

**Blue-green algae** : are photo autotrophic, prokaryotic algae, they are free living a group of soil micro-organisms have been shown to be agriculturally important, particularly in tropical rice field soils. This is because of capacity of some of cyanobacteria play an important role in maintenance and build up of soil fertility, consequently increasing rice growth and yield as a natural biofertilizer. Blue green algae (BGA) are photosynthetic nitrogen fixers and are free living microorganism and naturally occurring like solar energy, nitrogen and water to ensure soil fertility, synthesize organic substance and also to fix the atmospheric nitrogen for plant growth. This process is called biological nitrogen fixation.

### **AZOLLA AND ANABAENA**

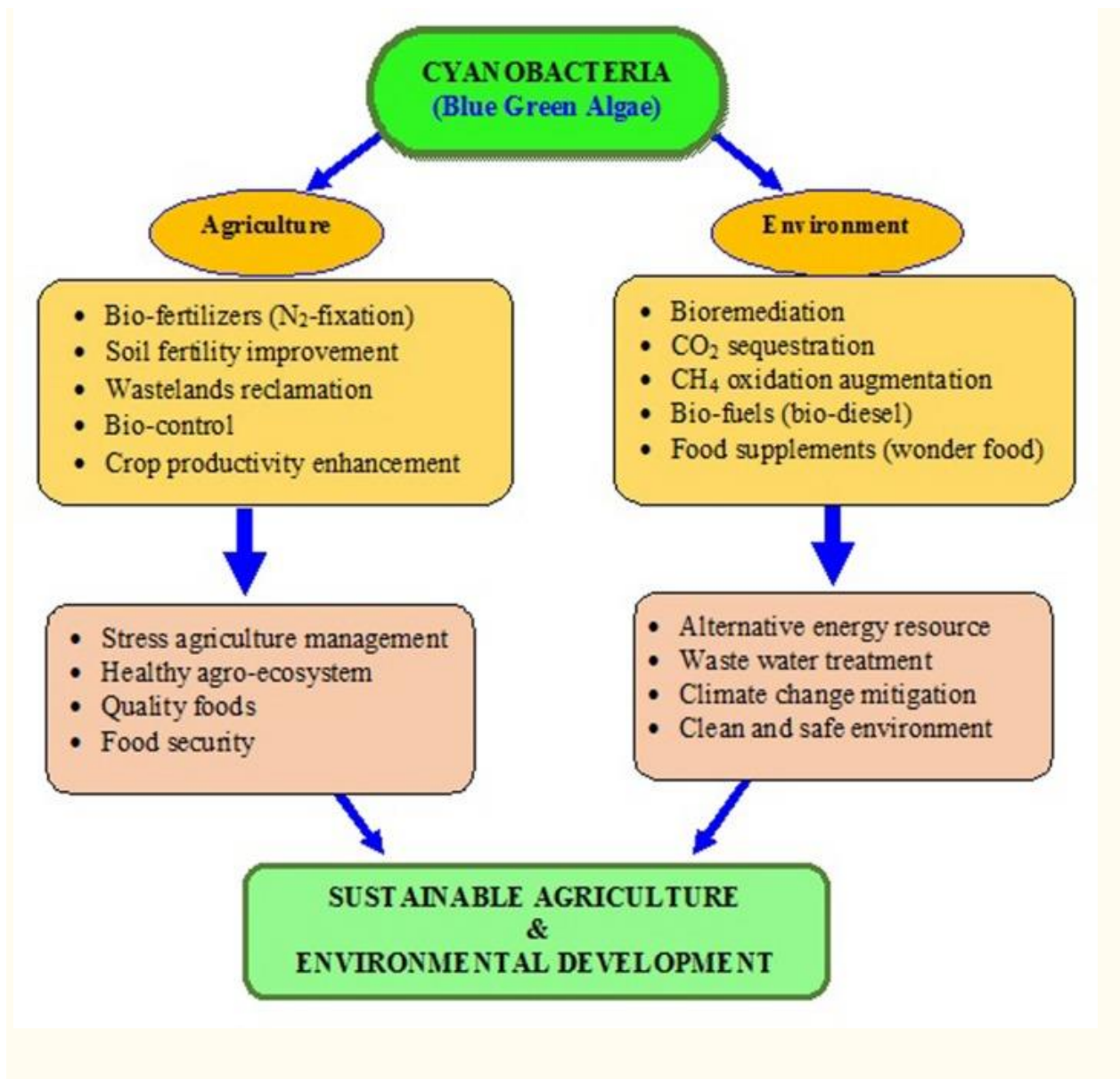
**Azolla** is a floating pteridophyte, which contains as endosymbiont the nitrogen-fixing cyanobacterium *Anabaena azollae* (Nostocaceae family). Widely cultivated in the Asian regions, **Azolla** is either incorporated into the soil before rice transplanting or grown as a dual crop along with rice. Indian agriculture has become a chemical agriculture in which numerous chemicals like insecticides, herbicides, and commercial fertilizers are being used for producing crops. Due to these major microbial population eliminated from soil and rhizosphere is getting polluted. Biofertilizers play an important role in improving soil fertility and boosting crop yields.

