# PHYSICAL WATER PROPERTIES AND SUSPENDED SEDIMENT DYNAMIC IN UMS-LKIM CAGE CULTURE AREA

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JUDUL: PHYSICAL WATER PROPERTIES AND SUSPENDED SEDIMENT DYNAMICS IN UMS CAGE-CULTURE AREA

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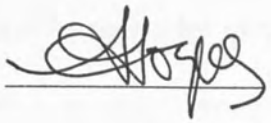

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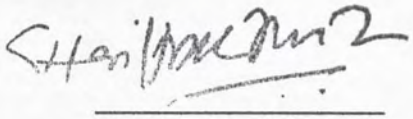

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# ABSTRACT

The study of water properties, velocity pattern and suspended sediment dynamic distribution was conducted at Sepanggar Bay cage culture area. There are seven stations chosen randomly. Sampling work was carried out on month of September, October and November during high tide and low tide. Water properties such as temperature, salinity, dissolves oxygen and pH were measured using YSI (in-situ), water samples were carried out using Water Sampler, whereas current velocity and direction were taken by using Aquadopp. The data of current and total suspended sediment were analyzed by Microsoft Excel software. The result of the research showed that most of the sediment distributed nearby the cage culture area. The furthes distance from the cage culture area, the distribution become lesser. Therefore, average of water properties as temperature, salinity, dissolves oxygen and pH shows that the high and lower average were due to the distance from cage culture and depend on high tide and low tide. The average current velocities for each stations were ranging from 0.05 $ms^{-1}$ to 0.8 $ms^{-1}$. The higher the current velocity, the higher the concentration and distribution of the suspended sediment transported. However, other factors such as cage culture activities, weather such as monsoon wind and tidal factor could affect the situation and can change the water properties and current velocity.

## *ABSTRAK*

*Kajian terhadap sifat-sifat air, pergerakan arus dan kandungan sedimen terapung telah dijalankan terhadap kawasan penternakan ikan di Teluk Sepanggar. Sebanyak tujuh stesen dipilih. Penyampelan telah dilakukan pada bulan September, Oktober dan November semasa air pasang dan air surut. Sifat-sifat air (suhu, saliniti, oksigen terlarut [DO] dan pH) dikaji dengan menggunakan alat multi-parameter YSI (in-situ), sampel air telah diambil dengan menggunakan Water Sampler, manakala arus telah diambil dengan menggunakan Aquadopp profiler. Data arus dan berat sediment terapung telah dianalisis menggunakan program Microsoft Excel. Keputusan kajian mendapati bahawa sedimen banyak tertabur di kawasan penternakan ikanberkurangan apabilas semakin jauh jarak dari kawasan penternakan ikan tersebut. Sifat-sifat air seperti suhu, saliniti, oksigen terlarut (DO) dan pH menunjukkan bahawa peningkatan purata adalah bergantung kepada jaraknya dari kawasan penternakan ikan semasa berlaku air pasang-surut. Purata kelajuan arus air di setiap stesen berada diantara 0.05 $ms^{-1}$ hingga 0.8 $ms^{-1}$. Semakin tinggi halaju arus, semakin tinggi jumlah sedimen terapung yang diangkut. Walau bagaimanapun, faktor-faktor seperti aktiviti-aktiviti penternakan ikan, keadaan cuaca dan pengaruh pasang surut boleh mempengaruhi keadaan tersebut seterusnya dapat mengubah komposisi sifat-sifat air, sedimen terapung dan kelajuan arus.*

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| | | |
|---|---|---|
| TSS | - | Total Suspended Sediment |
| $ms^{-1}$ | - | metre per second |
| ppt | - | part per thousand |
| mg/L | - | milligram per Litter |
| µm | - | micro metre |
| mm | - | mille metre |
| % | - | percent |
| $^{o}C$ | - | degree Celsius |

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

Accurate measurements of water properties and suspended sediment concentration are essential in many areas of watershed management. The impact of human and engineering practices on fluvial systems, measurement of soil losses, and reservoir sedimentation can all be assessed with water properties and suspended sediment. Much work has focused on the use of concentration measurements with various sampling methods to calculate suspended sediment and to measured water properties. Suspended sediment is highly variable in both time and space, further compounding the difficulty in obtaining accurate and representative measurements.

