Training Manual

Water Quality Sample Collection and Handling Course

Guide for the training of water quality lab technicians of 8 farms that form Belize's Shrimp Cluster

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Training Manual on Water Sample Collection and Handling

Introduction to the Manual and its Application

This manual is to be used for the training program involving personnel from eight shrimp farms in southern Belize in preparation for ASC-shrimp certification. The course was design to fulfil the training needs identified under the Needs Assessment and Training Program Design for Members of The Belize Shrimp Cluster.

Duration of the Training

The manual has been developed for a 1-day fundamental training course. The allotted time intervals may vary depending on the needs of the trainees. The training should take place from 9:00am to 4:00pm. The training will take place at one of the shrimp farms in southern Belize.

Training Methodology

The course is design to be 60% theory and 40% practical activities. With this in mind, a participatory approach to learning will be used. The trainers will serve as facilitators to help guide the trainees to understanding the information using discovery methods and hands on approach. The following approaches along with others will be use: Group discussion, case studies, demonstrations, data gathering activities, and simulation.

Number of Trainees

A maximum of 24 shrimp lab technicians can take part in the training. This would be a good size class to allow for the one on one approach. It will also ensure that the practical approach taken for this course be effective in the learning process.

Role of trainers in training

The role of the trainer is to serve as a facilitator. The trainer will create the learning environment for the trainees and serve as a guide to ensure that the right information is being obtained. A trainer is a facilitator and at the same time, a learner. In the process of blending learning materials with the knowledge and experience of the trainees, the trainer must ensure that best practices are identified and address any misconceptions the trainee may have in the subject area.

Training theme and useful instruction

The themes of the training have been determined in the light of practical need of the farmers at the field level and on the basis of evaluation and recommendation from the experts. In the different session planning, subject-oriented handouts are given in this manual. By reading the handouts, the trainers will enrich themselves, which in turn assist the trainees in participating in thematic discussion. Different subject matters are arranged chronologically. Running the session will be easy if the trainers prepare themselves by assessing the session planning thoroughly well-ahead of the training commencing.

Using the Training Manual

To implement a successful dynamic programme, crafting individual with necessary knowledge and skill is crucial.

1. Before the start of the session, the trainer should read through the session plan carefully. This will help the trainer to run the session properly.
2. Handout given with each session needs to be thoroughly studied. To maintain the sequence of subject matter and discussion, pre- prepared flip-chart/ power points should be used.
3. Needless to say the manual is only an instruction device. Therefore, trainer should run the session with necessary adjustment considering the knowledge and experience of the trainees.
4. The training sessions are arranged in sequence. Necessary information will be discussed within fixed time in each session. If necessary the trainer, in light of his/her own experience, can change or modify the session keeping main topic as it is. However timely starting and ending the session is good for both trainers and trainees.
5. Assessing the success of the training programme is important for both trainers and trainees. Therefore, learning of the trainees needs to be evaluated during the training.
6. The manual is a valuable resource. Please preserve it carefully. At present and in future the manual will act as a reference.

Learning Environment

A primary object of the training is to create lively environment. The issue of learning environment is even more important as a supporting tool. Lively learning environment is such an environment where every trainee will actively take part in discussion and comment on. Facilitator will take the responsibility to ensure this. The trainer will be keen to know the expectation, thinking and reaction of the trainees. The active participation of the trainees should be ensured and their experience and comment should be given priority. This way, a lively atmosphere will be created in the training. The following guidelines can be followed to ensure a good learning environment and to make it lively.

Training guidelines

- To be respectful to all others.
- To maintain gentle manner and impartiality.
- To give due priority to comments made by others, because something really good can come out from the discussion.
- To ensure the participation of each and every one particularly the silent ones.
- To be a good listener i.e., more listening and less uttering.
- To be careful about talking (side-talking, whispering) each other by the participants during discussion.
- To create environment so the trainees can talk one by one. If everyone speaks at the same time, nothing can be heard / understood.
- To be patient and understanding.

