Teaching Plan:

Module: Saltwater Shrimp - Section D

Problem Area Growing Out Shrimp

Estimated Time: 5-10 hours

Goal: The goal of this problem area is to understand how to care for shrimp in a growout system.

Learning Objectives: Upon completion of this problem area, students will be able to:

describe environments where shrimp are cultured
describe type of post-larvae needed for stocking
explain factors related to stocking rates
explain what shrimp eat and how they are fed
list factors related to growth rate
explain environmental parameters critical to shrimp culture
discuss how to manage a shrimp pond
discuss how shrimp are harvested and marketed
discuss diseases and parasites that affect shrimp

Resources: The following instructional resources are needed to complete this problem area:

Essential:

Copies of the slides and transparencies.

Practical Manual for Semi-intensive Commercial Production of Marine Shrimp, by Villalon, J.R., Texas A &M University, Sea Grant College Program, Publication #91-501, 104 pp., 1991.

Recent Advances in Aquaculture, by Muir, James F. & R.J. Roberts, Westview Press, Boulder, CO.

Pond if available. (An indoor raceway can also be used, but management of raceways will not be covered in this module.)

Additional:

Handbook of Shrimp Diseases, by Johnson, S.K., Texas A&M University, Sea Grant Publication #90-601, 25 pp., 1989.

Proceedings of the Special Session on Shrimp Farming, Editor, Wyban, J.W., The World Aquaculture Society, Baton Rouge, LA., 301 pp., 1992.

CRC Handbook of Mariculture (2nd ed.), Editor, McVey, J.P. CRC Press, Boca Raton, FL, 526 pp., 1993.

Principles and Practices of Pond Aquaculture, Editors, Lannan, J.E. et al., Oregon State University Press, Corvallis, OR, 252 pp., 1986.

Water Quality in Warmwater Fish Ponds, by Boyd, C.E. Auburn University, AL, 359 pp., 1979.

Contents and Procedures

Preparation (Interest Approach):

To develop student interest in this module, propose the following situation with your students. A man phones you, the teacher, and asked if your class would like to have some live shrimp. He is the manager of a shrimp farm and knows that your class is studying new and emerging agricultural technologies. To keep from offending him, you agree to take the shrimp. He tells you that he will deliver them to the school in 3 weeks. You hang up the phone and realize that you know nothing about raising shrimp and you should have refused the contribution.

Now that you have agreed to take the shrimp, what is your class going to need to know to keep the shrimp alive? What are the questions that need answering? Answers should include the following: What do shrimp eat? How much do they eat? What kind of facility will be needed to house them? What water quality is required? What temperature do they require? Ask the class: Where do we find the answers? (Books, periodicals, producers, researchers, and experiences of others are suggested answers.) In this module, you will learn how most shrimp are cultured, and recent developments.

Presentation:

A. What are the different environments in which shrimp are cultured?

Show TM D1 and discuss culture systems (ponds, etc.). Show slides #1-#4, shrimp ponds. Show #5, shrimp raceway culture in Hawaii, and #6, shrimp culture inland, closed recirculating system.

1. Worldwide, the most common way shrimp are cultured is in pond systems.
   a. After pond systems, tanks and raceways are used.
   b. Many producers and researchers are experimenting with indoor, intensive, closed recirculating systems.

2. If an intensive system, such as tanks, raceways, or indoor systems, is to be used it must have the following characteristics:
   a. Smooth interior, self-cleaning, ability to supply high-water quality, made of nontoxic material and easily sterilized if needed.
   b. Low construction cost, good feed distribution, water flow, and adaptable to various stages of growth of the shrimp.

3. As explained earlier, shrimp exist naturally in brackish water in the tropical regions of the world. When they are cultured, it is most often through pond systems with extensive, semi-intensive, or intensive management techniques.

Show slide #7, comparison of extensive, semi-intensive, and intensive cultures.

4. From the standpoint of commercial production of shrimp ponds, a semi-intensive stocking density and management level are most common, which is a middle ground or center of the road approach between both ends of the spectrum.

B. What type of post-larvae should be procured for stocking?

Show TM D2 and discuss post-larvae for stocking.

1. The best post-larvae (pl) to stock in ponds, raceways, or tanks have proved to be the most active, with good color, observed with full guts, clean shells, and good muscle development.
2. SPF, or High Health, post-larvae should be obtained if possible. (Permits must be obtained for exotics.)

