

The Costs of Regulations on US Baitfish and Sportfish Producers

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Abstract

The US regulatory environment has been characterized as complex due to the greater than 1300 laws promulgated at local, state, and federal levels. Recent declines in the growth rate of US aquaculture have been attributed, in part, to a complex, overlapping, and inefficient regulatory framework. This study is the first to examine this question by quantifying the farm-level regulatory burden and its economic effects in an aquaculture industry sector. A survey was conducted of baitfish and sportfish producers in the 13 major production states in the USA to identify the direct and indirect costs of regulation on producers. Survey responses captured 74% of the national volume of baitfish and sportfish production. The data revealed that only 1% of total regulatory costs are direct costs of regulation, such as license and permit fees, while 99% of the costs are due to manpower used for compliance, farm changes to remain in compliance, and sales lost without replacement. Costs due to regulations varied across states and farm sizes. Across all respondents, average total regulatory costs were found to be \$148,554/farm, or \$7383/ha. The farm-level cost to the US baitfish and sportfish industry was estimated to be in excess of \$12 million. On 38% of the farms, the cost of regulations exceeded the value of profits on baitfish and sportfish farms. Our findings confirm previous reports of the complexity of the regulatory environment. Results show that the total regulatory burden has increased farm-level costs and restricted access to markets, thereby reducing profitability and contributing to reduced growth of the US baitfish and sportfish industry.

KEYWORDS

baitfish, economics, regulations, sportfish

Although aquaculture production has grown rapidly across the world (5-yr average rate of growth of 6.5% in metric tons of production from 2000 to 2014), the US 5-yr average annual growth rate has been consistently less than that of the world since about 1990 (Fig. 1). In fact, Figure 1 shows a negative growth rate of US aquaculture since 2010 that indicates a decline in the total volume of US aquaculture production, despite the availability of abundant land, water (both freshwater and marine), capital, and research infrastructure (National Science and Technology Council 2014).

Economists have long recognized that the existence of various types of externalities

requires some form of governmental regulation to maintain the quality of life desired by its citizens. However, there is increasing evidence that the stringency of a country's regulatory environment can affect the rate of growth of aquaculture. For example, government regulations were found to reduce technical efficiency in Norwegian salmon production (Asche and Roll 2013), presumably reducing economic competitiveness of the sector. In an explicit comparison across a variety of developed and developing countries, the stringency of a country's regulatory environment was found to have a statistically significant and negative effect on the growth of aquaculture in that country (Abate et al. 2016). The USA was found to have the third most stringent set of environmental

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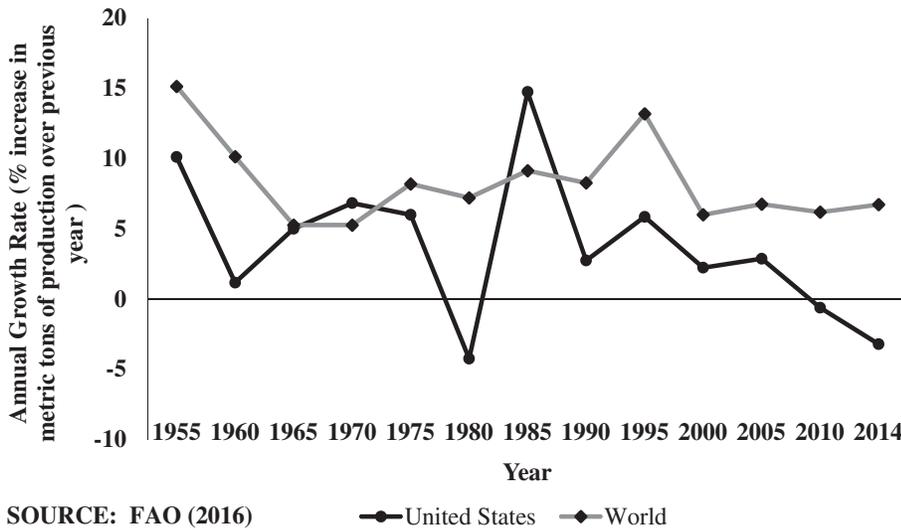


FIGURE 1. Growth rate of US and world aquaculture.

regulations and the second-lowest aquaculture growth rate of the 95 countries included in the study.

The US regulatory environment consists of over 1300 state and federal laws that directly affect the aquaculture sector (Engle and Stone 2013). Calls for relief from regulatory obstacles to aquaculture in the USA date back many decades and can be found throughout aquaculture trade magazines (see, e.g., Anonymous 1979 and Gibson 1979). Thunberg et al. (1994) recognized regulatory barriers to aquaculture more than 20 yr ago. To be clear, the relief that aquaculture producers seek is not to abolish all regulations but rather to reduce what producers report to be redundant, duplicative, and inefficient regulatory compliance measures.

Effects on the growth of aquaculture derived from the US regulatory framework have been found to include: (1) reduced competitiveness with lower-priced imports not subject to the same level of regulatory and enforcement stringency; (2) obstruction of marine aquaculture business development due to the lack of a clear regulatory framework for marine aquaculture; (3) delays in business implementation due to redundant and overlapping regulations across local, state, and federal regulatory agencies; and

(4) time and manpower expended on compliance with the total set of regulations faced by aquaculture businesses rather than innovation and efficiency (Engle and Stone 2013; Kite-Powell et al. 2013). Engle and Stone (2013) and Engle (2016) explicitly called for detailed, comprehensive analyses of the specific cost effects of the regulatory compliance burden on aquaculture businesses.

