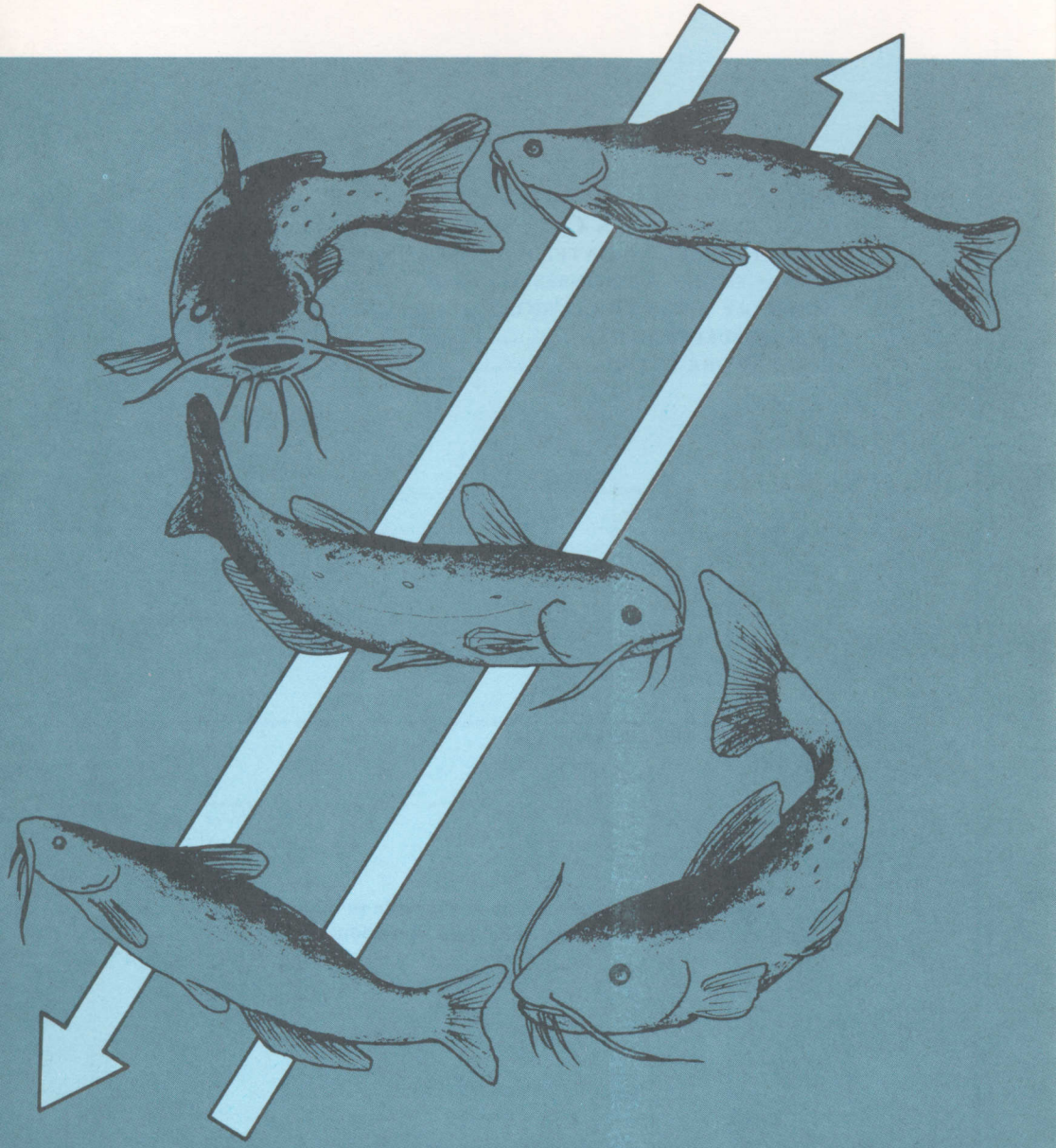
CATFISH FARMING RISKS IN ALABAMA



Circular 287 December 1986
Alabama Agricultural Experiment Station Auburn University
Lowell T. Frobish, Director Auburn University, Alabama

CONTENTS

FIRST PRINTING, 3M, December 1986

Catfish Farming Risks In Alabama

OSCAR CACHO, HENRY KINNUCAN, AND SCOTT SINDELAR[1]

INTRODUCTION

CHANNEL CATFISH farming is a rapidly growing industry in the United States, with production concentrated in Mississippi, Alabama, and Arkansas, which supplied 94 percent of the food size catfish sold in 1981 (*16*). Large processors (those with over 2,000 pounds per day capacity) handled 193 million pounds of catfish during 1985, an amount exceeding the total for the years 1978-81 (*16,17*). Over 10,000 surface acres of water were used in commercial catfish production in Alabama in 1985 (*2*).