C. At what rates are shrimp stocked in the various growout systems?

Show TM D3 and discuss rates shrimp are stocked at in various growing systems. Leave slide #7 up for this.

1. Stocking rates for shrimp will vary according to the type of growout system they will be placed in.
   a. In pond systems, stocking rates range from 5,000-500,000/ha (approximately 2,300-220,000/acre).
   b. Some producers stock nursery ponds at 2,000,000 pl/ha (approximately 1 million/acre) and after 1 month they transfer juveniles to growout ponds of considerably larger size.
   c. Most U.S. producers stock growout ponds at 150,000-200,000/acre and manage the ponds using intensive management techniques (increased water exchange, aeration etc.).

2. In systems other than ponds, it is difficult to determine average or recommended stocking rates.
   a. Much research is being conducted on this subject and the best answer lies with each specific system being used.
   b. Some producers suggest that in tanks the rate is about 100 pl/m^3 up to 1,000 pl/m^3.
   c. 5,000-6,000 pl/m^3 has been attempted but the lower stocking densities have proven more successful.

3. The question is not really how many shrimp can be stocked in a given system, but rather what is the most economical stocking density for the system employed and the level of management used.
   a. For tank systems, the question is how much feed can be fed on a daily basis without destroying water quality.
   b. When the stocking density is increased in a pond, the existing natural food supplies are depleted faster and water quality is stressed.
   c. Shrimp do not react well to stress and often develop secondary infections as a result of stress.
   d. They do respond well to good management and good nutrition. The limiting factor often is DO (dissolved oxygen), followed by ammonia toxicity.

D. What do shrimp eat, how is feeding managed by the farmer, and how are they fed?

Show TM D4 and discuss the nutrition of shrimp.

1. In a low stocking density situation (300 lbs/acre) there often is enough natural food for shrimp to survive.
   a. They eat diatoms, plankton, and/or detritus.
   b. On a dry weight basis, natural food can contain about 55% protein.
   c. To encourage natural food growth, ponds are often fertilized with organic and/or inorganic fertilizers.
   d. Researchers and producers have not agreed as to the amount of fertilization necessary or desirable. Research is being conducted on this subject.
   e. As the stocking density is further increased, not enough natural food is available and supplementary feeding becomes necessary.

2. Shrimp post-larvae can be weaned from *Artemia* to crumbled starter food (higher protein level than adult growout diet).

Show slide #8, shrimp feed label. Show slides #9 and #10, both on feed mills in China. Show slide #11, shrimp feed storage warehouse.

a. No one really knows the nutritional requirements of shrimp and much research is being conducted on the subject.
b. In other countries, producers have fed rice bran, broken rice, oil cakes, wheat flour, corn meal, and a variety of plant refuse.
c. In many countries of the world, excellent growout commercial feed formulas have been developed and proven effective, making feed the most expensive operating cost of a shrimp farm.
d. New methods have been found to stabilize vitamin C in diets and improve shrimp growth. New binders and increased levels of wheat as a binder have all proven to be successful.

3. Some producers begin feeding post-larvae with a 40-50% protein feed at a rate as high as 18-20% of body weight per day.

Show slide #12, post-larvae and juvenile on feeding tray. Show slides #13-16, feeding shrimp. Show slide #17, average shrimp feed conversion at 2:1, and #18, typical feeding schedule based on percent of estimated body weight and typical feeding curve. Show slide #19, feeding tray.

a. When pl weigh 1 g (in about 1 month) they are fed 15% of body weight/day, gain 1-2 g /week.
b. By the time they reach 18-20 g they are consuming about 3-5% of body weight/day.
c. Juveniles are fed commercial feeds (about 25-32% for *P. vannamei* and higher, 35-38%. for *P. monodon).* Their feed conversion is about 2 lbs of feed per pound of gain. A typical feeding schedule based on percent of estimated body weight and a typical feeding curve for *P. vannamei* can be seen in slide #18.

4. The feeding schedule is just a rough guideline to follow. A more accurate way to adjust feeding is by using feeding trays.

5. Semi-intensive feed management feeding trays. Feed twice each day:
   a. 40% of daily ration in the morning.
   b. 60% of the daily ration in the afternoon
   c. After the feed is spread throughout a pond in the morning, the feed trays are lifted, cleaned and 100 ml of feed is placed on each tray.
   d. Before feeding in the afternoon the trays are lifted and the quality of food remaining on each tray is recorded. Then an average is taken of the tray values for each pond.
   e. System for recording the presence of food left on tray:

      0 = no feed remaining.
      1 = small amount remaining, less than 12.5%.
      2 = medium amount remaining, between 12.5 and 25%.
      3 = large amount remaining, more than 25%.

