

# Development of racks for maximization of biological harvesting of N and P from sea and marine through aquatic birds producing resource guano

## Abstract

Huge increase of global population was creating stress on terrestrial ecosystems which worry food policy thinkers and planners. Biological nitrogen (N) and phosphorus (P) harvesting was an innovative research development using well accepted and circulated data about seven decades before, which was accepted as innovative way of linking hydro, fishery, aquatic birds, agriculture and environment. This linkage made easy way of opening vast ocean and marine resources harnessible for extracting organic macro nutrients for agriculture and industrial products. Objective of this study was to develop racks for enabling harvest of the guano. Study facilitated birds social and stochastic and heuristic on inspire design for racks for sitting of aquatic birds and collection of bird droppings in daily routines. The architecture of racks and materials of construction were developed. It was suggested to launch operational research project on harvesting of guano for intended use. Thus new world was created to harness sea resources for innovative product to benefit agriculture, industry and environment by effective use of vast ocean and other existing aquatic systems. This research created new dimension of linking ocean, fish, birds, agriculture, environment and human life easy and reducing stress on terrestrial ecosystems.

**Keywords:** aquatic birds, fishery, ocean and marines, organic nitrogen and phosphorus, maximization of production process

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## Introduction

Fishery products and services were getting emphasis in the present time. Biological harvesting of organic nitrogen (N) and phosphorus (P) were presented in innovative studies.<sup>1-3</sup> Such fortification of fishery business became innovative use of waste water. This extended application of fishery to wet was depicted by study.<sup>4</sup> This research enables turning non usable wetland waste water to usable water by treatment. Such fish are usable by wild animal zoos etc and aquatic birds that produce guano,<sup>5</sup> which is the basic resource. for producing organic nitrogen and phosphorus. Such organic products have several scientific and industrial uses besides bringing improvement in agriculture. That means there will be huge demand for such guano.

Vast oceans, rivers, ponds and water bodies will be getting used for producing plentiful fishery. As per ecological principle this becomes system of production and consumption and there will be natural development of wastes. Such waste products will get used by the aquatic birds. The birds will also thrive from small fingerling catch and sit around during the day times. If suitable racks are created for sitting of birds, it will enable harvesting of the guano. The sitting of birds for prey, and producing dropping is highly stochastic process. There had been advancements in statistics and mathematics for computing such stochastic processes. Therefore, this research was devoted on optimization of collecting guano from aquatic birds. Nature inspired computing algorithms were getting popular and serving as inspiration in the coming up biological components of the nature i.e. humans and animals or activities observed from nature. The main bases for these algorithms are evolutionary algorithm, population based and ecology-based algorithms. General Taxonomy of Nature Inspired Computational Intelligence will be coming in the following section of the study.

Water bodies may be in form of ponds, nearly circular of irregular boundary, same is situation of oceans shores of long lengths. The inland water bodies, lakes and rivers have fresh water and fish grow in such water situations. Fish grow and birds sprang around it during day times and habit on trees adjacent to water sources. Bird dropping are natural phenomena based, which had been occurring and deteriorating quality of waters. This bird dropping is called as Guano.<sup>1-3</sup> These studies reported that the guano contains high content of N and P, but no scientific attention came on it. The recent most scientific attention was reported by studies,<sup>2,3</sup> not only on quantity, but also on its multiple utility. The referred studies<sup>2,3</sup> dealt on how to harvest biological guano from the aquatic ecosystems. This scientific development enabled linking of water bodies, fishery, aquatic birds and human to harness vast un tapped resources and make multiple scientific uses. This means the plentiful area spreading resources can be easily harnessed for fulfilling variety of food, fuel and medicinal global emerging needs for present and posterity. This situation will upgrade utility with new thrust receiving development of plentiful fishery. It needs building resources of fish, birds for production of guano and develops mechanism for collection of the guano. The studies<sup>2,3</sup> dealt with on the potential and means of biological harvesting and it demanded to maximize the biological harvesting of guano. As the process is natural, it is possible to harvest. by fostering aquatic bird populations, enable them easily and adequately get fed, have comfortable stay around or inside the aquatic ecosystem of any nature ranging from small ponds to the oceans. Several factors need scientific considerations, which will take its own time in fortification. The most important feasible task is to provide inbuilt habiting environments that facilitate their moving pattern get manoeuvred making effective collection and quickly coming to house for stay, during which guano get dropped. The dropping can be collected at week or fortnight interval and duly

processed. Objective of the study was to develop bird sitting racks suitable architecture design for sitting of aquatic birds at comfortable place for taking rest and again reach for task for hunting enabling biological harvest of droppings to the extent possible.

