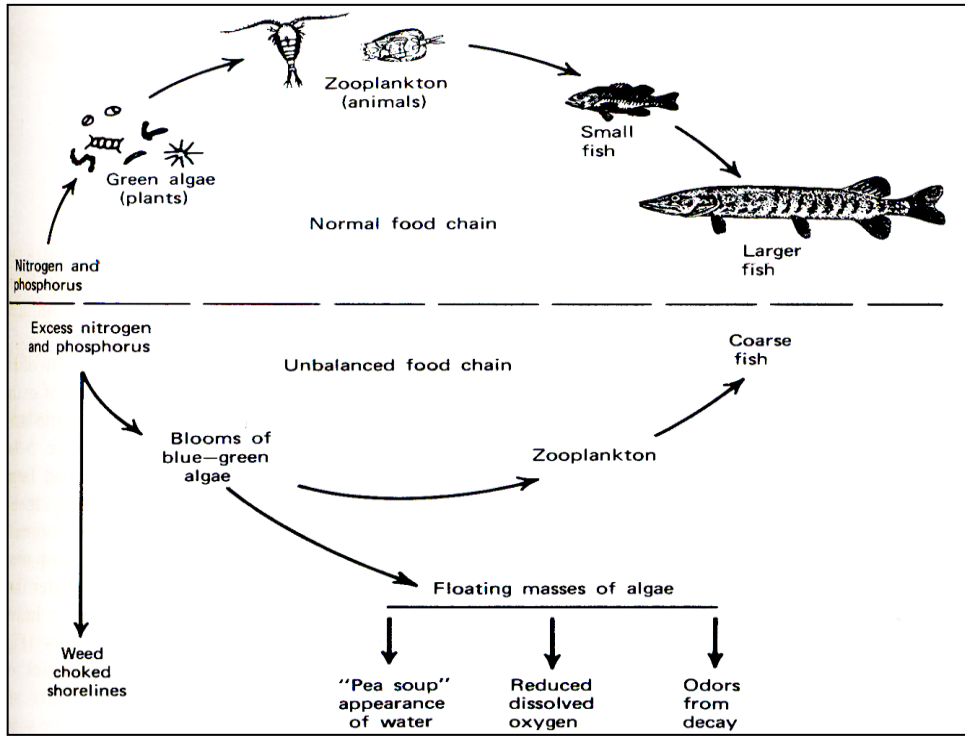


الإثراء الغذائي Eutrophication

يمكننا تعريف ظاهرة الإثراء الغذائي بأنها العملية التي يتم فيها إضافة المغذيات إلى المسطحات المائية عن طريق مصادر التلوث المختلفة وبالتالي تؤدي إلى الإخلال بتوازن الحياة المائية (الدورة المتوازنة للتغذية)، حيث تنمو الطحالب مستخدمة المغذيات الموجودة في البحيرة والتي بدورها ستوفر الطعام للأسماك، وعندما تموت الأسماك والطحالب تصبح بقاياها مخلفات عضوية تترسب في أسفل الجسم المائي، عندئذ ستقوم البكتيريا التي تستخدم أوكسجين الماء بتحويل البقايا العضوية إلى مغذيات وبذلك ستكرر الدورة من جديد، وعند طرح المخلفات العضوية والمغذيات بكميات هائلة من قبل البشر ستؤدي إلى الإخلال بتوازن دورة الغذاء وستساعد المغذيات الزائدة إلى نمو الطحالب بشكل كبير، وعندما تموت الطحالب فإنها تضاف إلى الترسبات العضوية وتستخدم البكتيريا كميات كبيرة من الأوكسجين محولة البقايا العضوية إلى مغذيات وبذلك يقل عدد الأسماك التي تبقى على وجه الحياة بسبب نقص الأوكسجين.



شكل (1) : مخطط يوضح الفرق بين المياه التي تحتوي على مغذيات طبيعية و المياه الحاوية على مغذيات عالية

Type of lakes according to nutrients :**1- Oligotrophic lakes :**

- a- Steep Sided, Clear Water.
- b- Low Nutrient Enrichment.
- c- Little Planktonic Growth, Low Productivity.
- d- Few Aquatic Plants.
- e- Sand or rock along most of shoreline.
- f- Coldwater, High dissolved oxygen content

2- Mesotrophic lakes:

- a- Moderate nutrient enrichment.
- b- Moderate planktonic growth.
- c- Some sediment accumulation over most of Lake Bottom.
- d- Usually supports warmwater fish species.

3- Eutrophic lakes :

- a- High Nutrient Enrichment.
- b- Much Planktonic Growth (High Productivity).
- c- Extensive Aquatic Plant Beds.
- d- Much Sediment Accumulation on Lake Bottom.
- e- Low Bottom Dissolved Oxygen.
- f- Only Warmwater Fish Species.

Factors other than nutrients :

Although nutrients are the prime cause of eutrophication. They should not be considered in isolation, because algal growth may also be influenced by other factors. These include mainly climatic, geographical features and physico-chemical characteristics of water.

