawfish can be processed in individually quick frozen (IQF) systems. For this method of processing animals must be live because post-mortem release of proteolytic enzymes from the digestive gland can cause the tail muscle to lose its natural firmness. Shelf life of IQF product is 4 to 6 months.

The longer harvest period possible with semi-intensive culture raised concern about changes in tail meat quality over time. Sensory evaluation panels at Mississippi State University tested crawfish harvested at different times of the year for an array of sensory properties. Crawfish were boiled without seasoning for sensory evaluation on the same day they were harvested. Analytical tests of shell rigidity and muscle shear were conducted on the same group of crawfish. No significant changes in quality, based upon the time of year of harvest, were detected, except for an increase in shell hardness during mid- to late July and early August. This seasonal change is not likely to affect consumer appeal.

Crawfish are divided into three size grades:

- peeler — > 21 count, 0.75 of an ounce (21 g);
- restaurant — 21 to 15.5 count, 1.04 ounces (29 g); and
- export — < 15.5 count.

Grades correspond to the preferred destination of each of the categories. The export term is irrelevant, however, because virtually no crawfish are exported. Export grades generally predominate during cooler months (October, November, March and April), while the restaurant and peeler grades predominate from April to September. Some seasonal size difference is related to more frequent harvests during warmer months when growth rates are higher. Harvesting more often increases yield while reducing harvest size.

Other management needs

Invasion of ponds by fish

Invasive fish species must be kept out of ponds to achieve maximum annual production in semi-intensive systems. Fish compete with crawfish for feed and natural food organisms. Green sunfish and bullheads of sufficient size consume young crawfish. The magnitude of the problem is directly related to the number of fish in the pond. If large numbers of small fish are caught in crawfish traps, or if fish are observed along the perimeter of the pond or feeding in the water column, there is apt to be a serious problem. Ponds must be drained to remove large numbers of fish. When surface water is used to fill the pond, an appropriate size screen must be in place to prevent the introduction of fish and fish eggs. Fish also may enter through the pond drain during overflows. Smaller ponds, 5 acres or less, are less likely to become a depository for fish or fish eggs introduced by birds and are easier to manage if a fish invasion does occur.

The best time to remove fish from production ponds is mid-August to mid-September when harvest is often suspended because of low CPUE. The pond should be drained approximately 1 foot, left for a week, then drained another 1 foot, etc., until it is completely drained. This gives crawfish time to burrow temporarily into the pond levee or bottom. Once the water is shallow enough, fish can be seined. When the pond is completely drained, any remaining fish are removed. Fish populations also can be eliminated by applying rotenone when the water is fairly shallow. Rotenone is a restricted-use pesticide and its application requires specific permitting. After fish are removed, the pond should be refilled.

Wildlife depredation

In traditional shallow ponds with planted forage, bird depredation can cause significant losses. The recommended pond depth and slope for semi-intensive production ponds without planted forage minimizes access to wading birds. If vertical substrate (see next section) is used, diving birds such as pelicans and cormorants also will be impeded. If, despite these practices, birds congregate around crawfish production ponds, they should be dispersed.

Mammals that eat crawfish include minks, raccoons, otters, beavers and muskrats. Managers should monitor ponds and control these animals to minimize damage.

Substrate

In the absence of planted forage, placing vertical substrate in ponds increases annual production. The area of substrate used (both sides, mesh included) should equal 50 percent of the bottom surface area of the pond. A thin, plastic mesh fencing 4 feet high has been used in experimental ponds, but less expensive forms of substrate, or a smaller amount of substrate, may achieve the same results. Substrate can be restricted to a specific area of the pond so that the rest of the pond can be seined if desired.

To determine the cost effectiveness of using substrate, compare the cost and presumed life of the substrate material to the added revenue from increased production. In small experimental ponds, using substrate increased annual production by about 30 percent, to between 2,200 and 3,000 pounds per acre (2,466 to 3,362 kg / hectare). Substrate increases survival and average individual harvest weight. The substrate apparently is a place for additional food to grow, and helps distribute the population of crawfish in three, rather than two, dimensions within the pond. The wider distribution of crawfish may reduce aggressive encounters, thereby reducing mortality while allowing animals to conserve more energy for growth. The effect has yet to be documented in large production ponds.

Economics

Economic analyses have estimated operational and fixed costs of different scenarios for production ponds with and without substrate. There are several investment scenarios based upon variables such as land and equipment purchase and pond construction. Of course, the highest net returns are realized where land and equipment are already owned and appropriately shaped ponds already exist. The purchase of traps, other harvesting equipment, and crawfish for the initial stocking of ponds is common to all scenarios.

