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Transitional fishery: a new resource for global nutritional food and medicinal security

Abstract

Sea and river junctions form lagoon, sites become largely marshy land with fresh water at upper approaching river reach and brackish water towards sea. Such bays are plentiful in numbers and visited by aquatic birds during the winter seasons. Previous studies established vast possibility of harvesting biological nitrogen (N) and phosphorus (P) through aquatic bird droppings viz Guano. The vast sizes and number of such sites have huge potential for fishery with differing in quality characters which is termed as transitional fishery in the present study. Objective of the present study was to bring impetus in this new category of fishery with scientific management so as to make the venture highly efficient and responsive, and enable harnessing plentiful benefits of nutritional food and medicinal security. The transitional fishery was considered as ecosystems and various networks of ecology of land, vegetation, fish and aquatic birds were brought in a band for managing it in new pattern. Ecological lessons were hypothesized and validated by results on fishery on lagoons available in literatures. First innovative lesson was that fish adopt site in North East direction of fresh water stream, as also corroborated by honey bee comb sites on N-E side of any circular water tank's supporting posts. The second innovative fact was to transformed terrestrial land as sites for growing highly palatable nitrogen rich organic feed for fishery. Thus, colonization and feeding become conclusive approach, as supported by past researches, as guide to fishery scientist to move steps ahead in harnessing productivity of lagoons. Thus, fresh and marine brackish water transition zones become vast resources for countries to derive prosperity and employment generations. The innovative fishery feed will be usable for other types of fisheries ie fresh water fishery as well as marine fishery.

Keywords: aquatic birds, biological nitrogen and phosphorus, fishery, marine and seas, iodine deficiency syndrome, nutrition and health

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Introduction

Fish is white meat which is preferred to other non vegetarian meal by health conscious people. These days there have been new focus to bring blue revolution, especially as non dispensable user of water. Interest of enhanced reproductive capacity makes it an attractive biological species involved in production and consumption. There exit class of upland fishery which grows in rivers and ponds or also termed as riverine fishery. There is other class of fishery viz marine fishery, which develops and grow in marine and oceans. Lot of research developments and explorations were made on both types of fisheries. In this situation both types of fish production is limited in riverine fishery and also limited under sea and marine for catching fish. The upland fishery is adversely affected by climate change which produces extremes of scarcity and at times too much surplus of rain causing flooding of ponds and rivers, thereby spoiling ongoing potential ecosystem for fishery production. This means these situations are not going to bring surplus commodity to fulfill various domestic and industrial needs. There is some still more innovative development on fishery, which can be implemented to harness resources of land, water, sea and marine and last reaches of rivers joining the sea.

The sea is vast and all terrestrial rivers convey fresh water and drain in to sea at lower level. Close to such junction river acquire braiding and make delta,[1] marshy lands, occasionally flooded during high tides. The site situation is represented vide Figure 1. In such situations fishery thrives with fresh, transitional salty and fresh water and sea brackish water. The entire domain of junction of terrestrial and sea including transition is brought to make subject coverage of fishery. Objective of the present study was to give deeper insight of associated potential, problems and possibility of harnessing the transitional fishery so that it becomes available for nutritional food and medicinal security.

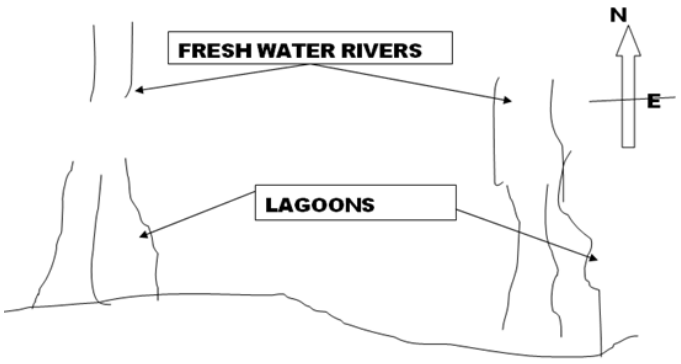

Figure 1 Schematic representation of sea shore and fresh water river junction forming lagoon.

Materials and method

Earth and ocean

The planet Earth is a planet of oceans.[2] The total area of the Earth is approximately 510 million square kilometers and the oceans cover about 71 percent of the Earth's surface, which is about 360 million square kilometers. There are total 5 oceans and they are the Arctic, Pacific, Atlantic, Indian, and the Antarctic Ocean. Out of these five, there are three major oceans, the Atlantic, Pacific and the Indian Ocean. They account for 90 percent of the area covered by oceans.