- To be careful about sensitive issues.
- To keep faith / confidence on the knowledge and experience of the trainees.
- To become fellow / co-worker so the trainees do not hesitate to speak out.
- To confess frankly if something is not known.

Training Sessions Timetable

Duration: 1 Day (6.5 hours)

Time	Subject Matter/Theme	Time Allotted
9:00am-9:15am	Welcome and Introduction	15 mins
9:15am-10:00am	Sample collection methods and safety of sampler	45 mins
10:00am-10:30am	Sample collection containers	30 mins
10:30am-11:00am	The use of additives or stabilizers in the field or point of collection	30 mins
11:00am-11:15am	**Break**	15 mins
11:15am-11:45pm	Specific place of sample collection	30 mins
11:45pm-12:25pm	*Written Test and Review*	40 mins
12:25pm-1:00pm	**LUNCH**	35 mins
1:00pm-1:45pm	Proper labelling and packing of water samples for transport to laboratory	45 mins
1:45pm-2:30pm	Place and conditions of storage of samples (impacts of light & heat)	45 mins
2:30pm-3:00pm	Preventing sample contamination	30 mins
3:00pm-3:30pm	*Post Test*	30 mins
3:30pm-3:45pm	Survey	15 mins

GROUP SESSION 1: Welcome and Introduction

	Time: 9:00- 9:15am	Duration 15 mins
Target Group:	Pond Technician, Lab Technician	
Title of Session:	Introduction	
Goal:	To welcome all trainees and provide them with an overview of the course	
Objectives:	**At the end of the session** • Trainers will be introduced with trainees and trainees will have optimistic notion about the course • Trainees will register their names in the particular forms of the course • Trainees will be able to express their expectation from the course timetable and course • They will be able to speak about course regulation, different activities and their effectiveness • They will be able to speak overall goal and objectives of the course	
Subjects to be discussed	Training Method	Time
Introduction		3 mins
Welcome: Welcoming the participants, exchange of greetings and sitting arrangement	Speech	
Subject Matter		12 mins
Distribution of training materials and registration • Notebooks, pens etc. should be distributed among the participants • Registration of the name of participants in particular form • Get to know one another **Assessment of the training expectations** • Trainer will know the training expectation of the trainees **Course timetable** • Trainer will distribute the timetable and explain queries (if any) about timetable • Course guideline and their importance • Overall goal and objectives of the course will be explained	Ice breaker activity Discussion and information sharing	
Wrap up and emphasis of major points	Question and Answer session	

GROUP SESSION 2: Sample Collection and Safety of Sampler

	Time: 9:15- 10:00 am	Duration 45 mins
Target Group:	Pond Technician, Lab Technician	
Title of Session:	Sample collection methods and safety of sampler	
Goal:	To learn the collection Methods and Protocol of water quality sampling properly	
Objectives:	**At the end of the session** • Trainees will understand and learn the pre-collection and collection methods properly. • Trainees will practice the steps of the accepted Protocol for collection of water sample • Trainees will learn the requirements of being safe.	

Subjects to be discussed	Training Method	Time
Introduction		5 mins
The overview and importance of Collection Methods and safety	Discussion	
Subject Matter		40 mins
Differentiate between Method and Protocol Explanation of before and during Collection Methods. Regional and national sample collection protocol Pre-collection preparation Documentation List of materials and reagents Prewash, Autoclave On-site sample collection Consistency, accuracy Safety Personal Protection Equipment	Discussion Power point presentation Practical activity Video	
Wrap up and emphasis of major points	Question and Answer session	

In this session, the trainer will present and discuss the definition of the following terms to the trainees: Protocol, Method, Procedure, Consistency and Accuracy.

The national and regional protocol for water sampling in shrimp farms will be described and discuss between the trainer and trainees in accordance to:

Pre-Collection Preparation

Here, Protocols, Methods, and documentation will be discuss and reviewed. Sampler (Pond Technician and/Lab Technician) need to prepare the material, equipment and field book before doing On-Site Sample Collection.

- Documentation - Do a water sampling collection Plan to carry it out with colleagues. Field Book need to be prepared. Confirmation of calibrated equipment.

