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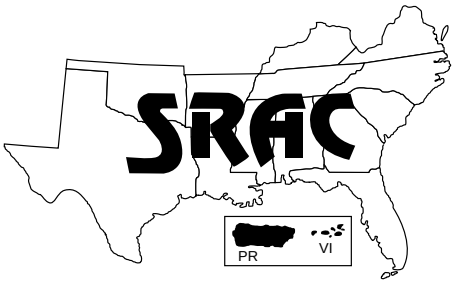


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# Guidelines for Developing Aquaculture Research Verification Programs

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Research verification trials were initiated as an Extension method to reduce the time lag between the discovery of new knowledge and its adoption by farmers (Miley, 1986). These types of trials created joint interdisciplinary research-Extension efforts on selected farm fields. The trials were designed to demonstrate and test Extension's research-based recommendations in a commercial setting, not to study current management practices.

Arkansas pioneered research verification programs in 1980. The first trials were conducted with cotton, which at the time was a crop with declining acreage and generally unprofitable yields. The cotton trials helped pinpoint needed refinements in crop production, which has increased state yield averages over time.

Today there are research verification programs for a variety of commodities, including rice, soybeans, wheat and, more recently, catfish.

Catfish research verification began in 1993 with a pilot program in four ponds in Arkansas (Heikes, 1995). Objectives of the program were to: 1) verify that current Extension recommendations could produce profitable yields; 2) estimate the cost of production for individual ponds and the corresponding feed conversion ratio (FCR), yield and survival; 3) identify research needs and update Extension recommendations; 4) develop an interdisciplinary management approach to help maximize net profits; 5) develop a protocol for future trials; and 6) provide practical field experience for Extension fisheries specialists, researchers and county Extension agents.

Cooperators agreed to manage verification ponds according to Extension recommendations for a period of 3 years. In addition to generating an excellent production and economic database, these trials also led to the development of new methods for describing fingerling populations being stocked into food fish ponds as an indirect method of estimating fish inventory, among others. Several lines of research at the University of Arkansas at Pine Bluff were initiated as a direct result of problems encountered in the verification ponds. The four ponds had an average annual marketable yield of 4,971 pounds per acre. The estimated 1996 Arkansas state average was 2,508 pounds per acre (Agricultural Statistics Board, USDA).

Specific benefits of the pilot program were: 1) identification of problem areas that required further research; 2) improved and refined Extension recommendations; 3) increased county agent expertise; 4) improved county and state level educational programs; and 5) refined management protocols for future trials.

## Infrastructure development

There are several steps involved in developing an aquaculture research verification program. The first is to develop an interdisciplinary verification committee. The committee's responsibility is to review the relevant research base, develop the specific management protocol to be followed by farmer cooperators who participate in the program, and provide technical

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advice to the verification coordinator throughout the verification program.

The management plan should be a written document that specifies both the protocol to be followed and the role of each participant. It is important to have a formal planning meeting with cooperators to review the detailed management plan. Specific responsibilities and expectations of the farmer/cooperator should be presented and discussed before making the final selection of participants. Although the plan is not a legally binding agreement, participants selected must agree to follow it.

### Developing the committee

Subject area specialists should recruit research and Extension faculty with the expertise needed for verification. Experts in production, nutrition, disease, water quality and economics may be needed; they should have balanced research and Extension expertise. The committee should include one or more county agents. An industry organization representative might facilitate communication with industry, but this individual should understand Extension methods and research-based recommendations. Annual meetings should be held to review data and protocols, particularly in multiple-year projects. Any modifications to the protocols should be made at the annual meeting.

### Summarizing the relevant research base

A review of available, pertinent research results should be conducted by all members of the committee before the verification program begins. The review should focus on evaluating the applicability of the studies to the specific objectives of the verification program. Thus, specific recommendations in the management plan are supported by a scientific knowledge base. The verification committee should meet to focus on specific materials for each aspect of production (feed management, water quality management, etc.) and to determine general areas lacking in research-based information. Researchers are encouraged to address these gaps in the knowledge base so that future management recommendations can be more complete.