Food. In addition to its traditional cultivation as a bio-fertilizer for wetland paddy (due to its ability to fix nitrogen), *Azolla* is finding increasing use for sustainable production of livestock feed. *Azolla* is rich in proteins, essential amino acids, vitamins, and minerals.

Besides several microorganisms such as algae and various inorganic compound fixing bacteria, *Azolla* is also used as biofertilizer in temperate as well as tropical rice growing areas. *Azolla* has been in use widely in countries like China and Vietnam for centuries but it is of a recent introduction in India. Presently there are several *Azolla* species which are under cultivation in India e.g. *Azolla filiculoides* and *Azolla rubra* in cold areas of India while *A. Mexicana*, *A. microphylla*, *A. nilotica* and *A. pinnata* grown under tropical conditions as they are tolerant to high temperature. The cyanobacteria are bestowed with ability to fix atmospheric  $N_2$ , decompose the organic wastes and residues, detoxify heavy metals, pesticides, and other xenobiotics, catalyze the nutrient cycling, suppress growth of pathogenic microorganisms in soil and water, and also produce some bioactive compounds such as vitamins, hormones, and enzymes which contribute to plant growth. These bio-agents can improve the soil quality and plant growth, and minimize the crop production cost by supplementing the good crop management practices such as crop

rotation, use of organic manures, minimum tillage, and the bio-control of pests and diseases. The use of cyanobacteria in agriculture promises definite beneficial effects on crop productivity, if used properly.

The application of cyanobacteria in management of soil and environment includes the economic benefits (reduced input cost), nutrient cycling, N<sub>2</sub>-fixation, bioavailability of phosphorus, water storage and movement, environmental protection and prevention of pollution and land degradation especially through reducing the use of agro-chemicals, and recycling of nutrients and restoration of soil fertility through reclamation



## AZOLLA AND ANABAENA ASSOCIATION

Azolla and the blue-green algae *Anabaena azollae* maintain a symbiotic relationship the algae provide nitrogen to the fern, and the fern provides a habitat for the algae. *Anabaena azolla* maintains a mutually beneficial symbiotic relationship with the water fern azolla which provides the cyanobacteria with a safe environment in exchange for nitrogen. Azolla is grown in tropical and temperate climates in calm bodies of water. Azolla will increase its heterocyst production up to 25-30%.

### Mass cultivation of cyanobacterial biofertilizers

For outdoor mass cultivation of cyanobacterial biofertilizers, the regional specific strains should be used. However, many germplasm collection laboratories have been established by the D.B.T. in different parts of the country for the development of starter inoculum. Mixture of 5 or 6 regional acclimatized strains of cyanobacteria, *e.g.* species of *Anabaena*, *Aulosira*, *Cylindrospermum*, *Gloeotrichia*, *Nostoc*, *Plectonema*, *Tolypothrix* are generally used for starter inoculum. The following four methods are used for mass cultivation : (i) cemented tank method., (ii) shallow metal troughs method, (iii) polythene lined pit method, and (iv) field method. The polythene lined pit method is most suitable for small and marginal farmers to prepared algal biofertilizer. In this method, small pits are prepared in field and lined with thick polythene sheets. Mass cultivation of cyanobacteria is done by using any of the four methods under the following steps:

(i)	Prepare the cemented tanks, shallow trays of iron sheets or polythene lined pits in an open area. Width of tanks or pits should not be more than 1.5 m. This will facilitate the proper handling of culture.
(ii)	Transfer 2 -3 Kg soil (collected from open place for 1m <sup>2</sup> area of the tank) and add 100 g of superphosphate. Water the pit to about 10 cm height. Mix lime to adjust the pH 7. Add 2 ml of insecticide <i>e.g.</i> malathion to protect the culture from mosquitoes. Mix well and allow to settle down soil particles.
(iii)	When water becomes clear, sprinkle 100 g of starter inoculum on the surface of water.

<i>(iv)</i>	When temperature remains between 35-40° during summer, optimum growth of cyanobacteria is achieved. Always maintain the water level to about 10 cm during this period,
<i>(v)</i>	After drying, the algal mat will get separated from the soil and forms flakes. During summer about 1 kg pure algal mat per m <sup>2</sup> area is produced. These are collected, powdered, kept in sealed polythene bags and supplied to the farmers.
<i>(vi)</i>	The algal flakes can be used as starter inoculum if the same process is repeated.

### **FACTORS AFFECTING GROWTH OF ANABAENA AND AZOLLA IN RICE FIELD**

1. Ecological factor: temperature, light, humidity, minerals, water and salinity.
2. Biological factor: bacteria, virus, fungi, insects and animals.
3. Physiochemical factor: heavy metals etc.