- Methods – 1. To prepare chemical solutions for a. prewashing b. additives and stabilizers.

  2. To prepare materials for a. transportation and b. handling of sample containers.

- Protocols – 1. Washing of Sample Containers and lab material used in on-site sample collection. List of Materials. (Manual de Buenas Practicas en el Laboratorios, 2007)

  2. Autoclaving – sterilization of sample containers

Water quality parameter in Shrimp Farms

As an introduction to water quality sampling and analysis in shrimp farms, the trainees will be presented to the water quality parameters analyse in the table belowe showing the limits of water quality parameter for effluents in Shrimp Farms (Effluent Limitations (Amendment) Regulation, 2009)

Table 1: Water Quality Parameter and Limits in Shrimp Farms

Shrimp Processing:	
BOD_5	30mg/L
TSS	30mg/L
Temp	35°C
PH	6-9 units
NO_3	10.0mg/L
PO_4	1.0mg/L
SO_4	200mg/L
COD	200mg/L

On-Site Sample Collection

The trainer will present and discuss the Protocol carried out for collection of water samples. The methods for water sample collection for the parameters mention in table 1 will be discussed in detail.

Personal Safety

The safety of the sampler is of importance before and during water sample collection. Therefore safety considerations and measures will be discuss. These safety consideration and measures are adapted from the United States' Environmental Protection Agency (US EPA) (EPA Water: Monitoring and Assessment - Safety Consideration, 2015).

Personal Protection Equipment (PPE) will also be discuss between the Trainer and Trainees (ECOSUR, 2011).

ACTIVITY 1: VIDEO SIMULATION and group work. Carry out t Water Quality Sample Collection Protocol.

GROUP SESSION 3: Sample Collection Containers

	Time: 10:00- 10:30 am	Duration 30 mins
Target Group:	Pond Technician, Lab Technician	
Title of Session:	Sample Collection Containers	
Goal:	To learn the properties of various sample collection containers To understand that different parameters require different sample collection containers.	
Objectives:	**At the end of the session trainees will be able to** • To know the properties and use of the various collection containers • To identify the correct collection container to the parameters being analysed.	
Subjects to be discussed	Training Method	Time
Introduction		5 mins
Definition and description of the containers used to do sample collection	Discussion	
Subject Matter		25 mins
Define Collection Containers Types and description of Containers Plastic, Glass, Dark, Transparent Importance of Parameter analyse – sample collection container.	Power point presentation Question and answer Discussion Matching Activity: Parameter – Container	
Wrap up and emphasis of major points	Question and Answer session	

In this session, the trainer and trainees will discuss and identify the types of Sample Containers used in Shrimp Farms for the identified and known water quality parameter being analysed.

Activity 2: Matching Activity – Parameter – Container.

In this table Student need to fill in the blank spaces – Match

Parameters	Sample Containers
Biological Oxygen Demand	
Chemical Oxygen Demand	
pH	
Ionized Ammonia	
unionized Ammonia	
Alkalinity	
Salinity	
Nitrate	
Nitrite	
Phosphate	
Sulphate	
Total Hardness	
Calcium	
Total Dissolved Solids	
Total Suspended Solids	

GROUP SESSION 4: The use of Additives or Stabilizer in the field or point of Collection

	Time: 10:30 – 11:00 pm	Duration 30 mins
Target Group:	Pond Technician, Lab Technician	
Title of Session:	The use of additives or stabilizers in the field or point of collection	
Goal:	To understand the importance of additives and stabilizers in water samples	
Objectives:	**At the end of the session the trainee will be able to** • Understand the properties, functions and application of stabilizers to water sample • Identify the specific stabilizer to be added to the water sample based on the parameter being analyse	
Subjects to be discussed		Time
Introduction		5 mins
Why is it importance of stabilizations to water samples	Discussion	
Subject Matter		25 mins

• Properties of Acids, Bases and Salts.
• Functions and application of stabilizers to water sample.
  • Volume
  • Concentration
  • Method
	Power point presentation
	Discussion	

Wrap up and emphasis of major points	Question and Answer session	

In this session, the Trainer will present and discuss with the trainees the properties of acids, bases and salts and the importance of acids and salts as additives and stabilizers for water sample to be analyse for nitrates and phosphate.