### Developing management plans

Regardless of the species involved, recommendations should be based on an annual cycle subdivided into monthly activities. Recommendations should be developed by those with expertise in the area, but modified as a result of committee discussions. Committee members must understand that knowledge from other disciplines might require them to use different decision criteria to arrive at the best recommendation. For example, the feed that a nutritionist might recommend might not be the most economical one. The effectiveness of the committee lies in its ability to interact in an effective manner and jointly develop profit-maximizing recommendations.

### Selecting cooperators

The selection of cooperators is possibly the most critical step in the research verification process. Success depends on selecting cooperators who have been successful, who are perceived to be leaders in the community, and who are among the “best” producers in the region or county. New producers usually are eager to learn the best management practices and often make excellent cooperators. New producers also may demonstrate significant improvement in production, whereas farmers who are already top managers will not be able to show a great deal of improvement.

The question of offering financial incentives to cooperators often arises. Cooperators who invest their personal financial resources in the program have a greater commitment. The verification committee must be equally committed to putting together a well-researched management protocol, given that the producers’ own resources are at stake.

### Collecting data

The committee should carefully consider the types of data and frequency of data collection needed for verification. Data to be collected should include:

- production records of stocking, feeding and harvesting;
- performance measures such as yield, average size and population size distributions; and
- key production inputs such as feed, fingerlings, labor and energy.

Some water quality data may be tracked, but it is not necessary to conduct exhaustive water quality monitoring. The committee should determine specifically who is responsible for collecting and compiling each type of record (grower, county agent or subject matter specialist).

Specific culture species and production systems may require different sets of data. For example, crawfish verification may require different forms from those used for hybrid striped bass because crawfish production requires a permanent breeding population that carries over from season to season. Conditions such as time of draining, end-of-season population structure, forage production practices, and weather conditions may all be important factors when evaluating inputs and performance measures in crawfish production.

### Synthesizing data

The results of research verification must be easily understood and should be readily accessible. Data should be summarized and presented as Extension findings and

not simply as records of cooperators. A Web site maintained with current data on stocking, feeding and harvesting will likely be widely used by a broad range of stakeholders. A few graphs showing inventory harvested and yield trends will be useful. Data synthesis at the end of a verification trial should focus on the most important results. Yield (both total and marketable), feed conversion ratios, survival, and cost of production will be most important in evaluating results. More specific tables can be generated for variables such as hours of aeration, labor costs per acre, etc., as determined by the verification committee.

## Program implementation

Research verification requires that commercial ponds be intensively monitored so that the results of using research-based recommendations in a commercial setting can be documented. Intensive monitoring requires a great deal of time and travel. Starting with a pilot program is advisable. This allows the verification committee to gain experience and develop the infrastructure for verification at a reduced cost during the pilot phase.

### Frequency of farm visits

A regular schedule must be set and adhered to so that data has continuity and scheduling problems are minimized. One of the key aspects of verification is to make timely decisions on the ponds, which is not possible without frequent visits. Ponds should be visited as protocol dictates during the active growing season. In the southern region, weekly visits are suggested from March through November. Ponds should be checked at least once per month during December, January and February. Participants should, therefore, plan on at least 42 scheduled visits to each verification site. Additional visits will be necessary at stocking (generally once per pond per year) and at harvest (plan for at least three harvests per pond per year for catfish multiple-batch production). Travel funds should be budgeted for several emergency troubleshooting visits. Therefore, a verification site with only one pond could require as many as 50 visits per year. Sites with several ponds will need more stocking and harvesting visits.

### Role of county Extension agents and specialists

The relationship between county Extension agents and specialists can vary from state to state, but county or area agents typically are considered the local contacts while specialists (state or area) are highly specialized in a particular subject.

In successful verification programs, the county agent is the leader and subject matter expert. County agents must market the program effectively, be able to justify the time commitments involved to other clientele, and juggle those commitments with other programmatic responsibilities. The county agent should help identify and select cooperators because they know them. Even if the county agent is not well versed in aquaculture, he or she sustains interest and provides continuity during periods when the specialist cannot visit the verification site as planned. Verification programs are an excellent way to educate county agents in all aspects of fish culture.

It is the responsibility of the specialist to train county agents and cooperators so that they understand the production protocols that will be verified. Specialists also provide support and guidance throughout the process and ensure that protocols are followed and adjusted when necessary. All management recommendations are the responsibility of the specialist, as is the collection, archiving, analysis and reporting of production data

Ideally, the specialist, local agent and cooperating producer should meet at least briefly during the weekly site visit to discuss any management problems and to make any adjustments for the following week. It is the responsibility of the specialist to train the county agent to collect any necessary data when the specialist cannot be present.

