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NATIONAL SYMPOSIUM 2023

ON

Emerging practices in animal husbandry and fisheries vis-à-vis climate change

1st July 2023

Organised by

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At
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Editorial

Climate change poses unprecedented and pressing challenges to the food industry, creating the prime hurdle in forming a hunger-free world, one of the major sustainable development goals enforced by the United Nations (UN), due to the sensitivity of the agriculture-livestock production system to changing climate conditions. The climate change issue became relevant in 1980 with the formation of the Intergovernmental Panel on Climate Change (IPCC) by the United Nations General Assembly. It is observed that the livestock sector contributes significantly to climate change through enteric fermentation. Although, it must be borne in mind that 70 per cent of the methane emission is from agriculture, and anthropogenic activities also act as a major stakeholders in this process. The threat of climate change is expected to influence the quality of forage and feed, water availability, livestock and fishery production and reproduction, quality of animal or fish products, and livestock or fish diseases. It is also predicted that global demand for livestock products will be doubled in the coming times due to the rise in the standard of living worldwide. To make a balance between demand and supply, specific climate change adaptation and mitigation strategies with multidisciplinary approaches emphasizing livestock and fishery production systems, animal nutrition, housing, management, animal and fish disease surveillance, and livestock and fish health management need to be addressed, not only for understanding but also for needful actions. With this, the *Indian Journal of Animal Health*, one of the oldest journals since 1962, associated with veterinary/animal/fishery/dairy/allied sciences in the country, is going to organize a national symposium on the effect of climate change on livestock, fishery and dairy practices, so that the emerging mitigation strategies to reduce the detrimental climate change effects can be communicated to the policymakers, scientists/researchers and the students. We hope to conduct similar kinds of symposiums in future also for the well-being of human civilization.

1st July, 2023
Kolkata, West Bengal

Prof. P. K. Das
On behalf of the Editorial Team

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About Symposium

Looking forward to the era of climate change– An insightful issue to be addressed by the mankind

Prof. Subhasish Biswas
Senior Editorial Board Member
Indian Journal of Animal Health

Indian Journal of Animal Health (IJAH) is the official scientific organ of the West Bengal Veterinary Association and has continuously served the scientific quench of the veterinary, fishery, dairy sciences and allied sector for the last sixty years. Recently the activity and quality of the journal have been significantly improved and is reflected in the increasing NAAS rating score of 5.25. The journal is published regularly and biannually. Besides, some initiatives have been taken to publish special issues at least once in a year and organise seminars/symposiums on some relevant issues. This current topic is 3rd in the row. The earlier two issues were ANTI-MICROBIAL RESISTANCE (AMR) and FOOD SAFETY. On both occasions, the participation and quality and publication were at par with satisfaction and appreciated by the readers and researchers.

The current topic, "*Emerging Technology on Animal Husbandry and Fishery vis-à-vis Climate Change*", is considered a much talked about topic and demands serious global attention. Out of all the catastrophes the MOTHER EARTH is facing, climate change resulting in global warming is the greatest threat, and the existence of the earth is at stake. Livestock and fishery have been identified as the major responsible avocation, apart from deforestation, considered to be the contributary factor for such an alarming situation of climate change. Therefore, refinement of the involving technology in these aspects should be reviewed in light of their capability for mitigation and sustainability.

Small livestock keepers, fisher folks, and pastoralists are among the most vulnerable to climate change. Climate change impacts livestock directly (through heat stress and increased morbidity and mortality) and indirectly (through quality and availability of feed, forage, and animal diseases). It is to be pointed out that the livestock sector contributes significantly to climate change through enteric fermentation. About 14.5 percent of all human-caused greenhouse gas emissions come from livestock-related activities. This amount is equivalent to 7.1 gigatons of CO_2 per year. Such emissions come from feed production and processing and methane from the ruminant digest. However, the wider adoption of existing best practices and technologies in animal feeding, health and husbandry and manure management could help in global livestock sector be more resilient and down its emission of greenhouse gas by as much as 30 percent. In order to achieve sustainable impact, adoption and change of policies to withstand climatic changes have been implemented in sub-Saharan Africa and South Asia, where the rural folks mostly rely on livestock for food, income, and livelihood by natural resource base. Control of

methane generation on the earth is significantly important for four main reasons, namely: CH_4 traps 84 times more heat than CO_2, accounts for 1/3 of climate forcing, responsible for half of the observed rise in O_3 level and is a short-lived climate pollutant with an atmospheric life span of 12 years.

On the other hand, 40 per cent of the anthropogenic source of methane is a natural source and 60 per cent of human activity is mainly enteric fermentation, manure, rice fossil fuel, land filling, biomass burning, wastewater etc. If global emission intensities are categorized species wise, the highest emission has resulted from cattle (2495 million tons of CO_2 equivalent), followed by dairy cattle, pigs, buffalo, chicken, and small ruminants (494 million tons of CO_2 equivalent). These emissions are related to agroecological conditions, farming practices, and supply chain management. These areas need focuses where opportunities for mitigation do exist. Moreover, it must be borne in mind that 70 percent of the methane emission is from agriculture, and the rest is from the livestock sector. Soil carbon sequestration in pasture and Greenland is an additional practice with promising mitigation potential. The tool has been developed towards achieving such a mitigation process by FAO in the name of "THE GLOBAL LIVESTOCK ENVIRONMENTAL ASSESSMENT MODEL", where the livestock environmental assessment performance (LEAP) partnership develops for comprehensive guidance and methodology for understanding the environmental performance of livestock supply chain to shape evidence-based policy means and business strategies. It also harmonizes accounting rules for quantifying greenhouse gas emissions from livestock.

The effect of climate change on fisheries has been observed in many ways. Marine aquatic ecosystems are being affected by rising ocean temperatures, ocean acidification, and ocean deoxygenation, while changes in water temperature, water flow, and fish habitat loss are impacting freshwater ecosystems. Climate change is modifying fish distributions and the productivity of marine and freshwater species. Climate change is expected to lead to significant changes in the availability and trade of fish products.

Warmer temperatures will influence the abundance, migratory patterns, and mortality rates of wild fish stocks and determine what species can be farmed in certain regions.

The primary factor causing these changes is due to human-caused emissions of greenhouse gases, such as carbon dioxide and methane. The existence of El-Nino and the genesis of different winds and depressions in deep seas should also need elaborate study. The role of the ocean in absorbing some of the extra carbon dioxides from the atmosphere and the resultant drop in the pH value of the sea should be looked at with serious note as it affects the fish in the ocean.

With all these in the backdrop, this symposium has been organised where the most esteemed and learned speakers in this area will deliver their thoughtful views and ideas. Some specific recommendations will emerge, and that will facilitate getting some tools for the mitigation of this important global issue in the near future to sustain the food chain system for the community.

I welcome everyone once again and let this endeavour of the INDIAN JOURNAL OF ANIMAL HEALTH be successful.

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Key Note Address

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Former Deputy Director General (Animal Sciences), ICAR, New Delhi

Challenges in livestock production and health under changing climate conditions

This gives me great pleasure to know that Indian Journal of Animal Health (IJAH), a scientific journal published uninterrupted since 1962, is planning to organize a seminar on the theme *Emerging practices in animal husbandry and fisheries vis-à-vis climate change* on 1st July (Saturday), 11.30 AM at the campus of West Bengal University of Animal and Fishery Sciences, Belgachia, Kolkata, West Bengal.

Over past decades, the Journal started way back in 1962 to promote the art and science of Veterinary and Animal Husbandry, as well as Fishery and Dairy sciences including their relation to Public Health and Agriculture, has been providing an professional and analytical insight into the progressive developments in different aspects of animal healthy. The Journal has creditably reached different Institutions and Universities and has brought the latest information about the advancement of professional science to the door step of end users.

The critical functioning of the animal system depends on the environment under which it has to live or perform. Climate is the description of the long-term pattern of environment in a particular area. The evolutionary process over past billions of years provides convincing evidence to the fact that biology, structure and functionality of plants and animals have undergone biological transformations, eliminations or additions.

Climate change is the complex and multidisciplinary change in global or regional climate patterns, which pose a significant risk for human and natural systems. The most intricate multifactorial global challenge, which jeopardizes human and natural system, is similarly threatened livestock production and productive performance. It is projected that global mean surface temperature will be increased by about 3.7°C (likely range of 2.6°C–4.8°C), and with changes to the frequency, intensity and duration of extreme weather events will be evident. As such the changes will directly and indirectly impact the production and health parameters of livestock and include a complex suite of interacting biophysical parameters that influence growth performance; meat and milk yield and quality; egg yield, weight, and quality; reproductive performance; metabolic and health status; and carcass traits as some examples.

There is urgent need to assess the likely impacts of climate change on livestock and livestock systems, and some of the resultant priority livestock development issues like water and feeds, livestock genetics and breeding, animal health, livestock's role in alleviating poverty and helping households to deal with climate variability and work out strategies to mitigate the adverse effects of climate change.

Major challenges in livestock production that need consideration

- Climate in recent years is showing alarming changes in both the long-term or short-term weather pattern in a region. More rigorously, it is the mean and variability of meteorological variables that are critical for any scientific work interpretation or field use.
- Long term horizontal studies are prerequisite for establishing of a cause and effect relationship.
- Livestock systems in developing countries are characterised by rapid change, driven by factors such as population growth, increases in the demand for livestock products as incomes rise, and urbanisation. Factor productivity studies on new technology should be taken up to ensure only tested technologies are taken to end user for ensured benefits.
- Climate change is adding to the considerable development challenges posed by these drivers of change.
- Livestock keepers challenge is to take advantage of the increasing demand for livestock products, where this is feasible.
- Under climate threat, the livestock assets of the poor be protected in the face of changing and increasingly variable climates through public sector support.
- Given the complexity of livestock and crop-livestock systems, a mix of technological, policy and institutional innovations will inevitably be required.
- There are considerable gaps in our knowledge of how climate change and increasing climate variability will affect livestock systems and the livelihoods of the people who depend on them.
- The need for detailed assessment of localised impacts, and the importance of identifying appropriate options that can help livestock keepers adapt to climate change.

