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***Corresponding author:** Subhas Chandra Datta, Headmaster & Secretary & Researcher, Eco-club, Kanchannagar D.N. Das High School (HS), Kanchannagar, Purba Burdwan-713102, West Bengal, India, Tel: +91 9832192464 / +91 7602303924; E-mail: dattasubhas@rediffmail.com / subhaschandra.datta@gmail.com

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ORCID: <https://orcid.org/0000-0002-5718-4969>

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Research Article

Artificial-Nest Rainwater-Harvesting with Fishery and Floating-or-Rooftop-Gardening Act as 21st Century COVID-19 Epidemic-Model: Improved Biodiversity Agriculture Socio-Economic Civil-Engineering Environmental-Sciences Technology-Communication

Subhas Chandra Datta*

Headmaster & Secretary & Researcher, Eco-club, Kanchannagar D.N. Das High School (HS), Kanchannagar, Purba Burdwan-713102, West Bengal, India

Abstract

Introduction: The past-two-decades have faced many-viral-epidemics. The present threat-COVID-19 causes great-loss of human-lives, change human-civilization, public health, agriculture, travel, socioeconomic, education, civil-engineering, environmental-sciences and clinical-research also. There are no proper-effective-treatment-methods. The low-income-households, senior-citizens, and street-children are not able to manage. So the whole world as well as the Government of India tries to reorient for the COVID-19 epidemic-crisis, by developing policy-initiative. So it is emphasis on the conservation of biodiversity, agriculture, socio-economic, civil-engineering, and environmental-sciences, for preventive-measures against "21st century-various-human-diseases like COVID-19-Pandemic".

Methods: In the two ecofriendly localities; rural and urban areas, where constructs or set up different types of artificial-nests in the building as well as in the trees, rainwater-harvesting with fishery, and nutritional-garden, forming the common-complex-ecosystem with landscaping by trees, garden, midday-meals, store-grains reservoir's, playground, pond, and river with agriculture.

Result: Various kinds of birds, rats, mice, moles, bats, squirrels, mongooses, insets, toads, snakes, and other animals, are the regular visitors. But the owls apparently act as a keystone-species within these food-chain-relationships. Rats that happen to spoil food items of mid-day-meals, store-rooms, and documents are checked by barn-owl. Bats make building dirty by their excreta are also controlled by this owl. Different pests and mongoose, which are found to significantly reduce food production in agriculture, pisciculture, tsar-industries, hatcheries, and poultry-farm, are appreciably kept on top of things. And, improves midday-meal, arouses the interest of locality on ecology-food-chain-relationships-issues, and contributes to sustainable-pisciculture-pond, agriculture, and kitchen-garden-management, micro-and macro- climate issues, and also community-health also. It's worth mentioning that the hooter plays the role of the simplest carnivore, predating on mongoose juveniles and bats, the

carrier of coronavirus, again confirming the “Biological and Bio-System-Engineering-Owl Controlled COVID-19 Engineering Bio-mechanical Biomedical-Science-Technology-Communication-Enriched-Agriculture-Environment with Joyful-Environment and Bat Secrets of Immunity Could Confirm the Clues to Treating-COVID-19”.

Conclusion: So the artificial-nest, rainwater-harvesting with fishery and floating-gardening shaded by solar-panel supplying-electricity for oxygen-producing-motor in water, OR rooftop-gardening attached with ‘Bird’s-/ Sky-Observer-Balcony’, act as 21st-century civil-engineering COVID-19-epidemic-model which improved biodiversity, agriculture, environmental-sciences, technology-communication, socio-economy-welfare, developing the future-policy; the theme “Vision-2040” that would retain the human civilization’s in old-forms because “Happiness brings good-health-and-wellbeing with the help of civil-engineering-and-environmental-biologist”.

Introduction

The past two decades have faced many viral epidemics, causing great-loss of human-lives, and the current ‘human-challenge’ pandemic coronavirus disease, COVID-19, has shown unique global-challenges to human civilization, our private and professional life and the social organization-communities, health systems-“the invisible patients”, devastating social and economic consequences, truism and education and the clinical research, with scientists, has been an urgency to develop vaccines against novel coronavirus, which comes from animals, and pandemic requires a unified global response [1-14]. And reopening of the educational institutions could also threaten the surrounding community, and employees will not be permitted to teach or work [9]. So the scientists, have been an urgency to develop vaccines against coronavirus [14,15] or to find out the quickest and most efficient effective-treatment- pathway and prevention strategies, but remain careful regarding scientifically robust and ethically sound clinical research by an international randomized trial; because the recent pandemic situation is analogous to war, the delay of every week in the deployment of a vaccine to the seven billion humans on earth will cost thousands of lives, and WHO develops a blueprint for diagnostics, vaccines, and therapeutics against novel coronavirus [16-23]. It has no effective treatment methods. Though the middle and upper classes are able to manage, but the low-income-households, street children, the marginalized in the cities, and groups like senior-citizens, are really suffering [24].

Now the whole world as well as the Government of India tries to reorient the COVID-19 epidemic-crisis, by developing policy-initiative [25,26]. It is thought that a safe and effective vaccine could help to protect in two distinct ways; direct protection and indirect protection, focusing on the common population, to enhance indirect protection due to vaccines induce weaker, like influenza vaccines, shorter-lived immune responses in the elderly than in young adults, increasing indirect protection may be a more effective strategy [27]. For these, Indian-researchers have strictly warned before that the red tape associated with the Convention on Biological Diversity, designed to protect countries from losing control of their biodiversity [28] because “Happiness brings good-health-and-wellbeing with the help of civil-engineering-and-environmental-biologist”. Modern essentials of architectural, design, and computation principles dictating the lighting of spaces for a properly lit space helps to bring in a sense of happiness, and the significant development of psychological aspects include mood betterment with increasing hygiene through lighting and therapeutic effects of lighting. [29]. So it is needed more details about the indirect protection as a more effective strategy which is recommended

to explain the different indirect protection methods and why the authors have chosen this way for his research.