Although there is an existing body of literature on the cost of regulations in other segments of agriculture in the USA (e.g., Hurley and Noel 2006), no such studies have been conducted for aquaculture. It should be noted that this study is not questioning whether there should be regulation of aquaculture; rather, it seeks to measure the magnitude of the regulatory cost burden that results from the total set of regulations and compliance activities as currently implemented on US aquaculture farms. As the first such effort, this study aims to quantify the cost of the regulatory compliance burden on one sector of the US aquaculture industry, that of baitfish and sportfish. Specific objectives of this study are (1) to identify the number and types of regulations affecting US baitfish and sportfish producers and (2) to estimate the average regulatory cost burden per farm, per hectare, and across the industry.

Materials and Methods

A survey was designed to measure on-farm costs of the total set of regulations faced by US baitfish and sportfish producers. The top 13 baitfish- and sportfish-producing states in the USA were included in the survey (Table 1). While budget constraints precluded a national survey, these states represented 81% of the baitfish and sportfish industry by volume (USDA 2014). The survey was designed as a census of all baitfish and sportfish producers in the top 13 producing states.

Contact lists of baitfish and sportfish producers in each state were obtained from state extension specialists, state aquaculture coordinators, state aquaculture associations, and other state agencies to develop the list frame for the survey. Telephone calls were made to verify that entries on the list were active baitfish and sportfish producers; those that were not were removed from the list frame.

Questions were formulated to collect descriptive information about each farm, farm production costs, marketing costs, sales, permits and license information, changes due to regulations, and manpower required to comply with regulations. Estimates for manpower cost were developed based on reported time spent by employees on regulatory compliance activities. In cases where salary information was reported by respondents, a percentage of the salary corresponding to the percentage of time spent on regulatory compliance was assumed to be the manpower cost of compliance. In cases where no salary was reported, a respective state average wage was tabulated and verified with existing literature on labor wages. Many respondents reported lost sales as a consequence of various regulatory measures. Most respondents were able to estimate the monetary value of their lost and foregone sales as a result of regulatory measures. These were not hypothetical markets, but the loss of markets previously served by respondents for which producers could not replace sales (i.e., they were unable to sell those fish elsewhere). In instances where lost sales were acknowledged, but no estimate was given, a respective state average of lost sales per hectare

was used. A section of the survey was dedicated to fish health and interstate transport regulations, and another section was dedicated to veterinary services and fish health regulations. Reliability of survey responses was monitored using the test–retest method and construct and face validity through pretesting (Litwin 1995).

The questionnaire was distributed through mail and e-mail to the state lists of baitfish and sportfish producers from October 2014 to February 2015. The mails sent were followed up by telephone call reminders as well as personal visits to farms. Follow-up activities lasted from November 2014 to the end of August 2015. The majority (85%) of the survey was accomplished by the senior author who traveled to farms to conduct direct personal interviews.

Response Rates

The overall response rate was 34% of baitfish and sportfish producers in the targeted states, with an overall coverage rate of 74% of the national production volume of baitfish and sportfish (Table 1). Refusals were obtained through mail, e-mail, or telephone communication with producers. The response rate is likely underestimated because, despite repeated efforts, follow-up contact was never established with a number of individuals. Those names remained on the list frame, but it is likely that some percentage of them were not in baitfish or sportfish production.

Survey responses were coded and entered into a spreadsheet (Microsoft Excel) that allowed for sorting and calculations. The total costs of regulations were calculated farm-wise and per hectare for each state with sufficient responses to protect confidentiality of individual responses. There were too few respondents in Florida, Illinois, Texas, and Kansas to report statewide averages. Responses from these states were averaged into an “Other” category and included in the calculations of national estimates. Survey responses were also tabulated based on farm sizes identified by the following breakpoints in the data on water surface area in production: (1) “large” (>202 ha), (2) “medium” (202 to 20 ha), and (3) “small” (<20 ha) farms.

TABLE 1. *Baitfish and sportfish survey response rates.*

State	List frame ^a		Refusals No.	Completed surveys No.	Response rate %	Coverage rate ^b %
	No. of farms	% of production				
Alabama	6	1.6	1	5	83	2
Arkansas	28	60.3	1	25	89	67
Florida	4	0.3	0	1	25	0
Illinois	5	4.3	2	1	20	1
Kansas	6	0.1	0	1	17	0
Louisiana	3	0.0	2	0	0	0
New York	8	0.4	1	5	63	0
North Carolina	21	1.1	2	3	14	0
Ohio	36	6.2	2	9	25	2
Pennsylvania	19	0.6	2	6	32	0
Texas	28	2.0	0	1	4	0
Virginia	4	0.0	0	0	0	0
Wisconsin	7	3.6	0	3	43	2
Total	174	80.6	13	60	34	74

^aList frame for this study consisted of the list of bona fide baitfish/sportfish producers identified in the states included in the study.

^bPercent of production represented in survey results.

Results

Characteristics of Baitfish and Sportfish Farm Respondents

The average size of baitfish and sportfish farm respondents varied by state (Table 2). Farm sizes ranged from 347 ha/farm in Arkansas to 5 ha/farm in New York and in Pennsylvania; nationally the average farm size was 156 ha. According to the farm-size distribution identified in this study, large farms constituted 27% of all respondent farms, medium farms 27% of respondents, and small farms 47% of respondents. All large farms were located in Arkansas, and a substantial percentage of medium farms were located in Arkansas as well. The small farm category included the greatest number of different states.

The majority (70%) of respondents indicated that they ship live fish to other states (Table 3). A small number of respondents (10%) also shipped live fish internationally in addition to shipping to other states. In contrast, less than a quarter of respondents (22%) shipped live fish only within their state. On average, respondents shipped to 10 states, with Arkansas respondents exhibiting the greatest average number of states shipped to (18) and New York, North Carolina, and Ohio the lowest average number of states shipped to (2).

