Department of Agriculture, Trade and Consumer Protection Division of Marketing Agricultural Development & Diversification Program (ADD)

Grant Project Final Report

Contract Number: 16028

Grant Project Title:

Farm Technology to Utilize Fish Processing By Products

Project Dates:
12 months July 2001 - June 2002

Amount of Funding Awarded:
$7,750.00

Name of Principal Contact Person:
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Submitted by:
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1) Describe the original intent of the grant project.

The overall objective of the proposed project was to develop a low-cost farm technology for production of fish feed pellets utilizing trout processing by-products. The specific objectives were:

*To determine by-products handling and pretreatment requirements.
*To develop a formulation that will maximize by-product utilization.
*To determine process conditions to extrude fish feed pellets using a low-cost pelletizer.
*To evaluate the physical, palatability, and nutritional attributes of the pellets.
*To calculate cost of small-scale on-farm feed production.

This was to be accomplished through a cooperative effort between the Bullfrog Fish Farm and UW-Stout and was to be a model in- "on the farm" transferring of technology. This combined expertise, networks and mutual regard of this industry/academia relationship, was to maximize results in scientific benefit, practical application, and economic focus.

- How was it projected to benefit Wisconsin Agriculture?

It was expected that by the end of this project we will be producing pellets and feeding it to fish. We would then begin to work on a final design and considerations for manufacturing and marketing this technology, making it available to other Wisconsin's fish farmers.

- Was it necessary to adjust the objectives during the project? Yes

*The reduction of funds from the original proposed ADD Grant to the eventually excepted proposal moved much or most of the "hands on" activities of feed manufacturing to the University lab. limiting farm input, experience and understanding… In hindsight this may have been best or may not have made a difference.
* This combined expertise, networks and mutual regard of this industry/academia relationship became "less than"...

2) Describe the work conducted in this project.

Adapted, installed and developed area in fish barn for 2- 60 gallon test tanks and work area… stocked tanks with trout, maintained tanks and logged information needed for study. Packaged and delivered processing by-products for fish feed manufacturing… Attended informational meetings at Stout. Networked with private sector for information and resource needs.

See attached report from David Sundal, farm's technical support person (farm Production Manager).

CONTACT- Dr. Gour S. Choudhury, Endowed Steenbock Chair,Department of Food and Nutrition College of Human Development University of Wisconsin-Stout, Menomonie, WI 54751- 0790

"RESEARCH OBJECTIVE" and "EVALUATION METHOD FOR PROJECT AT END OF YEAR"-
Applied Research Grant Proposal, University Wisconsin.

- How did the grant funds assist you in this project?

Without ADD funds the farm would not have able to afford to participate.

- What successes did you achieve with this grant project?

A pellet was made, at the University, similar in nutritional value to commercial feed using processing by-products… Again for reports contact Dr. Gour S. Choudhury

- What challenges did you face with your grant project?

The trout would not or only minimally eat the feed manufactured… Time and University Grant funds ran out so limited attempts were available to resolve situation…

3) Describe the public outreach efforts of this project.
   - What literature or educational materials were produced through this project? None

   What presentations, field days or other events were given related to this project? The Bullfrog Fish Farm is a very public and outspoken place… Its' activities, in economic development, to small farms is well known… The farm gives educational & scheduled tours at the rate of 60-80+ per year. These tours include schools, government agencies, business & professionals, farmers and general public… Many of these tours and other presentations given by the farm include a mention and promotion of this project.

   - What media outreach did you conduct through this project? Please identify specific papers or stations.

Stout arranged for a story in the Dunn County News and likely for in house publication which we have not seen…

4) Describe the results of this project.
   - Did the grant project results meet your original expectations? No Why or why not?
   - What new agricultural products, technologies or production methods were developed through this project?

