**AGRICULTURE AND AQUACULTURE:**

**THREATS TO BIODIVERSITY**

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**ABSTRACT**

Agriculture and aquaculture form a major source of income in the Asian countries. Along with the benefits provided by both sectors to mankind, there are many adverse consequences also produced to the ecological functions and services. Methane emissions from the cattle rearing, eutrophication due to point and nonpoint sources of drainages, pesticides, antibiotics, escapement of introduced, exotic or genetically modified organisms etc. are included in the negative consequences. In all cases, fresh freshwater and marine aquatic organisms are affected by means of bioaccumulation and biomagnification and it will directly affect the biological functions of the organisms. Therefore there it is required strict guidelines for the proper aquaculture and agriculture practices that will have positive impact on the biodiversity.

**Keywords- Threats, Biodiversity, Agriculture, Aquaculture, Eutrophication**

1. **INTRODUCTION**

Agriculture is a major source of income in many Asian nations. Around the world, 50% of people are employed in agriculture. Rice production dominates the area with a range of other crops, plantations, and livestock also raised, and mixed crop/livestock farming methods are also widespread. Seeds, fertilizer, machinery, and labour are crucial inputs. Crops, wool, dairy, and rooster merchandise are the various system's outputs. However, productivity is still a problem, and there is still a lot of poverty and starvation in rural regions. It is challenging for millions of small-scale farmers to provide food for their families, much less turn a profit from their labour, due to water shortages, climate change, and fragmented land holdings.

 Fish and seafood farming, or aquaculture, is a widely recognized strategy for providing protein for human consumption. Fish is ingested as a source of protein and important nutritional components like omega-3 fatty acids. There are many methods used by the mankind to raise the fish in natural water bodies as well as the manmade ponds and raceways. Many innovative methods like biofloc aquaculture, Recirculatory aquaculture, aquaponics etc are helps to reduce the negative impacts of the aquaculture to the natural ecosystem and the biodiversity.

1. **Agriculture**

 India ranks second as the largest producer of rice, wheat, and dry fruits in the world. India's population is still mostly reliant on agriculture. Agriculture is the backbone of the Indian economy. Over 56.6% of the main workers in India are engaged in agricultural and allied activities, contributing sixteen percent (16%) of the total GDP and ten percent (10%) of total exports. Aside from the advantages, agriculture has certain unfavourable effects.

1. **Effect of Agriculture on Coastal Ecosystem**

 The water quality of the coastal water deteriorates due to polluted runoff from various land-based activities. The runoff from nonpoint sources enters the river ecosystem, which eventually gets entry into coastal waters. Urban and agricultural runoff are the main contributors to organic and mineral materials suspended in coastal waterways, as well as inorganic nutrients that cause eutrophication (such as additional loads of N and P). Based on various studies regarding land-derived pollution and water quality and the susceptibility of the coastal zone to watersheds found that Point sources and non-point sources are the two main categories of sources from which pollutants reach the aquatic environment.

**A. Point Source and non-point source**

 A single observable source is referred to as a point source of pollution. A drain or a pipe are examples of point sources, which are isolated, distinguishable sources of pollution. In this sense, the industrial waste that is routinely disposed of by being dumped into rivers and the ocean directly is considered as point source pollution. Non-point sources of pollution, often known as "diffuse" pollution, are those inputs and effects that spread over a large region and are difficult to assign to a single source. This comprises sewage discharges from on-site sewage disposal systems (such as septic tanks), runoff from agricultural and forestry land, and stormwater runoff from metropolitan areas.

 Non-point source pollution, or polluted runoff, is the greatest threat to coastal waters. An increase in contaminated runoff has been associated with a decline in the variety and number of aquatic species, including several significant commercial and recreational fish species. Additionally, non-point source pollution has contributed to the deterioration of coral reefs, a decrease in seagrass beds, and the occurrence of algal blooms (including toxic algae). In addition, many shellfish beds and swimming beach closures can be attributed to polluted runoff.