Technology for catfish farming has also developed rapidly with industry growth. Nutritionally complete diets, improved techniques for managing water quality, and new methods of disease prevention and treatment are now available. While these advances have made it possible to increase yields through higher stocking and feeding rates, they have also increased risks associated with fish farming.

A firm engaged in any type of agricultural production faces some risks. As a relatively new type of commercial agricultural enterprise in the United States, catfish farming presents some unique risks to producers. The fact that the construction of ponds required for fish production represents a permanent change in the nature of the land gives this enterprise a highly fixed character, irreversibly committing the farm to a long term investment with restricted capital mobility (*5*). This reduced flexibility highlights the effects of other risks faced by the catfish producing firm.

The research objectives of this study were to: (1) identify the important sources of risks experienced by Alabama catfish

[1]Graduate student, Assistant Professor, and Research Associate, respectively, of Agricultural Economics and Rural Sociology.

farmers, (2) assess the economic significance of these risks, (3) identify methods farmers currently use to manage these risks, and (4) establish farmers' perceptions of problems requiring additional research emphasis.

To accomplish these objectives, an on-farm survey procedure was selected. A questionnaire was developed and pretested using industry experts located at Auburn University. The refined survey instrument contained four sections dealing with: (1) general characteristics of the farm, (2) risks in catfish production, (3) management responses to risk, and (4) socio-economic characteristics of the farmer. Fifty randomly selected catfish farmers located in western Alabama were chosen to participate in the survey. During fall 1984, on-farm visits were made to the selected participants and 29 usable questionnaires were obtained.

This report presents the results of the survey. Characteristics of the surveyed farms and risk sources, especially those specific to catfish farming, are discussed first. Following this, management responses to risk as indicated by the surveyed farmers are presented. The report concludes with a discussion of economic implications of the survey findings.

GENERAL FARM CHARACTERISTICS

Table 1 provides some general information about the farm operators interviewed and their farms. Age of the surveyed farmers ranged from 25 to 70 years, with an average of 44 years. Experience in fish farming ranged from 1 to 32 years, with an average of 8 years. Number of years of catfish production experience is less than half that of other production farmers in Alabama (*18*).

Average work off the farm on a full-time basis for the surveyed farmers was only 1 day per year. However, part-time employment ranged from 0 to 150 days per year, with an average of 12 days. Off-farm employment among catfish farmers was not as common as for other farmers in Alabama. A survey by Hanson et al. (*4*) indicated that, in general, farmers in Alabama work an average of 12 hours per week in off-farm employment, and data from the agricultural census (*18*) present a figure of 12.28 hours per week. The fewer hours of off-farm work for catfish farmers is probably because management requirements are higher for catfish production than for most other crop or livestock enterprises (6), limiting the time that the farmer can devote to other work.

TABLE 1. GENERAL FARM CHARACTERISTICS OF WEST ALABAMA CATFISH PRODUCERS, 1984 SURVEY DATA

Item	Average	Minimum value	Maximum value
Age of operator	44	25	70
Years of experience in fish farming	8	1	32
Off-farm employment, days/year			
Full-time	1	0	21
Part-time	12	0	150
Acres of land			
Owned	858	0	14,000
Rented	358	0	2,850
Shared lease	121	0	2,000
Acres in crops	183	0	2,400
Acres in pasture	563	0	4,000
Stocking density fish/acre			
Fry	96,250	10,000	200,000
Food size	3,511	2,000	5,000
Average grow-out period, month			
Fry	9	4	16
Food size	11	6	18
Size of fish			
At stocking, inch	5.1	4	8
At harvesting, pound	1.1	0.8	2
Production, pound/acre	3,155	1,000	6,000
Form of business organization, percent			
Individual proprietorship		55.0	
Family partnership		31.0	
Other		14.0	
Water source, percent			
		Yes	No
Creek or river		7	93
Spring		17	83
Well		38	62
Wastershed		90	10
Other		14	86

Farmers interviewed owned an average of 858 acres of land, with acreage ranging from 0 to 14,000. Crops and pasture averaged 183 and 563 acres, respectively. According to the Agricultural Census (*18*), farmers in Alabama own an average of 315 acres; Hanson et al. (*4*) reported an average of 392 acres and Williams (*19*), in a 1982 survey of Alabama fish farmers, reported a figure of 478 acres. Since the sample for this survey is relatively small, the one farm with 14,000 acres greatly affects the mean (the median is only 80 acres). Removal of this observation reduced average farm size to 391 acres of land owned, a figure more comparable with data from other sources.