## Materials and method

### The fishery, bird and their dropping interface process

Figure 1 displays a real situation comprising shallow water depth, aquatic birds spiraling in search of fingerlings or quenching their hunger of feeding, have unpleasant sunshine and no place to rest during their hunting. The birds move to different sites and even dropping create problem of water pollution, hence causes deterioration of water quality. This natural process need to be ameliorated by scientific principle based population, heuristic facilitating colonization so that bird droppings get collected to the maximum extent. There will be different aquatic situations and this ideal concept involving solution will be challenging tasks for ornithologist, environmentalist, eco economists, fishery scientists, agriculturists and researchers in all such disciplines to find plausible solution. Such solutions will facilitate biological harvesting of guano from vast hydro- aquatic ecosystems, where fish grow and birds flocks gather. So far there had been no visualization of this nature based resource and researches<sup>2,3</sup> brought new vision almost after seven decades of note worthy publication.<sup>5</sup> Now this study results will guide development of racks architecture to maximize accumulation of the droppings at site which can be collected by visiting at convenient intervals. The collection features were adequately dealt with in the cited studies.<sup>2,3</sup>



**Figure 1** Scenario of bird flock at shallow water sites searching fingerlings for their feed.

### Existing scientific advancement on optimum status

There have been advancements in statistics and mathematics for stochastic processes,<sup>6-12</sup> for subject in physical sciences. The recent approach is to take lesson from nature, where different biological entities follow in organizing their force to capture prey, A highly comprehensive research document is Ph D dissertation thesis of Geleta.<sup>13</sup> Thus, for harvesting guano nature based considerations for architectural design of racks for sitting of birds will be advancing the scientific man oeuvre of marine and fishery science.

### Nature inspired prey capturing schemes

Various schemes were devised on the corollary of action resorted by nature entities of different species for attempting the catch of prey. These are highly resembled growth of honey bees, gravitational and teaching learning processes, in educational training course content. Such schemes and their mathematical models were devised and optimized for optimization<sup>14-22</sup> and for combination of renewable

energy of solar cell panel and wind mills for power generation by Geleta,<sup>13</sup> a Ph D. dissertation in the mathamaics. The computational algorithms demand advance knowledge of statistical theory and computational knowledge, which fall in discipline of physical sciences.<sup>14-23</sup> The fishery and biological harvesting of guano is of high interest to biological sciences. In this situation the nature based concepts were used and optimization was created to cover aspect controlled by stochastic process through exact and deterministic method of maximization. This study is innovative research in this direction introducing way on optimization of collection of guano. Therefore, situation on detailed description of computational algorithms falls beyond the scope of the present study.

### The scope of optimization of biological harvesting of guano

The aquatic systems are plentiful, where fisheries of one or other types can get fostered. Transitional fishery,<sup>24</sup> is new dimension in development of fishery, where birds concentrate for their feeds. Previous studies<sup>2,3</sup> also dealt with ways and means of enhancing population of fish under constraints of water quality, feed and food webs etc. The fingerling and waste fish become sources for food web for fish, which need to be harnessed through aquatic birds. There is no scope to bring any human intervention to foster the phenomena, hence maximization can help acquire by providing suitable inbuilt housing and sitting rakes for the aquatic birds. Therefore, it can be maximized by extending collection of system by launching operational research project on harvesting of guano by method suggested by Wagner.<sup>24</sup>

Nature inspired computing algorithm is a way to follow inspiration in the biological components of the nature i.e., humans and animals or activities observed from nature. As a result, these stochastic, population-based algorithms are termed as nature inspired algorithms,<sup>13</sup> The taxonomic classification is depicted vide Figure 2 note , Cultural algorithm, CS Cuckoo search algorithm, GA genetic algorithm, GP ES ED ,PSO particle swarm optimization ACO ABC artificial bee colony, BA FFA CE, GSO, gravitational search optimization, GWO gray wolf optimization, WWO water wave optimization, GSA gravitational search algorithm, TLBO teaching learning based optimization, GWO gray wolf optimization, PFO . The undefined notations concern higher mathematical computational factors, which do not come in the present study.