6. Guide for adjusting the daily feed ration (tray values):

Average Value on Trays	Action
>2	Reduce previous day's ration by 30%.
>l	Reduce previous day's ration by 20%.
0.5-1	Feed same amount as the previous day.
<0.5 for 3 days	Increase previous day's ration by 10%.

Note: If the ration exceeds 10% of the estimated biomass, increase the ration only after 3 days of feeding the same quantity with no food left on the trays.

7. Guide for adjusting the daily feed ration (dissolved oxygen in the morning):

Level of DO	Action
_3.0	Feed ration calculated above.
_2.5 & <3.0	Reduce calculated ration 50% and feed it all in the afternoon.
<2.5 & _2.0	No food that day.
<2.0	No feed that day and draw down level of water to 90 cm or lower and start a continual exchange until the morning DO level is above 3.

Note: When the daily ration is reduced because of low DO, return to the normal calculated ration the next day that the DO level is above 3.0 ppm. Use the figure for the last day that the DO level was high.

E. How fast do shrimp grow and at what weight are they harvested?

Show TM D5 and discuss how fast shrimp grow.

1. Growth of shrimp varies greatly with species, stocking density, and food supply. Other conditions such as water quality and temperature are also major factors.
2. Under ideal conditions, *P. vannamei* can reach 20 g in 120 days whereas *P. monodon* attains 35 g in the same period. The normal weight at which shrimp are harvested in the U.S. is about 16-18 g (31-35 and 25 count).

F. What are the environmental parameters critical to the culture of shrimp?

1. No matter what type of system is used in culturing shrimp, certain environmental parameters must be met for shrimp to survive, grow, and reproduce:
   a. Salinity tolerance, temperature tolerance, oxygen tolerance limits, carbon dioxide, pH and alkalinity, turbidity, and excretory products (primarily ammonia toxicity).
   b. These parameters vary for different species.

2. Salinity.

Show slide #20, refractometer used.

a. Penaeid shrimp are considered to be brackish water shrimp, but they grow up in bay sand estuaries of the world, which are subject to abrupt changes in salinity (and other parameters) due to freshwater or watershed runoff.
b. These brackish water shrimp actually grow better when the salinities are lower (10-25 ppt) than the normal oceanic seawater (35 ppt).
c. However, oceanic salinities and stable conditions are necessary for reproduction.

3. Temperature.
   a. Tropical shrimp tolerate only a small temperature range.
   b. Growth occurs from 23 to 34°C for most tropical shrimp; however, the reproduction temperature ranges are even more narrow (28±2°C for most tropical penaeid shrimp).

4. Shrimp do not tolerate low DO very well.

Show slides #21-#24, aeration devices, paddle wheels, etc.

a. Below 2.0 ppm DO begins to stress shrimp.
b. 0.1 to 1.5 ppm can be lethal to shrimp depending upon species and other parameters such as salinity, pH, temperature, etc.
c. A chronic low DO level can cause shrimp to stop eating, cause stress, and subsequently can cause the onset of secondary bacterial infections.
d. Pond aeration and water movement devices and pumping water are the treatments for low DO.

5. pH and alkalinity.
   a. Low pH affects blood affinity for oxygen. pH levels of less than 5 affect growth negatively.
   b. Shrimp can tolerate high levels of pH for a short time.
   c. Phytoplankton often cause the pH in the pond to rise to 9 or 10, sometimes higher, during the day and when there is a heavy bloom in the pond.
   d. A high pH converts more ammonia to the toxic un-ionized form.
   e. A pH level between 6.5-8.0 is recommended for growout and 7.88.2 for maturation.

6. Turbidity is generally an indication of the phytoplankton bloom in the pond and is maintained with pumping and fertilizing procedures. It is generally read by using a Secchi disc and is kept at an optimum reading of 8-10 inches.

Show slide #25, Secchi disc.

7. Excretory products.
   a. Culture systems should be designed and managed so that excretory products do not build up.
   b. In ponds, most excretory products will break down.
   c. In intensive systems, excretory products must be removed. Soluble metabolic by-products such as ammonia and by-products of organic materials breaking down to nitrites are a problem.
   d. Nitrites above 0.1 ppm may cause problems with reproduction. Tolerance levels in growout are not well known but much higher levels have been recorded (.75-2 ppm at 8.3 pH) without mortality.

e. Some gill damage may occur when the level of un-ionized levels of ammonia go above .5 mg/l and when other stresses are present (low DO, handling, etc.). However, growth can be reduced at these higher levels.