Farmers interviewed stocked an average of 96,250 fry per acre for fingerling production and 3,500 fingerlings per acre for food fish production. Average fish size at stocking was 5.1 inches and the weight at harvest was 1.1 pounds. The average growing period was 9 months for fry and 11 months for food fish; average production was 3,155 pounds per acre, ranging

from 1,000 to 6,000 pounds per acre. According to Jensen (*6*), experienced producers stock about 3,000 fish per acre. Because lower stocking rates reduce risks of losses to oxygen depletion and diseases, a stocking rate of no more than 2,000 fish per acre is appropriate for inexperienced farmers. Stocking rates reported in the survey ranged from 2,000 to 5,000 fish per acre, indicating producers have gained experience and confidence during the last several years and have increased stocking rates accordingly.

Fifty-five percent of the farmers used individual proprietorships as their legal business form, 31 percent used family partnerships, and the rest were organized as other partnerships or corporations. Availability of water is a key factor in determining the feasibility of a fish farming operation. The best source of water for catfish farming is a well, which reduces wild fish, flooding, pesticides, and muddiness problems (*15*). According to Jensen (*6*), areas with a combination of flat bottom land, good clay soils, and sufficient ground water are uncommon in Alabama. As a result, most catfish are grown in hill ponds, which typically depend on a watershed as the main source of water. In this survey, 90 percent of the farmers used watersheds as a source of water and 38 percent used well water as a supplement to watershed runoff as the primary water source.

SOURCES OF RISK IN CATFISH FARMING

Surveyed farmers were asked to indicate the degree of importance of different sources of risk in their operation, table 2. The scale of importance ranged from 1 (not important) to 5 (extremely important).

Relative entropy[2] is used as a measure of the degree of agreement in the answers. When entropy takes a value of 0, there is perfect consensus and when the value is 1, there is no consensus. Since this measure is not linear and because the numerical values will be affected by the number of response categories, the entropy value as well as the frequency of responses should be evaluated before drawing a conclusion.

---

[2]Relative entropy is calculated with the formula:

$$E = \frac{SUM(P_i \times \ln P_i)}{\ln(1/N)}$$

where: E = relative entropy, P_i = percent responding to ith category, N = number of response categories, and ln = natural logarithm operator. (Source: Frey, (3).)

TABLE 2. SOURCES OF RISK IN CATFISH PRODUCTION AND THEIR IMPORTANCE TO WESTERN ALABAMA FARMERS, 1984 SURVEY DATA

Source	Frequency of response[1]					Relative entropy[2]
	1	2	3	4	5	
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	
Rainfall variability	11	3	36	14	36	0.84
Freezes	59	14	18	9	0	.69
Other climatic factors	26	19	33	11	11	.94
Diseases and pests	10	4	41	14	31	.85
Commodity prices	3	11	18	11	57	.76
Cost of operator inputs	0	10	24	28	38	.81
Cost of capital equipment	22	26	15	22	15	.99
Availability of loans	29	21	13	8	29	.94
Cost of credit	19	12	19	15	35	.96
Use of leverage	23	14	27	9	27	.96
Leasing	41	18	12	23	6	.89
Changes in technology	26	21	26	21	5	.94
Government commodity programs	35	6	24	6	29	.87
Federal and state laws and regulations	22	26	26	13	13	.97
Inflation	4	15	23	19	39	.89
World economy situation	8	36	24	12	20	.92
Personal safety and health	8	8	34	19	31	.90
Family plans	9	26	26	22	17	.96
Hired labor	20	30	40	5	5	.84
Theft	25	14	32	7	22	.94

[1]The scale of importance goes from not important (1) to extremely important (5).
[2]The entropy value indicates degree of agreement, 1 = no consensus, 0 = perfect consensus.

Climatic factors other than rainfall variability did not seem to be an important source of concern for the majority of the farmers interviewed and there was general agreement that freezes are not an important source of risk. In the case of rainfall variability, even though the entropy value is relatively high (due to the same high percentage of response in two different categories), 86 percent of the farmers ranked this factor from moderately important to extremely important. Considering that watersheds were the water source for 90 percent of the farmers, a greater level of agreement would be expected. A closer look at the data reveals that of the farmers who reported watershed as a source of water, 37 percent had a well and 19 percent had a spring in addition to the watershed, which reduced their dependence on rain water.

Diseases and pests were considered moderately important by 41 percent of the farmers, and 31 percent reported this to be an extremely important source of risk. In total, 86 percent of the farmers responded in the range from moderately important to extremely important. (Risks related to diseases are evaluated in more detail in a later section.)

There was considerable agreement among the surveyed farmers that changes in prices received due to supply and demand factors (commodity prices) is an important source of risk. Only 3 percent of the farmers ranked it as not important. The risk represented by fluctuating prices of operating inputs had a higher entropy value than commodity prices. Each farmer identified this risk as being important, and 90 percent ranked it in the range from moderately to extremely important.

There was high disagreement among the surveyed farmers concerning the importance of unexpected variation in (1) machinery and land prices (cost of capital equipment), (2) availability of funds from lending institutions, (3) cost of credit, (4) vulnerability of cash flows and credit worthiness due to high leverage, (5) family plans, and (6) theft of farm equipment and crops.