The Pacific Ocean is the largest ocean, its area is 181 million square kilometers, which covers nearly a third of the Earth's surface. The Atlantic Ocean is the second largest, covering 94 million square kilometers, and the Indian Ocean is the third largest, covering about 74 million square kilometers. The oceans' tremendous presence causes it to have a huge effect on the planet and our civilization. It is greatly responsible for the climate of the Earth. It regulates air temperature and supplies moisture for rainfall. The ocean also provides us with food, energy, minerals, and a cheap method of transportation. Without the oceans, the Earth wouldn't be able to sustain life.

Some examples of lagoons which cover transitional fishery

The ocean and terrestrial interface line is large. All terrestrial spaces form part of one or other catchment for collecting and transferring concentrated runoff by rivers to the oceans. The catchment characteristics decide pattern of rivers and finally rivers close to the ocean acquire shape of riverine condition. The rivers which directly drain to oceans form such lagoons. This study is not concentrating on any survey of such lagoons, which is extensive. This study takes some known long rivers and draining in to oceans and forming the lagoons of huge significances. The example case cited here are long river Nile which joins at southern bank of Mediterranean sea falling in territoty of Egypt known as Bardawil.[3-6] The other important lagoon is at junction of River Ganga and forming lagoon at Sunderban basins.[6] These lagoons having large area spread acquire all essential charactieristics of general interest, particularly for environment and fishery. The features have entirely different features, which impose special problem. Such lagoons are inadequately harnessed, which form subject coverage under the present study. Figure 2A depicts geographical of Egypt,s Berdawil of size 650 kn2 and Figure 2B of Ganga at Sunderban covering 4230 km2 , the junction with bay of Bengal in Indian Ocean. Such large area with innovative transitional fishery and management for methane arresting will have perceptible result in reduction of global warming. This clearly shows need of effective innovative development of lagoon Sunderban more than that for Bardaweil. Both the continents Egypt and Best Bengal are highly fish loving states and the innovative technologies will have good prospect.

Figure 2A Lagoon of the River Nile and Mediteranian seapart in Egypt.

Associating features and characteristics

As brought out earlier, the junctions of upland rivers joining sea at lower elevation acquire riverine land geomorphological features develop in river morphology.[1] Such lands suffer occasional flooding due to sea rise and get receded fast. The up and down flow waives moderate topography with silted surface land. There remain lot of cross cuts and some divide lines. Such vast lands remain unusable for want of new innovative use. These lands largely remain as marshy lands,[7] which continuously emit methane to environment. During the dry months the water spread area get reduced to actual sea land area. These marshy lands are occasionally visited by aquatic birds, which remain thriving on fingerlings. Thus, the special featured ecosystems have not been scientifically harnessed for deriving useful produces. Large potential lands are remaining unharnessed and it requires some innovative suitable means of harnessing and making its best use.

Figure 2B Lagoons of India and Bangladesh ie Sunderban.

Liabilities and Assets with lagoons

The riverine land forming lagoons pose problem sites for release of green house gas (GHG) methane from its marshy sites. The sites are plentiful in numbers and large sizes have not caught attention of environmental conservationists as there could nothing be done from it. Methane gas with warming factors of 21-30 as against warming factor 1 of carbon dioxide emanate from the wetlands along ocean coast. However, there is no any attempt known to cite, to reduce such GHG emission. Thus, such lands have been posing lot of liability in terms of creating global warming. Such lands have been left under wild life reserve. The mystery of methane escaping strong sites and getting flamed in nights are given reasons and cause panic in the society. Such marshy sites can be suitably harnessed for capture and use of methane as cheap source of fuel. However, such ventures have not yet come to realization in the global scenarios, which otherwise would have reduced cause of development of global warming.

Vast sizes of the lagoons have transition of fresh water, brackish water and inter mixed quality in between the two. This means fishery which develop in this land and water featured situation, also termed as transitional fishery, can be harnessed and intensified. Such sites provide new opportunity for quality fishery, medium and totally marine fishery. The plentiful area and innovative technology can be used for planned measure based harnessing fishery for human, animal, production of organic N and P, production of iodine and codfish oil and many other medicinal purposes. These sites can be used for developing employment generation and engaging huge population migrating from other countries. Such arrangement will not build additional pressure on terrestrial land in the countries.