## 1.2 Background of the Study Area

The marine environment of Sepanggar bay is under the dynamic interface between the terrestrial systems dominated by the river discharges and surface water runoff from nearby upland and marine systems dominated by the wave action, tidal flow and wave current interaction. There are many major project development activities such as UMS jetty, BMRI and ODEC facilities, hatchery, LKIM-UMS aquaculture project and The Royal Malaysian Naval Base. These development have increased the coastline landform changing, highly affected the nearshore dynamics and beach morphology. Moreover, the coastal processes and seawater properties of this study area are significantly affected by the Inanam River and Menggatal River because the sediment transport in river is associated with a wide variety of environmental. One of the most serious environmental problems in UMS coastline is erosion and the consequent loss of soil. Erosion can be observed in some parts of the coastline where shoreline is moving landward, thus confining the water circulation. Although erosion is a natural phenomenon, the rate of soil loss is greatly increased by poor agricultural management that results increased suspended sediment loads in freshwaters (Kennish, 2001). These movements may affect UMS nearshore coastal community through environmental hazard and caused by the pollutants from UMS hatchery and aquaculture projects. It will also be a threat to the UMS jetty and other BMRI infrastructure.

Knowledge of water velocity and suspended sediments is of great importance in determining the fate and transport of suspended sediment and sediment adherent contaminants.