Major challenges in animal health that need consideration

Climate change presents challenges both direct and indirect for livestock health. With more frequent extreme weather events including increased temperatures, livestock health is greatly affected by resulting heat stress, metabolic disorder, oxidative stress, and immune suppression, resulting in an increased propensity for disease incidence and death. The indirect health effects relate to the multiplication and distribution of parasites, reproduction, virulence, and transmission of infectious pathogens and/or their vectors.

- More efficient management of lands and of manure can have a direct impact in decreasing emissions. Ensure decrease GHG emissions through decreasing the number of livestock required per unit product.
- Increasing the energy density of the diet to have a dual effect, decreasing both direct emissions and the numbers of livestock per unit product.
- Recalculating efficiencies of energy and protein production on the basis of human-edible food produced per unit of human-edible feed consumed give higher efficiencies for ruminants than for monogastric animals. The animal science community have a responsibility to provide an evidence base which is objective and holistic with respect to these two competing. More efficient management of grazing lands and of manure can have a direct impact in decreasing emissions. Improving efficiency of livestock production through health interventions or improving fertility.
- GHG emissions can be reduced through decreasing the number of livestock required per unit product. Increasing the energy density of the diet has a dual effect, decreasing both direct emissions and the numbers of livestock per unit product, but, as the demands for food increase in response to increasing human population and a better diet in some developing countries, there is increasing competition for land for food *v*. energy-dense feed crops

Challenge in mitigating climate change

The direct health impacts for livestock due to climate change by temperature-related illness, changes in metabolic functions, and morbidity due to extreme weather events pose a significant challenge. This coupled with the indirect impacts on livestock health, making it vulnerable to unprecedented diseases by the effects of any climate change, hard to predict. A vast number of studies have been demonstrated on climate change leading to impaired health and adverse effects on the animal immune system that can be compromised with distribution, growth, and incidence of diseases and reproductive health. Heat load and subsequent heat stress (HS) alone result in economic losses and health management costs. Metabolic disorders, oxidative stress, metabolic imbalances, immuno-suppression and mastitis are other conditions producing health impacts.

The most profound effect of climate has been documented on reproduction where a series of studies have shown direct and indirect effects of environment on animal maturity, estrus, estrous cycle, ovulation, fertilization, embryonic growth and development, on placenta, parturition, partum and post partum conditions and also affections connected to reproductive tracks.

Concludingly, it is obvious that livestock production and health are being impacted in many direct and indirect pathways. In order to have a resilient livestock to face the climatic challenge, we may need to prepare a road map which will involve a comprehensive program following. Specific recommendation for animal adaptation and mitigation of impact of climatic change will involve:

1. A comprehensive data generation on longitunal studies of the total physiological and endocrinological profile of the livestock.
2. A comprehensive land use plan and fodder production as per livestock requirement should be implemented. This becomes important since in the event of poor harvest, the first sufferer is the grass eating animal.
3. There should be a season based and annual/yearly plan for green fodder, to offset the ill effects of poor feed availability. Land use plan with carrying capacity of animal numbers need to be worked out for efficient livestock production.
4. To ensure healthy disease-free animals there is need to develop multiple vaccine doses so that all animals with farmers are covered under a state program. Full food bio-security and animal one health program should be implemented and monitored.
5. Fertility program and measures for optimum reproduction may be adopted and based on genomic selection breeds/animals having better capacity to with stand adverse climates should be selected in the National breeding program.
6. The delivery of livestock services to the end users needs to be reviewed and comprehensive guide lines issues to the field staff.

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Key Note Address

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Innovative tools and approaches for conservation and management of aquatic genetic resources in relation to emergent climate change

U. K. Sarkar* and T. Kumawat

Abstract

Aquatic genetic resources management and conservation face substantial challenges due to emerging climate change. However, a number of cutting-edge techniques and tools, such as genomic tools and techniques, cryopreservation, assisted gene flow, habitat restoration and connectivity, and integrating citizen science with participatory approaches, play a critical role in protecting and managing aquatic genetic resources in the face of emergent climate change.

Keywords: Aquatic genetic resources, Climate change, Conservation and Management, Transformative efforts

1. Aquatic Genetic Resources (AqGR)

Aquatic Genetic Resources (AqGR) refers to the finfish and aquatic invertebrate genetic material of current or potential value. AqGR is gaining importance due to dependency on food, medicines, materials, and recreational and eco-tourism. The global AqGR contains 36,532 valid fish species, of which 18,532 species belong to freshwater habitats (Fricke *et al*., 2023). The global fisheries and aquaculture production is increasing with 214 million tonnes in 2020 and employing about 58.5 million people (FAO, 2022). India has a rich and diverse aquatic resource ranging from deep seas to lakes, ponds, and rivers, which harbours nearly 10% of the global biodiversity in terms of fish and shellfish species. India has a vast coastline of 8118 km with 5.3 lakh square km of the continental shelf, which mainly supports marine fishing and navigation. India is also blessed with a 1.95 lakh km long river and canal system which supports numerous towns and cities and freshwater capture fisheries, 8.12 lakh hectares of floodplain lakes, 21 lakh hectares of ponds and lakes, 31.5 lakh hectares of reservoirs, 12.4 lakh hectares of brackish water bodies and about 12 lakh hectares of saline areas. The total EEZ area is 2.02 million square km, with total territorial water of 159,265 square km (Table 1) (National Fisheries Policy, 2020).

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The ichthyofaunal diversity of India is comprised of 3192 native fish species under the 1036 genus, 254 families and 53 orders as per the Aquatic Genetic Information System of India (AqGRISI) (https://aqgrisi.nbfgr.res.in/#/). The majority of these species are reported from marine ecosystems (1554 fishes), while the occurrence of 924 species was from freshwater ecosystems. The grouping of the Indian fish species under the IUCN conservation status revealed 1204 species under 'Least Concern', 116 under 'Vulnerable', 85 under 'Near Threatened', 84 'Endangered' and 21 under 'Critically Endangered' status. It is also worth mentioning that around 219 fish species reported from India are grouped under the 'Data Deficient' category.

Table 1. Aquatic resources in India and their utilisation modes

Resource type	Resource size	Fish production system
Continental Shelf area (million km.^{2})	0.53	Capture fisheries
Exclusive Economic Zone (million km.^{2})	2.02	Capture fisheries
Rivers and canals (lakh km.^{2})	1.95	Capture fisheries
Ponds and tanks (lakh ha)	24.1	Aquaculture
Reservoirs (lakh ha)	31.5	Culture-based fisheries/ Stock enhancement /Cage culture
Floodplains and lakes (lakh ha)	8.12	Culture-based fisheries and pen culture
Brackish water area (lakh ha)	12.4	Aquaculture
Bheels (million ha)	1.3	Culture-based fisheries/ Aquaculture
Wetland (Inland and coastal) (million ha)	15.26	Capture and aquaculture
Mangrove (km.^{2})	4975	Livelihood enhancement

2. Innovative tools and approaches

Emergent climate change poses significant challenges to conserving and managing aquatic genetic resources. However, several innovative tools and approaches play a crucial role in conserving and managing aquatic genetic resources in the face of emergent climate change, such as:

i. **Genomic tools and techniques:** Our understanding of genetic diversity and population dynamics has been completely transformed by advances in genomics. High-throughput sequencing and genotyping technologies are two examples of genomic methods that can provide essential insights into the genetic makeup, adaptability, and vulnerability of aquatic species to climate change. These methods can assist in prioritising conservation efforts, identifying populations with distinctive adaptive features, and informing management plans.

ii. **Cryopreservation:** Cryopreservation is the freezing of genetic material (such as sperm, eggs, embryos, or tissue samples) at extremely low temperatures for long-term storage. It is a valuable method for preserving the genetic variety of aquatic animals, particularly those threatened by climate change. Cryopreserved genetic material can be used for artificial reproduction, reintroduction initiatives, and genetic rescue projects.

iii. **Assisted gene flow:** Assisted gene flow is the purposeful transfer of individuals or genetic material across communities to increase the adaptive capacity of the target populations. By adding individuals with adaptable features or genetic diversity to groups that are in danger, this strategy can help lessen the harmful effects of climate change. Genetic and ecological aspects must be carefully considered to prevent unfavourable outcomes like hybridisation or the spread of diseases.

iv. **Habitat restoration and connectivity:** Aquatic habitats can be harmed by climate change, which can result in habitat loss, fragmentation, and changed ecological processes. For populations to remain connected and permit species migration and adaptability, habitat restoration and the development of environmental corridors are essential. Aquatic species' genetic variety and resilience can be preserved by restoring damaged habitats, guarding vital spawning grounds, and encouraging natural mobility.

v. **Citizen science and participatory approaches:** Engaging local communities, stakeholders, and citizen scientists in monitoring and conservation efforts can provide valuable data and promote a sense of ownership and stewardship. Citizen science programs can help gather information on species distributions, phenology, and other ecological parameters, thereby contributing to understanding climate change impacts and informing conservation strategies.

vi. **Integrated approaches and collaboration:** Addressing the complex challenges of climate change requires interdisciplinary collaboration and integrated management approaches. A holistic understanding of the issues can be achieved by bringing together scientists, policymakers, conservation practitioners, and local communities. Integrated systems can combine multiple tools, such as genetic monitoring, habitat restoration, and policy interventions, to maximise the conservation and management of aquatic genetic resources.

These innovative tools and approaches can play a crucial role in conserving and managing aquatic genetic resources in the face of emergent climate change. However, adapting and refining these strategies based on scientific knowledge, technological advancements, and local context is important to ensure their effectiveness and long-term sustainability (Sarkar *et al.*, 2008, 2013; Sarkar and Borah, 2018).