Different indirect recommended protection strategy selected for research

Advantages of artificial-nest: Indirect protection is a more effective strategy in the ‘Artificial-Nest’. Several species of birds regularly introduce aromatic herbs into their nests putatively to reduce parasites or pathogens, thereby conveying positive effects to the chicks, allowing the behavior to evolve, which is most often seen in cavity-nesting birds and after nest building has finished [30]. Studies with artificial bird nests are useful for illustrating basic ecological principles, such as how predation occurs differently in different habitats, effects of land-use changes such as those resulting from habitat fragmentation on predation, and the effects of distance from the edge and edge type on predation (i.e., the so-called “edge effects,” where predation increases near ecotones. The coevolution between predators and their prey also is of interest to biologists and can be examined with artificial nests [31]. The ‘Nest design’ also varies adaptively in order to both minimize the detrimental effects of parasites and to create a suitable microclimate for parents and developing offspring in relation to predictable variation in environmental conditions. Our understanding of the design and function of birds’ nests has increased considerably in recent years, and the evidence suggests that nests have four non-mutually exclusive functions. And the design of birds’ nests is far more sophisticated than previously realized and that nests are multifunctional structures that have important fitness consequences for the builder/s [32]. Here the research further highlights the importance of behavioral plasticity, which might be especially important for city-dwelling species in the face of global urbanization [33]. Until now, it was believed that birds removed droppings from their nests to avoid the appearance of parasites and the feces activate the immune system of blackbird chicks and only attract insects [34]. Edible bird’s nest (EBN) has been widely used for enhancing immune competence, its antiviral efficacy has not been studied in detail. We found that EBN extract could strongly inhibit infection with influenza viruses and inhibit hemagglutination [35]. Edible bird’s nest (EBN) can enhance immune function, specifically humoral immunity and cellular immunity, via a stimulatory effect which is regarded as an immune-enhancing food, and observed the effects of EBN on spleen lymphocytes proliferation and activation, as well as immunoglobulin isotypes as indicators, which could promote the proliferation and activation of B-cells and increase IgE, IgA, IgM, and IgG3 levels. We also found that EBN extract can promote the secretion of sIgA in the small intestine. Using cyclophosphamide (CY) indicates that EBN also protects B-cells from the damage induced by CY and can reduce the intestinal

immune injury induced by CY by accelerating the proliferation and activation of B-cells and enhancing antibody secretion of B-cells [36].

Materials and construction methods of nests vary between bird species and at present, very important for the relationships between architecture and function in these structures. Utilizing its own saliva as a construction material allows the swiftlets full control over the structural features at a very high resolution in a process similar to the additive manufacturing the mechanical properties, which would vary between the structural regions of the nest (i.e. anchoring to the wall, center of the cup, and rim) mainly by means of architecture to offer structural support and bear the natural loads of birds and eggs, and it helps architecture, evaluate its strength and weak points if any, as well as to understand the rationale and benefits that underlie this natural structure. And it shows the macro-and micro-scale structural patterns are identical in all nests, suggesting that their construction is governed by specific design principles. These findings highlight the mechanical overdesign as a biological strategy for resilient, single-material constructions designed to protect eggs and hatchlings [37]. The presence of aromatic greens in with other building materials increased the time birds sat on their eggs, improving the health of the hatchlings [38].

Traditionally consumed in soup, edible birds' nests are now being turned into food and drink additives as well as put into cosmetics, say two Chinese researchers who have assessed just what is known about the nutritional and medicinal properties of this expensive, and to Westerners, strange-sounding health food. The nests also contain carbohydrates, ash, and a small quantity of lipids (naturally occurring molecules that include fats), which has indicated that the nests contain substances that can stimulate cell division and growth, enhance tissue growth and regeneration, and that it can inhibit influenza infections [39].

Injuries to the cornea, the protective layer on the surface of the eye, can be very painful because the healing process is slow. Corneal keratocytes are responsible for that healing – they keep the cornea strong and prevent it from getting cloudy via injury or other ailments. Some of these nests get their brilliant color from chemical reactions that take place between air, moisture, and bird waste. Some bird's nest companies will purposely leave bird waste in their nests to maintain red coloring, a practice that jeopardizes your health instead of helping it. Others use bleach and dyes to achieve bright whites or golden yellows to charge a premium on low-grade sub-quality products [40]. Bird nest benefits for children for several hundred years, Chinese culture celebrated the bird's nest soup for its nutritional value [41].

The climate change issue is probably the top priority concern of the governments of most countries of the world. Rigid and drastic measures have to be taken by all nations in order to reduce the noxious gases emission to the atmosphere., and Half of the world's population, 3 billion people approximately, on six continents, live or work in buildings constructed by earth-based building materials, which gives a contribution

on the earth-based building material properties and, in particular, for the development of adequate rehabilitation and strengthening techniques, based upon a biomimetic study. Sustainable construction techniques and management procedures of the existing building heritage should be designed to protect the environment, save resources, and conserve energy. Earth based building materials are sustainable, because its natural, recyclable, and abundant anywhere in the world, and the techniques used to manufacture these materials are usually simple, requiring an unexpressive amount of energy consumption and also having an unexpressive amount of CO₂ emissions associated [42].

Advantages of rainwater harvesting

Easy to maintain: Rainwater Harvesting Systems are based on simple technology. Maintenance of these systems requires little time and energy.

Reducing water bills: Water is required for a lot of non-drinking functions. When harvested rainwater is used for all these functions, it reduces the load on the water supply. This helps to reduce utility bills.

Suitable for irrigation: There is little requirement for building new infrastructure for the rainwater harvesting system. Most rooftop can be used as a workable catchment area, which can be linked to the harvesting system. This also lessens the impact on the environment by reducing the use of fuel-based machines. Rainwater is free from many chemicals found in groundwater, making it suitable for irrigation and watering gardens.

Reduces demand for ground water: In urban areas, the demand for water is continuously rising. This is catered by extracting groundwater leading to the depletion of groundwater. With the use of rainwater harvesting systems, this reliability on groundwater can be reduced.

Reduces floods: By collecting rainwater in large storage tanks helps reduce chances of flooding in some low lying areas.

Reduces soil erosion: Rainwater Harvesting also helps in reducing soil erosion and contamination of surface water with pesticides and fertilizers from rainwater run-off which results in cleaner lakes and ponds.

Can be used for several non-drinking purposes: Rainwater when collected can be used for several non-drinking functions like: Flushing toilets, Washing clothes, Watering the garden, Washing cars, Composting, Fire Protection, Cleaning homes, residences, And Helps reduce Water Footprint and Helps reduce Carbon Footprint [43]. The locally adaptable low-cost technologies for rainwater harvesting can be implemented as a viable alternative to conventional irrigation and drinking water supply schemes considering the fact that any land anywhere can be used to harvest rainwater with the help of the Government and local communities [44,45].

Water resources management is an important part of the farming system, development of agriculture, and enabled triple

cropping system for valley land and permanent horticultural intervention at hilltop and hillslope, and the potential of monsoonal rainwater harvesting and its impact on local cropping system development. Irrigation facilities provided by the managed rainwater harvesting reservoir increased the research site's cropping intensity and much more economical compared to forced mode pumping of groundwater because of the installation and annual operating cost of groundwater pumping. The perennial vegetation in the hilltop and hillslope would also conserve soil moisture. Water productivity and benefit-cost ratio analysis show that vegetables and fruit production were more profitable than rice cultivation under irrigation with harvested rainwater. Moreover, the reservoir showed the potentiality of integrated farming in such adverse areas by facilitating fish production. The study provides water resource managers and government officials working with similar problems with valuable information for the formulation of plan, policy, and strategy [46].