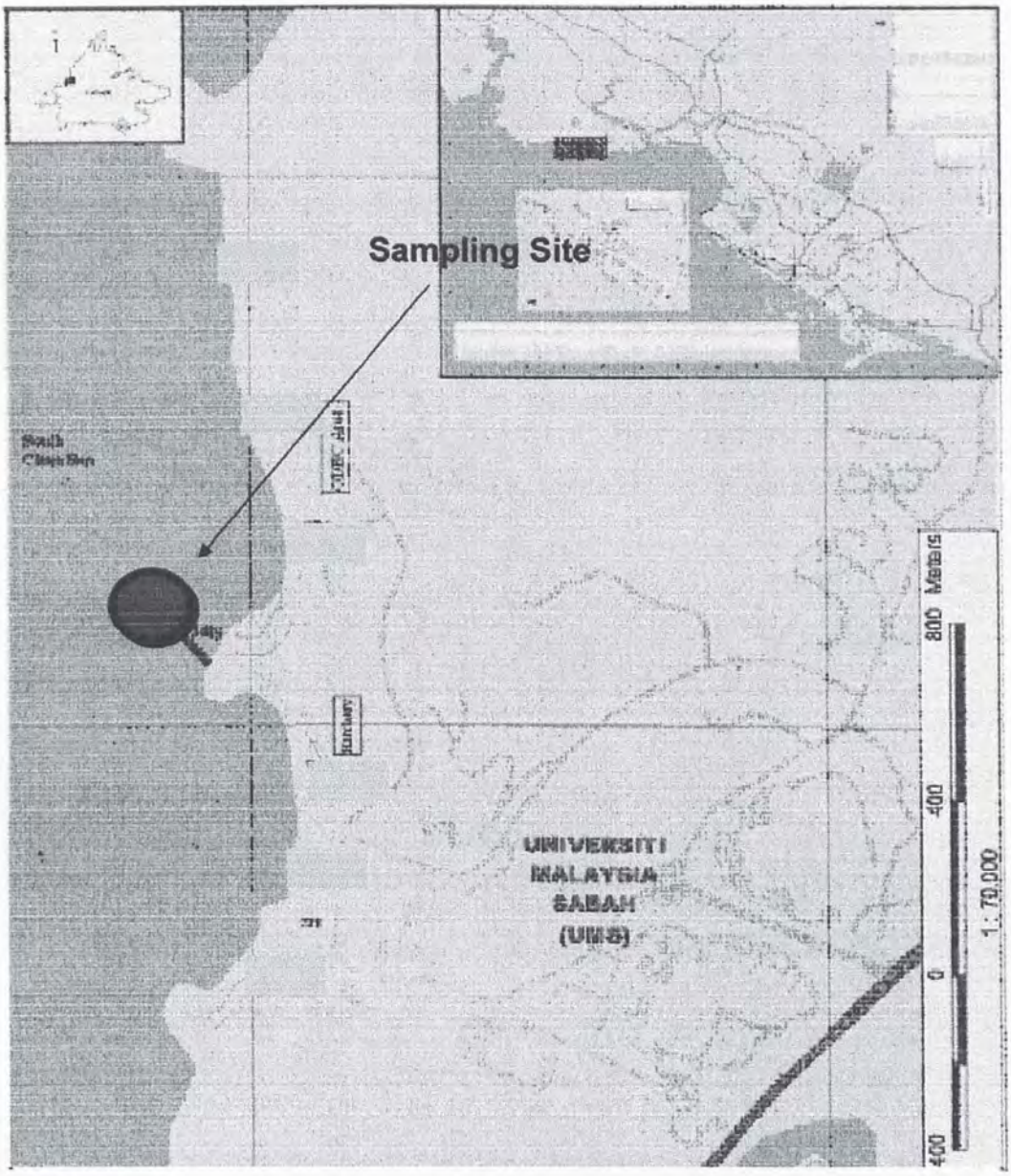


**Figure 1.1** Study Area (Resources: Jabatan Kajicuaca Sabah)

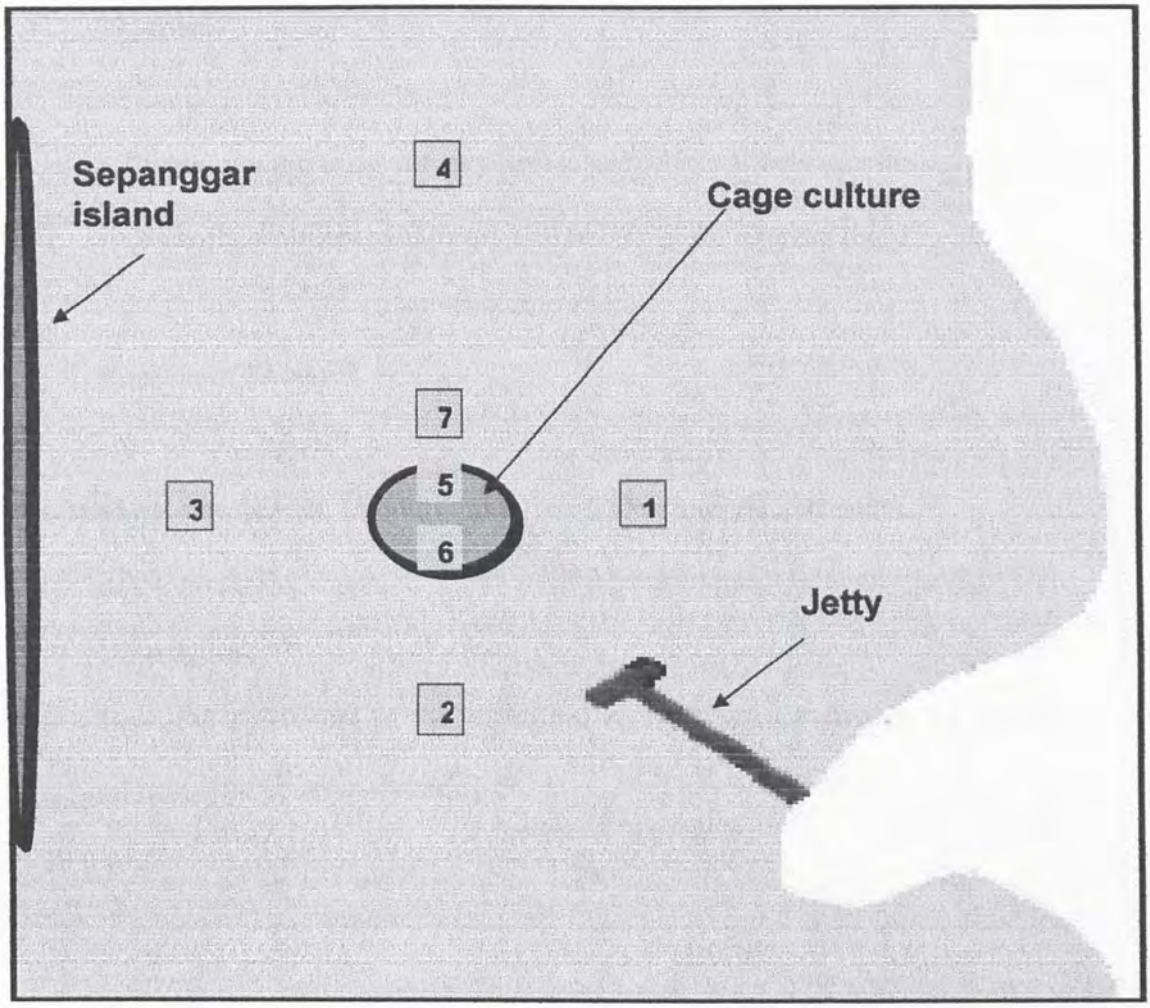


**Figure 1.2** Sampling station

## 1.3 Objectives

i. To investigate the water velocity pattern and physical water properties.

ii. To study the distribution of suspended sediments in the study area.

## 1.4 Significant Research

The findings of the present study will provide useful information to enable

i. Better predictive capability of the environmental impact from marine cage fish cultures and,

ii. Improved objectivity in the regulatory decision-making process for coastal management of the study area

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Water's Physical Properties

Water is unique in that it is the only natural substance that is found in all three states -- liquid, solid (ice), and gas (steam) -- at the temperatures normally found on Earth. Earth's water is constantly interacting, changing, and in movement.

Water freezes at 32° F and boils at 212° F (at sea level, but 186.4° F at 14,000 feet). In fact, water's freezing and boiling points are the baseline with which temperature is measured: 0o on the Celsius scale is water's freezing point, and 100o is water's boiling point. Water is unusual in that the solid form, ice, is less dense than the liquid form, which is why ice floats. Water has a high specific heat index. This means that water can absorb a lot of heat before it begins to get hot. This is why water is valuable to industries and in your car's radiator as a coolant (Officer, 1996). The high specific heat index of water also helps regulate the rate at which air changes temperature, which is why the temperature change between seasons is gradual rather than sudden, especially near the oceans.