All large farms (>202 ha) shipped to other states and shipped to an average of 21 states (Table 3). A total of 6% of large farms also shipped to international destinations. A total of 88% of medium farms (202 to 20 ha) shipped to an average of 10 different states. Smaller proportions (12%) of medium farms shipped fish only within their state or shipped fish internationally. Small farms (<20 ha) exhibited the highest proportion (36%) of producers who shipped fish only within their state and shipped, on average, to only three other states. Nevertheless, nearly two-thirds of all small farms shipped live fish to other states.

Challenges to the Farm Business

Respondents were asked to identify the greatest challenge to their farm business. A total of 30% of respondents ranked "Regulatory Issues" as their first or second greatest challenge, followed by "Labor" by 28% of respondents, and "Feed Costs" by 22% of respondents (Fig. 2). In addition to this, nearly half of all respondents (48%) indicated that regulations had resulted in unexpected changes on their farm to remain in compliance (Fig. 3). The exact nature of these changes varied per respondent, but examples included changes in permit or

TABLE 2. *Farm characteristics of baitfish and sportfish producer respondents.*

State	Average farm size (ha)	Percent (%) large farms (>202 ha)	Percent (%) medium farms (202 ha to 20 ha)	Percent (%) small farms (<20 ha)
Alabama	31	0	20	80
Arkansas	347	60	32	8
New York	5	0	0	100
North Carolina	8	0	0	100
Ohio	15	0	22	78
Pennsylvania	5	0	17	83
Wisconsin	44	0	33	67
National	156	27	27	47

TABLE 3. *Activity of baitfish and sportfish producers shipping live fish.*

State/Grouping	Ship live fish only in state (%)	Ship live fish to other states (%)	Ship live fish internationally in addition to shipping to other states (%)	Average number of states shipped to
Alabama	20	80	0	6
Arkansas	8	76	16	18
New York	60	40	0	2
North Carolina	33	33	33	2
Ohio	33	67	0	2
Pennsylvania	50	50	0	3
Wisconsin	0	67	33	5
Other states ^a	0	100	0	8
National	20	70	10	10
Large farms (>202 ha)	0	100	6	21
Medium farms (202 to 20 ha)	12	88	12	10
Small farms (<20 ha)	36	64	7	3

^aFlorida, Illinois, Kansas, and Texas are included under "Other."

license requirements, infrastructure changes on the farm such as installation of screens on water intakes/outflow, construction of fuel storage facilities, and additional record-keeping requirements. Over 60% of respondents also indicated that they had experienced opportunity costs in the form of lost sales as a result of regulations (Fig. 3), due to the combination of (1) difficulties obtaining clear instructions for how to apply for permits and (2) growing concerns of accusations and possible prosecution under the Lacey Act for paperwork violations that have resulted from overlapping regulatory authorities in some states. Only sales that were lost when a farm discontinued deliveries (and could not sell those fish elsewhere) to a state due to regulations were recorded. Thus, data on lost sales were not hypothetical, but a measure

of what had formerly been sold. In all cases of lost sales recorded in the survey, farms were not able to find alternative markets for the sales that were lost. Moreover, because the same regulations that either forced a farm out of a market or made it very risky to sell into a market prevented other farms from attempting to supply those same markets. The data set shows that other farms did not pick up sales to those states where farms reported to have lost sales.

Important components of what respondents identified as problematic regulatory issues were the need for farms to search out changes in regulations and keep track of renewal deadlines. Less than half of all respondents (43%) indicated receiving a reminder each time that a renewal was due; therefore, the majority of respondents

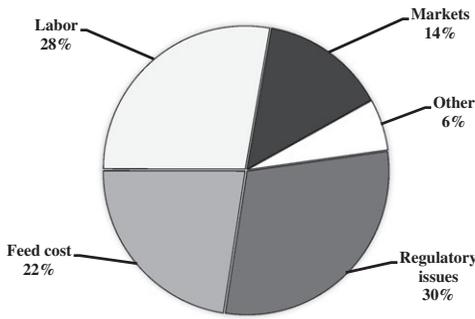


FIGURE 2. Combined greatest and second-greatest challenge to the business, US baitfish and sportfish survey, 2015.

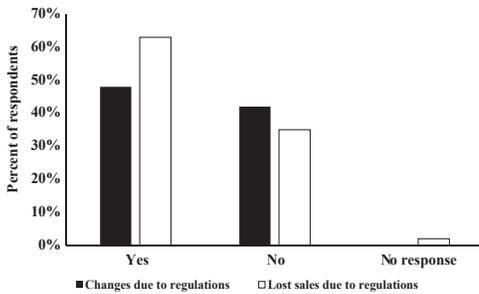


FIGURE 3. Percent of respondents who indicated that regulations resulted in either unexpected changes to their farm business or sales that were lost and could not be replaced, US baitfish and sportfish survey, 2015.

(57%) did not always receive reminders of permit or license renewals (Table 4). In fact, 25% of respondents indicated that renewal reminders were not received at least 50% of the time.² Similarly, 29% of respondents indicated that they never received notification of changes in regulations; only 24% of respondents indicated that they received notification of changes in regulations all the time. Thus, to remain in compliance, baitfish and sportfish producers had to devote time to seek out regulatory changes and deadlines for permit renewals.

Number and Type of Regulations and Annual Renewals of Permits and Licenses

The total number of different regulations reported by survey respondents was 193. Of

TABLE 4. Notification of permit renewals and changes in regulations, US baitfish and sportfish survey, 2015.

Percent of the time received (%)	Notification of permit renewals (%)	Notification of changes in regulation (%)
100	43	24
99-75	12	13
50-75	19	4
25-49	10	9
1-24	5	22
0	10	29

these, 10% were federal and 90% were state regulations. However, at least 33% of the state regulations were developed as mandated by federal statutes. Federal regulations were aligned more toward commercial trucking and department of transportation regulations (the US Department of Transportation), worker health and safety legislation (the Occupational Safety and Health Administration [OSHA]), and environmental management (bird depredation and discharge permits). In addition to those state regulations developed to enforce federal statutes, others originated from state or county agencies and regulators, and typically included items such as fish farm registrations, species permits, fish farm dealer and seller permits, import and export permits, business licenses, and tax registrations.