3. ICAR-NBFGR's transformative efforts for the conservation and management of aquatic genetic resources in changing climate

i. Discovery of new species

The institute has discovered 49 new fish species and six new shrimp species for enhancing fishery and aquaculture in future.

ii. State Fish: transformative efforts for conservation and management

ICAR-NBFGR is the pioneer institute that conceptualised and employed the innovative approach of 'State fish' in 2006 for the first time in India, which has exemplified a considerable improvement in fish conservation efforts. Presently, 20 states and one Union Territory have adopted the concept and declared their respective 'State fish'.

iii Exploration and documenting AqGR

- Exploratory surveys- documenting AqGR- various River systems
- Ganges, Gandak, Burhi Gandak, Bagmati, Mahanadi, Godavari, Cauvery, Sharavathi, Zuari, Mandovi, Luni, Chaliyar, Chalakkudy
- Developed Aquatic Genetic Resource Information System of India (AqGRISI), a fish diversity database of India containing information about 3,173 species
- Discovered new geographical distribution records of many species

iv. Live fish germplasm resource centres

- ICAR-NBFGR, Lucknow, has established seven live gene banks across the country (Lucknow, Kochi, Lakshadweep, Airoli, Gauhati, Telangana, Imphal) with an emphasis on the conservation and culture of indigenous and threatened fishes.

v. Community aquaculture centres

- Established and supported four community aquaculture units in Agatti Island- marine ornamental shrimps are successfully raised to marketable size by 45 women beneficiaries
- Innovative approach to community aquaculture of marine ornamental organisms- open avenues in livelihood development of the island women- along with conservation
- Hon'ble President of India, Smt. Droupadi Murmu visited Lakshadweep during March 18-19, 2023 and interacted with the beneficiaries associated with the institute's community aquaculture units
- The Hon'ble President mentioned and lauded ICAR-NBFGR's activities and hand-holding the community aquaculture units for enhancing the income of native women islanders

vi. Captive propagation of clownfish at Airoli

- Established clownfish breeding and training centre at Airoli- livelihood development of coastal fishers
- Hands-on training for capacity building has been provided to beneficiaries of three districts of Maharashtra
- Hatchery bred clown fishes, *Amphiprion percula* and *A. ocellaris* were provided to the beneficiaries
- Steps towards Marine Ornamental Village in coastal districts of Maharashtra

vii. Captive propagation and cryopreservation

- Captive breeding protocols developed for 15 ornamental fishes
- Captive breeding and milt cryopreservation protocol has been developed in 10 endemic and endangered fishes of the Western Ghats
- Sperm cryopreservation protocols- 35 fish species developed and seed produced for 24 species- field-level validation of IMCs

viii. Fish cell line and upscaling milt cryopreservation

- World's largest collection of fish cell lines

- National Repository of Fish Cell Lines (NRFC) cell line accessions- 81
- Up-scaling of fish milt cryopreservation
- 370 hatchery professionals trained in 12 training/field demonstrations
- 126 lakh spawn produced from cryopreserved milt in 38 hatcheries of 11 states
- Species-specific protocol developed for prioritised species *Viz. Pangas*, reba and *Gonius*

ix. Quality seed supply for livelihood

- The institute produced 1,144 lakh spawn of 12 species and a revenue of Rs.31,40,000/- generated
- Fish seeds were supplied to Fisheries Departments, fish farmers, and hatchery owners

x. Molecular biology and genomics – tool for conservation

- Generated whole genome sequencing of fin fishes; *Clarias magur*, *Labeo rohita* and *Tenualosa ilisha* & fungal pathogen *Aphanomyces invadens*
- Submitted 9,022 COI records of 424 fish species found in India
- Molecular markers for 35 finfish species identified
- Population genetic structure of 26 finfish and shellfish species studied
- Developed a genomics resource portal called FisOmics
- The portal hosts five genomic websites viz. FBIS, FishMicrosat, FMiR, Fish Karyome and HRGFish
- These databases have integrated tools for taxonomy, molecular phylogeny analysis, primer designing for SSR markers etc.
- The Institute also provides access to High-Performance Computing (HPC) for carrying out bioinformatics analysis on a request basis to limited users

xi. Initiatives in the NEH region

- A total of 11 collaborating partners are involved in research and extension activities
- Established two live fish germplasm resource centres (Guwahati, Assam and Imphal, Manipur)
- Exploratory surveys are being undertaken currently in 7 rivers of the NE region including, the caves of Meghalaya
- Karyotyping and chromosome preparation of endemic fishes of NE is being carried out through cytogenetic characterisation of endemic fishes of North-Eastern India

xii. Fish disease surveillance

- National Surveillance Programme for Aquatic Animal Diseases (States covered: 19; Collaborating centres: 31)
- Surveillance & aquatic animal disease diagnostics to help farmers reduce disease losses
- Strong network of diagnostic laboratories across the country
- Scientific advice to the fish farmers
- Nine new pathogens were detected in the country for the first time

- Alerts/advisories to the stakeholders following first-time report of new emerging diseases
- Phase II – recently launched

xiii. National Fish Museum and Repository

- Recognized and designated NBA as the nodal repository agency for the transfer of fish resources under the Biological Diversity Act, 2002 of India
- The National Fish Museum and Repository integrates different collections like vouchers, tissue, DNA, bacteria, cell lines, fish milt
- Displays finfish voucher specimens of freshwater, marine, and brackish water environments, including shellfish
- Radiographic facility to enable a comprehensive understanding of vertebrae counts, fin rays, and other osteological features

xiv. Outreach programmes – Livelihood development

- Mass awareness programs were organised at villages Kalauli, Sonebhadra, Malda and Sundarbans for SC farmers, including women and inputs were provided
- Promoting Indigenous Fish Culture as a potential livelihood option for small and marginal SC farm families in the Mayiladuthurai district of Tamil Nadu
- Technological and infrastructure support for tribal farmers under the TSP scheme in Uttar Pradesh

4. Recommendations

i. Sustainable utilisation of biodiversity for livelihood development and conservation

- Trade-offs between biodiversity and livelihoods/human well-being need to be settled in a progressive manner
- Declaration of protected areas imposes restrictions on subsistence-based livelihoods by enacting stricter management regulations and thereby alienating local stakeholders
- Community aquaculture centres for potential fish species- region-wise for prioritised species

ii. Genetic-based approach

- Adhering basic genetic management principles- effective population sizes and minimising inbreeding needs to be given serious thought in aquaculture practices
- Stock-specific replenishment of endangered fish species- Genetic stock structure analysis before river ranching
- Potential climate resilient management strategies must be adopted to cope with the adverse impact of climatic variability and associated stressors and to conserve fish genetic resources
- The fish species identified as climate-resilient fishes from the Ganga basin using reproductive vulnerability framework and modelling can be included in aquaculture for increased profitability
- Stations should be established for real-time ecological data generation on important

resources to generate a long-term database which will serve as a basis for management and policy decisions

- Stakeholders' inclusion in the decision-making process, especially in the context of managing AqGR
- Combining biological data with suitable statistical tools and models- in generating meaningful projections on the impact of climate change/variability on inland fisheries
- More research emphasis on live gene bank resources, captive breeding, resilient conservation tools, carbon sequestration and greenhouse gas emissions in aquatic system

iii. Creation of focused awareness and practices for responsible fishing and aquaculture

- The diversity of the AqGR ensures that the needs of future generations for the supply of fish and seafood can be met, even under changing environmental conditions
- National and international agencies like FAO, NACA, and APAARI to develop and create awareness on a package of practices for responsible and sustainable fishing and aquaculture

iv. Upholding Commitment

- COP15 - 30 by 30 deal (December 19, 2022)- 200 countries reached an agreement at the United Nations biodiversity summit to protect 30% of land and marine areas by 2030, up from the currently protected 17% of terrestrial and 10% of marine areas
- Incentivize farmers to upskill and upgrade to sustainable fishery practices
- Management bodies may pay attention not only to biodiversity alone but also to the genetic diversity important to sustainable aquaculture
- Research plans could be prioritised to address important questions such as characterisation of populations, optimising fast and efficient genotyping, evaluating environmental factors and protection approaches and estimating the effects of stock enhancement programs on genetic components of wild populations

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Emerging practices in animal husbandry to adapt climate change

Introduction

Climate change is referred to the global warming and its side effects, viz. melting glaciers, rising sea levels, unpredictable weather pattern, increase in extreme weather events etc. Heat stress has the most deleterious impact on livestock. Livestock use their circulatory systems to maintain a constant body temperature. Vasodilation brings more blood and heat to the body surface, facilitating radiation and evaporative heat loss. They exhibit adaptive mechanisms for their survival, if body temperature rises further, viz., morphological, behavioural, physiological, blood biochemical, neuroendocrine etc. However, these adaptive mechanisms for survival of the livestock are detrimental to their production performances. Heat stress not only reduces milk and meat yield in livestock, but also affects several other economic parameters like animal health and animal reproduction, resulting in significant economic losses to the dairy owners.

The FAO (2016) has advocated that livestock is relevant to almost all the *Sustainable Development Goals* (SDG). Therefore, maintaining and improving productivity of livestock is very much essential for achieving the SDGs of the United Nations. In addition to the existing challenges for livestock production in India like low productivity, shortage of feed and fodder, existing diseases, poor financial support etc., climatic change, heat stress in particular, is casting a long shadow on the future productivity of livestock. The animal husbandry contributes immensely to the food security. Hence, efforts are needed to improve the resilience capacity of livestock to impart them the ability to withstand the adversities associated with climate change as well as to maintain their productivity ensuring both the livelihood security of poor and marginal farmers as well as ensuring the food security of growing human population.

Strengthening of climate-resilience in the livestock

Resilient capacity of livestock against heat stress is the ability of livestock to recover their normal biological functions after the exposure to extreme heat and maintain the physiological status and production (Rashamol and Sejian, 2018). No single strategy can ensure adaptation of livestock to climate change. In one hand measures to reduce greenhouse gas production from livestock needed through management of ruminal function, waste management and enhancing feed conversion are needed. On the other hand, ameliorative measures and enhancing resilience in livestock against heat stress are to be achieved by the following strategies.

