

## **Eco-centric Learning and Living**

### **1. Avaya Pukur - a novel concept to conserve indigenous fish diversity**

In the second campus of Mahishadal Raj College, a pond of approximately 10000 square feet area having natural ecosystems is now used to conserve indigenous fish populations of our local area of Pura Medinipur. Since the past six years we have been conserving multiple indigenous fish species through proper natural management system. This is a type of ex-situ conservation attempt where, at present, nearly 37 species of indigenous minor fish species are conserved. Department of Zoology regularly monitors the populations and health status of these fish species. We are trying to maintain natural habitat and ecosystems by preventing unwanted contaminations by the hazardous chemicals such as pesticides, inorganic fertilizer and weedicide. It is an excellent source of local gene diversity of fish population. Various species such as koi, singi, magur, techokho, chanda, pankal, chuno, danrkani, falui, pabda, lata, shal, chang, dafur, six species puntuli, bheda, kholse and many more are present in this abhoy pukur. In this pond, proper ecological condition for the natural breeding of the fish is also maintained. This attempt not only conserves indigenous local fish species but also species of snail and aquatic insect fauna increased simultaneously.

Three threatened species of fireflies lay eggs on the bank of avaya-pukur. Every month a survey is made to make an estimate of the populations of the species. If the population of a species rises above the carrying capacity of the pond ecosystem we collect the excess organism and distribute among different students to maintain sub-populations in their locality. This is a unique attempt to maintain sustainable development of local aquatic ecosystem. Students of different schools and colleges visit this avaya-pukur to gather first-hand knowledge of local fish diversity.

### **2. Butterfly garden**

Department of Zoology of Mahishadal Raj College maintains a butterfly garden. They have been maintaining this experimental garden for the last eleven years. The garden is small in area but full of diverse species. To maintain these species near about 32 types of plant species are also regularly maintained and nurtured. At present there are 9 different species of butterfly present in this garden. They regularly complete their life cycles in this enclosed area. During severe winter and summer their population decreases. But the department tries to maintain this population by providing supplementary food and artificial comfortable environment condition for their survival. When the member of a particular species exceeds the carrying capacity of the small garden, the excess butterflies are released in the natural environment. This garden holds out a good opportunity to study post plant interaction behaviour biology of butterfly.

### **3. Identification characterization and preservation of five RELIC forests**

Relic forests comprise very original and unique cultural vegetation corresponding to the indigenous culture. This study examines the traditional values as a determinant that allows even fragmented relic forests to survive, and tries to consider the preservation of the surviving forests. As research materials at Mahishadal block, five relic forests, which are typical and representative of such forests in terms of their size or structure, were selected. Through a survey of the historical records of each relic forest, an eco-sociological reinterpretation of the origins of the forests was carried out. Also, an on-site phytosociological investigation of the relic forests and their habitat conditions was accomplished. The transformation of the cover-

abundance value was used to indicate the tree species performance of each relic forest. The selected five relic forests are thought to have originated from forests artificially created by certain unknown community or may be natural. This attempt prevents our local heritage and environment from qualitative and quantitative degradation of the forests. Due to change of values in our present modern society in the twentieth century it is very difficult to maintain this type of small patches of forest. However, they have undergone changes from ancient times to today's urban industrial times along with the decline of values. This attempt to declare these small patches of green area as relic forest is the last attempt to protect our local biodiversity and an attempt to create awareness among local people, school and college students and different NGOs. Relic forests of purba Medinipur are not spaces of landscape gardening for amusement but are rather a 'relic forest-traditional village ecotope', namely a unique cultural space in which nature and humans are in harmony.

Departments of Zoology and Botany have selected five such relic forests in our locality. One of them, about one hectare in area, exists near the Kolaghat Thermal Power Station. Second most important relic forest is situated in Nandigram Dhanno Kudiya, generally known as Bahadur Gram. The other 3 are very small patches, about 200 decimal area, each situated in the interiors of remote villages. For the last 4 years we have been trying to restore the floral and faunal diversity of this area. Required permission for the above is obtained and the entry and exit of new species of plants and animals of this forest are regularly recorded. We have finished proper identification and documentation have systematically preserved the herbarium sheet of the said places. Students of our college regularly visit these places as an educational purpose. We aim to establish the medicinal values of the plant present in this area and understand the type of seed dispersal and pollination patterns of the plant in this relic forest.

#### **4. Dolphin Research Centre**

The Gangetic river dolphin is India's national aquatic animal. It is a Schedule I animal under the Wild Life (Protection) Act, 1972. It has been declared an endangered species by the International Union for Conservation of Nature. The Gangetic river dolphin is one of four freshwater dolphin species in the world. This dolphin is found in India, Bangladesh and Nepal. It is blind and finds its way and prey in river waters through echolocation. Bihar is home to around half of the estimated 3,000 Gangetic dolphins in India. Dolphins prefer water that is at least five to eight feet deep. They are usually found in turbulent waters, where there are enough fish for them to feed on. Gangetic dolphins live in a zone where there is little or no current, helping them save energy. If they sense danger, they can dive into deep waters. The dolphins swim from the no-current zone to the edges to hunt for fish.