Enterprise budgets were developed for a farm with 131.6 water acres (176 land acres), consisting of 28 ponds of 4.7 water acres (6.0 land acres) each, without substrate. Net returns were based upon a conservative level of annual production—1,805 pounds (818 kg) per water acre. Table 4 shows an enterprise budget where land and machinery must be purchased and ponds constructed. Tables 5, 6 and 7 provide estimates of the investment requirement, annual ownership costs, and miscellaneous equipment investments for the different scenarios. These results suggest that the selling price of crawfish must be $1.50 to $1.60 per pound for the different semi-intensive production scenarios to show a profit. At $1.50 per pound, almost all scenarios, with or without the use of substrate, can realize a positive net return of $8 to $779 per acre (Table 8). In contrast, the break-even price for traditional forage-based farming (without the harvest of planted forage and its corresponding revenue) has been estimated at about $1.30 per pound (assuming machinery and land must be purchased and ponds constructed). As the selling price increases beyond $1.50 per pound, the net return for the semi-intensive system increases dramatically over that of the traditional system.

Conclusion

Semi-intensive crawfish farming in ponds without planted forage can increase total annual production over traditional systems, and provide a live product for more months of the year without sacrificing quality. Semi-intensive systems require more labor and feed / fertilizer, but the increased cost is partially offset by higher annual production. However, economic analysis indicates that a higher selling price per pound is necessary to break even. At a selling price of $1.50 or more, semi-intensive production is more profitable than traditional crawfish farming. Feed, labor and bait make up 76 percent of the cost of all crawfish enterprises. If the costs of any of these expenses can be reduced, then semi-intensive culture should yield a profit at a selling price of less than $1.50 per pound. For example, re-using bait for more than one trapping set will significantly reduce the cost of bait. Also, having crawfish to sell during the off season for traditional farming should contribute to higher net returns.

Table 4. Enterprise budget for semi-intensive crawfish farming in earthen ponds without the purchase of substrate on a 131.6-water-acre farm. The budget assumes a selling price of $1.50 per pound and includes the purchase of land and machinery and the cost of pond construction.

ITEM	UNIT	Entire farm	Per acre (sum of land and water acres)
GROSS RECEIPTS	Pounds	237,600	1,805
Crawfish sales	$ 1.50	356,400	2,025
VARIABLE COSTS			
BAIT (For traps)	$	36,075	205
FEED	$	78,894	448
LABOR			
Operations management	$	27,500	156
Hired labor	$	26,729	152
Crawfish harvesting	$	12,127	69
SACKS	$	1,974	11
FUEL			
Mowing	$	143	1
Water quality	$	123	1
Feeding	$	196	1
Electric floating paddlewheels	$	7,870	45
PTO-driven paddlewheel	$	1,361	8
Pumping	$	3,200	18
Transportation	$	1,007	6
Trap harvesting	$	492	3
REPAIRS AND MAINTENANCE			
Vegetative cover	$	1,120	6
Water supply (well, pump, motor and outlet pipe)	$	1,888	11
Feeding (truck, feeder with electronic scales and storage)	$	1,448	8
Water quality equipment	$	141	1
Harvesting equipment	$		
Boat, motor and trailer	$	732	4
Traps	$	521	3
Electrical (starter panels, service stand, meters and cables)	$	104	1
Miscellaneous equipment	$	12,280	70
LIABILITY INSURANCE	$	5,400	31
HAULING CRAWFISH	$	2,895	16
INTEREST ON OPERATING COSTS[1]	$	11,211	64
SUBTOTAL of VARIABLE COSTS	$	235,431	1,338
INCOME ABOVE VARIABLE COSTS	$	120,969	687
FIXED COSTS for land, pond construction and all machinery			
DEPRECIATION	$	60,077	341
INTEREST ON INVESTMENT	$	65,951	375
TAXES AND INSURANCE	$	4,214	24
SUBTOTAL of FIXED EXPENSES	$	130,241	740
TOTAL COSTS	$	365,672	2,078
NET RETURN ABOVE ALL SPECIFIED EXPENSES	$	-9,272	-53

Table 5. Different levels of investment required for a 131.6-water-acre farm with no substrate.

ITEM	Investment Required			
	I **Pond construction** **All machinery** **All land**	**II** **Pond construction** **All machinery** **No land**	**III** **Pond construction** **Some machinery** **No land**	**IV** **Existing ponds** **No machinery** **No land**
	($)	($)	($)	($)
LAND[1]	**140,800**	**0**	**0**	**0**
POND CONSTRUCTION				
Earth moving	274,050	274,050	274,050	0
Piping and fixtures	15,750	15,750	15,750	0
Gravel	69,315	69,315	69,315	0
Vegetative cover	1,403	1,403	1,403	0
Total Pond Construction	**360,518**	**360,518**	**360,518**	**0**
WATER SUPPLY (Well, pump, motor and outlet pipe)	**109,848**	**109,848**	**109,848**	**0**
FEEDING EQUIPMENT				
(3/4) Used truck, 3/4 ton, 4x4, feeding	5,250	5,250	0	0
2000-lb truck-mounted feeder	7,100	7,100	7,100	0
Electronic scales/printer	4,000	4,000	4,000	0
Bulk storage	1,800	1,800	1,800	0
Total Feeding Equipment	**18,150**	**18,150**	**12,900**	**0**
MISCELLANEOUS EQUIPMENT	**177,222**	**177,222**	**70,272**	**0**
HARVESTING EQUIPMENT				
Traps	15,792	15,792	15,792	15,792
Boats (14-ft., 42-in. bottom)	3,200	3,200	3,200	3,200
Outboard motors, 15 hp., 4-cycle	3,730	3,730	3,730	3,730
Boat trailers (14-in. wheels)	1,300	1,300	1,300	1,300
Total Harvesting Equipment	**24,022**	**24,022**	**24,022**	**24,022**
STOCK[2]	**31,584**	**31,584**	**31,584**	**31,584**
ELECTRICAL (starter panel, service stand, meter and cable)	**15,630**	**15,630**	**15,630**	**0**
TOTAL INVESTMENT	**877,774**	**736,974**	**624,774**	**55,606**
INVESTMENT PER WATER SURFACE ACRE	**6,670**	**5,600**	**4,748**	**423**
INVESTMENT PER LAND ACRE	**4,987**	**4,187**	**3,550**	**316**

