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A REVIEW OF THE EFFECT OF ALGAE AND WATER QUALITY FOR FISH PRODUCTION

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ABSTRACT

The rapidly growing field of aquaculture, which now accounts for 30 percent of the world's food fish, has pushed its way into the media spotlight. For some years now, aquaculture has been seen as a possible savior for the over-burdened wild fisheries sector and an important new source of food fish for the poor. Global consumption offish as food has doubled since 1973, and the developing world has been responsible for over 90 percent of this growth. Fish farming is gaining popularity as a means of augmenting fish protein supply, particularly, in Nigeria where the prizes of alternative fish protein sources are soaring and catches from capture fisheries is dwindling. Fish lives in water and to achieve maximum yield or production, the environment offish must be conducive enough to support high growth rate. This paper reviews the effects of algae and water quality on fish production. Freshwater habitats are inland bodies of water which include rivers, lakes, pools and ponds and are characterized by the presence of unidirectional current referred to as Lotic while the other group lacks a unidirectional current and is therefore stagnant or stationary called Lentic. Algae are plants or plantlike organisms that contains chlorophyll and other pigments that trap light from the sun. Contributors to algae growth include fertilization, feeding/feed among others. Algae are grouped according to the types of pigments they use for photosynthesis, the makeup of their cell walls, the types of carbohydrate compounds they store for energy, and the types of jlagella (whip like structures) they use for movement. They include Golden Brown Algae (Chrysophyta), Fire Algae (Pyrrhophyta), Green Algae (Chlorophyta) and Red Algae (Rhodophyta). It is important to know hydrology of the water and make sure that all water parameters are in right conditions for fish production because poor water quality is detrimental to fish. Water quality parameters such as temperature, turbidity, dissolved oxygen and pH are the physical, chemical and biological attributes that characterized water to be conducive for healthy growth of fish. Common harmful effects of harmful algae bloom are production of neurotoxins which causes mass mortalities in fish, seabirds; human illness or death via consumption of seafood contaminated by toxic algae; mechanical damage to other organisms, such as disruption of epithelial gill tissues in fish, resulting in asphyxiation and oxygen depletion of the water column from cellular respiration and bacterial degradation. In order to maintain a good fish production in water, it is necessary to keep pH between 6.5 and 8.5. The level of pH is usually obtained through the application of correct amount of lime to ponds and effective use of fertilizer.

Keywords: *Algae, Water Quality, Eutrophication, aquaculture, Fish Production, Eutrophtcation.*

INTRODUCTION

The importance of fish farming becomes obvious when viewed against the background of fish demand supply in Nigeria. Fish is an important source of protein required in human diet. Fish has the highest level of easily metabolisable, high quality protein, fats, vitamins, calcium, iron and essential amino-acids when compared with other sources of animal protein such as poultry and beef. Fish consumption is highly relished among people of all classes and ages in that, fish is less tough and more digestible when compared to beef mutton, chicken and bush meat. Furthermore, fish lives in water and to achieve maximum yield 01 production, the environment of fish must be conducive enough to support high growth rate. This paper therefore reviews the effects of algae and water quality on fish production.

FRESHWATER HABITAT

The freshwater habitat is an aquatic type of habitat character by low salinity. It also lacks waves and tides which are present in the sea (Fatunbarin, 2011).

Freshwater habitats are inland bodies of water. They include rivers, lakes, pools and ponds. Freshwater are characterized by the presence of unidirectional current and which as a result move along the direction of the current, are said to be LOTIC (this includes all flowing waters e.g. rivers, streams, springs). The other group

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lacks a unidirectional cusrrent and is therefore stagnant or stationary. These are described as LENTIC (e.g. lakes, ponds, pools, swamps and bogs). (Fatunbarin, 2011).
Freshwater organisms comprises of freshwater flora and fauna. The freshwater flora includes phytoplankton (blue-green algae, diatoms and dinoflagellates), freely floating macrophytes (duck weed- Lemna spp, water lettuce- Pistia stratiotes) submerged macrophytes (bladder wort-Utricularia spp, hornwort-Ceretophyllum spp) rooted macrophytes with long petioles and floating leaves (water lily-Nymphaea spp) and rooted emergent macrophytes (Oryza spp).
The aquatic fauna includes the zooplankton, some mollusks copepods, crustaceans, echinoderms.