Advantages of rainwater harvesting with fishery and floating gardening

Rainwater harvesting systems are crucial for climate change adaption in climates with a pronounced dry season and especially under rain-fed agricultural systems. Earthen storage ponds can be easily constructed in rural areas and expanded in their functionality to not only store water, but also to produce aquatic plants and animals. Particularly important plants in this context are *Azolla* spp. and duckweeds that are both among the most productive plants providing potential sources of animal fodder, bio-fertilizer and energy, while acting as a biological control against malaria spreading mosquitoes by covering the pond surface and even reducing the evaporation rate of the pond. A variety of different aquatic plants can be grown inside productive ponds to provide a great variety of agricultural products, boost biodiversity of agricultural systems and contribute to more stable and more resilient ecosystems. The high biomass productivity of certain aquatic macrophytes enables an accelerated soil building rate by supplying bio-fertilizer and mulch to agricultural fields in amounts that are hardly achievable in soil-based environments [47].

It is obligatory to take advantage of the nutrients in your fish pond by floating a vegetable garden on top. Cut down on time spent watering, weeding, and fertilizing plants in a typical garden, plants in a pond do not require this. Grow your own plants for food and keep the algae out of your pond at the same time.

Pond nutrients: Nutrients naturally accumulate in a pond when fish waste and dead organic material decompose. Nitrogen, the nutrient that's most critical for fish health and plant growth, cycles through the pond with the help of a variety of decomposers. Organic matter, such as dead animal and plant material, accumulates in the pond. Bacteria then start to decompose the organic material. Fortunately, bacteria will also convert ammonia to nitrite and then to nitrate, neither of which are as toxic to fish. Some nitrogen will escape into the air, but most of it will remain in the water as nitrate until plants use it again as they grow. Algae requires higher

levels of nitrate to grow than most other plants, so the key to controlling algae growth is controlling the level of nitrate in the water. The decorative plants, try growing vegetables right in the pond water. They will not only control algae but will also provide food for your table while they work.

Why grow in a pond?: Hydroponics is now a common way to grow vegetables, such as lettuce and tomatoes, commercially. In hydroponic systems, plant roots are suspended in water that contains fertilizer while the rest of the plant grows normally in the air. Provided you have some way to suspend the plants over the pond water, pond growing is virtually the same as a hydroponic system, with one important difference: You won't need to fertilize the pond, because fish, insects, bacteria, and decaying plant material will do this for you.

Choosing plants for aquaponics systems: In aquaponics systems, the roots of the vegetables will mostly be immersed in water instead of soil, so this system isn't a good choice for root crops. Most other plants will grow quite well directly in water. If you're just starting out with aquaponics, try growing any of the leafy greens, such as lettuce, spinach, or Swiss chard. If you're an experienced aquaponic grower, you might branch out to more adventurous options, such as peas, beans, tomatoes, cucumbers, or even peppers.

Growing vegetables on a raft: The easiest way to grow vegetables in a pond is to use a floating raft system. Dense polystyrene is the cheapest and most readily available material to make a floating raft. You can also buy larger sheets of polystyrene in building supply stores.

Although the raft system is easy to build and use, it does suffer from one limitation: Fish can get at the plant roots. Most fish will nibble on plant roots, but koi and other carp, such as goldfish, may eat enough to affect your plants' productivity. To keep your plant roots safe from piscine predation, you can add netting below the raft.

Balancing fish and plant load: Aquaponics systems are easy to set up, but for a commercial operation, the difficulty is in getting the fish-to-plants balance just right. If the fish level gets too high, the plants can't keep the nutrient levels under control and the fish die; alternatively, too few fish can't generate enough waste to provide the plants with enough nutrients [48,49].

Advantages of rooftop gardening

Rooftop gardening is a concept that has been around as long as there have been roofs. City dwellers have been tucking plants on roofs and fire escapes for generations. Even green roofs, roofs covered with soil and plants, have been around for years. It seems no matter how much land a gardener has, we always seem to be looking for more space, and rooftop gardens of all kinds are gaining popularity in both residential and commercial sites.

There are plenty of good reasons to consider a rooftop garden: They make use of unused or underused space, A garden beautifies an empty space, They can provide privacy, They can

be extremely environmentally friendly, There is usually good sun exposure, and No deer or rabbits [50].

Options for rooftop garden: There are a couple of directions to go in when considering a rooftop garden. Fully planted green roofs, where the roof is covered with soil and the plants are in the soil, make great environmental sense, but they are too difficult for homeowners to undertake on their own. It would need to need to hire a structural engineer or architect to conduct a structural analysis and probably a professional company to install it. The easiest and most personal approach to rooftop gardening is the use of containers and raised beds, and the containers are perfect for rooftop gardens because they are light, portable, flexible, and affordable [50]. Rooftop vegetable farming can help to meet food demand by supplying fresh and hygienic vegetables, reducing household expenditure for buying vegetables, creating a healthy atmosphere by improving air quality and absorbing carbon from the air, and lessening the impact of climate change [51,52].

The construction of roof garden in the old building has lots of difficulties and cost lots of money. But in a long run, architecture with the roof garden compared with the ordinary building will more cost-effective. Because they can protect the structure of the structure layer and waterproof layer, make it more durable, and reduce the maintenance costs. At present, the roof garden in the old building is still not enough popular. Scientific design, construction, and management methods, still need to constantly explore in practice [53-55]. These are the effective indirect protection as a more effective strategy which will be recommended to explain the different indirect protection methods, and why the authors have chosen this way for his research.

To overcome the pandemic situation, the main aims and objectives are to investigate new and more efficient solutions, technologies, products, and it has to emphasize the construction or set up “Civil-Engineering COVID-19 Epidemic-Model” through conservation of biodiversity, agriculture, socio-economic, civil-engineering, and environmental-sciences, for preventive-measures against “21st century-various-human-diseases like COVID-19-Pandemic”, and it is planned to publish as suggestions, to take preventive measure, by different ways, which may help policymakers and civil engineering.

Materials and methods

Study area, weather and duration

The experiment was carried out at the two eco-friendly different localities in West Bengal, India. The rural area was Dhanyakhuna Durga Mandir, Tantipara, Birbhum-731126, where the average temperature was $19 \pm 5^\circ\text{C}$, relative humidity was $79 \pm 5\%$, was situated near the Bakreswar river, and Tantipara is extending from 23.9046° North latitude and 87.3736° East longitudes with average annual rainfall 1405 millimeters. And the urban areas, Kanchannagar, Bardhaman, Purba Bardhaman-713102, where the temperature was 175°C , relative humidity was $67 \pm 5\%$, was situated beside the Damodar river and Bardhaman is extending from $22^\circ 56'$ to $23^\circ 53'$ North

latitude and from $86^\circ 48'$ to $88^\circ 25'$ East longitudes with average rainfall 1313 millimeters. Both the areas are surrounded with landscaping by trees, garden, midday-meals, store-grains reservoir's, playground, pond, and river with agriculture, (tsar-industries, hatcheries and poultry-farm in the village-Tantipara only, and rice mill, cold storage, small industries, rail station, goods shades, and storage etc., in Bardhaman town) [56-60]. The duration of experiments was 3-Years; ranging from September 2018 to August 2020, and all the data were counted for statistical analysis by the analysis of variance (ANOVA) [56-60].