     NONE

What did you learn from your grant project? What conclusions can you make? See final comment

- How will the grant results affect your business? We are further from this vision than expected…
- How will this project benefit the Wisconsin family farm? At this time none…
- What impact will this grant project have on the future of Wisconsin agriculture? At this time none…

5) How will the Wisconsin agriculture industry be able to use the information from this project? See final comment

6) Include an analysis of the information gained from this project. See final comment

7) Please include any other information you feel is appropriate.
(Examples: Samples of educational materials produced through this project
Clippings and/or audio/video tapes
What other research could be done to further this enterprise or activity?
Can an industry leader make a statement as to the value of this grant project?, etc.)

See final comment

ADDITIONAL COMMENTS:

This ADD Grant provided opportunity for the Bullfrog Fish Farm to work cooperatively and in conjunction with another grant through the University of Wisconsin. With the exception of certain supportive tasks done at the farm the **RESEARCH OBJECTIVES, ACCOMPLISHMENTS or "EVALUATION METHOD FOR PROJECT AT END OF YEAR" REPORTS** were to be the same. Again the University Report has not been made available to me nor have I been asked to collaborate on the task… The specifics of accomplishments will be better listed and understood when the report is completed or received. The farm will likely have additional comments at this time…

In the meantime and in order fulfill the requirements of this Grant I can report in general terms- A method has been developed to manufacture a trout feed on farm that is similar in nutritional value to commercial feed and made from fish processing by-products…

Issues not resolved by study are palatability, floating ability, phosphorus/water quality, fat content, labor/cost, viral contamination and machine…An appreciation and awareness for what has been accomplished by feed manufacturers over the last decade has been heightened… Better conversion rates and solutions or advancements to issues mentioned above have been improved significantly. Farm manufactured feeds from processing by-products will need to keep up or equal these improvements… A machine that will accomplish modern standards in feed quality and behavior will need to be replicated or downsized from existing technology- This investment may change the economic strategy to a higher initial investment and longer pay back situation than originally anticipated by this project.

While the full expectation of this project was not realized… it is a start. To accomplish this task would bring needed profits to small farms and processors by maximizing value of product raised, contribute to the local community and empower small farms to define or manipulate its' products. Sometimes the best attribute of an idea is the idea that follows…

To manufacture feeds that may be considered organic, sustainable or to manipulate flavors etc. carries the possibilities creating "signature" products for a farms' market niche…

Fish Farming in Wisconsin is generally a "marginal practice," our farms are relatively small and can not afford to be reliant only on the technology of a larger industry. Innovations in all aspects and all sizes will need to be developed and practiced in order to compete or increase profits. This farm technology should eventually be developed and contribute by significantly reducing the feed cost, the farms 2nd highest cost in production, and by eliminating the costs associated with the disposal of fish by-product or "waste".

The following and attached report is from-

David Sundal, farm's technical support person (Farm Production Manager).

Fish Feed Study Comparing Commercial Feed Verses A Formulated Feed

By David Sundal- Bullfrog Fish Farm, Production Manager

Purpose

Fish feeding is probably the most important task a fish culturist needs to understand in order to raise fish efficiently. Factors like temperature, dissolved oxygen, other water quality parameters, time of day, time of year, density levels and fish health all are closely related to feeding.

There are several types of feeds available to the fish culturist. Live feeds such as insects, worms and other fish are often used for certain species of fish, however, in intensive trout, catfish, and sunfish culture prepared commercial feeds are most often used. These commercial feeds are often made with fish meal, soybean, and several other additives to create a feed that meets the nutritional requirements of the fish. These feeds also have been "fine tuned" to help the fish culturist better manage feeding by creating feeds that float or sink depending on the best application for a desired species.

Currently commercial feeds are a major expense to many small fish farmers. Most fish feeds are made in large factories using ocean fish and many of these factories are located near states with some of the largest fish farms. Small farmers in other states must have this feed shipped long distances and at a great expense.

Many food producing fish farms have on-site processing facilities. With the processing of these fish comes "waste" in the form of viscera, bones, heads, fins, etc. This waste is usually between 40-60% of what is raised. Several options are available for use of this high protein by-product. In this paper we will be exploring the option of converting this "waste" into fish feed.