1. Environmental modification and thermal comfort: The following ameliorative measures are to be undertaken.

- Provide shelter/shades which reduces heat load by 30% or more.
- Proper ventilation of the animal house. Air speed @3-5 mph during periods of heat stress.
- Provide evaporative cooling and convection through sprinklers, fans and misters.
- Use air cooling system by flowing of cooler air through underground piping system.
- Studies showed that music therapy showed positive results on animal welfare (ICAR-NDRI).
- Reduce stocking density: Provide 30-inch feed bunk space to encourage dry matter intake. If difficult to provide such space to the whole herd, at least, provide the same to fresh and high-production cows.

2. Nutritional interventions and management: Livestock consume less feed to reduce metabolic heat production during heat stress. Additionally, the rumen function is altered due to lesser activity of ruminal microflora due to high temperature. High producing cattle are more vulnerable to heat stress. The ameliorative measures are to be undertaken are as follows.

- Reducing the quantity of fibrous diets and increasing concentrate in ration.
- By-pass nutrient (fat/ protein) feeding.
- Use of feed additives like antioxidants (Vit C, Vit E, and Se) in diet.
- Supplementing diet with buffers (Sodium bicarbonate) to reduce acidosis which commonly occurs in animals under heat stress.
- Supplementing with betaine, chromium, niacin and yeast in diet.
- Adjust potassium loss in diet which occurs due to increased sweating.
- Heat stress greatly increases water intake in cows, so, provide more water for drinking.
- Change feeding schedule to the cooler parts of the day e.g., early morning and late afternoon.

3. Animal health management: The heat stress induces metabolic disorders, oxidative stress, immunosuppression and even death. The proteins, including enzymes, may denature if the body temperature exceeds 50^0C. The parasites and pathogens increase their development and arthropods (vectors) are more active at higher temperatures. Animal disease is the single greatest threat to livestock assets, a major risk to human health, and huge source of risk due to new emergent diseases. Majority of the animal diseases are climate sensitive. A report on climate and livestock disease from the International Livestock Research Institute shows that climate change can increase the burden of livestock diseases and suggested the following recommendation (Grace *et al*., 2015).

- Improve disease surveillance and response to detect changes in disease in a timely way.
- Increase capacity to forecast the occurrence of climate-sensitive diseases, and to predict longer-term distribution of diseases through better epidemiological information.
- Improve animal health service delivery by investing more in public sector and encouraging private sectors.
- Support eradication of priority diseases where economically justified.

- Increase the resilience of livestock systems by supporting diversification of livestock and livelihoods, and integrating livestock farming with agriculture.
- Preventive early warning, detection and response for old and new diseases.
- Improvement in sanitation, hygiene or biosecurity at farm.
- Adopt breeding strategies for climate and disease resilient livestock.
- Risk management for emerging disease are to be addressed through *One Health* umbrella.

4. Genetic selection for disease resistance and thermotolerant livestock: It has been reported that, for resilience and adaptive capacity in dairy animals, important traits are long legs, short hair coat, higher sweating rate, higher capacity for maintenance of heat balance, lower metabolic rate, higher feed efficiency, higher tolerance to dehydration and capacity to alter the hormone and biochemical profiles to adapt to a particular environment (Rashamol and Sejian, 2018). Selecting animals based on those traits will help those animals to adapt better against heat stress.

4a. Conventional selection: Inherent resilience for heat tolerance have been recorded in some breed, also in some individual animal within a breed. The most important tasks when modelling the effect of heat stress are the identification of an appropriate heat stress indicator and the availability of a heat stress function with detailed information regarding the stress threshold. The most widespread indicator for heat stress is the Temperature Humidity Index (THI).

Ravagnolo *et al*. (2000) identified that THI 72 was the threshold for the onset of heat stress. Common indicator traits for adaptive mechanism in livestock are respiration rate, rectal temperature, sweating rate, panting rate, PCV, Hb%, cortisol, thyroid hormone, heat shock protein (HSP). The thermal circulation index (TCI) described by Curtis (1983) quantifies the transfer of heat from the core of the body to the skin surface and then to the environment under steady-state thermal conditions. Improvement of heat tolerance ability in livestock can be achieved by including traits such as rectal temperature or panting score into selection indices (Schierenbeck *et al*., 2010). High heritability of some climate resilient traits (Table-1) indicates that genetic progress can be achieved faster through selection programme for thermotolerance, and also disease resistance.

Table 1. Climate resilient traits and their heritability

Climate resilient traits	Heritability	References
Respiration rate	0.76 to 0.84	Burrow, 2001
Body temperature regulation	0.21 to 0.68	Dikmen *et al.*, 2012
Rectal temperature	0.13 to 0.32	Dikmen *et al.*, 2012; Gourdine *et al.*, 2021
Thermoregulation (pig)	0.39 to 0.83	Kim *et al.*, 2018; Brito *et al.*, 2020
Thermoregulation (pig)	0.34 to 0.39	Gourdine *et al.*, 2017
Resistance to TB	0.49	Makintosh *et al.*, 2000
Somatic cell count	0.11	Mrode and Swanson, 1996
Mastitis resistance	0.04	Mrode and Swanson, 1996

4b. Genomic selection: Genomic selection uses genome wide DNA markers to capture the effects of the many mutations that influence variation in a complex trait like heat tolerance, and allows young bulls and heifers to be selected on their genomic estimated breeding values (GEBV), thereby accelerating genetic gain.

With the introduction of high-density Single Nucleotide Polymorphism (SNP) chips with 50K markers, genomic selection became a reality (Van Tassell *et al.*, 2008). Adoption of genomic selection breeding programs in the major dairy-producing countries has led to significant changes in the worldwide dairy industry.

Identification of causative genes and characterizing the causal variants and pathways underpinning the genetic basis for heat tolerance in cattle is gaining increased attention due to global warming (Macciotta *et al.*, 2017; Luo *et al.*, 2018; Sigdel *et al.*, 2019). So far, many Genome-Wide Association Studies (GWAS) have aimed at understanding the biology of thermal stress on Holsteins (Dikmen *et al.*, 2013; Sigdel *et al.*, 2019; Cheruiyot *et al.*, 2021). Cheruiyot *et al*. (2021) identified promising candidate genes for heat tolerance by (ACLY, PDHA2, MDH1, SUCLG2, and PCK1) and Garner *et al.* (2020) reported that many candidate genes are differentially expressed under heat stress. There are many candidate genes in goats that could be harnessed for better adaptation, viz. genes related to heat stress (*HSF1, HSP20, HSP70, HSP90*), growth (*GH*, *GHR*, *IGF-1*, *LEP*, *LEPR*, T_3, T_4, *THR*, *NOS*), reproduction (*GnRH, GnRHR, FSHR, LHR, inhibin, PROGR, ESTR*), and immunity (*TLR2*, *TLR3*, *TLR8*, *TLR10*, *IL2*, *IL10*). The *HSP70* is the commonest genetic-marker of thermotolerance. Higher expression of *HSP70* mRNA in tissues is an indication of higher thermotolerance (Abioja *et al.*, 2023).

4c. Genome editing technology: Traditional breeding approaches and transgenic technology have been widely used to mitigate the risks of environmental stresses in plants and animals. The discovery of engineered nucleases as genetic scissors to carry out precise manipulation in crop stress-responsive genes and associated molecular network has paved the way for sustainable management of abiotic stress conditions.

Genome editing tools enable precise changes in DNA by introducing targeted mutation, insertion, deletion and specific sequence alteration using specific nucleases. Commonly used such enzymes are *Meganucleases* (Puchta *et al.*, 1993), *Transcription Activator-Like Nucleases* (TALENs) (Zhang *et al.*, 2013), *Zinc-Finger Nucleases* (ZFNs) (Zhang *et al.*, 2010), and *Clustered Regularly Interspaced Short Palindromic Repeats* (CRISPR–Cas9) (Jiang *et al.*, 2013). The CRISPR/Cas9 is the most successful genome editing system (Chen *et al.*, 2019).

Genome editing can be applied in breeding programs of cattle for disease resistance, to control parasite population, and tolerance to heat stress and also to control cattle methane emission. Gene editing together with genomic selection has the potential to double the genetic gain (Jenko *et al.*, 2015) and will be the future technology for disease resistant and thermotolerant livestock.

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Aspects of climate change

The Intergovernmental Panel on Climate Change (IPCC), an intergovernmental body of the United Nations refers climate change as a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in Earth's climate over time, whether due to natural variability or as a result of human activity at local, regional, or global scale.

Climate change is a real and undeniable threat to our entire civilization.The effects are already visible and will be catastrophic unless we act now. Starting with the industrial revolution characterized by excessive burning of fossil fuel until today, changes in the climate have been mainly the result of human activity.

Global warming is a term often used interchangeably with climate change.Global warming refers to the recent and ongoing rise in global average temperature near the Earth's surface which is linked to significant impacts on humans, wildlife, and ecosystems around the world. There is strong consensus among climate scientists, that human influence has been the dominant cause of observed warming trends since the 20th century. It is caused mostly by increased concentrations of greenhouse gases (GHGs) in the atmosphere. The burning of fossil fuels releases pollutants including greenhouse gases. Global warming is causing climate patterns to change. However, it represents only one aspect of climate change.

IPCC and climate change

The Intergovernmental Panel on Climate Change (IPCC) established in 1988 is the United Nations body for assessing the science related to climate change. The IPCC prepares comprehensive assessment reports about the state of scientific, technical and socio-economic knowledge on climate change, its impacts and future risks, and options for reducing the rate at which climate change is taking place. It also produces special reports on topics agreed to by its member governments.

The IPCC has three working groups and a task force, which carry out its scientific work. Working Group I assesses the physical science of climate change. Working Group II assesses the vulnerability of socio-economic and natural systems to climate change, negative and positive consequences of climate change and options for adapting to it. Working Group III focuses on climate change mitigation, assessing methods for reducing greenhouse gas emissions, and removing greenhouse gases from the atmosphere. IPCC informs governments about the state of knowledge of climate change. The IPCC does not conduct its own original research. Thousands of scientists and other experts compile key findings into "Assessment Reports" for policymakers and the general public.