The nature inspired processes viz GSA, PSO, GA and HGWOGA to compare the results obtained by these algorithms in case of total annual cost, reliability probability and convergence. The study<sup>13</sup> could be used as reference document for guide differ design of racks. Quantum of guano harvest will enable understand behavior of aquatic birds. The collected data will become source as repository for validaion of the nature inspired algorithms that might come in future.

### Design considerations for racks

Large bird population endeavoring catch fingerlings move to different aquatic systems as depicted by Figure 1. The architecture of different type of built environment need to be developed that should facilitate birds sit and corresponding come in action as their known nature inspired behavior for maximizing their prey, have long sitting times during day time so that their routine dropping accumulate in pan placed in housing. Thus bird species play an important role. At the same type, shore, depth and isolation from getting least disturbance are also factor. Collection of the guano can be done at convenience and time available with the guano collecting personnel.

The racks, shelter and collection trays will be as per schemes of architecture. Since this is the first attempt on maximization of guano harvesting after almost two decades. The biological harvesting of N and P will get conducted and many expected refinements would be coming in future. The studies on Guano<sup>2,3</sup> came almost seven decades after its publication in book<sup>3</sup> by Guftafson. Therefore, the the selected designs will be making advancement in aquaculture and marine biology. The keen watch of birds' preference will enable further refinement and replacement of racks.

### Collection of data

There will be variety of situations and plentiful sites globally, which need exhaustive endeavor for collection of guano. Such aquatic systems, climate, seasonal movement of birds will be different from region to region. This study presents various patterns of racks and built in shelter for collection, which can be used as per set objective, convenience and interest of collecting scientists.

### Optimization of collection

The first step of collecting guano will enable identify type of birds that flock in any given aquatic body at any site. There can be different results. Once that is established, next step will be to develop maximization<sup>22</sup> by deterministic optimization of the racks. This detail will be presented in the result part of the study.

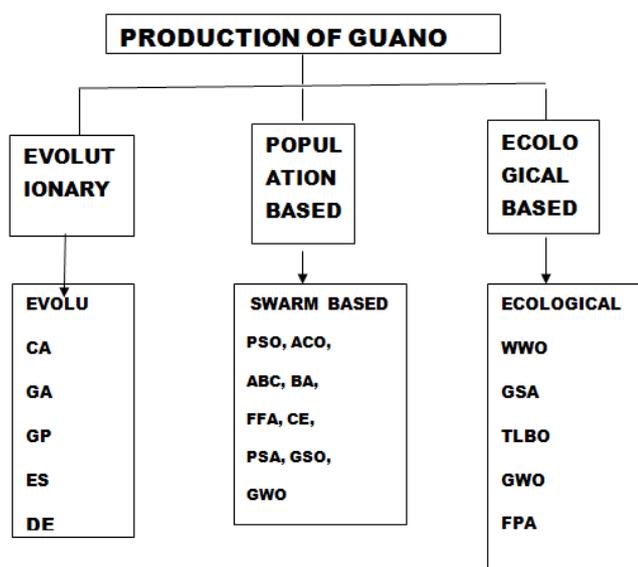
### Results

#### Different population, heuristic schemes and their implication for rack architecture

Scientific considerations went to take up insight of bird flocks' action and behavior and styles of their prey and style of hunting (Figure 2) were brought out in Table 1. This study closely followed nature inspired schemes. pattern of architect were developed for finding optimum combinations of different rack architectures. These aspects were sought in maximization of biological harvesting of bird droppings, the source guano for biological N and P.

**Table 1** Population, colonization and hunting behavior of birds corroborated by different nomenclatures

S.No	Nomenclatures	Inspiration	Clue for bird flock	Clue for desirable architecture of racks
1	GWO	Social hierarchy and hunting mechanism of wolf	Specific species of bird having unique requirement	Tree shape for night sitting
2	ABC	Intelligent behavior of honey bees	Organized participatory action	Honey comb
3	GSA	Theory of gravitation	Specific behavior of predators	Circular sitting for positioning in any direction of searching
4	PSO	Social behavior of bird flocks and food searching	Shallow depth search of catch	Low height of zigzag pattern
5	GA	Genetic biological evolution	General biological evolution of different species	Specific pattern based
6	Ecological	Eco-preferential search	Colonization and intermixed pattern at specific location	Different preferred racks
7	HGWOGA	Combined behavior of different flocks	Harness through all maximized racks	Optimized different pattern placed at any site



**Figure 2** Taxonomy of patterns of biological entities in catching their prey.

Based on the reviews of each of the algorithms GWO, ABC, GSA, PSO, GA and HGWOGA, the similarity, differences and common conventional Nature Inspired Algorithms effective for easy problems were sorted out Conventional methods are better than nature inspired optimization and give accurate optimal value when the problem is continuously differentiable. Whereas, nature inspired algorithm was more power full when the complexity of the problem increases, as it happens with stochasticity in the natural processes.