Objectives

The objectives of this study are to help develop a recipe that is similar in nutrition, palatability and floatability of the commercial feeds and to develop a machine and simplified method to create this feed on a smaller scale for on-site production of fish feed. The hope is that by utilizing this technology on a smaller scale fish producers are able to save money and be able to use the by-products of fish processing to raise fish.

The factors we hope to eventually determine with this research are:

1) Determining by-product handling and pretreatment requirements
2) Developing a formulation to maximize by-product utilization
3) Outline process conditions to extrude fish feed pellets using low cost pelletizer

4) Evaluation of the physical, palatability and nutritional attributes of this feed compared to one commercial feed.
5) Calculate costs of small-scale on-farm feed production.
6) Analysis of waste creation between the two feeds (Nitrogen, Phosphorous, Etc.)

The overall project covers the above aspects. This paper will discuss all of these but will focus primarily on the evaluation of the physical, palatability and nutritional attributes of this feed compared to one commercial feed. Due to time, money and fish behavior many questions we had hoped to obtain are still unanswered.

Materials and Methods

Feed formulation

The waste by-products from the processing of Rainbow Trout (Kamloop strain) from the Bullfrog's "Eat My Fish" Farm have been analyzed for protein, ash, and other nutrients through University of Wisconsin Stout under the direction of Dr. Gour Choudhury. From the data a recipe and method for creating this feed was developed. Eventually this will include cooking the fish meal to desired temperature in order to destroy any possible bacteria, viruses, parasites and other pathogens to ensure there is no spread of disease.

Fish Husbandry

Sexually immature female Rainbow Trout of the Kamloop strain were stocked in two aquariums. The tanks are 60 gallons each with measurements of 48"x15"x18". Each tank has an inflow and outflow of one gallon per minute and each is setup with an air stone measuring 12 inches.

Fish were fed on the normal farm schedule, for this size fish, once in the morning and once in late day Monday through Friday and once on Saturday morning. Fish are fasted Saturday nights and Sundays.

Each tank was initially stocked with fifty fish with an average size of 6.17inches or about 4.5 lbs per tank. These fish were about one year old, and have been fed Silver Cup commercial trout feed since swim-up.

After a short adjustment period the fish in one tank were switched from the commercial feed to the formulated feed. The fish in the other tank remained on Silver Cup trout feed.

Results

At first when we started feeding the formulated feed to these trout they took to it and seemed to eat it just as they had eaten the Silver Cup. Then within three days the fish seemed uninterested in the formulated feed. Some fish would take a pellet into their mouth then spit it out whereas others would ignore the pellets altogether. As a result these fish were not eating and growth rates dramatically declined and we knew something else had to be done.

As fish farmers our initial concern was in the palatability of this feed. This feed had a very different smell than the silver cup and we suggested changing the type of fish oil added to the recipe.

After three weeks of trying to see if these fish would get hungry enough to eat we decided to start over again armed with a new feed formulation and a new batch of fish.

These fish averaged the same size but this time we only stocked 40 in each tank.

This new feed had similar results, the fish would eat for two or three days then show little or no interest in the feed. We switched gears and instead of trying to compare the two feeds we were just trying to find a feed formulation that these fish would eat and keep eating. Altogether at least six different feed formulations were tried.

Our next idea was to restock the tanks with smaller fish that had not been eating the Silver Cup commercial feed for a year. We stocked each tank with fingerlings with an average size of 1 inch. The formulated feed was in pellet form so we had to grind it to a size these fish could eat. The results looked good for awhile; these smaller fish were eating the formulated feed well and seemed to be growing on it. However, within a month it was apparent these fish were not growing as fast as those feeding on the Silver Cup in the other tank. From there we suggested looking into the protein and fat content of the formulated feed compared to the Silver Cup.

We had hoped to keep working on solving this and finding out what could be done to increase the levels of fat and/or protein, however UW-Stout had run out of funding or had other problems that made us unable to go any further with this research.