 Agriculture's emissions and inputs are a substantial global source of pollution for the atmosphere and the coastal zone. The use of insecticides and other pesticides that impact all species, whether they are cultivated or not, as well as the release of methane and ammonia that contribute to the greenhouse effect are two of many ways that agriculture contributes to the pollution of coastal habitats. Pesticides, insecticides, and fertilizers, among other chemicals used in farming, find their way into the water and contaminate coastal waters. Red tide develops because the nutrients in the runoff from these pollutants stimulate the growth of algae. Harmful algal blooms are another name for red tides. The algae responsible for red tides contain strong toxins, which are poisonous substances that can kill fish, shellfish, animals, and birds. The Nutrients run off from silage and slurry-manure, use of fertilizers, etc. leading to eutrophication. The impacts of eutrophication range from altered species composition at mild eutrophication to enhanced growth of benthos, fish, and phytoplankton.

 Since maximum contaminants input the ocean with the aid of using flows from the encompassing land, specifically through rivers, the best concentrations are regularly discovered in estuaries and coastal areas and thus maximal effects of contaminants on this ecosystem could be expected to occur [1]. After entering the sea, contaminants are usually diluted and widely dispersed [1].Since maximum contaminants input the ocean with the aid of using flows from the encompassing land, specifically through rivers, the best concentrations are regularly discovered in the occurrence of elevated concentrations in the seabed in areas where this material settles [1].

 Areas, which are also close to direct sources of input, are double at risk, for example, estuaries and lagoons. Water quality is affected by toxic substances that are persistent in the marine environment [1]. They are not readily degradable, or not at all degradable which is toxic to living organisms, and bio-available. An essential component of this phenomenon is the accessibility of chemicals that have been absorbed by sediment to organisms. A chemical's exterior accessibility to an organism is known as bioavailability in the aquatic environment.

1. **Agricultural wastes and eutrophication**
2. **Nutrient content in agricultural wastes:**

In addition to meat, livestock and poultry operations produce another valuable commodity which is manure. Manure is a spinoff containing many plant vitamins and natural matter [2]. Animal manure may be an asset in preference to a legal responsibility for manufacturers while efficiently controlled and nicely used on area crops. Besides providing valuable macro- and micronutrients to the soil, manure supplies organic matter to improve the soil’s physical and chemical properties [2]. It also increases the infiltration of water and enhances the retention of nutrients, reduces wind and water erosion, and promotes the growth of beneficial organisms. The key to capturing the benefits of this resource is good nutrient management [2].

1. **Nutrient Contents in Manure:**

The real nutrient price of manure from a selected operation will fluctuate significantly with the method of collection, storage facilities, and the species of animal [2]. Chemical analysis on each sample should be obtained before applying manure in a field. Manure contains a high concentration of nutrients, including trace elements required for crop growth. These nutrients can be used in place of fertilizer for agriculture or crop growth, reducing the need for fertilizers.

1. **Nutrients in Manure and Commercial Fertilizers:**

Plant vitamins in business fertilizers are normally water soluble and easily to be had for plant uptake. Not all of the vitamins in manure are to be had to plants for the duration of the 12 months of application because some are in their organic form, while others can be lost during application [2]. The availability of nitrogen can vary from 30 to 80 percent depending on the type of manure and application method. Most of the nitrogen in lagoon effluent is in the ammonium form and is more subject to volatilization loss during storage and land application. The time of manure application also affects the quantity of nutrients available to a crop. Higher availability is expected when manure application matches the crop nutrient uptake [2]. The availability of phosphorus and potassium in manure is considered similar to that in commercial fertilizer since the majority of phosphorus and potassium in manure is in the inorganic form. For all manure types, 90% of phosphorus and potassium is considered to be available during the first year of application and 10% for future years. Plants make no distinction between nutritional sources. Manure, on the other hand, contains organic carbon, which is essential for sustaining soil health, including cation exchange capability, soil tilth, and water retention capacity.

1. **Bio-concentration (Bioaccumulation) and Biomagnification**

 Bio-concentration or Bioaccumulation of contaminants in the tissues of organisms is essential to understand. The term "conservative pollutants" refers to substances like certain pesticides, industrial chemicals like PCBs, and heavy metals like tin, lead, and mercury. Conservative contaminants cannot be degraded and thus accumulate in the soil or marine environment. Bioaccumulation describes the ratio of a compound in the organism and the concentration in the surrounding medium. Conservative contaminants can accumulate in the tissues of organisms at any time. Such organisms have the capacity to accumulate these contaminants at very high levels. This factor is a function of the stability of the chemical but also how it will accumulate in the fat of the body, i.e., its lipophilicity. Accumulation presents a risk to consumer organisms, including the human species.