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Innovative lessons immense values learnt from previous researches

The lagoons have been getting used for fishery in different countries for generating economic benefits. Researchers have produced some lessons of immense values, which make the task targeted feasible and manageable. Study on Bardawil lagoon in Egypt and keen insight of honey bee making their combs revealed following lessons.

(i) The spatial pattern of benthic assemblage is indicative that stations located in each specific sampled northern coastline tend to cluster together, which also suggest the influence of surrogate abiotic water conditions.

(ii) Such preferred sites were indicated by honey bees, which always prefer to build their combs in North East direction of the circular elevated water tanks.

Thus, it became a lesson of future use that when there is transition fishery large and delicate species and high density of benthic assemblages can be developed in North East corner and moved towards South West. How this lesson can be used in managing transition fisheries will be taken up in result part of the study.

Innovative technologies for harnessing aquatic bird droppings-Guano

a. Lagoons can be provides with rakes at sites on the shore so that aquatic birds sit during the day time and areas where these birds habit in night also provided plastic sheet as cover on ground for harvesting of guano for biological N and P.

b. Flat site can be sown with some fish loving vegetations which grow in brackish water, usually remain in short supply for assemblage get supplemented in the fresh water fishery form North East to South West side. There are innovative technologies which bring lot of esculent biomass grown from water drained terrain tops within the lagoons and usable for feeding the transition fishery.

c. There will be many innovative uses of the transitional fishery products to generate economy and employments, which will be presented in the result part of the study.

Acquisition of data

The innovative technologies will effectively produce plentiful fish for human, animal and wild life consumptions. This study brings innovations based on experiences and lessons learnt, in absence of such innovations plentiful. sites of transitional fisheries could not come in suitable use. The innovative development makes tasks of not known, ll get easy. The research will inspire fishery scientists globally apply this knowledge and produce global information of huge volume. The fishery products will be usable for plentiful product processing and finished products as clued in the result part of the study. The organic N and P had sufficient research base.[7,8] Thus, there are plentiful evidentiary results to show utility of transitional fishery focused in the present study.

Results

Large potential areas for transitional fisheries

The marine lives have their preferred zone of habitation. For example, corals intensively grow in the oceans zones having slow waves and still water low depths and strong incidence of solar radiation. Great Barrier reef in Australia and development of corals are example for such facts. Costal sea such zone will be revamped that will provide new material, products and employment and business which will be different from the marine fishery and shrimp production. Details on this aspect was given in different study.[9] Thus, development fishery in lagoons will make livelihood easy for people living in the coastal areas.

Ongoing practices of transitional fishery manoeuvres

Lagoons had been getting harnessed with weak thrust in their existing situations. What had been coming up had been taken for granted as only feasible and sufficient, only because there had been lack of visionary technologies. This fact is revealed bt Figure 3 for the Sunderans Lagoo. Such situations were apparent for both the example cases viz Bardawil, Egypt and Sunderbans, West Bengal, India cited in the study. Such lagoons also support development of vegetation viz mangroves and bushes as well as some trees, which form ecology[10,11] New innovations will create better utilizations of such lagoons for fishery and many other produces to be coming up in the following part of the study.

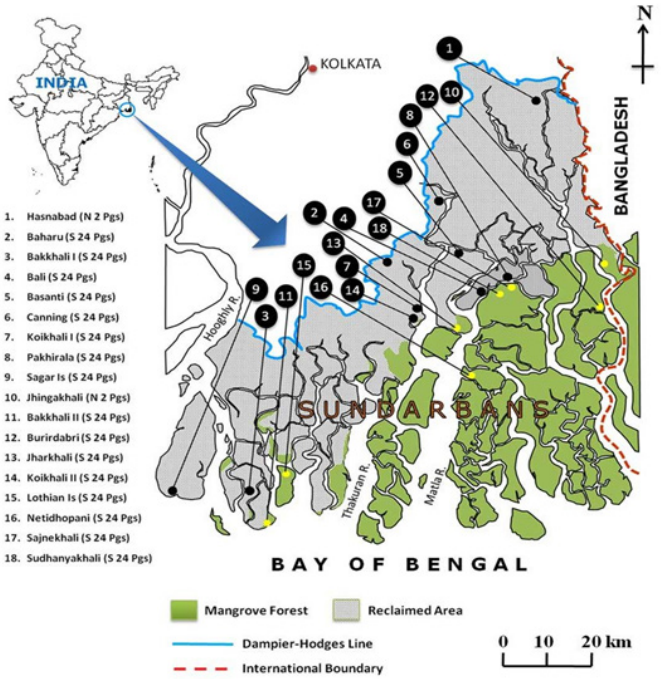

Figure 3 Exploratory attempts in Lagoon Sunderbans.