Baitfish and sportfish respondents identified an average per-farm regulatory burden³ of eight regulations, but the range was from 0 to 34 (Table 5). By state, the per-farm regulatory burden was greatest for Wisconsin, with 14 average regulations per farm, with a range of 7-21 regulations per farm. The smallest regulatory burden was identified in North Carolina, with three average regulations per farm, with a range of 1-5 (Table 5). The largest range of regulations was reported by producers in Arkansas, with 2-42 regulations per farm. Large farms, per farm, complied with 16 regulations, medium farms 6, and small farms 5. The ranges for large farms were between 3 and 35 regulations,

² From Table 4, 10% never received notifications, 5% between 1% and 24% of the time, 10% between 25% and 49% of the time, for a total of 25%.

³ Regulatory burden was calculated as the total number of regulations with which respondents complied divided by the total number of respondents.

TABLE 5. *Number of regulations, permits/renewals, and renewals per farm.*

State/Grouping	Number of regulations per farm		Number of state permits and licenses by farm		Number of federal permits and licenses by farm		Number of permit renewals per farm per year	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Alabama	2	1–4	3	1–13	0	0–1	4	1–13
Arkansas	12	2–42	9	1–34	2	0–6	20	1–182
New York	5	2–8	3	1–5	0	0–1	5	1–13
North Carolina	3	1–5	2	1–4	0	0	1	1–3
Ohio	5	2–8	3	1–6	0	0–1	32	1–203
Pennsylvania	4	1–15	3	1–8	1	0–3	5	1–15
Wisconsin	14	7–21	10	5–13	1	0–1	17	5–36
Other ^a	10	8–16	7	4–12	1	1	13	3–32
National	8	1–42	6	1–34	1	0–6	13	1–203
Large farms (>202 ha)	16	3–35	11	1–34	2	1–6	15	1–45
Medium farms (202 ha to 20 ha)	6	2–20	5	1–20	1	1–4	21	1–182
Small farms (<20 ha)	5	1–18	4	1–13	0	0–3	17	1–203

^aFlorida, Illinois, Kansas, and Texas are included under “Other.”

medium farms between 2 and 20, and small farms between 1 and 18.

Some regulations require specific permits or licenses. Nationally, the number of state permits or licenses averaged by farm was 6, with farms in Arkansas and Wisconsin reporting per-farm averages of 9 and 10, respectively (Table 5). Across the country, the number of federal permits or licenses was one per farm, on average, with Arkansas respondents averaging slightly higher at two per farm. Large farms exhibited the greatest average number of permits and licenses at 13 per farm (11 state and 2 federal), followed by medium farms with 6 (5 state and 1 federal) per farm and small farms with 4 (4 state and 0 federal) per farm (Table 5).

Renewals of permits and licenses ranged from 1 to 203 across survey respondents. The national average number of permit and license renewals per year was 13 (Table 5). The majority of respondents (55%) had at least 3 or more renewals per year, with 16% of respondents reporting between 4 and 10, 14% reporting between 11 and 24, 9% between 25 and 50, and 5% reporting in excess of 50 permit and license renewals per year (data not shown in tables). Large farms exhibited the lowest average number of renewals at 15 permits and licenses renewed each year (Table 5). Both medium and small farms exhibited higher average numbers of renewals, 21 and 17, respectively.

Duplication and overlap were reported as the cause of the high number of renewals by a number of respondents. Respondents reported having to submit the same sales records, shipping reports, and health certificates to multiple agencies in the same state to obtain approvals and permits to conduct business in that state. In some cases, farms were required to submit these records weekly to conduct business in a particular state. These duplicative activities add to the burden on manpower to comply with regulations.

Types of Regulations and Permits

Regulations identified by respondents were divided into five regulatory categories: “Legal and Labor Standards,” “Interstate Transport,” “Fish Health,” “Environmental Management,” and “Culture of Commercially Harvested Species” (Engle and Stone 2013). The “Food Safety” category identified by Engle and Stone (2013) was not applicable to the nonfood fish species raised for bait and as sportfish. The “Culture of Commercially Harvested Species” category had the highest number of regulations per farm across all respondents, with an average of four in total, ranging from 1 to 23 (Table 6). This was followed by the “Interstate Transport” category, with an average of two regulations per farm in total, ranging from 0 to 12. The categories “Environmental Management,” “Fish

Health,” and “Legal and Labor Standards” had an average of one regulation per farm. Examples of regulations listed under the “Culture of Commercially Harvested Species” category included farm permits and registrations, species permits, and fish dealer licenses. The “Interstate Transport” category included any commercial vehicle registrations, licenses, and International Fuel Tax Agreement (IFTA) fuel tax regulations. Regulations such as well permits, water-use permits, bird depredation, and discharge permits were grouped under the “Environmental Management” category. Regulations requiring the reporting and production of fish health certificates and testing for ploidy in grass carp were examples from the “Fish Health” category. The category “Legal and Labor Standards” included regulations related to employee safety, OSHA compliance, and migrant workers.

Annual Regulatory Cost

Survey respondents reported their annual production and marketing costs and identified which portion of those costs was incurred due to regulations. Respondents reported costs of permits and licenses, manpower to comply with regulations, fish health testing costs, costs associated with changes made to the farming operation in response to regulations, and opportunity costs associated with foregone and lost sales (Table 7).