Risk represented by changes in availability and terms of leasing farm land was ranked by 41 percent of the farmers as not important and only 6 percent regarded it as being extremely important. For the farmers who answered the survey, 24 percent did not own land, 45 percent owned all the land they managed, and the remaining 31 percent both owned and rented land. Thus, the land tenure structure may explain why a relatively large number of farmers were not concerned with this source of risk.

Answers concerning the importance of changes in technology showed high disagreement, with only 5 percent of the respondents ranking it as extremely important. A relatively uniform distribution existed for the rest of the response categories for this question.

There was some disagreement regarding the impact of government commodity programs and federal and state laws and regulations, but the responses seemed to be closer to the nonimportant side of the scale, especially for federal and state laws and regulations.

Inflation was considered to be an important source of risk for the farmers interviewed, with 81 percent of the responses in the moderately important to extremely important range.

The importance of the world economic situation and personal safety and health as a source of risk showed high disagreement, but in both cases only 8 percent considered them to be unimportant.

Finally, the risk of unexpected changes associated with labor appears to be relatively unimportant to Alabama catfish farmers, with only 5 percent identifying it as being extremely important. This is probably due to the fact that catfish farming tends to be capital and management intensive as opposed to labor intensive.

SPECIFIC RISKS IN CATFISH PRODUCTION

Surveyed farmers also were asked to rank the importance of diseases, oxygen depletion, and off-flavor as sources of losses in their operations, table 3, using the same scale of importance as in the previous section.

Diseases

In egg production, there was disagreement among the farmers regarding the risk of disease. Equal numbers identified this source as not important and extremely important, although most producers considered disease as moderately important. The disagreement in the response is probably due to the nature of egg production where preventive measures and cleanliness in the hatchery building can prevent most disease problems. The distribution of the answers may indicate the range of management techniques among the farmers surveyed. For fry and fingerling production and for food fish, the majority of the answers regarding disease ranged from moderately important to highly important, with few farmers identifying it as not important. Fry and fingerling production involves a more variable environment (ponds) than hatcheries

TABLE 3. IMPORTANCE OF DISEASES, OXYGEN DEPLETION, AND OFF-FLAVOR AS PERCEIVED BY WESTERN ALABAMA CATFISH FARMERS, 1984 SURVEY DATA

Item	Frequency of response					Entropy[2]
	1	2	3	4	5	
Rank the importance of the following factors as causes of loss in your operation.[1]	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	
1. Diseases						
(A) Egg production	18	9	46	9	18	0.87
(B) Fry/fingerlings	7	0	35	29	29	.79
(C) Food fish	8	4	38	12	38	.82
2. Oxygen depletion	3	7	14	14	62	.71
3. Off-flavor	8	11	8	8	65	.70
Which risk causes the greatest financial loss in your operation?	Diseases 32		Oxygen depletion 25		Off-flavor 43	

[1]/The scale of importance goes from not important (1) to extremely important (5).
[2]/The entropy value indicates degree of agreement, 1 = no consensus, 0 = perfect consensus.

and represents higher risks, which probably accounts for the variability of response.

Oxygen Depletion and Off-flavor

Entropy values were lower for oxygen depletion and off-flavor than for diseases, indicating a higher level of agreement among producers. The majority of the farmers identified each as extremely important (62 percent for oxygen depletion and 65 percent for off-flavor). When asked which source caused the greatest loss in their operation, the farmers ranked off-flavor in first place (43 percent), followed by diseases (32 percent) and oxygen depletion (25 percent). The greater loss attributed to off-flavor may be due to the fact that the other problems are relatively easy to solve. Emergency aeration can circumvent oxygen depletion, and a number of treatments are available to prevent and cure diseases. At present, however, there is no cost-effective method for preventing or eliminating off-flavor. In 1971, several large-scale processors reported that over 50 percent of the fish tested from different ponds before harvest contained such intense off-flavor that harvesting was postponed (*12*). Surveys of Mississippi farmers in 1985 revealed that 20 percent of the annual inventory of food-size fish could not be harvested because of off-flavor(*13*). Since off-flavor is not permanent and will eventually disappear, catfish farmers generally leave the fish in the ponds and wait for the off-flavor to disappear, but this can take several months (*10*). An alternative is to hold the fish in clean water for a few days before selling them. Lovell (*9*) found that most of the off-flavor can be removed after 6 days when the fish are held in clean water at a temperature of 74°F or above, but since the fish were not fed during that time, a weight loss of between 5 and 12 percent occurred. Thus, these alternatives are costly and can cause cash-flow problems.