Climate change evidences – IPCC AR-6 Synthesis Report (March-2023)

Human activities, principally through emissions of GHGs, have unequivocally caused global warming, with global surface temperature. Global GHG emissions have continued to increase, with unequal historical and ongoing contributions arising from unsustainable energy use, land use and land-use change, lifestyles and patterns of consumption and production across regions, between and within countries, and among individuals. IPCC AR-6 synthesis report indicates-

Surface Temperature:

i. Emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850–1900 in 2011-2020.
ii. Larger increases over land (1.59°C) than over the ocean (0.88°C).
iii. Global surface temperature in the first two decades of the 21st century (2001-2020) was 0.99 higher than 1850-1900.
iv. Global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years.

What is the greenhouse effect?

Certain gases in the Earth's atmosphere (water vapour, CO_2, methane and others) allow sunlight to pass through, but then stop the heat from escaping back out into space- much like glass in a greenhouse. Without this, our planet would be uninhabitable to most forms of life. However, by changing the balance of gases in the atmosphere, humans have increased the greenhouse effect, causing the rising temperatures we now see.

Causes of climate change

There are both natural processes and anthropogenic (human induced) activities affecting the earth's temperature and the resultant climate change. Natural influences on the climate include-volcanic eruptions, changes in the orbit of the Earth, and shifts in the Earth's crust (known as plate tectonics).

Anthropogenic activities of climate change indicate greenhouse gases (GHGs), that humans

are causing, is responsible for most of the current changes of climate. These GHGs are Water vapor, Carbon dioxide (CO_2), Methane, Nitrous oxide, Chlorofluorocarbons (CFCs) etc. While some of these greenhouse gases, such as water vapor, are naturally occurring, others, such as CFCs, are synthetic.

Carbon dioxide is the most common greenhouse gas in our atmosphere. CO_2 is released into the atmosphere from both natural and human-made causes due burning fossil fuels such as coal, oil, and natural gas and the deforestation and other changes in land use that release stored CO_2. Carbon moves between the Earth, living things, and the atmosphere in the carbon cycle. Like all animals, humans add carbon dioxide to the atmosphere when we breathe. Atmospheric carbon dioxide concentrations have increased by more than 40 percent since pre-industrial times, from approximately 280 parts per million (ppm) in the 18th century to 414 ppm in 2020.

Methane (CH_4) is the next most common greenhouse gas. Methane traps roughly 30 times more heat than carbon dioxide. Rice cultivation, cattle and sheep ranching, decay from landfills, mining are the main source of methane in the atmosphere. Methane is the primary contributor to the formation of ground-level ozone, a hazardous air pollutant and greenhouse gas.

Oxide of Nitrogen (N_2O) is about 300 times as potent as carbon dioxide at heating the atmosphere. And like CO_2, it is long-lived, spending an average of 114 years in the sky before disintegrating. Scientists at the IPCC have estimated that nitrous oxide comprises roughly 6% of greenhouse gas emissions, and about three-quarters of those N_2O emissions come from agriculture. Agricultural soil, especially because of the globe's heavy use of synthetic nitrogen fertiliser, is the principal source. When plant roots don't take up all the nutrients from fertiliser, the greenhouse gas N_2O is released.

Impact of climate change

Global climate change has many bad impacts on the environment. The impact of climate change are many folds:

1. Immediate impact:

a. Extreme weather events- will continue to increase in frequency and intensity as climate change continues to happen. Extreme weather influenced by climate change includes: stronger storms and cyclones, heat waves, forest fires, more flooding, more heat wave and droughts, erratic rainfall etc.

b. Safety and economic challenges- Rising global temperatures, changing precipitation patterns, climbing sea levels, and more extreme weather events will intensify the challenges of global instability, hunger, poverty, and conflict.

2. Long term impact:

a. Climate change-related health risks may include: Heat-related illness, injuries and fatalities

from severe weather, asthma & cardiovascular disease from air pollution, diseases from poor water quality, water and food supply insecurities.

3. Negative impact in ecosystems:

a. Agriculture- Agriculture is responsible for a significant portion of the world's greenhouse gas emissions. Agriculture is the largest anthropogenic source of methane (CH_4).The main sources are livestock (enteric fermentation), manure management, rice cultivation and residue burning.

b. Animal agriculture and fisheries- The world's population is predicted to increase to 9.6 billion by 2050 and to feed a population of this size, the global demand for livestock produce would have to increase by 70%. Livestock farming hugely detrimental to the environment. Livestock production is the largest methane source emitter in the world. Raising livestock for meat, egg and milk generates 14.5% of global greenhouse gas emission. Farming uses up 92% of our freshwater and 1/3 of this is due to production of animal product. Huge amount of fresh water are used up in the process of livestock farming. A single cow used for milk can drink upto 50 gallons of water per day and twice that amount in hot weather. Moreover, livestock farming and the expansion of livestock grazing land is the cause of deforestation and rainforest destruction. Fisheries and aquaculture are threatened by changes in temperature and precipitation.

c. Water and food resources- Severe weather and increased temperatures will continue to limit crop productivity and increase the demand for water. With food demand expected to increase by nearly 70% by 2050, the problem will likely only get worse.

d. Sea levels rising- Rising sea levels could have far-reaching effects on coastal cities and habitats. Increasing ocean temperatures and melting ice sheets have steadily contributed to the rise of sea levels on a global scale. At current rates the National Oceanic and Atmospheric Administration estimate sea levels to rise by at least 8 inches by 2100, potentially causing increased flooding and decrease in ocean and wetland habitats.

e. Shrinking ice sheets- While contributing to rising sea levels, shrinking ice sheets present their own set of unique problems, including increased global temperatures and greenhouse gas emissions. Climate change has driven summer melt of the ice sheets covering Antarctica to increase by nearly 30% since 1979.

f. Ocean acidification- The ocean is one of the main ways in which CO_2 gets absorbed. While at first glance that may sound like a net positive, the increasingly human-caused CO_2 is pushing the world's oceans to their limits and causing increased acidity. As pH levels in the ocean

decrease, shellfish have difficulty reproducing, and much of the oceans' food cycle becomes disrupted.

The future impacts of climate change

Much of the carbon dioxide we have already emitted will remain in the atmosphere for centuries, some even for thousands of years. As we continue to add to it, the concentration of carbon dioxide and other GHGs will increase and the planet will become even hotter. As the world warms, the impacts of climate change are becoming stronger and clearer: more frequent heatwaves, the declining availability of water in regions that are already dry today, substantial risks to the diversity of animals and plants around the world today. The consequences of these impacts, and the possibility of higher migration of people around the world to escape them, have led to efforts to slow and eventually halt global warming by tackling its causes.

Actions for a healthy planet

Climate change is a difficult issue to solve because of its global scale and complexity and requires global solutions. However, everyone can help to limit climate change from the way we travel, to the electricity we use and the food we eat, we can make a difference.

- Transforming our food production systems and consumption habits (going vegan) are undeniable solutions that must be part of the global roadmap to address climate change. Producing plant-based foods generally results in fewer greenhouse gas emissions and requires less energy, land, and water.
- To protect and conserve green spaces like local parks, ponds or community gardens is of utmost need as they absorb carbon dioxide and are associated with lower levels of air pollution, can reduce flood risk by absorbing surface rainwater and can provide important habitats for a wide variety of insects, animals, birds and amphibians besides regulation of temperature.
- Switching to renewable sources of energy, such as wind or solar from oil, gas or coal-powered energy, and use of electric vehicle can reduce carbon footprint to a considerable amount.
- All countries, especially the wealthy countries that generate the most emissions, must create more ambitious climate action plans to eliminate emissions.

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ABS-01

Minimizing the climate change impact through simulated carbon sequestration by *Trapa* sp. and its feedback to carbon dynamics

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Wetlands play key combined roles in carbon cycling and biological CO_2 sequestration by aquatic plants or microalgae asserting positive feedbacks to climate change. Carbon capture capacity and its impact on growth and carbon assimilation of water chestnut (*Trapa natans)* was studied in response to exogenously introduced compressed carbon dioxide comparing with that of humus fed condition as control. Compressed CO_2 was introduced for 5 minutes in the morning (5 M, 21.15 ppm) and evening (5 E; 21.15 ppm) and for 2.5 minutes in both morning and evening (2.5 M+E; 21.75 ppm). Lower bicarbonate concentration and higher carbon content of *Trapa* sp. leaves in single-dose treatment than split-dose treatment indicated excellent buffering capacity and carbon assimilation of the former system. However, low P/N in presence of introduced CO_2 indicated phosphorus limitation for the growth of *Trapa natans*. Therefore, although variation in CO_2 delivery influenced the carbon dynamics of the systems but the humus is finally considered as best strategy for both growth and carbon assimilation capacity of *Trapa natans.*

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ABS-02

Climate change and its impact on marine fisheries ecosystem

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Climate change due to several anthropogenic activities is the most significant concern of our society. Both natural processes and anthropogenic activities affecting the earth's temperature and the resultant climate change. Climate change mainly increase in sea surface temperature (SST) (El-Nino in short term and global warming in long-term) become the great threat to fisheries and aquaculture sector. Which cause changes in production and availability of fish species, loss of aquatic biodiversity, loss of coastal habitat, coral bleaching, altered timing of migration, spawning. Climate change poses a serious threat to coral reefs which harbour the highest biodiversity of any ecosystem globally, provide a sanctuary to a myriad of marine life and play a key role in protecting the coastline from erosion. Approaching climate change typically involves actions that reduces the amount of greenhouse gases (GHGs) in the atmosphere and taking strategies like blue carbon, carbon sequestration, adaptation, climate resilient agriculture.