AQUACULTURE

Aquaculture is the farming of aquatic organisms in enclosed water bodies such as ponds, dams, pens, raceways, aquaria etc. (Oyin Olukunle, 2004).
The word aquaculture' though used rather widely for the last two decades to denote all forms of culture of aquatic animals and plants in fresh, brackish and marine environments is still used by many in a more restrictive sense, (Pillay T.V.R and Kutty M.N, 2005).
By and large, aquaculture in the tropics remains small scale projects, run as community farm, homestead ponds or become integrated into rural development schemes. The major objective appears to be the proviso of high quality protein food for rural communities (Moses B.S, 1992).The word aquaculture though used rather widely for the last two decades to denote all forms of culture of aquatic animals and plants in fresh, brackish, and marine environments. (Pillay T.V.R and Kutty M.N, 2005).
Aquaculture is the rational rearing of fish and other aquatic organism in man-made ponds, reservoirs, cage or other enclosure in lakes and coastal waters. (Moses B.S, 1992).

CONTRIBUTORS TO ALGAE GROWTH

Fertilization

Fertilization is one of the ways by which phytoplankton (algae) growth in water is boosted.
They contain important nutrient, which helps in production of natural fish feed organism (plankton) (Ayoola S.O, 2010).
Application of fertilizers into the water increases production of phytoplankton which in turn increases production of zooplankton and benthos and eventually increase yield of cultured fish since these are major food organisms of various life stages of fish (Adiaha A.A. Ugwumba and Alex .O. Ugwumba, 2007).
A fertilizer is a substance which contains one or more plant food nutrient elements which can be taken-up by plants for proper growth, development and reproduction. Fertilizers can be either organic or inorganic and both can be used singly or combined (Adiaha A.A. Ugwumba and Alex .O. Ugwumba, 2007).

Organic Fertilizer

These are the wastes of animal and plant origin. Examples include cattle dung, pig dung, poultry/duck dung, sewage, compost, agriculture and industrial by-production such as brewers' dry grain, rice and corn bran and oil seed cakes (e.g. groundnut, palm kernel, cotton seed). Others are offal (e.g. fish, shrimp, poultry, piggery and abattoir) and blood meal to mention a few. After application, nutrients from the wastes are only released following decomposition mostly by aerobic bacteria (Adiaha Ugwumba and Alex O. Ugwumba, 2007).

Inorganic Fertilizer

These are chemical compounds, which mainly contain primary plant growth elements; such as, nitrogen, phosphorus and potassium (Adiaha Ugwumba and Alex O. Ugwumba, 2007).

Feeding/Feed

Supplementary feeding may be with the use of natural food like live organism or wastes of both plant and animal origin or it may be compounded/formulated feeds composed of various ingredients possibly fortified with added vitamins and minerals. Uneaten supplementary food also acts as organic fertilizer in water (Adiaha Ugwumba and Alex O. Ugwumba, 2007).

ALGAE

Algae (singular: alga) are plants or plantlike organisms that contains chlorophyII and other pigments (colouring matter) that trap light from the sun. This light energy is then converted into food molecules in a

process called photosynthesis. Most algae store energy as some form of carbohydrate (complex sugar) (www.fao.org,2010).

Algae can be single-celled or large, multicellular organisms. They occur in freshwater or salt water (most seaweeds are algae) or on the surfaces of most soil or higher plants, although some-like the giant kelp-have tissues that may be organized into structures that serve particular functions. The cell walls of algae are generally made by cellulose and can also contain pectin, which gives algae its slimy feel.

Types of Algae

Although, the term algae originally referred to aquatic plants, it is now broadly used to include a number of different groups of unrelated organisms. There are seven divisions of organism that-make up the algae. They are grouped according to the types of pigments they use for photosynthesis, the makeup of their cell walls, the types of carbohydrate compounds they store for energy, and the types of flagella (whip like structures) they use for movement. The colours of the algae are due to their particular mixtures of photosynthesis pigments, which typically include a combination of one of more of the green-coloured chlorophylls as their primary pigments. Algae are the designation botanists give to a group of thousands of multicelled, water-dwelling plants that photosynthesize sunlight. There are three primary types of algae: red, brown and green. The more complex red and green algae are commonly called seaweed. Microscopic types of algae form the base of the food chain in ocean and pond environments, feeding zooplankton that in turn feed larger fish and mammals. Some types of algae contain toxins harmful to aquatic life and humans. Clouds of blue-green algae are commonly called pond scum and are readily apparent in lakes and ponds in the summer.