 Conservative contaminants are not metabolized. As a result, when a predator consumes a polluting creature, the pollutants are simply transferred to the predator and start accumulating in its tissues. An organism may accumulate very high quantities of the pollutant in its tissues by devouring a large number of prey. The pollutant concentrations in the top predator could become quite high and occasionally fatal as the process moves up the food chain. This phenomenon is known as biomagnification [3]. Biomagnification describes a higher concentration in an organism than in its diet. It is related to the biological availability of contaminants to organisms and to their metabolism and excretion rate. Therefore, identical levels of specific contaminants can have different effects due to the fact that they can be present in different forms with different availability for uptake [3].

1. **Organic synthetic substances**

 More than 7,000,000 compounds are known as Persistent Organic Compounds (POCs) and there are almost infinite possibilities to combine new substances. POPs typically are halogenated organic compounds and as such exhibit high lipid solubility. Serious environmental damage is caused by some of these POCs in the sea. Effects take place at metabolic and physiological levels, both in marine vertebrates and invertebrates [4]. They exert their poor results in the surroundings through some processes, long-variety transport, which lets them travel far from their source, and bioaccumulation, which reconcentrates these chemical compounds to potentially dangerous levels [1]. Compounds that make up POPs are also classed as PBTs (Persistent, Bioaccumulative, and Toxic) or TOMPs (Toxic Organic Micro Pollutants).

 Aromatic compounds are extra reactive and liable to chemical and biochemical transformation and consist of pesticides (chlorinated such DDT – DDE, Polycyclic Aromatic Hydrocarbons, Hexanecyclo Hexane, and organometallics such as tributyltin) [5]. There are 209 congeners of Poly Chloro Biphenyls, all with specific properties. This variety makes both analysis and effect studies complicated [6]. It is doubtful how natural artificial chemical substances have an effect on marine organisms however PCBs, For instance, are regularly discovered in fish liver, seal blubber, hen eggs, and human fat. Organochlorines have been related to impaired reproductive capacity in seals and whales. For instance, octachlorostyrene (OCSs) had been located in benthic organisms. OCS concentrations may be taken as a demonstration of incomplete combustion resulting in the accumulation of chlorinated hydrocarbons in marine organisms [6]. Organometallic compounds inclusive of tributyltin have been used significantly as antifouling dealers and are actually banned in many nations due to their impact referred to as imposex. Imposex refers to a change of sexual characteristics in invertebrates, female gastropods growing for instance.

 The vulnerability of various organisms to contaminates varies to diverse degrees. Age, sex, the availability of food, reproductive health, and genetic makeup can all affect how sensitive an animal is to a certain toxin, even within the same species. The same species' young larval forms are typically significantly more sensitive than the adults. It is now well established that there are anthropogenic chemicals released into the surroundings that may disrupt the endocrine structures of a vast variety of biodiversity. The reproductive hormone-receptor structures appear like in particular vulnerable. Indeed, modifications in sperm counts, genital tract malformations, infertility, an improved frequency of mammary, prostate, and testicular tumors, feminization of male people of numerous vertebrate species, and adjusted reproductive behaviors, have all been reported.

1. **Waste production in agriculture**

The types and quantities of waste vary between farms. Common agricultural wastes include; Packaging materials, Silage plastics, redundant machinery, Tyres, Net wrap, Oils, Batteries, Old fencing, Scrap metal, and Building waste. Other less common wastes include unused pesticides and veterinary medicines, horticultural plastics, and spent sheep dip.

1. **Aquaculture**

Aquaculture is the farming of fish and other aquatic organisms under control conditions for food and other purposes. It is also known as Aquafarming. While only about 13% of the world's fish and other aquatic products come from aquaculture, it is growing rapidly (at approx. 6-7% annually, [7]) and it is currently the fastest growing food production sector in the world. Aquaculture productivity depends on a wide diversity of other aquatic organisms for food and for maintenance of water quality. In turn, it can have adverse impacts on the diversity of natural populations of aquatic organisms and the structure of ecosystems through the release of farmed organisms or the conversion of one habitat to something else.