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ABS-03

Adaptive changes of physiological functions of Black Bengal goats (*Capra hircus*) in coastal areas of Sundarban due to salt stress

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A study was conducted to assess the effects of salinity on physiological parameters of Black Bengal goats reared at coastal areas of Sundarban in comparison with goats of plain areas of West Bengal. Twenty (20) apparently healthy female Black Bengal Goats (*Capra hircus*) (1.5-2 years of age) of Sundarban coastal area were selected as Sundarban group and twenty apparently healthy female Black Bengal Goats were also selected from (plain area of Nadia district) as control group for the study. The study was done during three different seasons i.e. summer, winter and spring (as control). In both seasons (winter and summer), water intake (mL/day) by Sundarban group was significantly ($p<0.05$) higher compared to control group values. The packed cell volume (PCV) level during summer was significantly lower ($p<0.05$) for Sundarban. The highest value of PCV and Hb for Sundarban group was recorded during winter. The plasma glucose level was not affected by salinity of drinking water in both the seasons. The mean plasma glucose level for control as well as treated groups was slightly higher ($p<0.05$) during winter compared to values obtained in summer. The serum total protein (Tp) and albumin (Alb) concentrations in Sundarban group was higher during winter compared to control groups. In both seasons, the serum concentrations of Na^+ were significantly higher ($p<0.05$) in Sundarban group compared to control group. The increase in NaCl concentration in the drinking water increased the serum Na^+ level significantly during summer. The serum potassium (K^+) level in both seasons was lower in Sundarban group as compared to control group due to higher NaCl in the drinking water. The urine Na values were significantly higher ($p<0.05$) in Sundarban group compared to control groups during winter. All the changes observed in this study may be due to their adaptation in the saline coastal areas of Sundarban.

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ABS-04

Physicochemical and antioxidative property of branded Lassi samples sold in West Bengal market

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Lassi is a popular Indian traditional fermented milk beverage, which possesses various functional properties and is established as dietary adjunct. Lassi is mainly dahi (yoghurt) based drink consumed in South Asian region. The present study was carried out to evaluate physico-chemical characteristics, and antioxidative property of lassi samples of five different brands that were collected from the market of West Bengal. Significant variations were observed in composition and antioxidative activity. The average fat, protein, ash, total

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solids, sucrose, pH and titratable acidity, tyrosine value of lassi samples were found to be in the range between 1.21±0.01% to 2.12±0.01%, 1.29±0.01% to 2.36±0.02%, 0.43±0.01% to 0.67±0.01%, 18.95±0.05% to 20.92±0.01%, 10.43±0.01% to 11.91±0.02%, 4.13±0.05 to 4.44±0.04, 0.43±0.01% LA to 0.57±0.02% LA, 3.80±0.12 mg/100mL to 5.34±0.04 mg/100mL, respectively. The antioxidant activity of lassi samples as determined by ABTS and DPPH were ranged between 73.98±4.62 to 99.16±7.11 ìM Trolox /100g DW (DW= dry weight) and 9.12±0.54 to15.60±0.09% DPPH inhibition respectively. All lassi samples showed good antioxidant activity and varied significantly (P<0.05).

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ABS-05

Effect of hydroponic maize fodder supplementation on growth performance in Bengal goat

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The objective of the trial was to explore the effect of hydroponic maize (HM) feeding on the performance of Bengal goat. A total of 18 numbers of Bengal goats were divided into two groups. Control group was fed a total mixed ration diet while the goats of the second group were fed similar ration except that maize grain was 100% replaced by HM for 70 days of feeding trial. Goats were fed *ad-libitum* feed and fresh water twice daily. Daily feed offered and feed refusals were measured, while the body weight gain was recorded weekly, and feed conversion ratio (FCR) was determined. Results of the trial interpreted that HM had a positive effect on dry matter intake (386.27 g/day vs. 273.10 g/day), total weight gain (3.52 kg vs. 2.66 kg), average daily gain (50.25 g vs. 38.05 g), and FCR (7.81 vs. 7.20) on Bengal goats when compared with Control group. Thus, it was concluded that feeding of HM fodder with concentrate improve the DM intake, FCR, growth performance of Bengal goats in terms of body weight gain and can utilize it as an alternative fodder.

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ABS-06

Effect of feeding nutrient enriched rice straw based total mixed ration with or without exogenous enzymes on body weight gain and blood parameters in Jersey crossbred calves

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India is the second largest producer of rice after China, generating approximately 140.00 million metric tonnes of rice straw each year. Rice straw is rich in structural carbohydrates and could be a potentially cheap source of energy for ruminants but with poor digestibility. The concentrated alkali agents (Lime, Urea) in lignocellulose material results in rupture of the ester bonds between lignin, hemicellulose and cellulose. Use of exogenous fibrolyic enzymes (EFE) for ruminant is still at the developmental stage. A Feeding trial was

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conducted on 15 crossbred calves equally distributed into three groups, which were fed untreated rice straw (RS) based TMR (T0); urea-lime-molasses treated RS based TMR (T1) and T1 diet supplemented with EFE mixture @ cellulase 6,000 and xylanase 18,000 IU/kg TMR DM basis (T2). The Average DMI (kg/d/animal) in T1 and T2 were found significantly ($P<0.01$) higher as compared to T0 but T1 and T2 differed non significantly ($P>0.05$). The ADG (g/d/animal) was found significantly ($P<0.01$) higher in T1 and T2 than T0. The blood glucose concentration in T2 and T1 groups were significantly higher ($P<0.01$) in comparison to T0 group. However, Blood liver enzymes AST and ALT levels remain non-significant ($P>0.05$) among the groups.

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ABS-07

Emerging diseases of giant river prawn *Macrobrachium rosenbergii*

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In the last decade, the scampi industry of the world has witnessed catastrophic production losses due to white tail disease (WTD), Hepatopancreatic parvovirus (HPV), Covert mortality nodavirus (CMNV), Gill-associated virus (GAV), Infectious hypodermal haematopoietic necrosis virus (IHHNV), *Macrobrachium rosenbergii* Golda virus (MrGV) and White spot syndrome virus (WSSV) have been affecting scampi culture since 1980s. In 2020, Crustacea hepe-like virus 1 (CHEV1) and Decapod Iridescent Virus 1 (DIV1) have been identified causing production loss of scampi in China. Infectious precocity virus (IPV) linked to iron prawn syndrome (IPS) in *M. rosenbergii* is also identified. Water bubble disease (WBD) caused by the bacterium *Citrobacter freundii* has evolved in China in 2022 as an emerging disease resulting in over 30% mortality of the affected population. *Spiroplasma eriocheiris* infections in the river population of *M. rosenbergii* causing 80% mortality of the affected population have been reported from Bangladesh in 2018-19. Acute hepatopancreatic necrosis disease is also posing a threat to scampi culture. In China, *Enterobacter cloacae* have been isolated from scampi causing slow growth syndrome during 2017-19. Fungal disease incidences are though less in scampi, yet discoloration with low mortality rate in scampi was reported to be caused by *Batrachochytrium dendrobatidis* in India during 2007-11. This manuscript aims to highlight the emerging diseases causing havoc in scampi farming in the world to design suitable prevention and control strategies.

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ABS-08

Skill gap analysis of member farmers of farmer producer companies

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Farmer producer company (FPC) can play an important role by mobilizing and organizing small and marginal farmers for better market access, higher bargaining power, higher price to their produce, better information dissemination to bring economies of scale, reduce transaction costs and risks of farmers. The study was

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carried out among four FPCs in Dakshin Dinajpur district of West Bengal. Twenty farmer members from each FPC were chosen by simple random sampling method. The skill gap analysis of fish farmers was conducted by using mean weighted discrepancy score (MWDS) and their ranking. The topmost areas of training needs were in fish seed production and hatchery management skills (MWDS = 11.25) which was very significant finding in the study as the fish production in the district is expanding rapidly. There was a huge gap in fish seed production and demand, live fish handling and quality assessment skills (MWDS = 10.12), pond hazard management skills (MWDS = 9.92) were the other major skill gaps identified in the study.

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ABS-09

Bio-herbal culture based climate change adaptation strategies for diversified aquaculture to promote socio-environmental resilience

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Aquaculture is important for conservation of wetlands or water bodies and fish biodiversity, especially for local and endangered fish species. The integrated diversified aquaculture is considered as an ecosystem approach adaptation strategy to climate change which could generate environmental and economic benefits. It is recorded that organic herbs-based farming for enhancing water quality in aquaculture acts as a sustainable method to control water quality, with the added fish feed. As per scientific recommendations it has helped in long-term rural livelihood improvement for the fish farmers.

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ABS-10

E74-like factor 5 (*Elf5*) gene polymorphism and its association with milk production traits in crossbred and Vechur cattle of Kerala

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The *Elf5* gene belongs to the epithelium-specific E26 transformation-specific subfamily and is reported to play a pivotal role in mammary gland development. This work elucidates the significance of *Elf5* gene in milk production traits of livestock. Three novel single-nucleotide polymorphisms (SNP) (g.61st bp position A>C, g.180th bp position T>C, and g. 326th bp A>G) were identified in intron1 (420bp) of *Elf5* gene by DNA sequencing of pooled DNA samples of crossbred and Vechur cattle (a native breed of Kerala). PCR-RFLP was developed to identify the SNPs at g.180bp position T>C and g. 326bp position A>G and genotyped 81 crossbred and 52 Vechur cattle. Association studies revealed that the SNP at g. 180bp T>C locus, individuals with TT TG diplotype showed higher milk fat ($p<0.05$) and TC GG diplotype showed higher milk protein percent ($p<0.05$) in Vechur and crossbred cattle. Based on this study it can be said that the *Elf5* gene can roll out as a genetic marker for milk production traits in dairy livestock.

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ABS-11

Effect of various anesthetics on rohu fish fry (*Labeo rohita*) in laboratory condition

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Transporting fish seed in live and healthy condition is a very crucial event in fish culture. Use of anesthetics is known to help in seed transportation in various ways. Anesthetics (Ketamine, Xylocaine) were applied on *Labeo rohita* fish fry in laboratory condition and the tolerance limit was studied. These anesthetics were used in three various doses (0.5 mL, 0.75 mL and 1 mL per L water). The duration of exposures were 6 hrs, 12 hrs, 18 hrs and 24 hrs i.e., the fish fry were exposed to each anesthetics for those durations. In that time behavioural changes, water quality parameter and recovery time of seed from sedation were observed. Ketamine @ 1 mL/ L water showed significantly ($p<0.05$) better result than xylocaine. Metabolic activity in the anaesthetized fish was reduced, so, the fish seed did not get stressed as in the case of traditional transportation.