Component Categories of Regulatory Costs. The cost of permits and licenses on a national basis was \$1916/farm, or 1% of the average regulatory costs (Table 7). It should be noted that 30% of all licenses and permits identified by respondents were free and had incurred no direct costs to farms. Manpower to comply with regulations costs, on average, were \$15,948/farm, or 11% of the total regulatory cost. Fish health testing costs were \$7250/farm, or 5% of total regulatory cost. Changes due to regulations were \$32,016/farm, or 22% of annual total regulatory cost. The greatest cost resulting from the regulatory environment was that of the opportunity costs of foregone and lost sales that cost, on average, \$85,039 per farm, or 57% of the total regulatory cost for baitfish and sportfish producers.

Component Categories of Regulatory Costs by State. The magnitude of the various regulatory cost categories varied by state (Table 8); producers in Arkansas had the highest average cost per farm for permits and licenses at \$3787/farm. The lowest average per-farm cost of permits and licenses was recorded in North Carolina (\$23/farm). The average cost of permits and licenses, as a percentage of total regulatory cost, was greatest in Alabama with 5%. Per-farm average manpower costs to comply with regulations were greatest in Wisconsin (\$29,100/farm), followed closely by Arkansas (\$26,116/farm), and lowest in Alabama (\$1643/farm). However, as a percent of total state regulatory cost, Ohio had the highest average cost of manpower (38%) to comply with regulations. Average fish health regulatory costs per farm were highest in Arkansas (\$14,557/farm), followed by Wisconsin (\$9133/farm). On a percentage basis, the “Other states” (Florida, Illinois, Kansas, and Texas) had the greatest fish health costs relative to their other regulatory costs. The average cost of changes due to regulation was also highest in Arkansas (\$64,522/farm) and Wisconsin (\$64,067/farm). However, as a percentage of total state regulatory cost, changes due to regulations were highest in “Other states” with 32%. Wisconsin, Arkansas, Pennsylvania, and North Carolina were the states most affected by lost sales per farm (Fig. 4). Lost sales reported by respondents were not hypothetical. These were sales in markets previously served by respondents who were lost due to (1) a change in regulations that prohibited those sales or (2) an increase in the complexity and redundancy (often a second or third agency requiring permits for the same condition previously handled by a single agency) of obtaining permits that created concerns over the risk of paperwork violations resulting from confusion among agencies that could lead to charges under the Lacey Act. The average value of foregone sales per farm in Wisconsin was reported at \$273,667/farm, followed by Arkansas at \$137,149/farm. The states with the lowest average lost sales per farm were the “Other states” (\$16,250/farm), Ohio (\$23,587/farm), and New York (\$24,211/farm). Lost and foregone sales represented the major

TABLE 6. Average number of regulations per farm by six regulatory categories.

Category	State		Federal		Total	
	Mean	Range	Mean	Range	Mean	Range
Culture of commercially harvested species	3	1–23	1	0–1	4	1–23
Interstate transport	2	0–9	0	0–3	2	0–12
Environmental management	1	0–7	0	0–4	1	0–11
Fish health	1	0–5	0	0–1	1	0–5
Legal and labor standards	0	0–6	0	0–4	1	0–6

TABLE 7. Average regulatory costs per farm by category, US baitfish and sportfish survey, 2015.

Category	Cost (\$/farm)	Total regulatory cost (%)
Permits and licenses	\$1916	1
Manpower	\$15,948	11
Fish health testing	\$7250	5
Changes due to regulation	\$32,016	22
Opportunity costs of lost sales	\$85,039	57
Other	\$6384	4
Total	\$148,554	100

regulatory cost component in all states except for the “Other states” group; nationally this category was responsible for 57% of the total regulatory cost. However, looking at lost and foregone sales per hectare (Fig. 5) reveals that Wisconsin (\$25,946/ha), Pennsylvania (\$12,129/ha), Ohio (\$10,144/ha), and New York (\$3902/ha) were most affected by lost sales on a per-hectare basis.

Average Regulatory Costs. When the various types of costs incurred from regulations are summed, the national average regulatory cost was \$148,554/farm, with a per-hectare cost of regulations for baitfish and sportfish producers of \$7383/ha (Table 9). By state, the greatest average farm regulatory cost was observed in Wisconsin (\$379,629), followed by Arkansas (\$260,171), North Carolina (\$52,425), Ohio (\$40,960), and Pennsylvania (\$35,741). On a per-hectare basis, Wisconsin had the highest average regulatory cost (\$34,855/ha), followed by Ohio (\$17,740/ha) and Pennsylvania (\$15,480/ha). Even in Arkansas, with the largest average farm size (347 ha), regulatory cost was \$1046/ha. On a statewide basis, regulatory costs to the industry were highest in

Arkansas (\$7.3 million), the leading producer of baitfish and sportfish in the USA, followed by Wisconsin (\$2.9 million) and Ohio (\$1.5 million). The national farm-level cost of regulations on producers of baitfish and sportfish in the USA was estimated to be in excess of \$12 million/year (Table 9).

Regulatory Costs as a Percentage of Production, Marketing, and Total Costs. Regulatory costs composed 25% of all costs (including both production and marketing costs), but this effect was proportionally different on production costs compared with marketing costs (Table 9). The regulatory cost composed 42% of production costs, but 146% of the average marketing costs on baitfish and sportfish farms nationally. Effects varied by state, with New York exhibiting the greatest percentage of total costs (61%). New York also exhibited the highest regulatory cost as a percent of marketing cost alone, followed by Arkansas, Pennsylvania, and the “Other” states (Florida, Illinois, Kansas, and Texas combined). All states, with the exception of Wisconsin, exhibited a higher regulatory cost as a percent of marketing cost alone than of production costs alone. In Wisconsin, regulatory costs as a percent of production cost alone were 176%, the highest reported in the survey, and of marketing cost alone only 58%. Respondents in Alabama reported the lowest regulatory cost as a percent of production costs alone (12%), marketing costs alone (21%), and total costs (7%).