 The concurrent or sequential linkage between two or more activities is termed as integrated farming of which at least one is aquaculture. The term “waste” has not been omitted because of common usage but philosophically and practically it is better to consider wastes as “resources out of place”.

1. **Positive impacts of aquaculture**

 Aquaculture is also an important economic activity. Providing employment to 14.5 million people on fisheries activities for their livelihood [7]. This helps to compensating the low growth rate of Capture fisheries. Contributing 0.83% to total GDP and 4.73% to the Agricultural GDP (DADF-2020). Culture of mollusc and seaweed can counteract nutrient enrichment. And some other positive benefits from aquaculture are ;a) Production of fish can lessen stress on wild stocks, which can also additionally already be overexploited; b. Stocking organisms from aquaculture structures might also additionally assist to decorate depleted shares with constrained reproductive success; c) Effluents and waste from aquaculture can boom nearby production, abundance, and variety of species; d) Destructive land-use patterns, which includes slash-and-burn agriculture, can be changed with the aid of using greater sustainable patterns, such as aquaculture in ponds, which additionally might also additionally generate income, lessen poverty, and enhance human health [8].

1. **Effects of Aquaculture on biodiversity**

 The major problems are; a) the escapement of aquatic crops and their potential hazard as invasive species; b) The relationships among effluents, eutrophication of water bodies, and changes in the fauna of receiving waters; c) the conversion of sensitive land areas such as mangroves and wetlands, as well as water use; d) Other resource use, such as fish meal and its concomitant overexploitation of fish stocks; e) Disease or parasite transfer from captive to wild stocks; f) Genetic alteration of existing stocks from escaped hatchery products; g) Predator mortality caused by, for example, killing birds near aquaculture facilities; h) Antibiotic and hormone use, which may influence aquatic species near aquaculture facilities.

1. **Escapement and genetic alterations of wild stocks**

 Probably the maximum essential thing of aquaculture as a power on biodiversity is the poor effect of introducing new species or changing genotypes. General attributes of a successful invasive species consist of traits including an extensively dispensed unique range, a broad environmental tolerance, high genetic variability, short generation time, rapid growth, and early sexual maturation. Virtually all of these characteristics are traits favoured for species used in aquaculture, so the potential of many aquaculture species to become invasive is high [8].

 Tilapia is the most-mentioned invasive species instance of the terrible influences of aquaculture, due to the fact tilapia has invaded all continents, displacing many local species. Although it's miles tough to benefit goal statistics at the reasons of maximum introductions, more than half of the documented introductions of tilapia had been no longer the end result of industrial aquaculture however of intentional stocking of tilapia in natural waters through governmental entities. Introductions of many different species of fish stand up from the discharge of aquarium pets into natural waters; such releases aren't the end result of aquaculture. Indeed, most introductions of invasive fishes have not been the result of aquaculture, although aquaculture has played a role [8].

 The terrible genetic consequences of domesticated species launched from aquaculture structures inside their local variety are limited truly with the aid of using the character of aquaculture itself. Most species grown in aquaculture are basically wild, however, a few had been selectively bred for in advanced maturation, quicker growth, or different characteristics.. Some species were changed through hybridization or polyploidy to supply infertile fishes to culture. While everlasting infertility could do away with genetic troubles for escapees, there could nevertheless be issues about competition between native and cultured species, although the number of escapees would not expand after the escape. There also are worries approximately the permanence of infertility as a result of hybridization. A few species, inclusive of Atlantic salmon, do have genetically changed sorts advanced for better increase rates, however up to now none of those has been commercially cultured. The genetic composition of most species in aquaculture resembles that of the same species in the wild, although domestication rates (even unintentional ones) may be quite rapid in fish. Escapement from aquaculture is almost inevitable in all but the most biosecure aquaculture systems: fish escapes out from holes in cages or whilst ponds are tired for harvesting, and via different cultural practices.