Mahishadal Raj College is situated at the bank of river Rupnarayan and Haldi. It is interesting to note that although there is a good population of dolphins present in these two rivers, there have been no primary survey or any type of report till now. Department of Zoology is engaged to survey the population status and the cause of death and health status of this national aquatic animals from the last 23 years. In collaboration with WWF our research team have collected large data regarding their behaviours. We already established a very effective "dolphin map" along the lower Gangetic stretch where one can easily spot the jump of dolphin at any moment.

Dr. Subhamoy Das has published a patent of instrument called "dolphin detection device". He has invented an instrument which allow fishermen to locate positions of a dolphin which are entangled in their fishing net so as to rescue the dolphin with immediate effect. This research

is conducted at the lower stretches of the Gangetic plains from Kolaghat to Ghatal, a stretch of 50 km. Under Zoological Society of India, Kolkata, we have completed one project to estimate the population of Gangetic river dolphins from Mahishadal to Ghatal. We established a detailed report of death of this National aquatic animal in three districts in last 15 years. We also established the cause of death of these dolphins. We find out the probable cause of death and extinction of this animal of our locality. Recently we have started research to find out the effect of nano plastic in the different parts of the body of Gangetic river dolphin and their possible effect. We organised seminars, debates, workshops, and awareness programmes to protect them.

## **5. Chitin research, management and business program**

Huge number of prawns are harvested and exported every year. After export huge amount of exo-skeleton waste is thrown out and this creates pollution in this surrounding area. It is a very effective pollutant. Department of Zoology try to convert this organic waste into chitin, chitosan and finally, into bioplastic. We can convert waste into wealth.

Chitin is typically a natural biopolymer predominantly found in the exoskeletal structures of a variety of crustaceans. Chitin is a polymer of amino sugars and creates a very hard and tough outer shell in various organisms for protection. Consumption of chitin externally through diet serves as a tremendous source of insoluble fibers by providing prebiotic properties to the flora present in the gut. The enzyme responsible for breaking down chitin is known as chitinase. They play a role in the destruction of cell walls of pathogens entering our body. Chitosan is a derivative of chitin and tends to exhibit even greater properties than that of chitin. Chitosan is made up of two monomers- glucosamine and N-acetylglucosamine. Chitosans are soluble in water; hence they are biodegradable and biocompatible polymers. They have a wide range of applications in the food and biomedical industry.

Crustaceans and arthropods are the main and rich sources of chitin. Tons of waste shells obtained from prawns get dumped. Chitin is acetyl glucosamine groups while chitosan is obtained by removing enough acetyl groups and they are highly soluble in diluted acids. Chitosan is a biodegradable polymer has wide application in pharmaceutical and biomedical industrial, wastewater treatment and food industries. Chitin exhibited anti-proliferative capacity against colon cancer cell HCT116 with its unique feature of degree of acetylation chitosan showed high anti-tumour activity. Chitin polymer films have greater tensile strength compared to commercially available films.

India produces around 1 million metric tons of shrimp each year. However, 40 to 60% of the raw biomass is wasted in shrimp processing reference. Unfortunately, this waste is non-nutritive in most cases, making it unsuitable for use in feed or food. Consequently, a substantial portion ends up in landfills, contributing to greenhouse gas emissions and emitting foul odors as it rots. The challenge is to transform this underutilized waste into a valuable resource, addressing both economic and environmental concerns.

### **Relevance**

A method was developed for commercial scale production of chitin and chitosan in Purba Medinipur from *P. Monodon*, *P. Indica*, *P. Vanamae* *P. Japonicus* and freshwater prawn, *M. Rosenbergii*. Export-oriented prawn processing industries in West Bengal produce about 300,000 tons of waste. We have developed a low-cost technique of commercial production of

medicinal products, chitin and chitosan, from these factory wastes of Purba Medinipur. Both chitin and chitosan have very wide industrial application in more than 200 different fields.

Every year West Bengal imports huge quantity of chitin and chitosan. This new production technique has opened the avenue of serving four important purposes:

- i.) The country can be able to earn substantial amount of foreign currency by exporting chitin and chitosan;
- ii) instead of disposal, the shrimp processing factory can be able to realize handsome profit by introducing simple process-line for the products;
- iii) Effective waste recycling can help develop an environment-friendly waste management system, sanitation and minimize environmental pollution. The study suggests that chitin and chitosan can be produced in existing prawn processing plants of the country with the simple renovation.
- iv) Formulation of Bioplastic from chitosan save our environment and we reach towards the goal of green and circular economy.