Seven types of scientific and mathematical approaches were sought in maximization of renewable biological product guano. These aspects serve as guide for enabling designing racks for bird sitting and hunting as well as harvesting of the droppings. The lessons on renewable energy in optimization are used for collecting maximum quantity of guano. Inferences in last column of Table 2 are designed to serve specific social and behavior need of bird and collection of Guano.

#### Architectures of racks for sitting of birds at varying sites

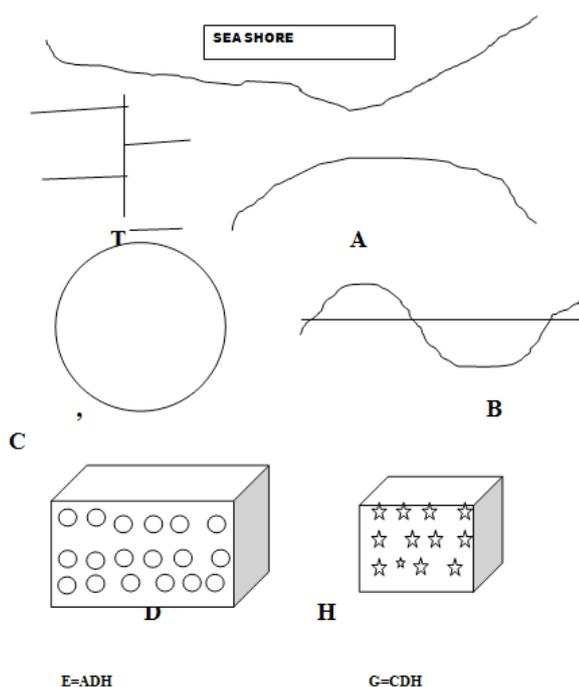
Combining collective colonization guided by population, sociological need for food, genetic with aim to facilitate in organized

form of sitting of bird as man oeuvre of situation depicted by scenario Figure 3 are developed in the study, These racks are suitable for specific hydro- eco and aquatic situations. The collection of quantity of guano will reveal suitability in consideration of not only one specific pattern at a location, rather with many locations. This study

opened new frontier and created new interest in marine biology. Preference of birds becomes new source to understand birds' social psychology. Fishery scientists have moved far away in understanding benthic behavior of fish, the present study will generate psychology and cleverness of bird in hunting for prey.

**Table 2** Suitability of racks for different hydro-terrestrial situations

S No	Bird sitting racks	Suitability	Guano collection tray
1	Tree type	Night sitting	Plastic sheet spread with some absorbing substance spread on it.
2	Circular arch	Sea shores	Hanging tray for wash and collect
3	Circular	Deep water hunting	Hanging tray for wash and collect
4	Zigzag	Shallow water searching	Corresponding hanging tray
5	Pigeon holes	Ecological preference	Flat glass plate that can be scraped
6	Honey bee comb	Organized sitting	Wash and collect
7	Combination	As per types of racks	As per types of racks



**Figure 3** Different architectures of bird sitting racks.

There exist different aquatic system, climate especially with respect to low temperatures and types of aquatic birds. The birds move in search of fish fingerlings and move to find rest sites. The racks, overhead shelters and trays for collection of guano become setup for the biological harvesting of Guano.

Collection of guano in liquid as well as dry form will be possible. Tree type racks for sitting of birds will be highly effective in collecting guano that get dropped by birds during the night sitting on trees existing on brim of water bodies. Under such trees spreading of plastic sheet and sprinkling of any powdery items such as ash, saw

dust or chaffs of crops to absorb wet guano for easy collection is to be followed. Other architecturally formed racks for bird sitting should be provided with plastic trays or even glass plates which permit washing or even scraping. The guano liquid or solid should be stored in normal cool and dry shelter and duly processed for its intended uses.