1. **Effluents' effects on water quality**

 Another major negative impact of aquaculture on biodiversity has to do with effluents from aquaculture systems and pollution of receiving waters. Humans depend upon the assimilative ability of waters as an important atmosphere service; we treat wastes and discharge them into water with the intent that the water will assimilate them into primary or secondary production. Aquaculture and agriculture are no different in that wastes from both enterprises can be assimilated by natural systems. The importance of aquaculture wastes may be pretty large, so the capability effect of those wastes is a crucial consideration. The waters wherein wastes from cage or pond tradition are located have a big have an impact on at the effect of these wastes. Studies have proven that during greater oligotrophic marine waters, aquaculture effluents growth on local biodiversity.

 In evaluation with marine cage culture, freshwater structures have had plenty of extra problems with nutrient loading. More people have access to the freshwaters, and governments often fail to limit growth in the inexpensive cage systems that can be used there. Also, the smaller length of maximum freshwater structures limits their potential to assimilate waste. Another threat from aquaculture to coastal farming is the brackish water Shrimp culture practices. Shrimp farms pollute the land and water, which has an impact on the groundwater table and village agriculture. Shrimp farms have an adverse effect on coastal ecosystems and reduce water quality by releasing nutrient- and organic-rich effluents.

 A decline in water quality can also result from the intensive fish culture in ponds when the crop grows and food is added at high rates. The water then needs to be exchanged to improve the quality of the pond water, and in the exchange, the receiving waters gain nutrients and waste products, and the biochemical oxygen demand rises. Many current studies are evaluating ways to remediate the nitrogen, phosphorous, and particulate loading of natural waters by aquaculture systems, but many aquaculture systems, especially in developing countries, still discharge untreated water. Common treatment options for pond effluents include the use of settling ponds to sequester particulates, oysters to remove suspended materials from water before its discharge, and seaweed or other plants to act as biofilters to remove excess nutrients. This problem of eutrophication is mainly a by-product of intensive fish production, rather than extensive or semi-intensive systems. In most cases, water discharged from ponds is of much lower quality than the receiving waters, although in some cases, its quality is higher as a result of remediation treatments during aquaculture processes.

 Pollution of local waters that supply aquaculture systems threatens aquaculture itself as well as biodiversity. Obviously, poor water quality stimulates poor fish growth and production, and discharge waters from one facility often serve as supply waters for downstream culture facilities. When intensive culture was first expanded, pollution problems were common. Early feeding was often ineffective, with feed conversion rates (kg of feed, usually dry, per wet kg of fish produced) of five or higher, indicating high wastage by fish not consuming feeds. Similarly, the protein level and phosphorous content of feed were often much higher than necessary. More effective feeds and feeding systems have been developed to address these problems, which cost money as well as cause pollution. It is rare today for a well-developed intensive culture system to have a feed conversion rate exceeding 1.3, and low-protein, low-phosphate feeds are commonly used.

1. **Conversion of sensitive land**

 This is a perceived negative impact of shrimp aquaculture, in particular, has received much attention. One of the major objections to shrimp culturing is that mangroves are cleared to make way for pond facilities. Also, land is cleared and saltwater brought inland, resulting in the salinization of soils. As the intensity of shrimp production is stepped up, disease outbreaks and other conditions cause some aquaculture systems to fail. After ponds fail, they may be abandoned, and the altered land cannot be returned to normal productive processes because of soil salinization. This abandonment of shrimp ponds and conversion of mangrove forests into abandoned land is another of the major concerns about shrimp aquaculture.

In spite of these concerns, the growth in shrimp production has occurred in many parts of the world, in particular in China, Thailand, Vietnam, Indonesia, and India. Mangrove losses have been substantial; the best estimates are that 33% of all mangroves that once existed are gone today. Coastal development, which includes urbanization, agriculture, and pond shrimp aquaculture as well as the pond culture of other species, has caused these large losses. Aquaculture has been responsible for a share of mangrove loss, but aquaculture operations have also been set up in areas where forests have already been cleared and the estimate of less than 10% of the global loss of mangroves is responsible by shrimp farming because the total area of shrimp ponds globally is small. New, intensive pond systems need to be fully drained to harvest the shrimp, so they are commonly placed above the high-tide elevation, which is also beyond mangrove forest areas.