### **Proposed Solution**

Our proposed solution involves harnessing the untapped potential of shrimp waste by Extracting chitin, a valuable polymer of shrimp shell waste. Through further modification, Chitin will be converted into chitosan, which has diverse applications in agriculture, Medicine, cosmetics, and food processing. This creates a sustainable and economically viable solution to address the environmental challenges posed by shrimp waste. Additionally, chitosan will be further utilized in the production of biodegradable single-use Plastics, aligning with global efforts to reduce plastic pollution.

### **Outcome of the Proposed Solution**

1. Prevent environmental pollution.
2. Convert Shrimp Waste to Wealth
3. Looking towards circular economy.
4. Extraction of chitin from shrimp exoskeleton by modified method.
5. Extraction of Chitosan from chitin by chemical method.
6. Formulation of Bioplastic from chitosan.
7. Commercialization of Chitin, Chitosan and bioplastic.
8. Revenue generation of rural people and challenge against unemployment.
9. Reduce amount of imported chitin and save foreign exchange.
10. Sustainable rural green economy.

### **How is the present activity better from existing solutions?**

1. Low cost technique than previous one. (Rs-1700/Kg to Rs-300/Kg)
2. Time Saving technique than previous one. (5Days to 11 hours)
3. Technologically simple and no need of knowledge of biotechnology and microbiology.
4. More profitable than previous method.
5. More ecofriendly.

6. Create awareness against pollution and journey towards sustainable development and circular economy.

### **6. Ornamental fish breeding program**

Ornamental fish is an important commercial component of aquaculture. The culture of living jewels in the confined aquatic system is one of the most favourite commercial business and, second largest hobby in the world. Fishes with attractive colour pattern, swimming behavior and more resistant to captivity stress are considered as good candidate species. Among the commercially important ornamental fishes recorded from the country, export trade is mainly dominated by the indigenous fresh water species collected from the wild. The indigenous species like barbs and loaches have a huge potential towards contributing to the economy of the nation. Considering the importance of this sector, there need to develop different varieties by selecting proper breeding techniques which is an area that still remains least explored. Breeding of the ornamental fishes and the protocol and management methods are species specific. For proper management of fishes in closed captive conditions, a well-designed aquarium is required. Arranging the components such as aquatic plants, rocks, stones, or driftwood, in a pleasing manner within an aquarium is called Aquascaping. Aquascaping itself is a flourishing industry and income generation to many. Colour enhancement of the ornamental species is an area of current attention, which is influenced by several factors, like feed, water quality, and the surrounding environment. Feed plays a major role in the ornamental fish. Feed and feeding management decides the sustainability, profitability, and well-being of an aquaculture system and is essential for the growth, health and reproduction of ornamental fishes. For sustaining the system, health management in the ornamental fish sector is also essential mainly due to the financial investments involved in it. Awareness and knowledge of fish health management is the need of the hour to sustain the industry without major economic loss. Present generations always have a demand for better options that brought value addition in the sector to develop colored varieties which enhances the aesthetic appearance and generates higher income.

Department of Zoology of Mahishadal Raj College is engaged in ornamental fish breeding for last 6 years. We have established a well-equipped ornamental fish breeding centre and research laboratory. In this centre we successfully established breeding activity of 16 types of ornamental fishes. At the same time we want to establish proper methodology of fish breeding in our tropical country. For this purpose, our department takes assistance of local people of Howrah districts who are professionally engaged in this activity. We arrange three seminars and workshops every year. In the same time we reared and maintain a large stock of gravid female for reproduction. After successful breeding program we distribute these new hatchling of fish species to the student and encourage them for business of ornamental fish.

### **7. Herbal Abir production**

Department of Zoology in association of WWF, a production and research centre concerning manufacture and marketing research of herbal Abir was established in 2020. In this centre variety of herbal Abir of ten different herbal sources are regularly manufactured. They are ready to sail in every year in local market. It enhances the economic status and awareness against inorganic colour containing office in the local community.

### **8. Pollination Biology Centre**

In second campus of college a Pollination Research Centre was established where large number of wild weed plant species are planted and method of their pollination strategy by different pollinator are studied regularly. This attempt enhances biodiversity resource of local area.

### **9. Adoption of The Miyawaki forest**

The Miyawaki forest is one of the most effective tree planting methods for creating forest cover quickly on degraded land that has been used for other purposes such as agriculture or construction. It is effective because it is based on natural reforestation principles, i.e. using trees native to the area and replicating natural forest regeneration processes. At Mahishadal Garhkamalpur area at Rajbari campus a large Miyawaki forest were established by Haldia Development Authority. At present this forest is under Panchayat Samity. Department of Zoology has adopted this Miyawaki forest for its maintenance and research. This department is actively involved in developing the canopy of forest and increasing the biodiversity of this Miyawaki forest.

### **10. Animal Rescue Centre**

In the Department of Zoology one animal rescue centre was established in 2019. In this centre injured and stressed animals are rescued from different parts of the district of Purba Medinipur, who are then released in the wild post appropriate treatment. A good number of birds mammals and reptiles are rescued by this centre.