Estimated losses due to disease problems, off-flavor, and oxygen depletion for the 1981 through 1983 crop years are shown in table 4. The percentage of farmers who reported losses to diseases and off-flavor increased from 1981 to 1983, while the percentage reporting losses to oxygen depletion remained relatively constant over the 3 years. Financial losses associated with off-flavor appear to be steadily increasing in importance. When the percent of total loss for each year is considered, off-flavor caused 16 percent of the reported losses

TABLE 4. MONEY LOST TO DISEASES, OXYGEN DEPLETION, AND OFF-FLAVOR BY WESTERN ALABAMA CATFISH FARMERS IN 1981, 1982, AND 1983, 1984 SURVEY DATA

Year and cause of loss	Percent reporting loss	Total reported loss	Average survey loss	Percent of total loss	Surveyed farmers reporting loss			Average survey loss (constant 1967)[1]
					Average	Minimum	Maximum	
		Dollars	*Dollars*	*Pct.*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1981								
Diseases	28	44,300	1,528	20.9	5,538	100	30,000	558
Oxygen	24	135,000	4,655	63.6	19,286	1,000	75,000	1,701
Off-flavor	14	32,950	1,136	15.5	8,238	50	30,000	415
Total		212,250	7,319					
1982								
Diseases	38	128,250	4,422	53.7	11,659	100	60,000	1,536
Oxygen	21	49,500	1,707	20.7	8,250	500	20,000	593
Off-flavor	24	60,950	2,102	25.6	8,707	50	30,000	730
Total		238,700	8,231					
1983								
Diseases	52	35,400	1,221	23.2	2,360	100	10,000	418
Oxygen	28	61,800	2,131	40.5	7,725	200	20,000	730
Off-flavor	28	55,450	1,912	36.3	6,931	50	30,000	655
Total		152,650	5,264					

[1]Calculated using the June CPI for the appropriate year.

in 1981, 26 percent in 1982, and 36 percent in 1983. This increase in the frequency and importance of off-flavor may be due in part to the fact that farmers are using higher stocking and feeding rates, which can impair water quality and promote the development of odor-producing organisms which are believed to be responsible for some types of off-flavor (*1*).

Total undeflated dollar losses for the group of surveyed farmers amounted to $212,250 in 1981, $238,700 in 1982, and $152,650 in 1983. On average, individual farmers in the survey group lost, in undeflated dollars, $7,319 in 1981, $8,231 in 1982, and $5,264 in 1983. Although it cannot be determined from the survey what the actual impact of the dollar losses were to total farm revenues for the surveyed group, in light of the importance the farmers placed on these risks, the impact is probably large for those affected. In this regard, table 4 also includes average, minimum, and maximum losses for surveyed farmers who actually sustained a loss to these three problems. Among farmers reporting losses, the amount lost was relatively concentrated among the farms. For example, of the $32,950 reported lost due to off-flavor in 1981, $30,000 was reported by one farmer. Similarly, nearly half of the $128,250 lost to diseases in 1982 was sustained by a single farmer. Losses from these problems are not distributed equally among those affected, thereby increasing the perceived risk.

The last column in table 4 shows the average loss reported in constant, 1967 dollars providing a more accurate picture of the relative movements over the survey period. No obvious trend is indicated and the figures for all three problems differ widely each year. These fluctuations in average dollar losses add to the uncertainty and probably contribute to the perceived degree of risk of these problems for fish farmers.

Although off-flavor was perceived by the surveyed farmers to cause the greatest financial loss, this was not the case in any of the 3 years. Total dollar losses due to disease or oxygen depletion were higher in all cases. A possible explanation was indicated previously. Off-flavor losses represent an increasing percent of the total amount lost, and while disease and oxygen depletion can be remedied with existing technology, there is still uncertainty regarding causes and effective treatments of off-flavor. This uncertainty may increase the risk perceived by fish farmers. Add to this that off-flavor is usually not identified until harvest, at the "last minute," and the anxiety felt by farmers regarding this problem is understandable. This

uncertainty highlights the need for a better understanding of off-flavor and potential cost-effective remedies.

Farmers were asked to rank in order of importance the three diseases causing the most problems in their operations, table 5. Bacteria in general and columnaris in particular were the most important diseases, followed by "no blood disease." Parasites also were important, but most farmers ranked them in second or third place. Stress caused by handling, low dissolved oxygen, and overcrowding is commonly known to increase the susceptibility of fish to bacterial infections. Some of these stressful situations are produced with high stocking and feeding rates, creating an ideal environment for development of columnaris which can cause explosive disease buildups in susceptible fish. In overcrowded conditions, it has caused mortalities of up to 70 percent among the young and most susceptible fish (*14*). The cause of "no blood disease" is unknown. The disease is characterized by extremely anemic fish and is caused by a drop in blood cell volume to 85 to 97 percent of the volume in healthy fish. Most cases of "no blood disease" in 1983 were reported in Alabama, with several in Georgia. However, the disease has not been an important problem in the Mississippi Delta where catfish production is heavily concentrated. The cause of this geographical difference is not known, but Lovell (*11*) speculates that the pattern of occurrence indicates that an environmental factor is involved.