1. **Inefficient resource use**

 Another important impact is the use of fish meal and fish oil in prepared feeds. Given the current rates of aquaculture growth and the rising importance of intensive aquaculture, forecasts are for even higher demands for fish meal. Because fish meal is composed of many captured species, overexploitation results in declining biodiversity. Fish meal commonly comes from small pelagic species of fish, whose harvest can also reduce food for production for larger predatory fishes at sea. For these reasons, the use of fish meal in aquaculture must be considered a negative impact of the industry.

Overall, the use of fish meal in aquaculture is becoming a major impediment to future production in intensive systems because of the expense of the feed and its limited availability for future expansion. Feeds are currently produced using the components of the fish carcass that are not used for human consumption (by-products) to substitute for fish meal, with good success. Other sources of protein will become important components of fish feed, including plant protein and waste products from other operations, as will the culture of more species at lower trophic levels for human consumption, since these species do not require fish protein in feed. Alternate feed derivations have been a major subject of aquaculture research and development, and efforts are intensifying. Moreover, aquaculture is not the only user of fish meal but also using intensively in livestock feeding, and the pet food industry. Fish meal is well established in the animal feed business, and elimination of fish meal from aquaculture feeds does not remove it from other uses. Reducing the pressure on species used in fish meal production will take a comprehensive effort in all areas of animal feed production.

1. **Disease or parasite transfer from captive to wild stocks**

 This is also an important negative impact of aquaculture is the transmission of diseases or parasites from farmed animals to wild fish stocks. These problems, combined with concerns about antibiotic resistance that could develop from use of antibiotics in culture, have been suspected for a long time but not substantiated.

1. **Eutrophication**

 Aquatic plants and algae gradually fill in freshwater lakes and estuaries over time in a natural process called eutrophication. This process is controlled by low concentrations of certain nutrients (like phosphate and nitrogen) that the plants and algae require to grow. Usually, phosphorus is the limiting nutrient in freshwater and nitrogen in estuaries and salt water. However, when humans release nutrients like phosphate (agriculture ~50%, human metabolism ~20%, industry ~10%, detergents ~10% and natural erosion ~10%), the process of eutrophication is accelerated. In a worst-case scenario, the excess growth of plants and algae can smother other organisms when they die and begin to decay. An eutrophication indictor is derived by converting the different chemical forms of phosphorus and nitrogen into a common or equivalent form. Then, the proportion normally found in aquatic algae is used to weigh the phosphorus and nitrogen. These values are added into an overall indicator.

1. **UNEP recommendations to minimise the adverse impacts of aquaculture on wild stocks:**
2. Closed culture: better containment to prevent escape of the organism.
3. Sterilisation: easily induced way of avoiding direct genetic effects.
4. Localisation: locating farms away from wild populations, and choosing locations for sea ranching that minimise straying so as to reduce gene flow to wild populations.
5. Coastal parks: providing totally protected areas for valuable wild populations.
6. Reduced or selective fishing: protecting native populations by reducing fishing pressure or by directing that pressure toward cultured fish.
7. Restrictions on transport: reducing the spread of exotic genes and diseases by restricting transport or live fish and eggs.
8. Gene banks: counteracting extinction of local populations by the establishment of gene banks.
9. Minimal genetic differences from native populations: reducing effects of gene flow by minimising the genetic differences between escaping or released fish and recipient wild populations
10. Training of workers: basic training of aqua-culture workers (including non-specialists) to minimise the risk of accidental releases of organisms into aquatic ecosystems.
11. **CONCLUSION**

 Pollution from agricultural runoff is a growing problem worldwide. Aquaculture in coastal areas is also contributing enough problems to the coastal ecosystems that are adversely affecting biodiversity. There is strict enforcement in management measures for the sustainable use of agriculture as well as aquaculture.

 Documentation of wild genetic resources and threats to their survival is the first step toward implementing specific measures to protect the wild population and their environments. The International Centre for Living Aquatic Resources Management (ICLARM) and FAO have developed a database (FishBase) that now includes nearly half the world's finfish, including nearly all of those that are directly useful to humans.

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