### Innovative progress on placement /siting of the racks

After deciding the design of most suitable architecture of racks for harvesting guano for the aquatic site, next important aspect is the location of the sites of placement of such racks so that birds concentrate in region where they get adequate fish for their feed to produce guano, which will be new venture for different countries having large aquatic resource. In this direction an innovative development was that such fishery site existing in South –West (S-W) was proven as an ideal site.<sup>23</sup> Such sites should be invariably fixed for harvesting guano for which a virtual innovative coordinating set was developed in study.<sup>23</sup> This information is confirmed by dealing in the study<sup>23</sup> for transitional fishery.

### Data on maximum harvest of guano

Next important work is conducting study on collection of field data on such task of guano. As stated earlier, the domain of the hydro ecosystem is almost 71 % of Earth surface and in addition water bodies in terrestrial part such as rivers, lakes and wet lands also form part that also support fishery. Thus, setting of principle is the right approach to inspire global gentry to take right path on new dimension, which was taken up using well known data on organic nitrogen (N) and phosphorus (P) after almost seven decades. Thus, the development of architecture of bird stand, a next important need was taken up in the study. It is expected that new development will inspire global gentry that will bring lot of data on maximization for different situations. Such approach is ideal for fostering any development by peoples' participatory action. Therefore, novelty of this research on the design of architecture of racks for bird sitting compensate the likely skepticism of no data collection in the present study. Instead, this novel research makes new hydro resources come in vision of large

global population who will be able to quickly harness such nature based process for human welfare.<sup>24</sup>

### Deterministic maximization of guano harvest

Once some data becomes available next step becomes on making setup with varying provisions to optimize size of racks that would enable catch maximum harvest of guano. The stochastic process can be brought to deterministic optimization. This approach will enable reach on size of multiplication and use of stand at sites along large coasts in global countries. For this range of minimum and maximum collections can be optimized by standard optimization technique to

deterministic method, instead of waiting results of nature inspired algorithm. The entire range should be splitted at least for six levels. These sizes will be 0, 20, 40, 60, 80, 100 and 120% of the upper range which should be fabricated and placed at the most suitable sites. Data on guano collection will be optimized as polynomial convex maximization (Figure 4). Such optimized level was 55% of normal seed rates in developing eco-zero weeding.<sup>23</sup> This result gives indication of development of ecology of mixed species of birds, which rely on aquatic fingerlings. Thus, the difference between optimized level and usual level of harvesting of guano will build new niche in organic N and P on the global scale.

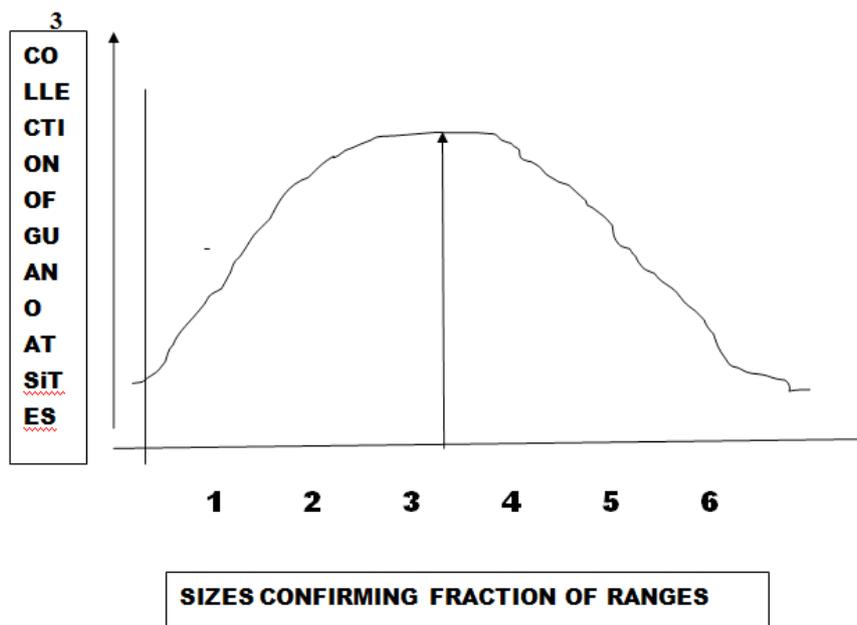


Figure 4 Modular scheme for maximization of size of different types of racks for birds.