The most common treatment of fish diseases in Alabama appears to be copper sulfate, with potassium permanganate

TABLE 5. DISEASES CAUSING MOST PROBLEMS IN CATFISH PRODUCTION AS RANKED BY WESTERN ALABAMA FARMERS, 1984 SURVEY DATA

Disease	Frequency of response by ranking[1]		
	1	2	3
	Pct.	*Pct.*	*Pct.*
Columnaris	27	22	0
Bacteria	20	7	0
No blood	20	14	11
Parasites	7	22	56
Ich	7	0	11
Aeromonas	7	7	0
Brown blood	6	0	0
E. ictaluri	6	0	0
Fungus	0	7	0
Hamburger gill	0	7	0
Trichodina	0	14	0
Trichophrya	0	0	22

[1]Indicates the order of importance in which farmers mentioned a particular disease.

second and medicated feed third, table 6. All survey respondents regarded the treatments as effective, table 7.

Farmers also were asked to give recommendations on areas of research needed to help them control risks in catfish production. Results in table 8 indicate that farmers regard research on off-flavor as the most needed (45 percent), while research on diseases (17 percent) and on oxygen depletion (10 percent) were considered of lesser importance. One farmer commented that solving the off-flavor problem would only highlight the marketing problem that producers are facing with limited and fluctuating demand. However, Kinnucan (7)

TABLE 6. MOST COMMON TREATMENTS USED FOR FISH DISEASES BY WESTERN ALABAMA CATFISH FARMERS, 1984 SURVEY DATA

Treatment	Frequency of response by ranking[1]		
	1	2	3
	Pct.	*Pct.*	*Pct.*
Copper sulfate or copper	36	44	23
Potassium permanganate	23	32	11
Medicated feed	23	6	22
Karmex	5	6	11
Antibiotics	5	0	11
Salt	4	6	0
Lime	0	6	11
Malachite green	0	0	11
Other	4	0	0

[1]Indicates the order of importance in which farmers mentioned a particular treatment.

TABLE 7. EFFECTIVENESS OF TREATMENTS USED FOR FISH DISEASES AT DIFFERENT PRODUCTION STAGES AS PERCEIVED BY WESTERN ALABAMA CATFISH FARMERS, 1984 SURVEY DATA

Production stage	Frequency of response by ranking[1]					No response
	1	2	3	4	5	
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Egg production	0	0	30	20	10	40
Fry/fingerlings	0	0	25	17	25	33
Food fish	0	0	16	44	24	16

[1]From not effective (1) to extremely effective (5).

TABLE 8. RECOMMENDATIONS FOR AREAS OF RESEARCH GIVEN BY WESTERN ALABAMA FARMERS TO HELP THEM CONTROL RISKS IN CATFISH PRODUCTION

Research area	Response
	Percent
Off-flavor	44.8
Diseases	17.2
Marketing	10.3
Oxygen problems	10.3
No answer	13.8

found that, in general, the demand for catfish at the farm level is price elastic. This means that an increase in quantity supplied by farmers will increase revenues for the industry as a whole. Solving the off-flavor problem, therefore, would result in a larger supply of catfish which would be beneficial for the industry.

MANAGEMENT RESPONSES TO RISK

A number of methods used by some farmers to deal with risk are presented in table 9, along with responses concerning the perceived importance of such methods to surveyed farmers.

TABLE 9. MANAGEMENT METHODS USED BY FARMERS TO DEAL WITH RISK, AND THEIR IMPORTANCE TO WESTERN ALABAMA CATFISH PRODUCERS, 1984 SURVEY DATA

Management method	Frequency of response[1]					Relative entropy[2]
	1	2	3	4	5	
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	
Enterprise diversification	4	12	4	42	38	0.77
Geographic diversification	41	12	12	23	12	.91
Production practice diversification	38	22	17	16	17	.99
Maintaining feed reserves	26	22	4	22	26	.93
Spreading sales	8	13	22	22	35	.93
Forward contracting	20	7	13	33	27	.93
Use of future markets	13	13	13	48	13	.88
Market information	12	4	16	40	28	.87
Government commodity programs	39	22	0	11	28	.81
Hail insurance	92	0	8	0	0	.17
All-risk crop insurance	61	8	0	23	8	.65
Maintaining financial reserves	4	14	9	23	50	.81
Holding inventory reserves	36	7	29	14	14	.91
Holding credit reserve	12	6	6	17	59	.75
Debt management	26	5	11	11	47	.83
Utilize government credit programs	58	0	0	17	25	.60
Maintain flexibility in farm organization	9	18	14	27	32	.94
Idling production capacity	32	16	0	31	21	.84
Pacing of investments and expansion	5	5	10	15	65	.68
Off-farm activities by operator	22	11	0	6	61	.65
Off-farm activities by family members	23	24	0	15	38	.83

[1]The scale of importance goes from not important (1) to extremely important (5).
[2]The entropy value indicates degree of agreement, 1 = no consensus, 0 = perfect consensus.