Sample preservation and holding times are parameter specific (Table 1). The preservation procedures for samples are pH adjustment or storage related (Stednick, 1995):

Adjustment - Ultra-pure or metal grade nitric acid, suitable for trace metal analysis, will be used. Sufficient nitric acid (typically 2 mL/L) will be dispensed into the sample bottle to lower the pH to less than 2. The nitric acid will be used to preserve the samples to be analyzed for dissolved

zinc. The nitric acid preservative will be added into the sample bottle prior to filing with the filtered water sample. H_4SO, and HCI are also used as preservatives.

Storage Temperature - All aliquots and samples will be stored in ice chests, other insulated container or under refrigeration at 4°C until filtration and preservation is performed and prior to and during delivery to the laboratory.

The table below shows the additives and/or stabilizers for the water quality parameter shown in the table (Stednick, 1995)

Table 1. Sample preservation and holding times for required measurements.

Variable	Sample Preservation	Maximum Holding Time
pH, field	closed container	measured on site
pH, lab	closed container	measured in lab upon return
Alkalinity, field	field titration	measured on site
Alkalinity, lab	store at 4°C	14 days
D.O., field	field titration	measured on site
E.C., field	field measurement	measured on site
Temperature, field	field measurement	measured on site
Conductivity	store at 4°C	14 days
SO_4^{2-} and Cl^-	filter through 0.45 μm, store at 4°C	28 days
NO_3^- and PO_4^{2-}	filter through 0.45 μm, store at 4°C	7 days
Total Nitrogen Total Phosphorous	freeze, -20°C	6 months
Metals	filter through 0.45 μm, store at 4° acidify with HNO_3 to pH 2.0	6 months

GROUP SESSION 5: Specific place of Sample Collection

	Time: 11:15 – 11:45 noon	Duration 30 mins
Target Group:	Pond Technician, Lab Technician	
Title of Session:	Specific Place of Sample	
Goal:	To understand the theoretical background of the various sample collection frequency at sites based on the parameters being analyse.	
Objectives:	**At the end of the session** • Understand the reasons for sample collection frequency at site for sample collection • Practice water sample collection based on the parameter being analyse.	
Subjects to be discussed	Training Method	Time
Introduction		5 mins
	Discussion	
Subject Matter		25 mins
Site Documentation Frequency of water samples Depth, Time Protocol for sample collection for specific parameters.	Power point presentation Discussion Class activity	
Wrap up and emphasis of major points	Question and Answer session	

In this session, the trainer will present and discuss the methods about frequency, number of samples and time for collection in shrimp farms.

According to Water Quality Monitoring Protocol submitted to the Belize's Department of the Environment, to determine site selections for water sampling and monitoring depends on the points below (Stednick, 1995).

1. **Prior planning with maps**
2. **Degree of mixing**
3. **Accessibility**
4. **Safety**

Monitoring frequency is, in general, dictated by the program objectives, temporal variation in riverine conditions and program budget. In addition, field investigators are responsible for observing any unusual conditions which may indicate a need for additional water quality sampling outside a scheduled monitoring event. The type of samples and their preservation

should be consistent with the type of analysis that the investigator thinks is warranted by the prevailing conditions (Stednick, 1995).

GROUP SESSION 6: Test Activity

	Time: 11:45pm - 12:25pm	Duration 40 mins
Target Group:	Pond Technician, Lab Technician	
Title of Session:	Test Activity	
Goal:	To test the knowledge acquired by the participants in the areas of training	
Objectives:	**At the end of the session** • An assessment of the knowledge garnered by the trainees will be obtained • Trainees will identify their level of understanding of the subject matter at this point. • Trainer will obtain an overview of the effectiveness of the training session.	
Subjects to be discussed	Training Method	Time
Introduction		2 mins
Explanation of the ptest procedure and why it is being carried out	Speech	
Subject Matter		38 mins
Distribution of test and trainees take test **Assessment of the test** The trainer and trainee will together go over the test	Test taking Question and answer Discussion	

A test will be prepared and given to the students at the end of the session. The post-test will be used to evaluate the objectives of the training session. The test will consist of no more than 10 multiple choice/short answer type questions. Students will have 15mins to complete the quiz at which time, they will exchange papers and the questions will be reviewed. Students will be encouraged to share their answers and participate in the discussion.