Universal fact based management innovative plan

Using information enumerated in section 2.5 an innovative virtual plan of laying efforts to harness the transitional fishery is depicted vide Figure 4. The NE is best and SW is the most inferior quality and productivity prosperity sites. N E sites with fresh water will produce best quality and highest quantity of fish. Depending on sites the fishery prices will be ranging from NE (highest) towards decreasing S W.side. This coordinate will be universally applicable as the Sun always rises in East, be for Northern or for Southern hemisphere**.** The NE corner will receive fresh water and SW brackish sea water at any side of sea shore.

Feeds and Feeding

Large fish make pray of smaller size fingerlings. Fish also eat sea weeds that grow in marine bottom. Fish assemblage develops as

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affected by availability of such sea vegetation. In Bardawil lagoon sea grasses (*Cymodocea nodosa* and *Halophila stipulacea)* were the **2nd** highest abundant rather (373 tufts/m^2, representing 18.9% of the total annual average fish), which recorded at the most sampling sites in the lagoon. This information was taken as lesson for enforcing human effort based manoeuvre in enhancing transitional fishery. These information support that some innovative feed for fishery can be developed for fostering the transitional fishery, at least where fresh water is available in the fresh water rivers approaching sea junction. Previous experiences[12,13] guided that rice puffs, soyabean chunks and some nitrogen containing seculent green leaves chopped and mixed in a optimized combination can be supplemented to create huge production of quality fish. There were innovative way of raising high N containing crops,[10] that will serve as ecological network support[8,9] of terrestrial support for enhancing productivity of transitional fishery. Previous researches have produced ample and highly convincing yields of such feeds given to fish and the innovation here will be highly effective, enable confidence and convincing research results. Since the innovations were derived from actual data, it will become as inspiring fact and for the future researcher to straight way in production mode as operational research project. This researcher had full confidence that such ORP will be highly desirable and beneficial for the future researchers. This consideration served as basis of fostering research on transitional fishery.

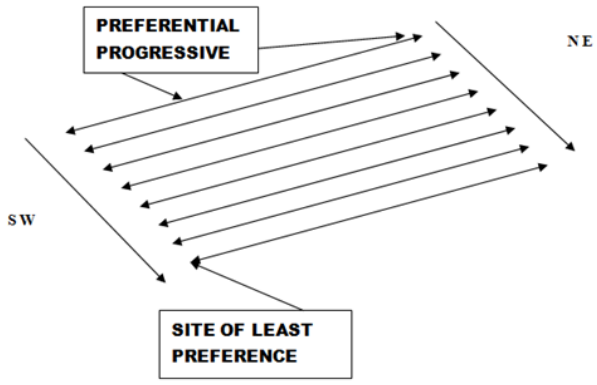

Figure 4 Virtual coordinate of innovative transitional fishery harnessing plan.

Land improvement form for cultivating biomass feed for transitional fishery

Raised bed and furrow (RBF) is an ideal land form[13,14] which support harnessing productivity of soil (Figure 5). Land existing along freshwater joining stream can be transformed in the RBF. Such land form create well drained sufficiently aerated soil top profile to be able to support fast growth of esculent high N containing vegetation. Such measures were established to produce high quality biomass from salt containing coastal lands. Other selection of crop, and cultivation have already been established, which should be followed[11,12] for producing fishery feeds. Such good fields, fresh water and natural environment will be able to produce good N containing crop viz alfalfa that will produce quality fish under transitional fishery. Such feeds can be spread at such sites or hanged in caged packets. Such feeding arrangement and feed will open new impetus for transitional fishery.