8. Acceptable ranges for water quality parameters in shrimp ponds:

Show TM D6 and discuss water quality parameters for tropical shrimp ponds.

G. How is a shrimp pond managed?

1. Keys to good pond management:
   a. Pond preparation.
   b. Water management (including screening out predators).
   c. Enhancing natural productivity.
   d. Acclimation and stocking.
   e. Feed management.

2. Preparation of pond bottom:

Days After Harvest	Activity
1	Flush organic debris from pond
2	Seal gates & perform maintenance
3-10	Expose bottom to air: mineralize organic matter & kill predators
7	Add lime (1,000 kg/ha)
8	Till bottom
9	Add organic fertilizer
10	Set boards & screens in place
10	Kill predators & competitors

Show slide #26, round pond is drained and allowed to dry in the sun. Show slides #27-#29, predator control.

3. Preparation of pond water.

Days Before Stocking	Activity
10	Let water into pond & raise to full level as rapidly as possible (using predator screens on inflow-0.5 mm mesh screen or .5 micron or screen with 52 sq/inch)
9	Add initial dose of inorganic fertilizers
8	Start monitoring daily parameters
7	Start regular program of fertilization

4. Water management:
   a. Know how much water is exchanged.
   b. Calculate volume, area, average depth, and mark structure in pond.
   c. Methods of exchanging water: flow-through, draw down, flowing water through gates.
   d. Arrangement of boards and screens. Discharge from bottom.

Show slide #30, effluent gate (boards and screen).

5. Benefits of deep draw-down and continuous exchange of water at the lower level to correct problem of low DO:
   a. The wind mixes water more effectively when the depth is shallow.
   b. The area below the surface layer that consumes more oxygen is reduced.

6. Photic zone: 0.5 m x 10,000 = 5,000 m^2.
   a. Consumption zone - At 1.2 m depth: 0.7 m x 10,000 = 7,000 m^2= 140% of photic zone.
   b. At 0.8 m depth: 0.3 m x 10,000 = 3,000 m^2 = 60% of photic zone.
   c. The percentage of water exchanged is increased. At 1.2 m depth, 20 cm exchange = 16.7% of total water in pond.
   d. At 0.8 m depth, 20 cm exchange = 25% of total water in pond.
   e. Water can be flowed through the pond when the pumps are not operating.
   f. The quality of organic matter in the water is reduced when water is drained from the bottom.

7. Suggested programs for daily water exchange.

Show slides #31-#35, intake canal, pumps, pumping and water exchange.

Semi-Intensive Water Management Exchange.

Day	CM Exchange
-10 to -4	+15
-3 to 0	0
0 to 10	+3
11 to 16	±3
17 to 30	±6
> 30	Rate determined by stocking density

#Stocked/ sq m	CM Exchange
8	10
9	11
10	12
11	13
12	14
13	16
14	17
15	18
16	19
17	20
18	22

8. Programs of fertilization:
   a. Organic: Chicken manure - 1,000 kg/ha to pond bottom during preparation. Plant meal: soybean, sorghum, cottonseed - 200 kg/ha to pond bottom during preparation. 22 kg/ha to water every 3 days until feeding with pelted feed starts.
   b. Inorganic: Initial dose - urea- 28 kg/ha. Triple superphosphate (TS) 3.2 kg/ha. Urea - 24.5 kg/ha diammonium phosphate (DAP) 3.2 kg/ha. Maintenance dose - Divide the initial dose by 7 and add daily when the preceding day's transparency reading is 40 cm or above and the pH is less than 7.8.

H. How are shrimp harvested and marketed?

Show TM D7 and TM D8 and discuss harvesting and marketing shrimp. Show slides #36, pond drained harvested, and #37, shrimp caught in net and placed in 100 lb. boxes. Show slides #38 and #39, shrimp harvested with a fish pump. Show slide #40, harvest net.

1. In a pond culture situation, harvesting is usually done by draining the pond. Sometimes cast nets and seines are used. Traps are used with *P. japonicus.*

2. Usually they are caught in a net as the water passes out the sluice gate.

3. In most places in the world where shrimp are cultured, it is processed (deheaded) and frozen green headless and sold to U.S. or Japan.