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ABS-12

Effect of Rosemary extract on *Hypophthalmichthys molitrix* (Valenciennes, 1844) fillets during refrigerated storage (4±1p C)

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Fish is a very perishable commodity that needs to be stored at low temperature and chemical techniques are frequently used for controlling the changes taking place in fish which is a very common practice nowadays. In the present study, a plant extract named rosemary was used to study its effect on the shelf-life of silver carp (*Hypophthalmichthys molitrix*) fillets during refrigerated storage (4±1p C) for a period of 15 days. The total phenolic compounds (TPC) in ERE, HWRE, and EHWRE were found to be 126.70±1.77 mgGAE/g, 74.89±1.42 mgGAE/g, and 136.99±0.76 mgGAE/g, respectively. The different chemical parameters like TVBN, PV and pH were within the acceptable limits except control sample. It also maintained the same trend in case of aerobic plate count (APC). The findings of the present study revealed that dipping the silver carp fish fillets in rosemary extract is an efficient and effective technique to preserve quality and extend the shelf life.

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ABS-13

Recent advancements of magnesium based bio-ceramics in bone tissue engineering

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The main objective of bone tissue engineering (BTE) is to address and repair bone defects that are considered too extensive, specifically non-union fractures that fail to heal properly through the body's natural healing processes. To achieve this goal, synthetic materials that closely resemble the natural bone extracellular

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matrix (ECM) have been the subject of extensive research. Resorbable bioceramics based on magnesium have recently been created for BTE. Although calcium-based bioceramics are the most commonly used bioceramics, their principal limitations include limited solubility and gradual, slow breakdown when implanted *in vivo*. Magnesium (Mg) is an essential component of the human body since it is crucial for DNA stabilisation, skeletal development, and bone metabolism. The main objective of this abstract is to emphasise the significance of bioceramics based on Magnesium and bioactive factors for biomedical applications, which demonstrate the manufacturing processes and *in-vitro* and *in-vivo* biocompatibility of MgP and MgS bioceramics, and list some recent advancements in metal ion-doped MgP and MgS scaffolds during bone tissue engineering.

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ABS-14

Study of antibacterial activity of lactoferrin isolated from the milk of crossbred and indigenous breeds of cattle

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Lactoferrin (Lf) is a multifunctional iron binding glycoprotein, which exerts a broad-spectrum primary defense activity against bacteria, fungi, protozoa and viruses. Lf from bovine milk (BLf) can be mainly used in medicinal activity because of its easy availability. In the present study isolation and evaluation of the antimicrobial activity of isolated BLf from the milk samples of HF cross bred and indigenous breeds of cattle i.e., Sahiwal and Poda thurpu was done and the antibacterial activity of BLf were compared among the mentioned breed using broth microdilution. BLf isolated from milk of indigenous breeds showed higher antibacterial activity as evidenced by their lower minimum inhibitory concentration (MIC) values, compared to that of HF cross bred. From this study, it was concluded that bovine lactoferrin (BLf) isolated from Poda thurpu breeds of cattle showed the more potent antimicrobial activity followed by Sahiwal cow milk against selected gram-positive and gram-negative bacteria. The antimicrobial activity was least in HF cross bred cow milk when compared to indigenous cow breeds such as Sahiwal and Poda thurpu.

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ABS-15

Surgical management of faecolithiasis in a dog

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Intramural obstruction of the intestinal lumen may be as a result of bolus of incompletely digested food, dehydrated intestinal contents (faeces) or an ingested foreign body due to indiscriminate feeding habits of pet animals. A 2.4 years old Labrador dog with history of intermittent vomiting and absence of defecation was diagnosed as obstruction in ileo-caecal junction with fecolith based on contrast radiography. Exploratory laparotomy was performed to remove the obstructed fecolith along with relieving the obstructed ileo-caecal junction by dilatation. The dog showed uneventful recovery without recurrence of the clinical signs.

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Impact of cadmium, a heavy metal on livestock and poultry ABS-16

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Cadmium (Cd) is an environmental pollutant that can have detrimental effects on livestock and poultry when they are exposed to its high levels. It is one of the heavy metals that is recognized to have no biological use. It interferes with nutrient absorption and utilization, leading to poor feed conversion efficiency and reduced overall growth performance. It can lead to reduced fertility, abnormal estrous cycles, testicular damage and decreased sperm production. Cd exposure can suppress the immune system of livestock and poultry which can lead to increased mortality rates and reduced overall health and productivity. Due to induced oxidative stress brought on by reactive oxygen species formation, Cd affects the antioxidant defense mechanism, which in turn leads to a variety of diseases. Livestock and poultry can accumulate Cd in their tissues, including milk, meat and eggs. Consumption of Cd-contaminated eggs, milk and meat can pose health risks to humans.

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Integrated multi-trophic aquaculture- a new trend in aqua farming ABS-17

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The Integrated multi-trophic aquaculture (IMTA) is a specialized form of aquatic polyculture, which is actually the co-culture of various species, often without regard to trophic level. The IMTA concept is very easy and flexible. It can be land-based or open-water systems such as marine or freshwater systems, and may comprise several species combinations. The combination of fish/ seaweed/ shellfish is very important for IMTA because this combination covers all trophic level of water bodies. The system allows one species' uneaten feed, wastes, nutrients and by-products to be recaptured and converted into fertilizer, feed and energy for the other crops, and take advantage of synergistic interactions between species. The aims of IMTA are "to ecologically engineer system for environmental sustainability, economic sustainability and societal sustainability" and it is a new trend in aquaculture.

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Studies on welfare of *Heteropneustes fossilis* (Bloch, 1794) in biofloc rearing system maintained with different carbon and nitrogen ratios ABS-18

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The biofloc technology has gained popularity in aquaculture sector during last decade due to its ability towards bio-security, growth, feed utilization, health and cost effectiveness. In this study the impact of water quality on welfare of *Heteropneustes fossilis* in different carbon-to-nitrogen (C:N) ratios in biofloc systems

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were investigated. A randomized design (2.33 kg/m^3 in 1500 L) was used in triplicate, where a control without biofloc and three fish (5.0±0.5 g) groups were cultured with biofloc in three different C:N ratios of 8:1 (CN8), 12:1 (CN12) and 16:1 (CN16) for 180 days. The fish were fed at 5-2% of their body weight daily. Lower nitrogenous substances, and higher floc volume were recorded with increasing C:N ratios. CN12 showed better results compare to others while measuring stress, liver function, haematology, innate immunity and antioxidant properties. The results suggested the higher C:N ratio may not be suitable always for maintaining superior health order of *H. fossilis* in biofloc system.

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ABS-19

Endocrinological profiles in Black Bengal (*Capra hircus*) does during transition

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Black Bengal goat, a prized and highly adaptable breed distributed widely in Eastern India and Bangladesh, is known for its excellent meat and skin quality. Scanty works were done on endocrine profile of Black Bengal goat during periparturient period or transition. A small attempt was made to elucidate the endocrinological profile of Black Bengal goat in farm condition during transition. Blood samples were collected from twelve healthy pregnant Black Bengal goats maintained in standard managemental practices, on day 30, day 15, day 7 pre-partum, day of kidding and day 7, day 15 and day 30 post-partum. The blood endocrinological profiles viz. plasma cortisol, T_3 and T_4 levels were evaluated using commercially available kits. Plasma cortisol, T_3 and T_4 levels were increased significantly ($P<0.001$) from day 30 pre-partum and reached maximum value on the day of kidding and significantly ($P<0.001$) decreased thereafter. The results were analyzed and discussed.

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ABS-20

Climate adjusted rearing practices (CARP) in aquaculture

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Aquaculture is the fastest growing sector among agriculture and food production sectors. Like other farming system aquaculture is also directly influenced by climatic factors. But now climate has changed due to industrial pollution, green house effects, global warming etc. So, aquaculture practices are hampered by these issues like rising temperature, ocean acidification, sea level rising, changes in rainfall pattern etc. We can't neglect these environmental and climatic factors rather we can adjust our culture systems as per changed scenarios. Here lies the importance of climate adjusted rearing practices (CARP) in aquaculture sector. CARP can minimize the risk of climate changing factors and secure the production rate in an adjusting approach.

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Environmental and socioeconomic stability is the main objective of CARP. Introduction of new eco-friendly farming system, optimum use of resources and avoid of the climatic hazards are the main component of CARP. Through CARP we can achieve sustainability and food security.

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ABS-21

Recombinant expression of beak and feather disease virus capsid protein in Baculovirus based insect cell expression system

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Psittacine beak and feather disease virus (BFDV) consist of non-enveloped icosahedral, circular, single-stranded DNA genomes, is a globally distributed and the most studied avian circovirus known to infect wide range of psittacine birds (parrots, cockatoos, lorikeets) and causes abnormality in beak and feather. In this study, BFDV_ Indian isolate capsid sequence (ORF2) has been selected for synthesis (720bp) as the ORF2 of other circovirus was previously reported for expression of immunogenic protein. The sequence was optimized for baculovirus expression system. The synthesized sequence subsequently cloned into pOPINE vector (6.1kb), and transformed into baculovirus to produce recombinant baculovirus containing BFDV_ Indian isolate capsid sequence (ORF2) in insect cell line (*Spodoptera frugiperda*). The ability of recombinant virus to express the capsid protein will be analyzed by western blot. If successful, the ability of the capsid protein to assemble into empty capsid particle will also be assessed by negative stain Transmission electron microscopy (TEM). Further characterization and immunological study of the empty capsid will be required for the development of empty particle-based vaccine against psittacine beak and feather disease virus.

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ABS-22

eDNA- Emerging tool

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eDNA is a new promising tool for the surveillance of species biodiversity, represents a source of information for extracting knowledge about past and present biological diversity. Although, only few studies have been conducted to collect, separate and interpret the eDNA application, still this tool is quite helpful in improving the conservation and management. It has revealed the ancient terrestrial systems and organisms. This is a literature review to assess the information regarding the origin, sustenance and degradation of eDNA in an aquatic system. The approach in aquatic system is found marred by biases regarding the DNA behaviour and its degradation in an environmental scenario, contamination is common and reference database is incomplete. This chapter comprises an outlook on the origin, evolution, methodology, and application.