Regulatory Costs and Farm Size. Large farms exhibited the highest average regulatory cost (\$356,513/farm), followed by medium farms (\$108,968/farm) and small farms (\$53,193/farm)

TABLE 8. Average regulatory cost per farm by category and by state, US baitfish and sportfish survey, 2015.

State/grouping	Permits and licenses		Manpower		Fish health		Changes due to regulation		Opportunity costs of lost sales	
	Value	Percent (%)	Value	Percent (%)	Value	Percent (%)	Value	Percent (%)	Value	Percent (%)
Alabama	\$1520	5	\$1643	5	\$2160	7	\$60	0	\$25,333	82
Arkansas	\$3787	2	\$26,116	11	\$14,557	6	\$64,522	26	\$137,149	56
New York	\$122	0	\$3122	10	\$2084	7	\$410	1	\$24,211	81
North Carolina	\$23	0	\$3000	6	\$1000	2	\$0	0	\$48,235	92
Ohio	\$103	0	\$15,476	38	\$934	2	\$528	1	\$23,587	58
Pennsylvania	\$521	1	\$3792	5	\$946	1	\$0	0	\$75,000	93
Wisconsin	\$1472	0	\$29,100	8	\$9133	2	\$64,067	17	\$273,667	73
Other states ^a	\$1363	3	\$7935	21	\$2175	9	\$29,625	32	\$16,250	35
National	\$1916	1	\$15,948	11	\$7250	5	\$32,016	23	\$85,039	60

^aFlorida, Illinois, Kansas, and Texas are included under “Other.”

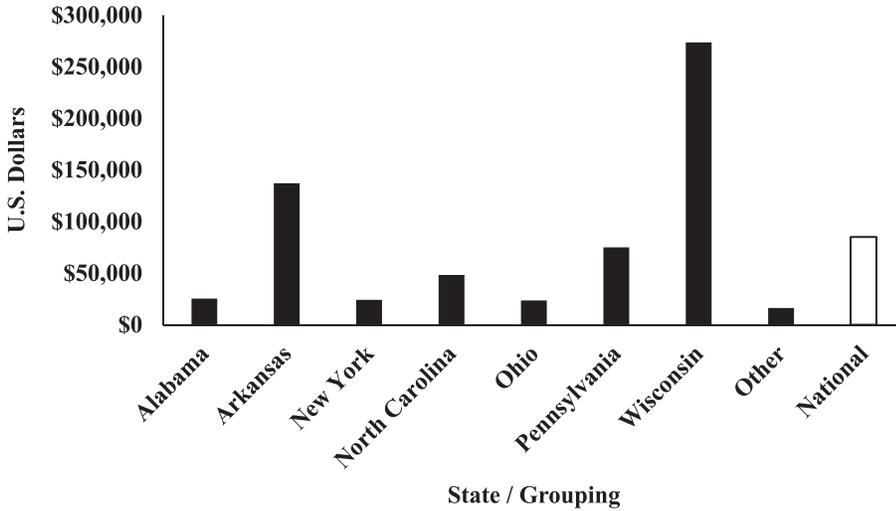


FIGURE 4. Average lost or foregone sales due to regulations, US baitfish and sportfish survey, 2015. Florida, Illinois, Kansas, and Texas are included under “Other.”

(Table 10). This trend was reversed, however, when looking at regulatory cost per hectare, with small farms exhibiting the highest average regulatory cost per hectare (\$13,914/ha), followed by medium farms (\$1778/ha) and large farms (\$794/ha). Regulatory costs as a percent of combined production and marketing costs (total costs) were lowest on large farms (16%), followed by medium farms (26%) and small farms (29%). Looking solely at production costs, a similar pattern was observed with large farms exhibiting 22% regulatory cost as a percent of production costs, medium farms 38%, and small farms 54%. As a percentage

of marketing costs the trend was reversed, with large farms exhibiting the highest regulatory cost as a percent of marketing costs (183%), followed by medium farms (173%) and small farms (114%).

Costs by Regulatory Category. The regulatory costs were further divided into the categories of laws and regulations as listed by Engle and Stone (2013). On average, compliance with regulations in the “Environmental Management” category resulted in the greatest proportion of regulatory costs (61%), despite composing only 17% of the regulatory burden faced by baitfish and

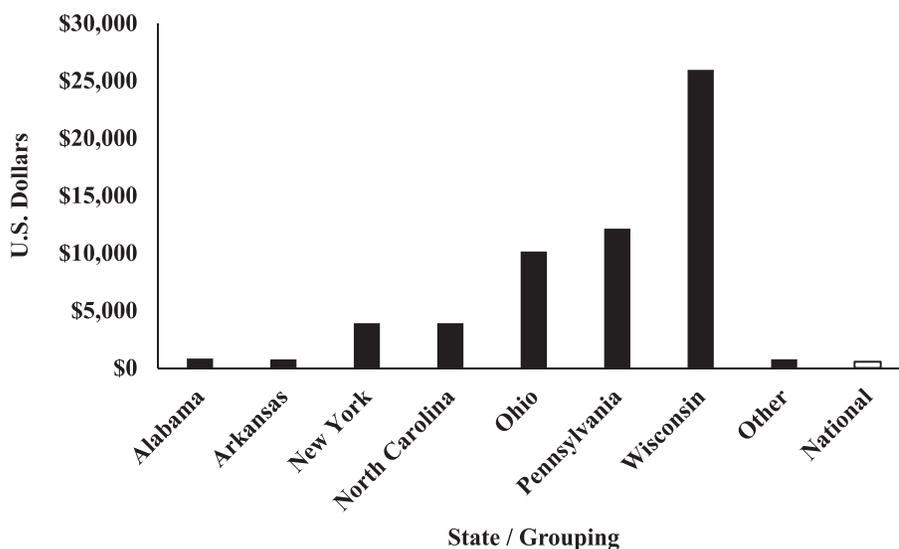


FIGURE 5. Average lost or foregone sales per hectare due to regulations, US baitfish and sportfish survey, 2015. Florida, Illinois, Kansas, and Texas are included under "Other."