GROUP SESSION 7: Proper Labelling and Packing of Water Samples

	Time: 1:00pm -1:45pm	Duration 45 mins
Target Group:	Pond Technician, Lab Technician	
Title of Session:	Proper Labelling & Packing of Water Sample	
Goal:	To learn the proper labelling and packing of water samples	
Objectives:	**At the end of the session trainees will be able to** • Know the proper labeling of water sample containers. • Practice in labelling water sample containers.	

Subjects to be discussed	Training Method	Time
Introduction		5 mins
Importance of labelling sample containers	Discussion	
Subject Matter		40 mins
• Sample Integrity • Sample labelling • Containers' Labels • List of materials • Temperature	Power point presentation Discussion Labelling Activity	

Recording Field Data and Sample Identification

Field notebooks, preferably containing water resistant paper, are used to record the chemical and physical parameters measured at the time of sample collection. These parameters include pH, temperature, specific conductivity (EC), dissolved oxygen (DO), and stream flow. This documentation should include the conditions for which the various instruments were calibrated and the conditions in which the measurements are made. Field data include (Stednick, 1995).

1. Sample identification and location
2. Sample collection date and time
3. Sampler Name
4. Weather conditions
6. pH meter used
7. Pond temperature
8. Specific conductance meter used, its calibration and measurement
9. The amount of sample collected and its relative location
10. If quality assurance samples were collected at this site
11. Any additional notes or observations pertinent to this sample or location for this sampling period

All entries should be made clearly and in ink. If an incorrect entry is made, a single heavy line should be drawn through the incorrect entry and the correction made. A11 corrections should be initialled and dated. The completed notebooks will be maintained by station in chronological order. The field notebook should be used to record parameters for analysis; this is particularly true when parameters may change between stations.

Sample Labelling

A sample identification scheme should be developed that includes sample station identification and type of sample preservation. This type of labelling scheme is useful, as a control check, and invaluable if the field book is lost. (Stednick, 1995)

For example:

BRB-A-6/94-07-jds

Meaning:

BRB - Belize River at Belmopan

A - Anions - sample filtered, no preservative

6/94 - Sampled June 1994, date and time may be included

07 - Sample number 7, see field notebook

jds - Initials of sampler

Common water sample identifiers:

T - Total (raw)

TA - Total Acidified

A - Anions

D - Dissolved

DA - Dissolved Acidified

The sample container should be labelled with a waterproof marking pen on a pressure-sensitive label. The sample container label should contain:

1. Sample identification
2. Time (24 hour / military)
3. Date of collection
4. Name or initials of the person collecting the sample
5. Sample treatment (preservation)
6. Discharge (@/s or gal./min.)
7. Remarks

ACTIVITY 3: Sample labelling: Trainees will be ask to label the sample containers as practice.

GROUP SESSION 8: Light, Heat and Location for Storage of Samples

	Time: 1:45 -2:30pm	Duration 45 mins
Target Group:	Pond Technician, Lab Technician	
Title of Session:	Light, Heat and Location for Storage of Samples	
Goal:	To understand the theoretical content of exposing samples to light and heat. To learn the importance of location and conditions needed for storage of samples	
Objectives:	**At the end of the session trainees will be able to** • Understand the impacts of light and temperature to water samples. • Understand the importance of sanitary and documentation of locations for storage of samples.	

Subjects to be discussed	Training Method	Time
Introduction		5 mins
Importance of place and conditions of storage of samples.	Discussion	
Subject Matter		40 mins
• Nature and source of light • Temperature and Relative Humidity • Impacts of light and heat to water samples • Equipment: List, sanitary • Documentation	Power point presentation Discussion	
Wrap up and emphasis of major points	Question and Answer session	

In this session, the trainer will present and define the terms: Light, temperature and heat. The importance and impacts of light and temperature will be discuss with the trainees.