Golden Brown Algae (Chrysophyta)

The chrysophyta, or golden-brown algae and diatoms, are named for the yellow pigments they posses. These single celled algae live both in freshwater and salt water. Their cell walls have no cellulose but are composed mostly of pectin, which is often filled with silica, a compound that makes the walls quite rigid. These algae store energy both as carbohydrate and as large oil droplets. Diatoms have two glasses water shell made largely of silica that fit together like a pill box and are exquisitely marked.

Fire Algae (Pyrrhophyta)

They are single celled algae and include the dinoflagellates which have two flagella used for locomotion. Most of these microscopic species live in salt water, with some occurring in fresh water. Some species of dinoflagellates emit bright flashes of light when exposed to air, which at night look like fire on the ocean's surface.

Green Algae (Chlorophyta)

The green algae occur in freshwater although, some live in the sea. Most green algae are single-celled and microscopic forming the slimy green scum found in stagnant ponds. Others are large and more complex, forming spherical (round) colonies composed of many cells or occurring as straight or branched filaments.

Red Algae (Rhodophyta)

They are marine plants that live mainly in shallow waters and deep tropical seas.

POND WATER QUALITY

Water quality includes all physical, chemical or biological factors that influence the beneficial use of water. Where fish culture is concerned, any characteristics of water that affect the survival, reproduction, growth, production and management of fish in any way is a water quality variable. (Ayoola S.O, 2010).

Water Quality Management

Water quality with reference to fish culture includes any characteristics of water whether physical, chemical or biological which affects the survival, growth and reproduction of fish. Water quality management in fish culture is therefore primary importance.

The characteristics of good water quality are

1. It must neither be too acidic nor alkaline
2. The pH range is between 65-8.5
3. It must contain enough dissolved oxygen (above 5mg/litre)
4. it must not be muddy or turbid

5. It must not have offensive odour
6. it just be free of pollutants such as oil film, detergents, heavy metals e.t.c

It is also necessary to monitor the pond water quality weekly or bi-weekly in order to know the effects of fertilizer or fish feed on the pond environment. The growth of fish is dependent on the water quality. Poor water quality is detrimental to fish. Thus it is important to know hydrology of the water and make sure that all water parameters are in right conditions for fish production (Ayoola S.O. 2010).

Water Quality Parameters

These are the physical, chemical and biological attributes that characterized to be conducive for healthy growth of fish. The physical parameters of water quality can be broken down into many topics such as turbidity and taste or odor to name a few. There is need to also take into consideration, the nature of the physical parameters of the ecosystem surrounding a water source to also understand the physical appearance of later finished water.

Temperature

Water temperature affects the activity, behaviour, feeding, growth and reproduction of all fishes. Temperature also affects the level of dissolved oxygen in the pond. Dissolved oxygen decreases with the increase in temperature level as oxygen consumptions of the fish increases with rise in temperature. The desirable water temperature suitable for fish production in the tropic for example in Nigerian varies between $21^0C - 32^0C$ ((Ayoola S.O. 2010). Rise in temperature can be caused by the presence of solid particles in the water body. Temperature affects sediment and microbial growth among other source water characteristics.

Turbidity

Water is turbid when it is not clear. It is therefore, a measure of
Water transparency. In pond culture, turbidity means that pond water contains suspended materials that interfere with passages of light. Turbidity can be caused by plantation or by clay participles. A turbidity range of between 30-60 cm is desirable (Ayoola S.O. 2010). It is the cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eye similar to smoke in air. The measurement of turbidity is a key test of water quality.

Dissolved Oxygen

Fish and other aquatic animals require oxygen just like man and other terrestrial animals. Dissolved oxygen is a critical factor in fish culture. Oxygen is required for respiration of fish thus; a sufficient quality should always be available in the pond. Dissolved oxygen of 5mg/litres and above will ensure optimum performance of the fish (Ayoola S.O. 2010).

PH

This is a measure of hydrogen ion concentration and it ranges from 0-14 on pH scale. The parameter measures the amount of acidity or alkalinity in the water. This is one of the major problems affecting the provision of nutrients to plants and animals. It controls the concentration of many biochemical active substances that is dissolved in water.

ALGAE BLOOM AND ITS EFFECT.