Simple design of the experiment

Figure 1, shows the simple diagrammatic presentation of the experimental design of the idea, “Artificial-Nest Rainwater-Harvesting with Fishery and Floating-or-Rooftop-Gardening Act as 21st Century Civil-Engineering COVID-19 Epidemic-Model” with the help of policymakers, civil engineering and the workers of different sectors, which may be temporary or permanent as follows [56-60]:

Different type of artificial-nest in the attic

- Round Earthen pots of different sizes for different animals especially birds.
- Prism or Triangular shaped wooden or permanent pots.
- Cylindrical nest of different sizes.

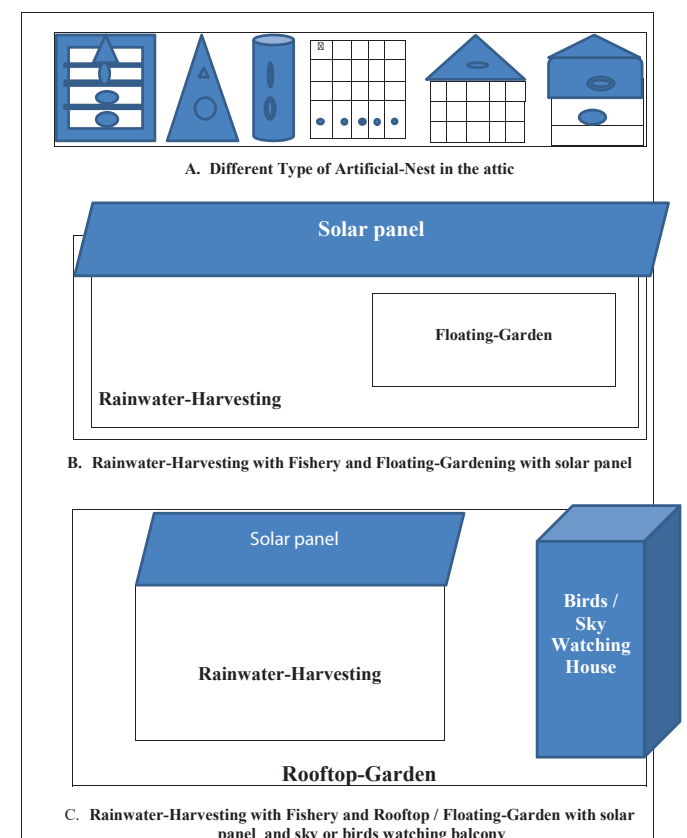


Figure 1: Simple Diagrammatic Presentation of the Experimental Design.



- Box with honeycomb patterns of different sizes.
- Different types of boxes etc., with round or square aperture with west cleaning doors, windows and siting stand in front and inner side of the box [56–60].

Rainwater-Harvesting with Fishery and Rooftop or Floating-Gardening with Solar Panel and sky or birds watching balcony: Detailed design provided by the expert-civil engineer depending on the availability of space or old/new building [29-60].

Civil engineering's constructs activity or Set-up

The construction or set up or hangs of different kinds and

sizes of comfortable artificial permanent concrete or temporary wooden nests, as per availability, in the building as well as in the trees for the several types of bird, mongoose and squirrels, rainwater-harvesting with fishery for pisciculture, and floating or rooftop gardening for food, or nutritional kitchen garden for nutritious fruits and vegetables, forming the common-complex-ecosystem (Plate 1), with landscaping by trees, garden, midday-meals, store-grains reservoir's, playground, pond, and river with agriculture, where exhibited an enriched faunal diversity attracting or comprising small mammals, birds, reptiles, toads and insects etc., and some examples are mynah, dove, magpie, drongo, oriole, bulbul, crow, cuckoo, babbler, kingfisher, woodpecker, migratory birds, squirrel, bats, tailor birds, snake, mongoose, mice, frogs, cats, stray dogs, different



Plate 1a: Rural Area .

21st Century Civil Engineering and Environmental Science Innovative COVID-19 Epidemic Model and Activity of Complex Ecosystem for the "Vision-2040."