Show slides #41, green headless frozen in 5-lb box, #42, plat freezer used to freeze shrimp, and #43, frozen heads on for European market.

   a. The U.S. prefers frozen. Japan prefers fresh or secondly green headless frozen.
   b. A number of large food processors in the U.S. market frozen shrimp through grocery stores.
   c. Some shrimp farms market their own shrimp, but most are sold to a broker or processing house.
   d. The European market prefers a head-on product (frozen mostly because fresh is not economical).

I. What diseases and parasites affect shrimp?

Show TM D9 and discuss diseases that affect shrimp.

1. Diseases and parasites are somewhat less of a problem in shrimp growout than in the hatchery phase.
   a. Although there are few chemicals allowed for the treatment in the U.S. shrimp hatcheries, they are not as heavily restricted in other countries that culture shrimp.
   b. Antibiotics are allowed to be placed in shrimp growout feed in the U.S., but this is also heavily regulated.
   c. Most countries require that antibiotics be withdrawn from the shrimp feed 15-21 days before harvest if the shrimp are for human consumption.

2. Protozoans often attach themselves to shrimp. Some protozoans are *Acimeta, Ephelota, Zoothamnium, Epistylis,* and *Lagenophrys.*

3. Bacterial diseases that affect shrimp include *Vibro* and filamentous bacteria.

4. The best treatment for diseases seems to be in prevention.
   a. Water quality, temperature, keeping stress low, and good nutrition are vitally important to preventing diseases.
   b. Purchasing post-larvae from a reputable source is also necessary. If possible obtain High Health stock.

5. Viruses such as IHHN, Baculovirus, Parvovirus, etc., have caused various negative effects (runting, size variation, deformities) in penaeid shrimp. The development of High Health shrimp helped in the control and hopefully the eventual irradication of these diseases.

Review:

Review by having students demonstrate their knowledge and understanding of the objectives for this problem area. Lead a discussion with students by asking questions that cause them to explain the content that goes with each objective.

Application Activities:

Application can be addressed in several ways. If the class has access to a tank or suitable pond, a growout project would make an excellent application. An aquarium growout project with shrimp can also be substituted. There is great potential for further knowledge in this area. Current periodicals are a must to keep up with the developments in shrimp culture.

Evaluation:

Evaluation should focus on the extent to which students achieved the objectives of the problem area. Examples include oral questioning, a class debate on the merits of spawning shrimp, written reports, and written exams. Example of exam questions are attached.

TM D1

Cultural Systems for Shrimp

- Pond: Most popular, worldwide
- Tank
- Raceway
- Indoor
- Intensive
- Closed recirculating

TM D2

Penaeid Shrimp Post-Larvae

- Best for stocking in ponds:
  P. vannamei pl 5-10
  P. monodon pl 18

TM D3

Stocking Rates

- No set answer
- Depends upon each individual system
- Depends on level of management
- Average stocking rates
- Extensive: 1-5/m^2
- Semi-Intensive: 5-25/m^2
- Intensive: 30-75+
- Common average: 12-17

TM D4

What Do Shrimp Eat?

- Zooplankton (copepods, rotifers, etc.), diatoms from benthos and detritus, marine worms and other creatures small enough to capture and consume
- Water can be fertilized to encourage natural food growth
- Will eat supplemental feeds
- Various organic products and grain
- Many producers use a shrimp feed with 27-35% protein for *P. vannamei* growout and 35-38% protein for *P. monodon* growout
- Many producers feed a reducing feeding scale
- Starting at 18-20% body weight per day when first stocked
- Body weight is cut down to 2-3% by the end of the growing system

TM D5

How Fast do Shrimp Grow?

- Growth rates are highly variable
- From egg to post-larval 5 (5-day-old pl) takes approximately 18 days at 28°C
- From pl 5 (stocking in nursery) they will be an average of 1 g within 30 days
- From a juvenile stocked into a growout pond (1 g) (under optimum conditions) after 120 days of growth:
  P. vannamei will be 20 g
  P. monodon will be 35 g

TM D6

Water Quality Parameters for Tropical Shrimp Ponds

Parameter	Minimum (Maximum)
Temperature (°C)	Growth: 23-25° (33-34°) Lethal: 12-15° (34-38°)
Salinity* (ppt)	Growth: 0-10 (30-40) Lethal: NA (Unknown)
pH	Growth: 7.0-7.5 (10-11)
Dissolved* * Oxygen (ppm)*	Growth: 2.0-3.0 Lethal: 0.1-1.5
Secchi Disc (inches)	8-10
Un-ionized Ammonia (ppm)	(0.1)
Total Ammonia Nitrogen (ppm)***	1-40

* Species-specific minimum and maximums
** Weight-specific minimum
*** Function of pH, temperature, and salinity

TM D7

How Are Shrimp Harvested?