Parallel ecosystem along the terrestrial and sea coast

The transitional fishery sites occur with parallel eco-system, which provides useful and supporting information[13] that had been utilized in developing management practice for transitional fisher (depicted in sub section 3.5). This parallel eco component[13] is the vegetation in form of agriculture crops and flowering plant as well as tree species. The honey bees collect nectors from flowers and store in their combs providing precious product honey, which is nowhere synthesized, thus it is pure natural product. Honey collection process facilitates pollinations that produce fortifying effect on crop yields. Like the fishery honey and beekeeping is also non dispensable water user. There exist parallel ecological networks in any eco-sysytem.[8] The estuary lagoons provide several ecological entities, which flourish in its own way. Derivation of services from such eco component becomes easy and economical. The transitional fishery sites constitute ecosystem supporting in term of providing commodity which is highly useful for medicinal preparations. The colonization of honey bee on vegetations will be supporting transitional fishery, which does not demand extra effort and investments, besides efforts in extracting honey. As brought earlier the occurrence of large quantity and quality of fish will be in direction where honey combs get built by honey bees, thus it serves as confirmatory guiding indication.

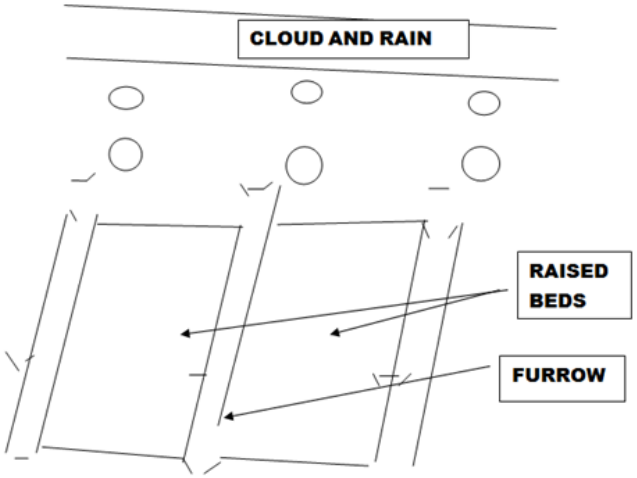

Figure 5 Raised Beds and Furrows und rainfed agriculture to produce high N containing crop.

Such honey bee (Figure 6) is new insight for transitional fishery sites exemplified for Berdawil in Egypt as well as for Sunderbans in West Bengal, India. The South West corner of the transitional fishery sites should be equipped with sitting racks with collection trays for harvesting guano.[14,15]

Figure 6 Honey bee as soft resource for egenerating hony from flowering vegetations crops and plants.

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New venture of honey bee keeping along lagoons

The fishery is the most efficient synthesizer of feeds in proteins. Hence, new innovative feeding to the extent will revamp fish production which will be usable for human, animal and aquatic birds. The portion of fish which is not usable by human and animals will get consumed by the birds. The harvesting of bird droppings rich in organic N and P are usable in bringing multiple uses.[13,14] Easy and important uses of fishery are enumerated in Table 1.

The products from fishery are usable for listed six uses for N and eight for P. Large quantity of fish produced in transitional fishery when becomes surplus it can be processed for making variety of products. The organic P is higly desirable as nutrient for agriculture. Both N and P are important macro nutrients for crop. The P is very costly. Additionally, it gets fixed and uses efficiency by plants as around 20 percent. The organic P is highly efficiently used by plants as it remains in solubilized form extractable by crops.

The organic N is having lot of innovative potential industrial uses such as low temperature industrial refrigerant. In contrast to N, P is equally well usable in textile industry for white wash and bright color painting. P is also usable in preparation of instrument panels and conducting scientific research on measuring velocity as tracer dye. The fish oil is extracted from fish and iodine (I) which is an important human nutrition.

Table 1 Biological organic compounds

S.No	Form of nitrogen	Nature of use	Product
	Biological nitrogen (N)		
1	Plant nutrient N	Fertilizer for agriculture	High yield of crops
2	Azoo components	Used as dye stuff	Contain double bonded nitrogen
3	TNT Tinitrotoluene	Mixture of concentrated Nitric acid and Sulphuric acid	Scent
4	N_2 used to provide inert and dry atmosphere	Used as preservative	Check chemical degradation of food that goes in presence of oxygen and water vapor
5	In liquid form	Used as low temperature industrial refrigerant	Refrigerant
6	Nitrogen and Carbon	Used for making plastics	plastics
	Biological Phosphorus (P)		
7	Organic phosphorus (P)	As plant macro nutrient	Increase in crop yield
8	Phosphorus dye	Textile bright washing	Becoming acceptable for textile manufacturing company
9	Building material	Trace added for bright color getup	Useable in paint and polishing materials'
10	Textile coloring	Trace added for bright for color getup	Fast color printings brightness of colors, enhance
11	Cloths and clothing maintenance	As finishing products	Removes yellow tint and produce some brands of soap.
12	Instrumentation	Used as phosphorescent chemical dye	Used in instrumental panel and dash boards
13	Scientific research studies	Used as tracer dye in scientific research	Measurement of velocity of flow
14	Velocity measurement	As tracer dye	Direct measurement of river discharge