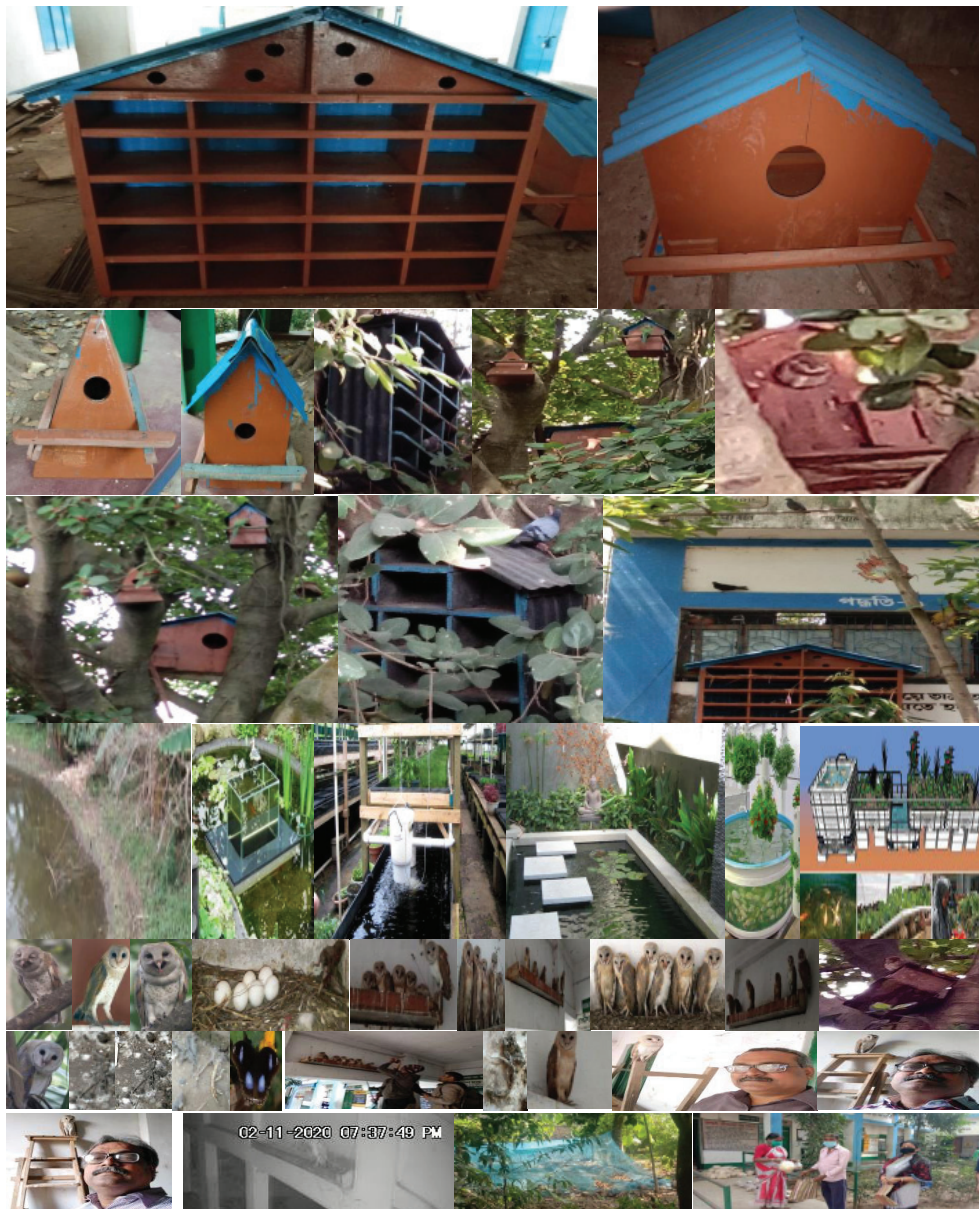


Plate 1b: Urban Area.

21st Century Civil Engineering and Environmental Science Innovative COVID-19 Epidemic Model and Activity of Complex Ecosystem for the Vision-2040.

types of coleopteran, hemipteran...insects, monkeys, etc., and all the data were counted for statistical analysis by the analysis of variance [56–60].

Group formation and function

The local teachers, students, residents, relatives, and communities form the main groups. They observe all and report. Here it is focused mainly on owls for keynote species in the food chain [29–34]. First Group includes Class-V and -VI, will observe and report regarding the number of owls sitting on the nest and surroundings. Second Group includes Class-VII and -VIII, observe and report regarding the number of pellets on the nest and surroundings. The third Group includes Class-IX and -X, observe, collect, and report regarding color, size, and number of pellets on the nest and surroundings. Fourth Group includes Class-XI and -XII, observe and report

regarding number prey consumed from pellets on the nest and surroundings. The fifth one includes all the residents, relatives, and community, will observe everything with the guidance of the Headmaster (Principal). All the data were submitted to Headmaster and were counted for statistical analysis by the analysis of variance [12–13,56–61].

Collection of pellets

The diet composition of the barn owls were studied by the analysis of the materials found in the pellets and the prey remains collected from the demarked floor-bade underneath the nest of owls, nest box and its vicinity, in variable numbers throughout the studies, surveyed and analyzed [56–61]. Solid pellets collection was done on a daily basis in the morning (at 10 am), afternoon (at 1 pm) and in the evening (at 5 pm). All the pellets were not included in the samples [56–64]. They

were carefully, numerically numbered and measured with the date and time, placed in polyethylene bags, and brought to the laboratory for further analyses and all the data were counted for statistical analysis by the analysis of variance [56–64].

Analysis the pellets

For analysis, the pellets were immersed in water in plastic boxes for 10 minutes [4–6,16–18]. Bones and sclerosis fragments were separated from the pellets by morphological characteristics. Each pellet before being dissected was photographed and length was measured [12–13,56–64]. Pellets were separated with sharp forceps and contents were checked for tiny mammals, birds, and insects. The dissected bird of night pellets were critically examined, and materials identified were designated as small mammals, birds, and insects, as predominant prey items. All the identified food items were compared and contrasted with available reference materials for various rodent species, mainly on the idea of their dentition and skull patterns, etc. and therefore, the other prey were identified using any recognizable remains [12,13,65–95]. Analysis was done regularly, and every one the information was counted for statistical analysis by the analysis of variance (ANOVA) [12,13,65–95].

Maintenance of records

All the pellets sampling and all the data of barn owl pellets in the study site, and their predilection for specific food items, as determined from their pellet were counted for statistical analysis by the analysis of analysis (ANOVA), and records were maintained [83–95]. Species richness estimation regarding the relative population abundance of prey items was calculated to explain the results meaningfully [89–95].

Observation on different civil-engineering bio-environmental role

Nesting and hunting behavior, egg-laying, incubation and hatching behaviors, breeding behavior, sound-producing behaviors, cleanliness behavior, and social behaviors, as well as bio-indicator behaviors or social distance maintaining behaviors, has been proved “Birds Are the World’s Best Engineers” [83–102]. Relationship or interaction or attitude among the parent’s owls, among the hatchlings of owls, pigeons, other birds, dogs, cats, students, teachers, closely related staff, community, photographers, visitors, and media personnel, etc., has also been studied for four years. The mechanical analysis took place to determine the position of nest boxes provides direct physical access to observe all, and depends on the construction patterns of birds’ nests provides insight into nest-building behaviors, and the morphology and biomechanics of the nest of the birds, for the use of “Civil-Engineering Artificial-Nest Project” feeder watch to engage in ‘Bird Studies and Behavior’ and “Why Birds Matter, and Are Worth Protecting Including Cause of Divorce” and introduction of comparison in an urban area with agriculture settings for success. Different behavior and attitude of the animals has been observed by direct physical access, and all the data were counted for statistical analysis by ANOVA [83–87,103–106].

Science and technology communication

The activity of NGO, relatives, students, teachers, staffs, community, photographers, visitors and media personnel, -campaign or -aware or -make the news or -publication regarding importance in Science and Technology Communication of the barn owl in different audiovisual media (TV channels), social media, newspaper and journals is recorded [12,13,83–87,101].

Results and discussion

The results of the typical idea of experimental design, “Artificial-Nest Rainwater-Harvesting with Fishery and Floating-or-Rooftop-Gardening Act as 21st Century Civil-Engineering COVID-19 Epidemic-Model”, need the author to do a deeper analysis properly, and also interpret the results in a scientific way emphasis on food chain relationship, and the keynote species like barn owl to consumable microorganisms by aquatic animals of both the ecosystem as follows [29–82].