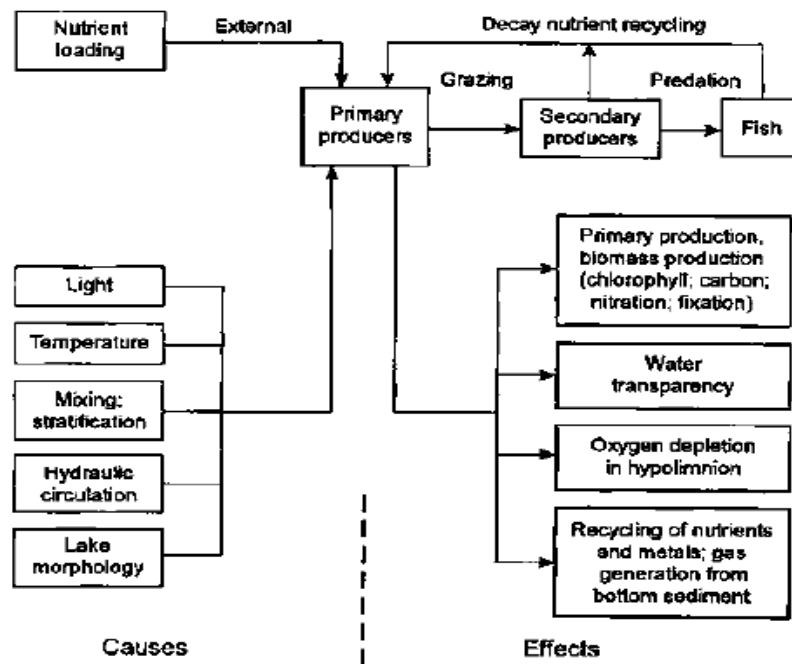
Temperature of water is an important climatic factor which strongly influence the algal growth. A large number of algae require relatively higher optimum temperatures. The rate of eutrophication is usually higher in tropical waters than the waters of temperate or colder regions. Seasonal temperature changes cause the lakes to overturn which results in the mixing of the whole water column. Early spring blooms of certain algae are the result of this overturn when the nutrients released at the bottom by decomposition of organic matter are made available to the surface phytoplankton. the process, sometimes, is referred to as "internal fertilization".

Light is an important factor which limits the photosynthesis in water. The light penetration in waters can be related to the presence of turbidity and color that restrict the depth of photic zone.

Mean depth of water body is an important factor which influence the rate of eutrophication. Shallow waters are more susceptible to the forces of eutrophication in comparison to deeper waters, as they are well mixed and receive light in the greater part of the water mass. The rate of internal fertilization is also higher in shallow waters since the released nutrients can get easily distributed to the upper layers because of their well mixed nature, whereas, most deep lakes are stratified during considerable part of the year.

Overall accumulation of nutrients in lakes is dependent on the retention period of water. With fall in the retention period of water, or in other words the rise in flushing rates, the nutrients are increasingly flushed out from the system which reduce their progressive accumulation in water bodies

Nutrient availability is also affected by the Physico-Chemical conditions of water.



شكل (2) : مخطط يوضح الأسباب المؤدية لحصول ظاهرة الازدهار والآثار الناتجة عنها

Sources of nutrients:

- 1-Rainfall and Atmospheric deposition.
- 2-Urban and Rural Run-off.
- 3-Agriculture Run-off.
- 4-Domestic Sewage.
- 5-Industrial Waste.
- 6-Water Fowl.
- 7-Groundwater.

THE PROCESS OF EUTROPHICATION

The eutrophication is basically a natural phenomenon which gets accelerated by increased nutrient supply through human activities. The process of eutrophication starts as soon as the lakes are formed, because of the entry of nutrients by natural means, but the rate of eutrophication remains quite low under natural conditions. The process of eutrophication has been discussed under two heads of natural and accelerated processes, though, its basic features remain essentially the same.