- From Ponds:
  Draining mostly
  Seining
  Cast netting

- From Tanks or Raceways:
  Netting
  Seining
  Draining

TM D8

How Are Shrimp Marketed?

- Normally, shrimp are sold green headless (frozen, shell on, head off) to U.S. market and Japanese market.

- Japanese market also prefers fresh or if possible live in sushi bars.

- The European markets prefer heads on so they are usually frozen with the heads on.

TM D9

Diseases and Parasites

- Diseases and parasites are somewhat less of a problem in shrimp growout than they are in the hatchery phase.

- Parasites that are found on shrimp include epicomensal protozoans *(Zoothanium, Epistylis,* etc.).

- Diseases that affect shrimp include bacterial infections and viruses.

- The best treatment for diseases seems to be in prevention.

- Water quality, temperature, and good nutrition are vitally important in preventing diseases.

- Purchasing post-larvae or broodstock from a High Health dealer is recommended.

Quiz for Section D

Name:

Date:

Quiz on Producing/Marketing Shrimp

Circle a T for True statements or an F for False statements.

1.	T	F	The most popular cultural method for shrimp in the world is pond systems.
2.	T	F	The best type of post-larvae to stock are called High Health.
3.	T	F	Post-larvae should be pl 5-10 for *P. vannamei* before stocking and pl 18 for *P. monodon.*
4.	T	F	Shrimp will not consume supplemental feed.
5.	T	F	Stocking rates depend on the cultural system used and the level of management employed.
6.	T	F	Shrimp are normally harvested from ponds by draining the pond.
7.	T	F	In the U.S. shrimp are normally marketed when they reach about 5 g.
8.	T	F	Shrimp are immune to disease.
9.	T	F	The best treatment for diseases is prevention.
10.	T	F	Many producers feed shrimp supplemental feed at the rate of 20% body weight per day to start and taper off to 3%.

Fill out the chart using your notes:

Water quality requirements for tropical shrimp - optimum.

Temperature •(°C)_____

Dissolved Oxygen (ppm)_____

pH_____

Un-ionized Ammonia (ppm) _____

Total ammonia _____

Secchi disc in inches _____

Turbidity (ppm) _____

Salinity (ppt)_____

Key for Quiz - Section D

1. T
2. T
3. T
4 F
5. T
6. T
7. F
8. F
9. T
10. T

Slides for Section D

#1. Shrimp ponds Hawaii.
#2. Shrimp ponds Indonesia.
#3. Shrimp ponds Indonesia.
#4. Shrimp ponds Texas.
#5. Shrimp raceway culture - Hawaii.
#6. Shrimp culture in inland, closed recirculating systems.
#7. Comparison of extensive, semi-intensive, and intensive shrimp culture strategies.
#8. Shrimp feed label from Ecuador.
#9. Feed mill in China.
#10. Feed mill in China.
#11. Shrimp feed storage warehouse.
#12. Post-larval and juvenile shrimp on feeding tray.
#13. Feeding shrimp by hand from a boat - Ecuador.
#14. Feeding shrimp from boat (amphibious vehicle) - Texas.
#15 . Feeding shrimp from bank with feed blower - Texas.
#16 . Feeding shrimp from bank with feed blower - Texas.
#17. Average shrimp feed conversion rate (FCR) is 2:1.
#18. Typical feeding schedule based on % of estimated body weight and typical feeding curve.
#19. Feeding tray.
#20. Refractometer used to read salinity.
#21. Aeration devices.
#22. Aeration devices.
#23. Aeration devices.
#24. Aeration devices.
#25. Secchi disc (for reading turbidity level in pond).
#26. Round pond being dried in the sun.
#27. Predator screen (sock placed over inflow).
#28. Screen box used for predator control on inflow.
#29. nlet gate; copper sheet with holes drilled in it for predator control at later stages of shrimp culture.
#30. Arrangement of boards and screens on effluent gate, the purpose is to adjust the flow and screen is to keep shrimp in the pond. (screen size changes with shrimp growth).