There was relatively close agreement among surveyed farmers that enterprise diversification is a good risk-reducing strategy; only 4 percent of the respondents ranked it as not important. Geographic and production practice diversification show disagreement in the responses, but both seem to gravitate towards the non-important side.

There was some disagreement concerning the importance of spreading sales to stabilize prices and to approach the average price during the marketing period, but only 8 percent of the farmers identified this strategy as not important compared to 35 percent identifying it as extremely important.

There was no agreement among farmers concerning the importance of maintaining feed reserves to offset drought or other unfavorable conditions and the importance of the use of forward contracting.

Farmers were about equally split on using future markets to stabilize commodity prices, but 74 percent of them identified this strategy in the range from moderately important to extremely important. Use of market information to improve knowledge of expected prices showed some agreement, with 84 percent of the farmers identifying it in the range from moderately to extremely important.

The strategy of maintaining eligibility for government loan, price support, and income programs was ranked by 61 percent of the farmers in the non-importance side (1 and 2) and the remaining 39 percent ranked it in the importance side (4 and 5).

There was general agreement that hail insurance and all-risk crop insurance are not important risk management techniques in catfish farming.

Maintaining financial reserves was an important risk prevention technique for the farmers interviewed, with 50 percent ranking it as extremely important and only 4 percent noting non-importance. There was disagreement concerning the importance of holding inventory reserves, with 36 percent ranking it as not important and 14 percent ranking it as extremely important. There is agreement that limiting borrowing to have a credit reserve is a good management strategy, with 59 percent of the farmers identifying it as extremely important. There was some disagreement concerning the importance of debt management, but 47 percent of the farmers qualified it as extremely important as opposed to 26 percent qualifying it as not important.

The entropy value concerning the importance of maintaining flexibility in farm organization was high, indicating disagreement. Nevertheless, only 9 percent of the farmers ranked organizational flexibility as not important and 32 percent ranked it as extremely important.

The entropy values for (1) the importance of becoming eligible for government emergency credit programs; (2) the ability to idle acreage, livestock production, or other productive capacity with changes in operating capacity; and (3) the importance of off-farm activities by family members were all low due to the presence of zero values in some of the response categories. Nevertheless, the opinions were divided evenly, indicating disagreement on these issues.

The strategy of pacing investment and expansion to avoid becoming over-extended shows good agreement, with 65 percent qualifying it as extremely important and only 5 percent noting non-importance.

Usefulness of off-farm employment as a risk reduction technique showed a high degree of agreement, with the majority of the farmers qualifying it as important and only 22 percent as not important.

Purchase of used instead of new machinery appeared to be a relatively important strategy used by catfish farmers in Alabama, table 10, with 86 percent qualifying it from moderately to extremely important. Ability to delay machinery purchases during low income years was qualified by 61 percent

TABLE 10. INFORMATION CONCERNING THE USE OF MACHINERY BY CATFISH FARMERS IN WESTERN ALABAMA, 1984 SURVEY DATA

Question	Frequency of response by ranking[1]				
	1	2	3	4	5
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Purchase of used machinery to reduce machinery ownership and interest costs.	7	7	19	30	37
Ability to delay machinery purchases during low income years.	9	9	4	17	61

	Average	Minimum value	Maximum value
What share of your machinery tends to be purchased used? (percent)	57	0	100
How much do you save by purchasing used instead of new machinery? (percent)	44	25	75
What is the average age of your tractors and combines? (years)	11.2	0	40

[1]Ranking is from1 (no importance) to 5 (extremely important).

of the farmers as extremely important. The role of used machinery in catfish production can be seen on the second part of table 10. An average of 57 percent of the machinery owned by the farmers interviewed was purchased used. Producers estimated a savings of 44 percent, on average, by purchasing used rather than new machinery. The average age of tractors and combines of respondents was 11.2 years, suggesting long-term usage of farm equipment by catfish farmers.

SUMMARY AND CONCLUSIONS

Farmers in Alabama's major catfish production area were surveyed in the fall of 1984 via on-farm visits to determine the nature of risks associated with this farming enterprise. Results indicated that two production-related problems—fish diseases and oxygen depletion—and two marketing-related problems—off-flavor and fluctuating commodity prices—are the major sources of risk currently faced by the industry. Between 1981 and 1983, average losses due to off-flavor, disease, and oxygen depletion were estimated to range from $5,200 to $8,200 annually per farm in undeflated dollars. In 1981, one surveyed farmer lost a reported $75,000 to oxygen depletion alone. Although farmers indicated some confidence in their ability to control problems associated with disease and oxygen depletion, less confidence was evident relative to off-flavor prevention. When asked to give recommendations on areas of research needed to help control risks in catfish farming, respondents reported that research on off-flavor (45 percent) is most needed, while research on diseases (17 percent) and oxygen depletion (10 percent) was deemed of lesser importance.