Discussion

The transitional fishery sites are recognized as estuarine in hydraulic engineering.[1,7] It is also accepted as special ecosystem of mixed quality[6] of fresh and brackish marine and sea water. The transient fishery designation become impetus in building strong sites. Such sites are used for harnessing fish in their exiting forms, as it happens for the marine and ocean fishery. When the transitional fishery is innovatively managed there will be huge production in quantity and good quality with fresh water portion of the fishery. There will be enhancement in fish to be used by human, animal and use by aquatic birds.[11,12] There are different numbers of innovative production studies, conducted in the present study. Nevertheless, this study produced and introduced innovations, which will produce eagerness in researchers to carryout plentiful researches of immense values. There were many innovations which can be brought in transitional fishery as depicted in the following deliberations**.**

With innovations the ecology of different entities will get flourished that will provide several services from the ecosystem where such lagoons exist. Thus, with innovation the transitional fishery will be highly responsive to produce new resource, reducing pressure on marine and terrestrial fishery. The transitional fishery is having opportunity to enhance its productivity by feeding and harnessing quality fish from the large areas which can get intensively developed for its intended purposes (Table 1). Thus, this situation complacent the ideal action that first sow then reap the benefits, which had been limited in marine fishery and remain expensive for inland fishery for want of available suitable sites. Therefore, transitional fishery will have huge global potential resource.

This research demonstrated innovative developments of transitional fishery that any lagoon should be brought under the grids of Figure 4, be on left or right side of sea, it should be invariably followed in the fixed pattern for all sites. As a sun technology, be in northern or southern hemisphere. This research makes management of transitional fishery easy and better manageable than what had been going on, for global lagoon based fishery, in general.

This research provided new insight of how biological process of honey is made use to support the hydro process of fishery. Thus, this study effectively demonstrated easy way of assessing services of eco-systems from ecology which run parallel in any ecosystem.[8] There can be some derogatory process in any ecosystem, which will come to notice when some icons are found in bad effect producing

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components. There will be opportunity for quick corrective remedial measures. Such situations developed from bats is one example that became originator of expanded pandemic such as of COVID-19.

This study presented many uses of transitional fishery, making nutritional food, and new sources of industrial and scientific use materials. Such system of fishery will be versatile and sustainable. Thus, this research brought new type of class of fishery vis inland fishery and marine fishery. Thus study created new resource of plentiful fishery resource for nutritional food and medicinal food security.

Fishery scientists get worried for adverse impacts of climate change on fish production[15] thereby they attempt developing suitable species of fish. Such conditions demand budget, resources and scientific time. The new transitional fishery will be highly manoeuvrable brought under transient fishery make the task easy as variety of situations exist in transition, hence transitional fishery. In this direction climatic forecasting developed on hydrological front[16] is an exemplary research endeavour to take pre preparations to make transitional fisher highly sustainable. The present research produced composite impact of water bodies, including sea and marine and reduce worries of environmentalists.

Conclusion

The present study added a new class of fishery termed as transitional fishery to the existing upland riverine and marine fishery, which occupies large areas under large no of sites in the globe, which get revamped with innovations. The new class of fishery equipped with number of innovations from associating ecology networks, highly productive and provider of ecosystem services. The innovative virtual plan of management devised and validated with data from previous researches created innovative management, for which fishery scientists had been devoying lot of time, effort and budget. Multiple uses from enhanced productivity of fishery bring nutritional and medicinal security. Biomass based fish feed developed in the study will be usable for fish rearing, in general that will help best transformation of biomass in nutrition protein**.** As revealed by the two cited cases on transitional fishery, it will produce huge prosperity and employment generation, which should be used for reducing land pressure arising by migrations.

Conflicts of interest

The author declares that there is no conflicts of interest.

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