[1]Valued at $800 per acre.

[2]100 pounds per acre.

Table 6. Estimated annual ownership costs (depreciation, interest, taxes and insurance) for a 131.6-water-acre farm with no substrate.

ITEM	I Pond construction All machinery All land	II Pond construction All machinery No land	III Pond construction Some machinery No land	IV Existing ponds No machinery No land
	($)	($)	($)	($)
DEPRECIATION[1]				
Ponds	18,026	18,026	18,026	0
Water supply (wells, pumps, motors and outlet pipes)	5,492	5,492	5,492	0
Feeding (truck, feeder with electronic scales and storage)	3,630	3,630	2,580	0
Harvesting equipment (boat, motor, trailer and traps)	2,402	2,402	2,402	2,402
Stock	6,317	6,317	6,317	6,317
Electrical (starter panels, service stand, meters and cables)	782	782	782	0
Miscellaneous equipment	23,428	23,428	10,288	0
Subtotal	**60,077**	**60,077**	**45,887**	**8,719**
INTEREST ON INVESTMENT[2]				
Land	10,641	0	0	0
Pond construction	27,246	27,246	27,246	0
Water supply (wells, pumps, motors and outlet pipes)	8,302	8,302	8,302	0
Feeding (truck feeder with electronic scales and storage)	1,281	1,281	910	0
Harvesting equipment (boat, motor, trailer and traps)	1,677	1,677	1,677	1,677
Substrate	0	0	0	0
Stock	2,229	2,229	2,229	2,229
Electrical (starter panels, service stand, meters and cables)	1,181	1,181	1,181	0
Miscellaneous equipment	13,394	13,394	5,311	0
Subtotal	**65,951**	**55,310**	**46,856**	**3,906**
TAXES AND INSURANCE	**4,214**	**4,214**	**4,214**	**4,214**
TOTAL	**130,241**	**119,600**	**96,957**	**16,839**

[1] Computed by the straight line method with zero salvage value.
[2] Average interest on investment was computed using an 11% interest rate over the life of the loan divided by the length of the loan.

Table 7. Estimated investment required for miscellaneous equipment for a 131.6-water-acre farm with no substrate.

MISCELLANEOUS EQUIPMENT	Farm and aquaculture machinery	Only aquaculture machinery	Depreciation for all equipment	Depreciation only for all aquaculture equipment
	($)	($)	($)	($)
Tractors (56-80 hp new)	25,000	0	3,571	0
(56-80 hp used)	12,500	0	1,786	0
Trucks (1/2-ton new, 4x4)	20,000	0	2,857	0
(1/2-ton used, 4x4)	10,000	0	1,429	0
Service building with office and bath (20 ft. x 40 ft.)	27,000	0	1,350	0
Office equipment	1,000	0	200	0
Computer with printer	1,000	0	200	0
Telephone	50	0	10	0
Farm/shop equipment	6,000	0	857	0
Oxygen meter[1]	2,036	2,036	407	407
Oxygen meter membrane and KCL kit	36	36	12	12
pH meter[2]	320	320	64	64
pH meter buffer solution	24	24	8	8
Paddlewheels				
Electric floating (3 hp/4.7 water acres)	59,416	59,416	8,488	8,488
Portable PTO-driven (10-in.)	7,900	7,900	1,129	1,129
6-ft. side-mount mower	4,400		880	
Waders	440	440	147	147
Hip boots	100	100	33	33
TOTAL	177,222	70,272	23,428	10,288

[1]Includes meter, 25 feet of cable and probe.

[2]Includes meter, 13 feet of cable and probe.

Table 8. Expected per acre (sum of water and land acres) net returns at four different levels of investment and different crawfish selling prices. Shaded net returns are positive.

Scenario	Selling price $/pound	I Purchase of land and machinery	II Purchase of all machinery and no land	III Purchase of some machinery and no land	IV Purchase of no land or machinery, and using existing ponds
With substrate	$1.00	**-$701**	**-$641**	**-$512**	**-$ 43**
	$1.25	**-$290**	**-$229**	**-$101**	**$368**
	$1.50	**$121**	**$182**	**$310**	**$779**
Without substrate	$1.00	**-$728**	**-$667**	**-$539**	**-$ 83**
	$1.25	**-$390**	**-$330**	**-$201**	**$254**
	$1.50	**-$ 53**	**$ 8**	**$136**	**$592**

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