### Role of cooperators

The role of the cooperator should not be underestimated. Without the full and active participation of the cooperator, yield verification cannot succeed. The cooperator must be able and willing to adhere to the pre-defined management and harvesting protocols before committing to the program. The cooperator must understand that additional production expenses may be incurred as a result of participating in the program and that a long-term (1- to 3-year) commitment is required. Cooperators will be expected to follow management recommendations and to work with the specialist and county agent to ensure the systematic collection of production-related data at the weekly site visit. The cooperator is expected to meet with the specialist and the county agent during the weekly site visit to provide observational data and to discuss the following week's management. The cooperator must notify either the specialist or the local agent before harvest or stocking. Most important, the cooperator must fully understand that the primary goal is not to verify his or her management style, but to verify research-based management recommendations as outlined in the protocols. All farm employees who might affect a verification pond must be trained on the importance of the management requirements.

### Production cycles

There must be starting and ending points for an aquaculture verification pond in order to calculate and summarize production data. The production cycle for fingerling production verification or single-batch production systems is straightforward because fish are stocked into a clean pond and completely harvested within 1 year.

The opposite extreme is Delta-style, multiple-batch commercial catfish production, in which ponds are in continuous production and drained only once every 6 to 10 years. In multiple-batch systems, fingerlings are not expected to grow off in 1 year and estimating inventory is a problem. Catfish verification programs to date have spanned three full production cycles to minimize the effect of the initial start-up phase. However, beginning inventory could be established with the depletion estimation technique (Engle et al., 1998). Or, mixed sizes of fish from another pond (an off-flavor pond might be a reasonable choice) could be transferred to a freshly pumped-up pond. This would establish a beginning inventory for the verification program (preferably an amount to simulate carry-over from a previous year) and would benefit the producer by purging fish. Ending inventory must be established by either seining and draining, or by the depletion estimation technique.

### Resource commitments

Successful verification programs require full commitment on the part of Extension administrators, specialists, agents and producers. All partners in the process must commit time and resources and buy in to the research verification process.

**Time.** The time required to verify the effect of aquaculture research recommendations on production varies widely and depends on the degree of cooperation of the producer, the geographic location of ponds, and the interest level of participants. Research verification is more than collecting production data and checking water quality. Educational opportunities arise during the scheduled site visits, particularly if the participant's interest level is high. Each site visit can require approximately 1 to 2 hours, with more time required for a site with multiple ponds. Approximately half the time is for collecting data and the rest is for discussing management issues and addressing other questions.

Stocking and harvesting can be quite time consuming. Seining seldom occurs as planned and much time can be spent waiting. Moreover, the specialist should expect to spend approximately an hour or 2 per week per pond on the logistics of organizing, processing and archiving data, and on coordinating schedules.

**Funding.** All production costs are the responsibility of the cooperating producer. The majority of the program funding is for travel. Additional funds should be budgeted for water quality testing equipment and supplies, sampling gear, and publications.

**Personnel.** Coordinating and conducting a research verification program involving four to six ponds most likely will be a full-time job for one person, depending on the objectives of the program and the number of people involved.

## Assessing results and benefits

The principal benefit of verification is to determine if the sum of research-based Extension recommendations produces yields, feed conversion ratios, and costs consistent with results from research trials. Researchers and Extension personnel learn whether their recommendations are valid in commercial settings and whether or not recommendations and research programs need to be adjusted. The adoption of verification practices is expected to increase industry yields. The development of the verification management plan encourages open dialogue among researchers, producers and Extension specialists.

The Southern Regional Aquaculture Center Verification Project produced a wide variety of benefits. In Alabama, the project resulted in an increased awareness of the cost of catfish production. Participating farmers paid more attention to tracking costs and maintaining water quality. One producer who normally stocked ponds at 12,000 to 15,000 fish per acre reduced stocking rates as a result of the verification program. Overall, the project demonstrated that Extension guidelines resulted in profitable production.