Comparison of consumption

Table 1 shows the comparison of consumption of animals by barn owls in the two different; rural and urban areas, for the three years, ranging from September 2018 to August 2020 (Plate 1). The total average consumed prey animals of the barn owl (%) in three years duration, are analyzed from the total average 6498-regurgitated pellets; rats/mice 52.40% in rural and 48.55% in urban areas totaling 100.95%, bats 112.58% in rural and 112.72 % in urban areas totaling 225.30%, moles 27.42% in rural and 39.70% in urban areas totaling 67.12%, and mongoose 66.19% in rural and 47.06% in urban areas totaling 113.17%, remained high in the owls dietary proportions, and others average total consumed; squirrels 49.06%, small birds specially babbler 17.40%, coleopteran insects 15.12% and others animals like toads 11.83% ($P < 0.1$ by ANOVA). It is interesting that the average consumption of bat is the 1st highest in both rural and urban areas, next the 2nd highest one, is mongoose and last the 3rd highest is rats/mice. Here the barn owl is the topmost carnivores and the microorganisms are the decomposer in the “Food Chain and Food Web Relationship”.

Civil-engineering choice for diets

Regarding the rodent composition in its diet, rats/mice, bats, and moles, were found to be the most preferred food item of ‘Civil-Engineering Choice Barn Owls’, while squirrels, were the next consumed food item. Of the others, mammal’s mongoose and birds were moderately preferred in the diet but the amphibian’s toads and coleopteran insects were the least preferred in both the areas and surrounding environment. These observations suggest that the barn owl is an opportunistic predator taking whatever prey is available, and it is also interesting that barn owls are capable of switching to alternative prey when mammals become rare, but that they return to preferred prey as soon as it becomes available [12,13,56–68].

Effect civil-engineering diet on Owl populations

Pellet analysis also indicated a relatively richness of the

Table 1: Comparison of consumption of animals by barn owls in the two different areas.

Study Area Rural / Urban	Average Number of Pallets / Year, Subtotal and Total	Serial Number of Years	Duration of Consumption: 3-Years (September 2018 to August 2020)							
			Average Consumption Percentage (%)							
			Rats/ Mice	Moles	Bats	Squirrels	Small Birds (Babbler)	Insects	Others Animals (Toads etc.)	Mongoose (whole Cranium with Skeleton)
Rural: Tantipara (Birbhum)	1498a ±29.02	1 st Year	30.85a% ±2.21	12.87b% ±0.91	14.73b% ±2.01	13.76a% ±1.42	1.89b% ±0.03	3.61a% ±0.05	6.62a% ±0.08	15.67b% ±2.21
	847c ±9.03	2 nd Year	13.53b% ±1.01	8.69c% ±0.06	47.83a% ±8.11	2.31c% ±0.01	1.07c% ±0.01	1.58b% ±0.02	1.43b% ±0.03	23.56a% ±2.24
	839c ±6.01	3 rd Year	8.02c% ±1.04	5.86d% ±0.22	50.02a% ±8.28	3.12c% ±0.02	2.79b% ±0.03	2.17a% ±0.01	1.09b% ±0.01	26.96a% ±2.24
	3184	3	52.40%	27.42%	112.58%	19.19%	5.75%	7.36%	9.14%	66.19%
Urban: Kanchannagar (Purba Bardhaman)	1534a ±27.06	1 st Year	30.64a% ±2.18	27.49a% ±2.23	13.57b% ±2.21	8.89b% ±2.41	6.32a% ±0.18	2.22a% ±0.02	0.47c% ±0.01	10.48c% ±2.20
	883b ±5.01	2 nd Year	14.62b% ±2.88	9.90c% ±1.28	46.69a% ±6.13	11.11a% ±2.91	2.12b% ±0.02	2.59a% ±0.07	0.70c% ±0.02	12.19c% ±2.21
	891b ±3.11	3 rd Year	3.29d% ±0.27	2.31e% ±0.01	52.46a% ±8.48	9.87b% ±2.73	3.21b% ±0.03	2.95a% ±0.06	1.52b% ±0.02	24.39a% ±2.23
	3308	3	48.55%	39.70%	112.72%	29.87%	11.65%	7.76%	2.69%	47.06%
Total: 2	6498	6	100.95	67.12	225.30	49.06	17.40	15.12	11.83	113.17

a,b,c,...- different small letters in a column show significant difference by 'ANOVA' (P<0.01)

'Civil-Engineering Choice Dietary Habit' in each sample for the barn owl, therefore, rendering it to be the cosmopolitan bird of prey [12-13,56-82]. Nevertheless, the percentage composition of small mammals was largest which showed its affinity for them throughout the present studies, lasting from fall through winter, relatively cold and dry weather, which had no impacts from rainfall, as there are incidences of the rain to affect the barn owl populations, and during the rainy days, resource availability certainly increases to affect the barn owl population. Perhaps, the species richness for Barn Owl (rodents) would be considerably higher during the November to March, with more availability of food to them, than in the fall and winter seasons populations [12-13,56-82]. As the majority of the rodents have proved to be destructive to important cash crops causing substantial economic losses, the efficiency of barn owls among the woodlands might trigger the reverse trend to control their populations through an efficient control, and augmented global trend for management of pests using non-chemical methods to protect the already dwindled agricultural systems, as well manifested in oil-palm plantations in Malaysia using the Barn Owl populations against rodent pests populations [66]. Of the mongoose, toads and insects present in the Barn Owl pellets can also be regarded as an alternative diet of the owl due to the diminishing of their preferential foods, the rodents, in any habitat populations [12,13,56-82] and finally, the incidence of avian fauna was found in small proportions in the barn owl pellets, with babbler in relative abundance, whereas, some traces were also found for other birds. Impacts of rodent pests have been unparalleled on sustainable agro-ecosystems in the areas, causing considerable depredations to mid-day meal stored grains and the materials [84-92]. The requirements of modern-day agriculture in wake of the alarming increase in population, demand better crop quality and yield [84-95]. Cropping systems throughout India are plagued with various vertebrate pests, mainly rodents, insects, and mammals, disrupting the stability and sustainability of the rich diversity of food crops [84-95]. It, therefore, augments that, propagation of the barn owl in the cultivations would be beneficial to do away with the rodent menace largely, inhibit the damage and economic losses, without putting any serious implications of the sustainability of agro-ecosystems and

surroundings [12,13,56-95].

Civil and Bio-system biological engineering

It is already seen that the "Biological and Bio-System Engineering Barn Owl Breeding Project" in the school premises not only helps to escalate the vegetation profile of the school as well as the surrounding area but also keeps the pond ecosystem viable [56-60]. It is worth mentioning that the Barn owl in both the environment plays the role of the top carnivore, predated on mongoose juveniles and bats which are mainly dependent on fishes and aquatic animals in the ponds. And, as such, an improved midday meal is possible conserving aquatic biodiversity also. In fact, it is observed that Barn owl keeping helps improve the environment, arouse the interest of students as well as communities on ecology and food chain relationships as well as biodiversity, and improving Science and Technology Communication issues. And, this ultimately contributes to sustainable pond and kitchen garden management, macro-and micro-climate issues [12-13,56-74].