An algal bloom is a rapid increase or accumulation of algae in an aquatic system. Algal blooms may occur in freshwater as well as marine environments (Wikimedia foundation Inc, 2011)

Fresh water algal blooms are the result of an excess of nutrients particularly, phosphorus. The excess of nutrients may originate from fertilizers that are applied to land for agricultural or recreational purposes. These nutrients can then enter watersheds through water run-off. Excess carbon and nitrogen have also been suspected as causes. (Wikimedia foundation Inc, 2011)

When phosphates are introduced into water systems, higher concentration caused increased growth of algae and plants. Algae tend to grow very quickly under high nutrient availability, but each alga is short-lived, and the result is a high concentration of dead organic matter which starts to decay. The decay process consumes dissolved oxygen in the water, resulting in hypoxic condition. Without sufficient dissolved oxygen in water, animals and plants may die off in large numbers (Wikimedia, 2011). An algae bloom may make a water body look like it is teeming with life and it is, temporarily. Algae produce oxygen during daylight hours. The extra oxygen and plant matter can feed millions of micro-organisms and lead to increased fish populations. However, when the algal bloom dies off either all at once if the nutrient source stops, or over time if the

nutrient source keeps flowing decomposition of the algae structures depletes the water body of oxygen, resulting in fish kills and other environmental damage. If the algae bloom is toxic, it can sterilize the pond.

HARMFUL EFFECT OF ALGAE

In the freshwater/marine environment, single celled, microscopic, plant-like organisms naturally occur in the well-fit surface layer of any body of water. These organisms, referred to as phytoplankton or micro algae, form the base of the food web upon which nearly all other marine organisms depend.

Common harmful effects of harmful algae bloom are;

1. The production of neurotoxins which causes mass mortalities in fish seabirds, sea turtles and marine materials.
2. Human illness or death via consumption of seafood contaminated by toxic algae.
3. Mechanical damage to other organisms, such as disruption of epithelial gill tissues in fish, resulting in asphyxiation.
4. Oxygen depletion of the water column (hypoxia or anoxia) from cellular respiration and bacterial degradation (Wikimedia foundation Inc, 2011).

In order to maintain a good fish production in water, it is necessary to keep pH between 6.5-8.5. The level of pH is usually obtained through the application of correct amount of lime to ponds and effective use of fertilizer.

EFFECT OF ALGAE ON FISH

Algae are essential component of all aquatic systems since they serve as the base of food chain for all organisms. Fertilizers can be used to enhance algae growth for beneficial purposes. Raising fish in ponds for personal or commercial harvest requires cultivation of algae to create fish food and a proper habitat. Scientists and entrepreneurs are also exploring ways of combining excess fertilizer, such as sewage sludge or animal manure, with carbon dioxide emissions from power plants and factories to grow algae under stressed conditions to produce biodiesel and ethanol fuels.

CONTROL OF ALGAE BLOOM FOR WATER AQUATIC

1. Decrease nutrient inputs to the ground water from residential and commercial land uses.
2. Decrease nutrients inputs from rain water run-off.
3. Decrease nutrients inputs from the atmosphere.
4. Decrease nutrient inputs from the agricultural sources.
5. Reduce nutrients inputs from point sources.
6. Improve water clarity by reducing sediments inputs.
7. Decrease inputs of toxic contaminants.
   (www.mdcoastalbays.org, 2011)

Aquatic ecologists are concerned with blooms of algae in reservoirs, lakes and streams because their occurrence can have ecological, aesthetic and human health impacts. In water bodies used for water supply, algal blooms can cause physical problems (e.g. clogging screens) or can cause taste and odour problems in waters used for drinking. Blooms involving toxin-producing species can pose serious threats to animals and human (Brain D. Hoyle, K.Lee lerner and Elliot Richmond, 2011)

CONCLUSION

The rapidly growing field of aquaculture, which now accounts for 30 percent of the world's food fish, has pushed its way into the media spotlight. For some years now, aquaculture has been seen as a possible savior for the over–burdened wild fisheries sector and an important new source of food fish for the poor. Global consumption of fish as food has doubled since 1973, and the developing world has been responsible for over 90 percent of this growth.

Fish farming is gaining popularity as a means of augmenting fish protein supply, particularly, in Nigeria where the prizes of alternative fish protein sources are soaring and catches from capture fisheries is dwindling.

The importance of fish farming becomes obvious when viewed against the background of fish demand supply in Nigeria. Fish is an important source of protein required in human diet. Fish has the highest level of

easily metabolisable, high quality protein, fats, vitamins, calcium, iron and essential amino-acids when compared with other sources of animal protein such as poultry and beef.
Fish consumption is highly relished among people of all classes and ages in that, fish is less tough and more digestible when compared with beef, mutton, chicken and bush meat.
Furthermore, fish lives in water and to achieve maximum yield or production, the environment of fish must be conducive enough to support high growth rate. Also, all possible causes of mortality should be avoided or reduced to minimal level. Fish farmers should also contact Limnologist immediately there is an occurrence of eutrophication in their ponds.

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