TABLE 9. Cost of regulations by state and per farm.

State	Average regulatory cost per farm	Average regulatory cost per hectare	Estimated regulatory cost per state	Regulatory cost as percent (%) of total (production + marketing) cost	Regulatory cost as percent (%) of production cost	Regulatory cost as percent (%) of marketing cost
Alabama	\$30,716	\$1123	\$184,306	7	12	21
Arkansas	\$260,171	\$1046	\$7,284,781	18	25	190
New York	\$29,948	\$5632	\$239,586	61	93	225
North Carolina	\$52,425	\$4146	\$1,100,919	52	57	73
Ohio	\$40,960	\$17,740	\$1,474,569	23	34	101
Pennsylvania	\$35,741	\$15,480	\$679,075	40	47	168
Wisconsin	\$379,629	\$34,855	\$2,657,401	37	176	58
Other states ^a	\$63,558	\$6045	\$1,542,342	12	15	102
National	\$148,554	\$7383	\$12,027,128	25	42	146

^aFlorida, Illinois, Kansas, and Texas are included under "Other."

sportfish farms (Table 11). This was followed by the "Fish Health" category (20%), "Legal and Labor Standards" (14%), "Interstate Transport" (4%), and "Culture of Commercially Harvested Species" (1%). Although the "Culture of Commercially Harvested Species" had the greatest number of regulations (42%) because a fairly substantial number of permits and licenses were free (30%), this category resulted in the lowest cost. In a similar fashion, the cost of "Interstate Transport" regulations were also low (4%), despite accounting for 22% of all the regulations recorded by the survey.

Discussion

In 2003, when examining regulatory constraints for aquaculture in the northeastern region, Duff et al. (2003) concluded that aquaculture was probably "one of the most highly regulated industries in the United States." The estimated costs of regulations on US baitfish and sportfish farms, as reported by this current study, has confirmed Engle and Stone (2013) regarding the degree of importance and effect of the regulatory burden on the economics of this sector of US aquaculture. The fact that 30% of respondents indicated that "Regulatory Issues"

TABLE 10. *Cost of regulations by farm size.*

Category	Large farms (>202 ha)	Medium farms (202 ha to 20 ha)	Small farms (<20 ha)
Average farm size (ha)	484	87	5
Average regulatory cost per farm	\$356,513	\$108,968	\$53,193
Average regulatory cost per hectare	\$794	\$1778	\$13,914
Regulatory cost as percent (%) of production and marketing cost	16	26	29
Regulatory cost as percent (%) of production cost	22	38	54
Regulatory cost as percent (%) of marketing cost	183	173	114

TABLE 11. *Cost of six regulatory categories.*

Category	Percent (%) of regulatory cost	Percent (%) of number of regulations	Percent (%) of state regulations	Percent (%) of federal regulations
Environmental management	61	17	12	45
Fish health	20	12	14	3
Legal and labor standards	14	7	5	1
Interstate transport	4	22	20	31
Culture of commercially harvested species	1	42	49	3
Food safety	0	0	0	0

were their first or second greatest challenge indicates that regulatory issues are a critical problem for US baitfish and sportfish producers.

Of the various categories of regulations, those related to environmental management constituted the greatest costs for US baitfish and sportfish. Similarly, the greatest regulatory costs for California agricultural producers were found to be those of environmental management (Hurley and Noel 2006).

The costs of permits and licenses were found to compose a very small part of the total cost of regulations. Hurley and Noel (2006) similarly noted that the cost of permits for California agricultural producers was lower than other costs that farmers were required to pay. Greater costs were incurred by baitfish and sportfish farms that have resorted to increasing manpower to comply with regulations to keep track of a high number of renewals. This follows the trend observed by California agricultural producers, who reported a 40% increase in time spent on regulatory compliance over the 5-yr study interval, with labor accounting on average for their largest single farm expense (Hurley 2004). Manpower is likely underestimated in the baitfish/sportfish survey because many producers struggled to quantify time spent identifying

the appropriate offices, individuals, and forms required and to value the opportunity cost of their time.

US baitfish and sportfish farms shipped fish to nearly all states across the continental USA. Thus, their businesses depend heavily on regulations related to transporting live fish into the states where their buyers were located as well as through states en route to end markets. Thus, 86% of the regulations encountered by baitfish/sportfish producers were state regulations. However, because states are required to enforce federal statutes, a number of the state regulations were mandated by federal rules.

Sixty percent of respondents indicated that they had experienced opportunity costs in the form of lost sales as a result of regulatory complexity and a lack of clarity. The data on lost sales in the survey were measures of markets that producers had prior access to. In some instances, respondents had been directly shut out of markets in particular states or by bans instituted on the species they were producing. In other cases, producers were unable to expand their operations to increase production volume due to a regulatory constraint, such as a water-use restriction. Uncertainty of state import or transit regulations and a fear of potential federal