Civil engineering Bio-indicator 'Social Vaccine'

It is also noted that the availability of food or balance of the ecosystem or maybe due bio-indicator 'Civil Engineering' activities against any thresholds forming 'Social Vaccine'! [56-60,62-83,89-101]. The researchers proposed bats (or mongooses) as the most likely reservoir for SARS-CoV-2 as it is very similar to a bat coronavirus and bat secrets of immunity could offer clues to treating COVID-19 [56-60,83,102-104]. The scientists found that the SARS-CoV-2 backbone differed substantially from those of already known coronaviruses and mostly resembled related viruses found in bats and pangolins. The researchers proposed bats as the most likely reservoir for SARS-CoV-2 as it is very similar to a bat coronavirus [83,102-104]. There are no documented cases of direct bat-human transmission, however, suggesting that an intermediate host was likely involved between bats and humans [83, 102-104]. An analysis of public genome sequence data from SARS-CoV-2 and related viruses found no evidence that the virus was made in a laboratory or otherwise engineered [102-103]. Significantly, the size and color of the Barn Owl pellets were

also variable (average length 5 to 9 cm, diameter 12 to 18 cm, and color blackish to deep brown), but sufficiently large to include the scats of variable small mammals, insects, and small-sized birds [56-60,62-68]. Recently, a panel of leading scientists has been appointed by the Indian government delivered a startlingly optimistic message, "India the world's second-largest COVID-19 epidemic has rounded a corner" and India's new mathematical model suggests "they may have reached herd immunity," Assuming measures such as social distancing, wearing masks, and handwashing remain in place, the group said the pandemic could be "controlled by early next year" [105].

Social interaction in the civil engineering complex ecosystem model

The artificial-nests, rainwater-harvesting with fishery and floating-gardening shaded by solar-panel supplying-electricity for oxygen-producing-motor in water, OR rooftop-gardening attached with 'Bird's-/ Sky-Observer-Balcony', were the civil-engineering-model for social interaction of different animals in the complex ecosystem, and for safe nesting, various types of boxes, pitchers, and swings are provided along with water for drinking and bathing, food particles, and sandpits [56-60]. Birds, squirrels, bats, monkeys, owls are the regular frequenters of these environments with good relationships among themselves. Barn Owl always gives positive responses for the relationship or interaction or attitude among the parent's owls, among the hatchlings of owls, pigeons, relatives, students, teachers, communities, and closely related fellows. Owls give negative responses to other birds, cats, dogs, photographers, visitors, and media personnel. But they behave good positive responses when very close related relatives like family members, headmaster or guards accompany them, and interaction with loveable students resulted in improved mental health and development forming joyful learning experiences with "Improving Science and Technology Communication by Joyful Learning Environment" [56-60].

Biodiversity on the civil engineering complex ecosystem

Therefore, it is observed that the biodiversity of both the areas enriched. It is seen that the procreation of the barn owls are taking place in the same environment where relatives, students, communities, visitors, and birds and animals like mynah, dove, magpie, drongo, oriole, bulbul, crow, cuckoo, babbler, kingfisher, woodpecker, migratory birds, squirrel, bats, tailor birds, snake, mongoose, mice, frogs, cats, stray dogs, different types of insects, monkeys, etc. are amicably co-existing, and all are attracted due to 'Civil-Engineering-Model Complex Ecosystem' Three years ago, the droppings of the bats in the tree used to make walls dirty, but surprisingly, it does not occur anymore due to the presence of the owls. Foodgrains of mid-day meals attract rodents resulting in a rapid increase of rats and mice but the presence of owl compels them to run away from the premises [56-60].

Social distance behavior for civil engineering COVID-19 epidemic model

It is interesting that at the end of December 2019 the

parent's owl only comes for the distribution of food items to the hatchlings and flies away quickly to maintain social distance in both the rural and urban areas. And from the 15th March 2020 to till date, all the owls also maintain social distance by sitting at least average 12 ft. or more or separate places [56-60,83-103]. It may be assumed that barn owls serve as Bio-Indicator by biologically recognized regarding the spread of threatened epidemic human invisible enemy, the novel coronavirus; the novel COVID-19, which is initially observed in the Wuhan province of China, now firstly spreading around the world [83-103]. It is reported that owls have proven to be sensitive to a wide variety of toxic compounds, including pesticides, PCBs, metals, and fluoride, and are highly susceptible to secondary poisoning from consuming pesticide-poisoned prey by Steven R. Sheffield [83] and also reported that much more work in the hazardous waste sites, smelters, landfills, agricultural croplands, and other major sources of environmental contamination [83]. So it may be told that barn owls may provide as Bio-Indicator an "early warning system" for toxic contaminants or threatened epidemic COVID-19 virus in the environment, and these barn owls are positioned at the top of food chains and are in a position to be negatively impacted by secondary poisoning and bioaccumulation of contaminants in the environment [56-60,83-103]. It is of importance to monitor wild populations of owls at such locations as hazardous waste sites, industrial areas, agricultural areas, landfills, mining areas, and other potentially contaminated sites [56-60,83-103]. The rationale for using Barn Owl as 'Bio-Indicator Social Vaccine' of a wide variety of environmental contaminants and it can provide an early warning to potential environmental health hazards [56-60,83-103]. Because a social vaccine can be defined as, 'actions that address social determinants and social inequities in society, which act as a precursor to the public health problem being addressed'. While the social vaccine cannot be specific to any disease or problem, it can be adapted as an intervention for any public health response, education and research crisis, unhealthy social and economic pandemic situations. The aim of the social vaccine is to promote equity and social justice that will inoculate the society through action social determinants of health [96-104]. It need to expand international efforts of monitoring bio-indicator behaviors in Barn Owl by continental monitoring, identifying areas of high probability of exposure, is important, and should be implemented [96-105]. Barn owl easily saves our society by ecological balancing of animals, as well as "Social Distance Behavior for Civil Engineering COVID-19 Epidemic Model" by reaching herd immunity in the 21st Century, which may suggest future directions for research in these areas [56-60,83-105].