In Arkansas, county agents in the northeastern part of the state had had little exposure to catfish producers. Producers in this part of Arkansas had turned to non-Extension sources of information. As a result of the verification program, word spread that Extension personnel had important information and county agents have seen an increase in the number of aquaculture-related calls in their counties. One agent has asked that catfish verification be continued in his county indefinitely. The number of producers submitting disease cases to Extension Fish Diagnostic Laboratories in Arkansas has increased, indicating an increased level of trust in Extension services.

In Louisiana, the major effect of the project has been the interest of field agents in participating in a proactive program. Field agents learned much about crawfish production, such as the importance of crawfish population structure, the summer management of natural forage or rice, the effect of precipitation patterns while crawfish are estivating in burrows, proper pesticide use, and fall flooding protocols. Two of the cooperators reported learning that higher trap densities improve overall catch rate.

## Potential problems and pitfalls

Problems obtaining reliable data from aquaculture research verification projects are largely caused by misunderstandings of responsibility and procedure. Misunderstandings can be minimized with a clearly worded, detailed protocol document with which everyone agrees and in which all roles are clearly defined. Three main sources of problems are cooperator risk, the Extension agent role, and outside factors.

### Cooperator risk

Many of the problems encountered with research verification projects stem from producers' fear that they will lose money. Management protocols proposed by the verification trial may be new to the producer and could be perceived as risky. Most cooperators are understandably unwilling to take a financial risk unless some clear benefit is anticipated. To minimize risk to the producer, the verification trials should include only a small percentage of the operator's crop, or only one or two ponds per farm.

The agreement to participate in a research verification trial may be with the farm owner, while the manager is responsible for day-to-day operations on the farm. The manager may find it inconvenient to fill out data sheets on a daily basis or count and weigh dead fish. In addition, farm managers' pay may be based on a percentage of total sales, not on the profitability of the business.

One of the main economic burdens placed on the producer is the requirement to drain the pond at the beginning and end of the study. Lost production time before restocking and additional electrical costs associated with refilling the pond will increase costs. The producer must understand at the outset that it is essential to either repeatedly seine the pond or to drain it at the end of verification.

### Agent role

A verification project requires a significant commitment of time on the part of the Extension agent. District administrators should be made aware of the demanding nature of aquaculture research verification. Agents must be willing and able to make changes in their schedules to be present at unscheduled harvests or stockings to collect the necessary data. Regular visits by Extension agents are critical to encourage complete and accurate record-keeping and to answer any questions from cooperators about new management practices. Time spent on these visits is time taken away from visits to other producers and other work.

### Outside factors

It is not possible to completely quantify or verify all aspects of aquaculture production. It is especially difficult to account for the fate of all fish that are stocked. If ponds cannot be drained after final harvest, the number of fish remaining must be estimated by other means, such as using the depletion estimates (Engle et al., 1998).

It is imperative to be forthright with potential cooperators before the trials start. An agreement detailing the responsibilities of all parties should be presented to each and signed as part of a "contract" that is not legally binding but spells out clearly how the verification trial will proceed. Revisions and changes in protocols must be discussed and agreed upon by all. This will minimize any misunderstandings about responsibilities and procedures.

## Disseminating information

The methods used for disseminating the information generated by yield verification programs should fit the target audience. Commercial aquaculture producers and Extension personnel can benefit from "real-time" information for impending management decisions. Summary or "year-end" data can be used for planning subsequent production cycles and for reporting to external interests such as banks, federal agencies, or natural resource agencies.

Real-time information can be disseminated electronically through Web sites or e-mail lists. Weekly or monthly printed updates should be sent to clientele without Internet access. The appropriate background information concerning the production parameters of the study sites should be included in any presentation of the data.

Once the production cycle being evaluated is complete, summaries should be given to producers, Extension agents, administrators, infrastructure personnel, and appropriate funding agencies. Where appropriate, summary presentations should be given at commodity association meetings.

## Potential funding sources

Yield verification projects may require additional funding for travel, equipment, communication (mailing, Web page development, etc.), and salaries of seasonal or permanent employees. Potential funding sources may be categorized as either internal or external.

Internal funding sources are those within the university system, such as small, competitive grants. Once the benefits of a yield verification project have been demonstrated, administration might be persuaded to provide more permanent funding.

External sources might be the aquaculture commodity infrastructure, including producer associations, research and promotion boards, and suppliers of feed or equipment. In some states, trade association funds were leveraged with university funding to conduct the verification programs.

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