1- Natural Eutrophication

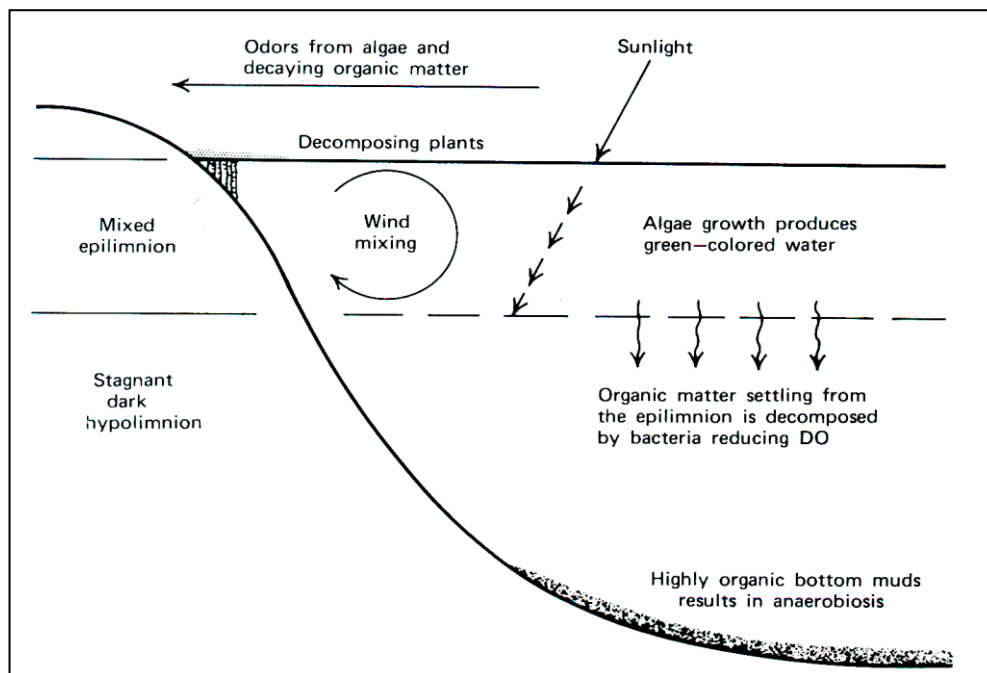
The lakes generally originate as oligotrophic and have only limited quantities of nutrients depending upon the mode of their formation and composition of original sediments. These nutrients are insufficient to produce any significant algal growth. At this stage the lakes have only (indigenous nutrients cycling therein), which usually recycle completely in the absence of any outside supply. All the biological production is completely decomposed after death.

As the (nutrients from outside) start entering the lake, the process of eutrophication sets in. The principal natural sources of nutrients are the natural run-off, fall of leaves and twigs from the surrounding vegetation, periodical submergence of the nearby terrestrial vegetation, rain fall and bird droppings. etc.

The buildup of nutrients through this slow mode of entry gradually starts increasing the growth of algae. When the algae die and decompose, the locked nutrients are again made available to the fresh algal growth. During each cycle, the nutrients are progressively increased in the water body. With the advancement of eutrophication the cycling of nutrients is unable to maintain an equilibrium between production and decomposition with the result that an everincreasing organic matter is introduced in the lakes which ultimately gets deposited at the bottom. Slowly, the thickness of the bottom sediments increases with time, leading to the formation of swamps, bogs, marshes, and finally to the extinction of the water body.

2- Accelerated Eutrophication

The process of eutrophication is greatly augmented by the increased supply of nutrients through various human activities such as discharge of domestic sewage, industrial wastes, agricultural and urban runoff. Increased levels of air pollution also make the water bodies rich in nutrients through their transport with rains or by dry fallout. This increased supply of nutrients triggers the algal growth at a much faster rate, thus, increasing the speed of eutrophication.



شكل (3) : مخطط يوضح مقطع في بحيرة حدثت فيها ظاهرة الازدهار أثناء فصل الخريف

PROBLEMS AND EFFECTS OF EUTROPHICATION

The major problems associated with eutrophication are outlined below:

- 1- The treatment of drinking water may become difficult and the supply may have unacceptable odour and taste.
- 2- The water may be injurious to health.
- 3- The recreational value of the water may decrease.
- 4- Increased vegetation may impede water flow and navigation.
- 5- Commercially important fish species may be replaced by less important species.

In general, the majority of effects of eutrophication are related to the increase in plant and animal biomass, which often lead to the increase in turbidity and decrease in oxygen levels. The rate of sedimentation also increases, shortening the life-span of the water bodies.

خطوات علاجية :

- أصبح من المؤكد أن ما يقوم به الإنسان من إفساد لبيئته البحرية قد سبب الضرر الكثير له ولغيره من الكائنات وأنه قد حان الوقت لاتخاذ إجراءات حاسمة لتدارك الموقف ومحاولة التقليل من الآثار الضارة لتواجد ظاهرة الـ (Eutrophication) :
- 1- التحكم في كميات المياه المصروفة إلى المسطحات المائية والعمل على معالجتها ومحاولة إعادة استخدامها في ري بعض المحاصيل.
 - 2- استخدام الحد الأدنى من الأسمدة.
 - 3- العمل على تطبيق القوانين التي تنظم إقامة المنتجعات السياحية على امتداد الشاطئ وما يتبعها من إنشاء حواجز للأمواج.
 - 4- ضرورة توقيع اتفاقيات دولية بين الدول المطلة على نفس الساحل للتنسيق فيما بينها وخاصة ما يتعلق بمعالجة مياه الصرف والكميات المطروحة.
 - 5- إجراء الحسابات الدقيقة بخصوص المطلوب خفضه في كميات الأملاح الغذائية والاستعانة بأصحاب الخبرة وتبادل المعلومات حتى لا يؤثر ذلك على الثروة السمكية.
 - 6- التوعية المستمرة عبر وسائل الإعلام المختلفة لجميع المواطنين والصيادين.
 - 7- التدريب المستمر للعاملين في المزارع السمكية واستخدام وسائل حديثة في التغذية.
 - 8- إقامة برامج المتابعة وعلى فترات زمنية قصيرة.