Barn owl Act as 21st Century civil engineering COVID-19 epidemic model

Barn owl apparently acts as a keystone species in the food chain relationships [56-60,84-103]. We are amazed to find the coexistence of predator and prey on the same complex ecosystem platform where owls and pigeons are found busy in incubation also [56-60]. It does not attack the pigeons. Owls do not cause any harm to the other resident birds and other cats within the 'Civil Engineering COVID-19 Epidemic Model

Campus'. When the nestlings owlets are able to fly and their food habit resulted in them as the "Social Civil Engineer-Guard" for the cleanliness of both the areas [56-60]. Their breeding helps to escalate the vegetation system of the area and made the ponds clean; directly emphasized the ecosystem [56-60,74,83-99]. Directly or indirectly they are helping us in various ways. They are influencing the ecosystem not only as a joyful environment, but also the artificial-nest, rainwater-harvesting with fishery and floating-gardening shaded by solar-panel supplying-electricity for oxygen-producing-motor in water, OR rooftop-gardening attached with 'Bird's-/ Sky-Observer-Balcony', forming "21st-century civil-engineering COVID-19-epidemic-model which improved biodiversity, agriculture, environmental-sciences, technology-communication, socio-economy-welfare by acting as social vaccine bio-indicator civil-engineer", and huge support to agriculture, horticulture, and viticulture [56,60,74,83-99]. The Union Health Minister of India has recently asserted that lockdowns and social distancing are the most effective "social vaccines" available to fight the pandemic (Covid-19) and unveiling bat secrets of immunity could offer clues to treating COVID-19 [104]. They are also opening a path of research for the students of our school who are observing them closely. Barn owl breeding project in the school premises helps to escalate the vegetation profile of the school area and even keeps the pond ecosystem viable. It preferred to consume a variety of rodents inhabiting the kitchen stored as well as the school campus. Foodgrains of mid-day meal attract rodents resulting in a rapid increase of rats and mice but the presence of owl compels them to run away from the premises and they become 'guards for the cleanliness' of the school. It is worth mentioning that the Biological and BioSystem Engineering Barn owl in both the environments play the role of the top carnivore, predating on mongoose juveniles and bats which are mainly dependent on fishes and aquatic animals in the ponds. And, as such, an improved midday meal is possible conserving aquatic biodiversity. Evidently, the Barn owl would ensure a substantial management of ecosystems for better growth of economically important crops and their management in agriculture, horticulture as well as pisciculture also. In fact, it is observed that Barn owl keeping help improve the complex environment as well as surroundings, arouse the interest of students and communities on ecology and food chain relationships as well as biodiversity conservation issues. The farmer, in turn, was saved from using toxic rodenticides or depending upon rat-trappers to safeguard his crops. And, this ultimately contributes to sustainable pond and kitchen garden management, micro-and macro- climate issues, and also health and awareness development including joyful learning experiences. It is one of the milestone events amidst many important changes in the past decade that have necessitated the formulation of a new outlook and strategy for Science, Technology, and Innovation (STI). STIP 2020 by way of its decentralized, bottom-up, and inclusive design process aims to strategize priorities, sectoral focus, and methods of research and technology development for larger socio-economic welfare, based on the theme "Vision 2040" that would help policymakers with the "Convention on Biological Diversity, designed to protect countries from losing control of their biodiversity"[23-26,28].

So it is confirmed that the barn owl breeding project become the 'Social Guards for the Cleanliness' of both the areas and surroundings; improved midday meal, conserving biodiversity, and arouse the interest of students and communities on ecology and food chain relationships issues, and contribute to sustainable pisciculture-pond, agriculture, and kitchen garden management, micro-and macro- climate issues, and also community as well as students' health and awareness with "Biological and BioSystem Engineering owl Controlled COVID-19 Engineering Bio-mechanical Biomedical Science-Technology-Communication Enriched Agriculture-Environment with Joyful-Learning-School-Environment and Bat Secrets of Immunity Could Offer Clues to Treating COVID-19". They are also opening a path of more future research and communication and we strive towards the betterment of societal conditions benefitting global humanity by advancing innovations in the fields of scientific research, and methods of research and technology development for larger socio-economic welfare, based on the theme "Vision 2040" that would help policymakers. And fulfill the recent views of the Department of Biotechnology (DBT) in India's Ministry of Science and Technology, which has been emphasized on the societal challenges for Make in India, and has been played a major role in impacting food and agriculture, nutrition, healthcare, research spanning prevention and cure for major diseases, the environment, and industrial growth, and the economic and social growth of the country, to developing innovative solutions for national nutrition needs and a clean environment, DBT is leading the way for path-breaking biotechnological research. As we prepare ourselves for a new world, our focus must be on the importance of indigenous research and the development of impact-driven innovation. This is key to our march towards an Atmanirbhar Bharat [106].

Importance in science and technology communication

The activity of students, teachers, relatives, community, photographers, visitors, and media personnel campaign, aware, arrange workshop and seminars, make news and publish, the importance of the artificial-nest, rainwater-harvesting with fishery and floating-gardening shaded by solar-panel supplying-electricity for oxygen-producing-motor in water, OR rooftop-gardening attached with 'Bird's-/ Sky-Observer-Balcony', which improved biodiversity, agriculture, environmental-sciences, technology-communication, socio-economy-welfare by acting as social vaccine bio-indicator civil-engineer", and huge support to agriculture, horticulture, and viticulture (TV channels), different social media, different -national and -local newspaper, and different -national and -international journals. We are amazed for Science and Technology Communication to find the coexistence of predator and prey on the same platform where owls and pigeons are found busy in incubation. It does not attack the pigeons. Owls do not cause any harm to the other resident birds within the campus also and directly or indirectly they are helping society in various ways. They realize the meaning of Science and Technology Communication -relationship so they did not feel irritating when visitors, community, and students went to meet them [12-13,56-60,74,83-96].

How is it possible to generalize the results of this research?

In the introduction, it has been stated in the generalized “Food Chain and Food Web Relationship”-detail manner [29–55]. Here the barn owl is the top most consumer carnivores and the microorganisms are the decomposer in the “Food Chain and Food Web Relationship”. In the rainwater harvesting ecosystem, algae and phytoplankton is the producer. The civil engineering are getting the idea of constructions, construction materials, and pollution free coat or resistance etc [29–96].

Conclusion

The conclusion shows the details about how this research would help policymakers from the “Food Chain and Food Web Relationship”. Civil engineering is getting the idea of constructions, construction materials and pollution-free coat or resistance etc., with the biomedicine use. The 21st Century Civil Engineering and Environmental Science Innovative Model for the “Vision-2040; the artificial-nest, rainwater-harvesting with fishery and floating-gardening for nutrition, shaded by solar-panel supplying electricity for oxygen-producing motor in water, OR rooftop-gardening attached with ‘Bird’s-/ Sky-Observer Balcony’ creating a common ‘Complex Ecosystem’, where barn owl the ‘Social Civil Engineer Guards’, act as “21st century civil engineering COVID-19 epidemic model” which improved midday meal, biodiversity conservation, agriculture, environmental, sciences, technology, communication, socio-economy, welfare, and ‘Social Guards for the Cleanliness’, and arouse the interest of students and communities on ecology and food chain relationships issues, and contribute to sustainable pisciculture-pond, and kitchen nutritional garden management, micro-and macro- climate issues, and also community as well as students’ health and awareness, developing the future-policy; the theme “Vision-2040”, preparing ourselves for a new world, that would retain the human civilization’s in old-forms because “Happiness brings good-health-and-wellbeing with the help of civil-engineering-and-environmental-biologist”.

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