prosecution under the Lacey Act due to a paperwork violation also contributed to decisions to not sell to markets in states in which the regulatory processes were especially convoluted, confusing, and difficult to navigate. Respondents reported that they were not able to find alternative markets; thus, lost sales were not recouped by that particular respondent. Moreover, the study data set shows that lost sales by a particular respondent were not replaced by sales from other farms in those particular states. Thus, it is clear that the current regulatory environment has restricted and reduced access to markets for US baitfish/sportfish producers. Lost and foregone sales have more serious negative consequences for smaller-scale baitfish and sportfish producers due to economies of scale⁴ (Engle 2010), similar to findings in other sectors of agriculture (Halwart et al. 2007; Duffy 2009; Engle 2010). During their study on regulatory compliance costs in California agriculture, Hurley and Noel (2006) came to the conclusion that becoming a large producer brought with it relative cost savings by spreading regulatory costs across increased production volume. Tabulating regulatory costs from the baitfish/sportfish survey by farm size demonstrated that large farms were indeed better able to spread regulatory costs (\$794/ha) over a larger production volume when compared with the regulatory costs of \$1778/ha and \$13,914/ha identified on medium and small farms, respectively. The lower regulatory costs per hectare are indicative of economies of scale associated with the regulatory cost burden on US baitfish and sportfish farms that allow larger farms to cope more effectively with increasing regulatory costs. Thus, study results showed that regulations are not only increasing costs on baitfish and sportfish farms, but also simultaneously limiting the ability of baitfish and sportfish producers to spread those costs over an increased production volume. In effect, the current regulatory environment has created a dual negative economic effect of increased costs (which reduce profitability) and restricted market growth and expansion for US baitfish and sportfish producers.

⁴ Economies of scale exist when average costs of production decrease as the scale of the operation increases.

This evidence that regulations can result in significant lost or foregone sales reaffirms results by Dresdner and Estay (2016), who concluded that regulations aimed at limiting salmon production in Chile for biosecurity concerns proved costly in terms of foregone sales. In the case of Chilean salmon, Dresdner and Estay (2016) were able to develop estimates of “optimal” levels of regulation that would avoid excessively costly regulations in the context of biosecurity. This is in contrast to our finding that the US baitfish and sportfish industry seems to be operating under excessively costly regulatory conditions.

The number of baitfish/sportfish farms in the USA declined by 25% from 2005 to 2013 (USDA 2014). The regulatory costs estimated for US baitfish and sportfish in 2015, on average, exceeded reported per-hectare profits on baitfish farms in 1996 of \$679/ha (Engle and Stone 1996). While the number of the largest baitfish/sportfish farms remained the same from the 2005 to the 2013 Census, medium farms declined by 21% and small farms declined by 29% (Fig. 6). Although other factors may have contributed to this decline, the disproportionately greater regulatory costs per hectare for smaller farms may explain a portion of this decline. Thus, this study appears to provide microlevel farm data within one sector of US aquaculture to support the conclusions of Abate et al. (2016) that the stringency of environmental regulations in the USA has contributed to limited growth of US aquaculture.

Conclusions

The estimated total annual cost of regulations to the baitfish and sportfish industries was greater than \$12 million, with an average national cost of \$148,554/farm (\$7383/ha). These costs are relatively higher (\$13,914/ha) on small farms (<20 ha) than on medium (\$1778/ha) or large farms (\$794/ha). Such overall compliance costs are high and, in many cases, result in economic losses. The direct costs of regulation (permits and licenses) composed only 1% of the average national regulatory cost, with indirect costs making up the remaining 99%. The major components of the indirect costs of

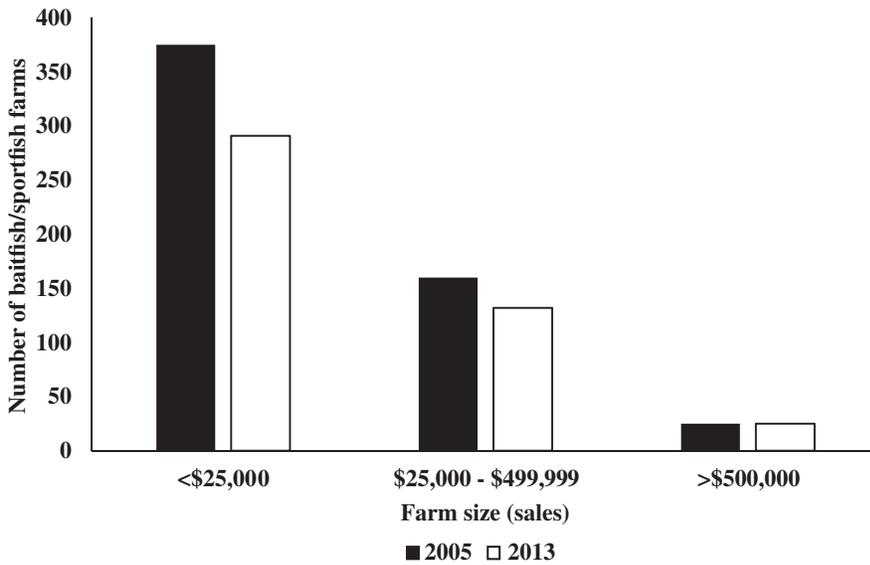


FIGURE 6. Numbers of baitfish/sportfish farms in 2005 and 2013. Source: USDA (2014).

regulation were lost or foregone sales (57%), changes due to regulations (22%), manpower to comply with regulations (11%), and fish health testing (5%).

Some farms have to contend with a high frequency of annual permit and license renewals; 33% of respondents had between 10 and 203 annual renewals. The majority of the regulatory burden is from state regulations (90%), although at least 33% of state regulations were promulgated as mandated by federal statutes. The regulatory environment, especially when considered in its total context, is clearly difficult to navigate and costly for baitfish and sportfish farmers, who spend a great deal of time attempting to identify regulatory changes, obtain application forms, and make the changes necessary to be in compliance.

While there is a general need for governmental regulations that address externalities to maintain the quality of life desired by citizens of a country, this study points to a level of regulatory redundancy across agencies and in reporting of compliance by farms that has imposed an excessively convoluted and costly business environment on baitfish/sportfish farms in the USA. There is a strong need for policy makers across the various agencies involved in regulating baitfish/sportfish

producers (local, state, and federal) to work jointly to identify ways to streamline regulatory processes, reduce duplication in both regulations and in compliance reporting, and develop easily accessible information systems to notify farmers promptly and reliably of regulatory changes.

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