### Huge potential requiring industrial processing of plentiful bio N and P

There will be large aquatic ecosystems, types of birds which thrive on fingerlings and produce droppings viz guano. Such guanos become polluting sources for the water bodies. This study is overcoming problem and making best use as resource for organic N and P. This organic product becomes highly usable organic input for agriculture industry and medicines. Thus, this study created new resource and method of building it and bring in use for welfare of global gentry. The aquatic birds do not damage agriculture in any way, instead this venture will become organic source for macro nutrient N and P. Earlier studies have proved that one fourth of total recommended N in form of organic N produces maximum yield of crops.<sup>25</sup> Thus, this organic macronutrient will enhance yield to eliminate any hunger and at the same time it will reduce input cost in agriculture. The venture will also bring employment opportunity in the countries, which will reduce migrations in search of employments.

### Operational research project on biological harvesting of guano

This study produced answers for almost all dimensions involved in the biological harvesting of guano. In order to generate data and also learn lessons and bring simultaneous improvement, operational research project on biological harvesting of guano is recommended.

Such approaches will equip global launch and generate data and working experience.<sup>26</sup> Thus, scarcity of data will get compensated and shortfall made up for any innovative project. This endeavor will equip globe with knowledge, working experience and valuable organic N and P. The vast aquatic resources will get new dimension of producing useful products. Such developments on fishery will become means of new reforms in waste water treatment and bringing economic prosperity. This will enable make use of brackish water covering two third area of planet Earth in ocean and marine get utilized as non dispensable use and create resourceful world.

### Discussion

This study was devoted on building racks for birds that will enable maximum biological harvest of guano, which will be usable for agriculture and industrial applications. This product is usable for serving as refrigerant for low temperature that is usable for safe keeping of vaccines and developing scientific advanced magnetic rail project, a global dream project. While there have been plentiful aquatic ecosystem, biological harvesting of guano is new wing of fishery, which were brought to different innovations, used as guide in developing racks for facilitating bird sitting where guano will come naturally, This is a novel research direction on adding further strength to the new innovations in fishery. The following paragraphs are added for further ratification on such issues in the study.

## Biological harvesting of Guano as a new scientific vision

Earlier studies<sup>2,3</sup> were on biological harvesting of Guano as new scientific vision. These researches were highly read globally and this author was awarded Winner of World Academic Championship in Biological Science in 2018. The present study on bringing innovative architecture for racks for sitting bird that will foster maximization of harvest of guano became further fortification of the biological harvesting of Guano. Different uses and utilities of biological sciences overcoming many reforms in water resources as well as environment were new innovations fostering fishery, support to the agriculture and environment.

## Bringing new wisdom on social psychological aspects learning through nature inspired algorithm

There have been always endeavors for learning from nature. Such nature inspired mechanisms are particle swam, colonization, organizations in accomplishing task such as honey bee and ants, grey wolf, teaching learning, gravitational and genetic behavior presented in detail Goleta, 2020.<sup>13</sup> This study brought developing architectures for racks for bird sitting as new dimension in fostering maximum harvest of guano. This study brought scientific application on organizing situations for birds wandering depicted vide Figure 1. Circular shape architecture represents teaching learning and gravitational action in catching fingerlings. Different racks can be evaluated, which is spread in global domain, hence it displays a new scientific vision in this direction.

## Innovative development for linking sea, and amarine, aquatic birds, agriculture, environment and people

This research brings all wandering and weakly used resources in usable and organizable pattern, which will bring plentiful resource from existing scarce situation. Such resources and ways of harnessing will enable global gentry going in their endeavor to the extent possible and harness for their benefits as well as for national welfare. Thus, this research brought as open ended resources' use for people to extensive use and enjoy livelihood, improve agriculture, create employment and protect water and environment. Earlier study<sup>24</sup> on sea and marine generated coral vessels and dining sets developed innovative vessels resources for people keep food prepared and kept ready for dining. Equally innovative research was the design of racks for biological harvesting of guano. This research also showed innovative way to harness vast ocean resources for bringing global prosperity. Launch of operational research project<sup>26</sup> on global scale need to be implemented.

## Conclusions

This study did set nature supplementing action of biological harvesting of guano from aquatic birds, which thrive on fingerlings, thus, enabled linking aquatic system to come in human grip for making plentiful uses of vast marine and oceans in usable resource. The study organized nature based algorithm of social, ecological, hunting and organizing wisdom to develop different architecture based racks for sitting of aquatic birds. In this process the study developed mathematical procedure for maneuvering stochastic, heuristic population and develop deterministic optimization to stand as the maximum biological harvest of new non conventional resource ie guano from aquatic birds.

## Conflicts of interest

Authors duly declared that there is no any conflict of interest for authorship. It was also declared that the study did not receive any financial support for the study.

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