Diagram 1: Light Spectrum. (Light and Tempreture , 2015)

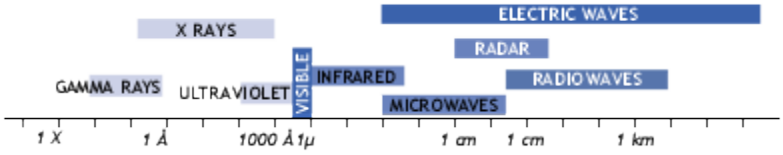

Table 3: Temperature – Humidity Table (Light and Tempreture , 2015)

Temperature	5° C	10° C	20° C	30° C
Humidity at saturation	7 g/m^3	9 /m^3	17 g/m^3	30 g/m^3

The trainer will present and discuss the importance of documentation, location and sanitary conditions for the storage of water samples.

Field Quality Assurance

The Field Quality Assurance program is a systematic process which, together with the laboratory and data storage quality assurance programs, ensures a specified degree of confidence in the data collected for an environmental survey. The Field Quality Assurance program involves a series of steps, procedures and practices which are described in the following sections.

General Measures

(a) All equipment, apparatus and instruments should always be kept clean and in good working condition by means of the techniques and practices given elsewhere in this manual.

(b) Records should be kept of all repairs to the instruments and apparatus and of any irregular incidents or experiences which may affect operation.

(c) Conditions should be such that they encourage and maintain a safe work environment, both in the laboratory and field settings.

(d) It is essential that standardized and approved methodologies, such as those recommended in this manual, be used by field personnel. If any changes to the approved methods are made, they should be documented and experimental data obtained to ensure that the results are valid and comparable to the earlier data.

GROUP SESSION 9: Preventing Sample Contamination

	Time: 2:30 -3:00pm	Duration 30 mins
Target Group:	Pond Technician, Lab Technician	
Title of Session:	Preventing Sample Contamination	
Goal:	To learn the importance of Best Practices. To improve the sanitary of the sample collection and handling	
Objectives:	**At the end of the session trainees will be able to** • Understand Best Practices, sanitary and documentation to prevent sample contamination.	
Subjects to be discussed		Time
Introduction		5 mins
Importance of	Discussion	
Subject Matter		25 mins
• Best Practices • Sanitary • Maintenance • Documentation	Power point presentation Discussion	
Wrap up and emphasis of major points	Question and Answer session	

In this session, the trainer will present and discuss with the trainees the best practices for preventing sample contamination. In the presentation and discussion, sanitary measures and maintenance will be emphasis for the prevention of sample contamination. Also, the importance of documentation of contamination will be discuss.

GROUP SESSION 10: Post Test Activity

	Time: 3:00 – 3:30 pm	Duration 30 mins
Target Group:	Pond Technician, Lab Technician	
Title of Session:	Post Test Activity	
Goal:	To test the knowledge acquired by the participants in the areas of training	
Objectives:	**At the end of the session** • An assessment of the knowledge garnered by the trainees will be obtained • Trainees will identify their level of understanding of the subject matter at this point. • Trainer will obtain an overview of the effectiveness of the training session.	
Subjects to be discussed	Training Method	Time
Introduction		2 mins
Explanation of the post-test procedure and why it is being carried out	Speech	
Subject Matter		20 mins
Distribution of post-test and trainees take test **Assessment of the post-test** The trainer and trainee will together go over the pre-test	Test taking Question and answer Discussion	
Summary		3 mins
Wrap up and emphasis of major points	Question and Answer session	

A post-test will be prepared and given to the students at the end of the session. The post-test will be used to evaluate the objectives of the training session. The test will consist of no more than 10 multiple choice/short answer type questions. Students will have 15 mins to complete the quiz at which time, they will exchange papers and the questions will be reviewed. Students will be encouraged to share their answers and participate in the discussion.

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