Useful strategies in coping with the unique risks associated with catfish farming included seeking off-farm employment to supplement farm income, diversifying the farm operation into other enterprises such as livestock and grain production, and careful planning of machinery and equipment purchases to avoid becoming over-extended financially. In regard to the last item, most surveyed farmers agreed that purchasing used rather than new equipment and the ability to delay machinery purchases during low income years are especially effective risk management strategies.

Catfish farming is a management intensive, risky venture. These facts must be considered and weighed carefully by those wishing to enter the industry and by bankers who extend

credit to the industry. As the farm-raised catfish industry matures and new techniques for managing risks are developed, it is probable that the risk in catfish farming can be reduced. In the meantime, the importance of risk factors to the financial success of catfish farming in Alabama must be appreciated and understood before resources are committed to this venture.

ACKNOWLEDGMENTS

Alex Bocek, former graduate student in the Department of Agricultural Economics and Rural Sociology, took major responsibility for the design, conduct, and implementation of the survey. Appreciation is expressed to W.A. Rogers, Department of Fisheries and Allied Aquacultures, Auburn University, for his assistance in developing and refining the survey instrument and to the catfish producers who gave unselfishly of their time by participating in the survey. The survey instrument used in this study is adapted from the one developed by the S-180 regional research group to analyze farming risks nationwide. Financial support for this research was provided in part with funds made available by the Department of Fisheries and Allied Aquacultures.

LITERATURE CITED

(1) BROWN, S.W. AND C.E. BOYD. 1982. Off-flavor of Channel Catfish from Commercial Ponds. Trans. Am. Fish. Soc. 111:379-383.

(2) DANTZLER, MARSHALL L. AND R.L. JEFFERSON. 1985. Alabama Catfish Growers Survey Oct. 1, 1985. Ala. Crop and Livestock Reporting Service. Ala. Dept. Agr. November.

(3) FREY, BRUNO. 1984. "Consensus and Dissension Among Economists: An Empirical Inquiry." American Economic Review. 74(5):986-994.

(4) HANSON, G.D., H. KINNUCAN, AND D. OTTO. 1986. Tax Management Costs in Agriculture: Evidence from Iowa and Alabama. North Central Journal of Agricultural Economics. Vol. 8. No. 1.

(5) _____, N.R. MARTIN, JR., AND J.B. FLYNN. 1984. Production, Price and Risk Factors in Channel Catfish Farming. Southern Journal of Agricultural Economics (July):173-182.

(6) JENSEN, J. 1981. Channel Catfish Production in Ponds. Alabama Cooperative Extension Service, Auburn University, Alabama. Circular ANR-195.

(7) KINNUCAN, H. 1986. Demand and Price Relationships for Commercially Processed Catfish with Industry Growth Projections. *In* Auburn Fisheries and Aquaculture Symposium. R.O. Smitherman and D. Tave (eds.): Alabama Agricultural Experiment Station, Auburn University (in press).

(8) _____, AND G. SULLIVAN. 1986. Monopsonistic Food Processing and Farm Prices: The Case of the West Alabama Catfish Industry. Southern Journal of Agricultural Economics. Vol. 18.

(9) LOVELL, R.T. 1979. Flavor Problems in Fish Culture. *In* R. Pillay and W. Dill (ed.) Advances in Aquaculture. Fishing News (books) Ltd., London.

(10) _____, 1983a. Off-flavor in Pond-cultured Channel Catfish. Wat. Sci. Tech. Finland 15:67-73.

(11) _____, 1983b. "No Blood Disease" in Channel Catfish. Aquaculture Magazine. Nov.-Dec.

(12) _____, AND L.A. SACKNEY. 1973. Absorption by Channel Catfish of Earth-musty Flavor Compounds Synthesized by Cultures of Blue-green Algae. Trans. Am. Fish. Soc. 102:774-777.

(13) Mississippi Crop and Livestock Reporting Service. 1985. Catfish: Mississippi Catfish Growers Survey. January, April, July, and October.

(14) POST, G.W. 1983. Textbook of Fish Health. TFH Publications, Inc. Canada.

(15) Soil Conservation Service. 1982. Catfish Farming. Government Printing Office. Washington, D.C.

(16) U.S. Department of Agriculture. 1982. Aquaculture Outlook and Situation. ERS, AS.3. April.

(17) _____, 1986. Catfish. Crop Reporting Board. Statistical Reporting Service. Washington, D.C. January.

(18) U.S. Department of Commerce. 1984. The 1982 Census of Agriculture State Report: Alabama. Washington, D.C.

(19) WILLIAMS, STELLA B. 1983. Groundwater Demands Associated with Catfish Production in West-Central Alabama. Unpublished Ph.D. Dissertation, Auburn University, Auburn, Alabama.