Conclusions

In intensive aquaculture there are many unanswered questions that a fish farmer has to try and make educated decisions about. This feed study has shown us that fish don't necessarily eat anything offered to them even if it has the nutritional requirements they need. Palatability is a major factor to consider when developing a feed. To be more palatable to the fish we tried changing the fish oil in the recipe as well as other ingredients. The smaller fish may have taken to the formulated feed better than the six inch trout because they have not been used to eating the commercial feed for a year. Other fish farmers we spoke to had seen similar results when changing from one commercial feed to another but usually they would take to a new feed within a few days.

Another factor that surely has merit in mentioning is the system used to create the feed. In large commercial fish feed factories an extrusion process is used in which the ingredients are crushed and mixed then are baked at high temperatures and pressures to create a floating feed. The formulated feed we obtained through UW-Stout was manufactured on a much smaller scale using a different process to create a floating pellet.

It is very possible if the recipe or recipes we used were made into feed using an extrusion process the fish may have eaten it more readily.

While trying to figure out why these fish would not eat the formulated feeds we learned about many other factors in creating and feeding fish a formulated feed of any kind. One mention

was to be aware of the phosphorous levels in the feed that will be utilized by the fish. If there is too much unusable phosphorous in the feed this will affect the water quality in your system. Also since we are planning on using our fish by-products to create this feed we want to make sure there is no chance of passing any diseases onto our fish. What we hope to still figure out is how our method for creating this feed will ensure that any pathogens are destroyed before any risk of spreading a disease occurs.

In our attempt to figure out the answers to many of our questions we found a feed company that is creating a fish feed that is almost entirely free from fish meal. Their "vegetarian feed" is made mostly of soy products and contains just enough fish oil to be palatable to fish. This company has given us 150lbs of this feed and we are currently in the process of setting up a tank to see if this feed is a viable option to our current feed.
We will be looking at growth rates, water quality, and flavor of these fish over the next few months.

Although the results we had hoped to obtain through this study were not seen through, we still hope that someday we will be able to continue on our quest to create a fish feed made on site using our fish processing by-products. This opportunity has surely taught us many new things and has enabled us to see more clearly what types of obstacles we are dealing with. Fish farming is a somewhat new field of agriculture and there are many unanswered questions and concerns that make it hard to be profitable. If all goes well there still may be a chance that The Bullfrog Fish Farm or another interested party will go further with a project like this so the small farmer can be less dependent on feeds manufactured from outside fish sources and use their own fish wastes in a sound way, in hopes of saving the wild stocks of fish used in making feeds and utilizing all of what a farmer is producing.

Submitted By: ____Herby Radmann_ Date: Oct 14 2002_____

Farm Technology to Utilize Fish Processing By-products

Gour S. Choudhury

Objectives of the project:

The overall objective of the project was to develop a low-cost farm technology for production of fish feed pellets utilizing trout processing by-products. The intent was not to become a fish feed manufacturer, but to reduce/eliminate the quantity of feed purchased from commercial producers by maximizing by-products recovery and utilization. The feeds produced will be utilized in the farm without complicating issues of packaging, distribution and marketing. Such a system will improve profitability by reducing feed cost, and will alleviate by-product disposal problems.

Results of the project:

The process for on-farm production of fish feed from trout processing by-products has been developed. The fish feeding trial is continuing. The process for fish feed production is simple and consists of five steps:

- Heat treatment of the trout processing by-products in a pressure cooker
- Grinding of the heat treated by-products
- Mixing with other dry ingredients
- Extrusion to form pellets
- Drying of the pellets

Relationship of the project to the Wisconsin economy:

The Wisconsin trout farmers market approximately 50% of the harvest. The other 50%, consisting of heads, viscera, frame, and trimmings, is mostly disposed as waste/by-product. The solid by-products are as high in protein as the fillet, and current disposal methods result in a loss of valuable nutrients. This study developed a resource recovery system that will eliminate/reduce by-product disposal cost and increase utilization of harvested catch. The farm technology will help fish farmers in the state to reduce the production cost and improve profitability. We plan to work with Wisconsin Aquaculture Association to inform all farms in the State of Wisconsin about the availability of this technology.