Water has a very high surface tension. In other words, water is sticky and elastic, and tends to clump together in drops rather than spread out in a thin film. Surface tension is responsible for capillary action, which allows water (and its dissolved substances) to move through the roots of plants and through the tiny blood vessels in our bodies. pH is an important measurement of water. The pH of distilled water is 7, this is neutral. Any solution with a pH below 7 (pH 1.0 to pH 6.9) is an acid and any solution with a pH above 7 (pH 7.1 to pH 14) is an alkali. Acidic solutions have a pH between 1 and 6.9. Alkaline solutions have a pH between 7.1 and 14. Our small intestine is pH 9. Neutral solutions are neither acidic nor alkaline so their pH is 7 (Gross, 1992).

## 2.3 Suspended Sediment Transport

Sediment transport is a direct function of water movement. During transport in a water body, sediment particles become separated into three categories: silt + clay + sand: relatively inactive the bedload and the saltation load. Suspended load comprises sand + silt + clay-sized particles that are held in suspension because of the turbulence of the water. The suspended load is further divided into the wash load that is generally considered the silt + clay-sized material (< 62 μm in particle diameter) and is often referred to as "fine-grained sediment". The wash load is mainly controlled by the supply of this material (usually by means of erosion) to the river. The amount of sand (>62 μm in particle size) in the suspended load is directly proportional to the turbulence and mainly originates from erosion of the bed and banks of the river. In many rivers, suspended sediment (i.e. the mineral fraction) forms most of the transported load (Hunt, 1986).

## 2.4 Composition of sediment

According to Duxbury (2003), an amount and nature of suspended load in a water body is affected by the availability of sediment as well as by the turbulent forces in the water. The sand component of the suspended load in a river originates mainly from the river bed. As discharge increases, so do the turbulent forces that cause the sand to be taken into suspension. Sand particles tend to settle quite rapidly because of their shape, density and size. Therefore, the concentration of sand is highest near the bed of a river and lowest near the surface (Wyatt, 1986).

## 2.5 Cohesive Sediment

Cohesive sediment differs from the granular sediment in two important respects. First, the strength characteristics of cohesive sediment change markedly with time after deposition, and secondly, their properties depend on their ion exchange potential. Cohesive sediments are of interest to the coastal engineer because much of the required dredging in deepened channel is due to cohesive sediment deposition. The cohesive nature of sediments usually becomes apparent at size less than approximately 0.074 mm (Hunt, 1986). The critical shear stress for cohesive sediment is grater than would be anticipated from estimates based on the sediment size alone. The transport of cohesive sediments occurs largely in suspension, although aggregates on the bottom referred to as a fluid mud may move along the bottom as a viscous flow (Gross, 1996). For a particular shear stress, the erosion will occur down to the depth at which the critical shear strength corresponds to the applied shear stress. Cohesive sediments are deposited out of suspension through flocculation and settlement to the bed (Hunt,

1986). At this stage the sediment are very weak and the bulk density is very low. However, if the sediment is allowed to consolidate, its strength increases with time and depth into the sediment bed.

# CHAPTER 3

# MATERIALS AND METHODS

## 3.1 Field measurement

Extensive field measurement of water properties and sediment requires that many simplifying assumptions be made. This is largely because this water property is a dynamic phenomenon and measurement techniques cannot register the ever-changing conditions that exist in water bodies, particularly in river systems. It conducted at different sampling points in the adjacent areas. There are 7 stations of sampling that be made. Sampling dates and time determined based on the tidal data table produced by Hydrographic Department of the Royal Malaysian Navy. This investigation performed for a total of three month: including the measurement that taken twice a month during the low tide and high tide. Some of the sources of methodology for the field measurement are discussed below:

### 3.1.1 Water Current

The methods and equipment used for water current measurement were simple. Current measurement performed using Aquadopp and were conducted at each location of transects. This equipment (Aquadopp) read the flow velocity and recorded at every 15 minutes within 0.5 m depth increment.

### 3.1.2 Water Properties

This measurement procedure is similar to flow velocity measurement and sediment solids measurement. Using the YSI meter, an in-situ measurement dissolve oxygen (BOD), salinity, temperature, turbidity and pH data were recorded at 30 minute interval of each station. These data were collected at surface, middle and bottom of the sea.

### 3.1.3 Sediment Sampling

The method and equipment used for sampling suspended sediment are different from those used for deposited sediments. Suspended sediment was collected using the water sampler at every sampling point. Samples were collected at the surface, middle, and bottom of the sea. Then, it was taken to the laboratory for analyzing the total suspended sediment.

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