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ABS-23

Efficacy of inulin and whey protein concentrate as fat replacers on physicochemical, microbiological, textural and sensory characteristics of low fat paneer

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The present study aimed to develop a low-fat paneer (LFP) enriched with inulin, whey protein concentrate (WPC) and their combination (0.25 g/g inulin (S_2), 0.30 g/g WPC (S_3), and their combination 0.27 g/g (S_4) milk fat replaced respectively). The quality of the laboratory-made LFP was compared with control (S_1) made from milk having 4.5% fat and 8.5% SNF. The sensory attributes of the LFP were significantly ($p<0.05$) affected by the incorporation of fat replacers. S_2 got the highest overall acceptability score**.** Texture profile analysis (TPA) showed significant changes ($p<0.05$) in the values of hardness, cohesiveness, gumminess, and chewiness in all samples. The physicochemical and microbiological quality of the LFP were also evaluated. The titratable acidity, TBA, tyrosine value and free fatty acids got increased and water activity and pH got decreased in all samples during storage at 7 ± 1^0C for seven days. S_2 marked the highest acceptability grade during storage. The result suggests that inulin enriched traditional paneer can be a viable alternative to the health conscious consumers.

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ABS-24

Study on effect of zinc oxide nanoparticles on performance of broiler chickens

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A study was conducted to evaluate the effect of supplementation of zinc oxide nano particles (NPs) on growth performance and meat quality in commercial broiler chickens. The dietary groups were: (1) Negative Control (NC), (2) NC + 20 ppm Zn from inorganic ZnO, (3) NC + 40 ppm Zn from inorganic ZnO, (4) NC + 20ppm Zn from Zn NPs, (5) NC + 20ppm Zn from Zn NPs. The body weight during starter, grower and finisher period were not affected ($P>0.05$) by Zn supplementation either from zinc oxide (ZnO) or zinc oxide nanoparticles (ZnONPs). Zno and ZnONPs supplementation had no effect ($P>0.05$) on ADG, ADFI and FCR during starter (1-14 d), grower (15-28 d), finisher (29-35) and overall (1-35 d) period. ZnONP does not affect the carcass characteristics in broiler chicken. No significant ($P>0.05$) differences in numbers of *Escherichia coli* and *Lactobacillus* spp. were observed. But ZnONPs supplementation significantly reduced ($P<0.001$) the count of *Salmonella* spp in comparison to control group. Zinc supplementation either from ZnO or ZnONPs did not affect ($P>0.05$) antibody titres on 28 and 35 days in broiler chickens. ZnONPs did not affect ($P>0.05$) zinc concentration in tibia and breast although increases zinc concentration in liver tissues.

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ABS-25

Black soldier fly larvae meal: A sustainable model for waste to wealth

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Treatment of biodegradable waste using black soldier fly (BSF) larvae is a new emerging waste treatment technology that is attracting entrepreneurial activity worldwide. The flies undergo four stages; egg, larva, pupae, and adult fly, where the larvae are the primary workhorses in waste management. The larvae feed voraciously on wastes such as fruits and vegetable scraps, kitchen leftovers, garden trimmings, food waste from restaurants or markets, agroindustrial byproducts and others which have the potential to become feedstock for various commercial products such as animal feed, biodiesel, chitin as a biopolymer, soil fertiliser etc. High levels of calcium and phosphorus can be found in BSF larvae, which also include 35-42% of crude protein with high biological value and an amino acid profile similar to that of soybean meal (SBM). The amount of lysine and methionine in BSF larvae is similar to that in meat meal. Recent findings revealed that BSF larva's nutritional content is on par with fish meals. BSF larvae meal might increase the nutritional value of SBM diets or substitute fish meal without having any negative effects on production performance in aquaculture. Thus, BSF may prove to be a sustainable, efficient, and environmentally friendly way to handle organic waste, reducing reliance on landfills and contributing to a circular economy.

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ABS-26

Standardization of incorporation rate of *Pangasius surimi* powder in fish snacks

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Fish is rich source of proteins and healthy fats containing long-chain omega-3 fatty acids along with essential nutrients such as iodine, vitamin D and calcium. Surimi is concentrated myofibrillar protein, extracted from fish flesh by washing to remove fat and other water-soluble contents and mixed with cryoprotectant like sugar or an alcohol. Surimi powder is dried form of surimi which can be stored without frozen storage and can be used as dry mixes application. Fresh *Pangasianodon hypopthalmus* meat was used as a raw material for development of surimi powder which was incorporated in preparation of fish snacks. The highest expansion was recorded as incorporation level of SP-15 (11.31±2.38%) and SP-10 (47.00±0.00%) for area expansion and volume expansion ($p>0.05$) respectively. Overall acceptability scores reveal that (SP-10) (6.08±0.30) was best acceptable.

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ABS-27

Diagnosis and treatment of deep corneal ulcer (with protrusion of stromal layer, corneal edema, blepharospasm and loss of vision) with autologus serum therapy

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Corneal ulcer or ulcerative keratitis is very common which sometimes has a little tendency to respond with traditional therapy that ultimately lead to complete blindness. There may be different etiological factors like trauma, defects in eyelids, lachrymal disorders, bacterial, viral or mycotic infections or other idiopathic causes. It is characterized by superficial or deep corneal erosion with protrusion of underlying stromal layer. The present case was of chronic deep corneal ulcer of left eye with protrusion of stromal layer,corneal edema, bhlepherospasm associated with loss of vision caused by trauma which failed to cure with conventional therapy with antibiotic and anti-inflammatory eye drops in a two year old male Golden Retriever dog. The dog was treated with autologus serum along with sympathomimetic eye drop, antibiotic: Moxifloxacin, anti-inflammatory: Flurbiprofen locally and systemic supplementation of vitamins, minerals, carotenoids, lutein for one month that resulted to complete cure and re-establishment of vision.

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ABS-28

Life cycle assessment of dairy industry over cradle to plate scale

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The dairy industry recently contributing 3.4% of global GHG emissions. India being the largest milk producer 221.1 Mt (2022) is growing at a rate of 5.6% along with increase in per capita consumption. Analysis over GHG emission hotspot through cradle to plate scale is needed to go for Life Cycle Assessment studies. Nearly 20.3% emission comes from feed production, 51.5% from raw milk production stage and the rest is covered by processing, packaging and retailing. But the share changes with the change of composition and breed characters. The total emission from each kg of pasteurised milk, UHT milk, curd/ yoghurt, ice cream, butter, ghee, milk powder, cheese and paneer are around 60.5 kg $CO_{2\text{-}e}$. Climatic impacts like an increase in acidification, eutrophication potential and ozone layer depletion are linked to this emission. And we need to look for cleaner production technologies to meet the maximum emission limit of the Kyoto summit (COP:3).

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ABS-29

Growth performance of LIT chicken fed diet with rDDGS

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Increasing number of human population and changing food consumption pattern has led to increased demand for protein in terms of meat. Poultry plays an important role in meeting this demand because of its easy management, quick return to investment and lower price. Feed is the biggest expense in poultry farming comprising about 70-80% production cost. For successful poultry production, quality feed availability at reasonable price is a key concern. Price of conventional feed ingredients is increasing rapidly. There is competition between human and animal feed. It is necessary to search for alternative feed resource which should be cheap, easily available and nutritive dense. Rice is one of the major grains produced in India. A lot of by products are produced from rice processing industry. Among them rice distillers dried grains with soluble is a good protein source as it contains yeast protein which can be safely added in poultry diet.

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ABS-30

Physical meat quality parameters of Asian Sea Bass farmed in cage culture system

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The cage culture of Asian sea bass under All India Network Project on Mariculture, initiative of ICAR-CMFRI, was initiated in the district of South 24 Paraganas, West Bengal with the focus to popularize the farming technology. Since, Asian sea bass is popular among the consumers for the fillet, hence, the study was designed to determine the physical meat quality parameters of fish fillet cultured in cages. The pH of the fish was found to vary significantly ($p<0.05$) among the different size grades of fish during culture although Water Holding Capacity did not show any significant variation ($p>0.05$). A diminishing trend in cook yield (CY) percentage was observed. Among textural parameters hardness indicated highest value of 2630.39±392.94 g for the biggest size grade T6 that is, the fillet obtained from fish having a weight of 728.40±2.70 g and is considered table sized fish.

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ABS-31

Comparative analysis of radiographic and echocardiographic parameters in dogs with dilated cardiomyopathy, hypertrophic cardiomyopathy, and healthy controls

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The present study is carried out to compare the radiographic and echocardiographic parameters between dilated cardiomyopathy (DCM), hypertrophic cardiomyopathy (HCM)-affected cardiac diseases, and healthy controls. A total of 60 client-owned dogs were incorporated in the present study. Among these, 24 (40%) cases were categorized as being in the healthy control group. Based on clinico-physical, thoracic radiography, and echocardiographic findings, 28 (46.67%) cases were classified as having DCM and 8 (13.33%) cases as having HCM. Among different cardiac diseases, prevalence of DCM is higher, and in sex, breed, and age-wise findings, prevalence was higher in male Labradors with an age greater than 5 years. Thoracic radiography revealed a significant difference ($P<0.05$) between the VHS values of DCM with respect to the values of the healthy control group. As 2-D and M-mode echocardiographic studies revealed, the left ventricular volume parameters, left atrial dimensions, LA/Ao ratio, and different dimensions of intra-cardiac M-mode measurements were significantly increased in DCM-affected dogs in comparison to HCM-affected dogs. Based on the findings of this study, it can be concluded that thoracic radiography and echocardiography are valuable diagnostic tools for identifying cardiac diseases.

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ABS-32

Study on the presence of endoparasites at different stages due to seasonal influence in commercially important Catfishes *Heteropneustes fossilis* and *Clarias batrachus*

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Heteropneustes fossilis and *Clarias batrachus* are commercially important freshwater catfishes. Recent data show that *H. fossilis* and *C. batrachus* is a fish with high fecundity, with 10-15 thousand eggs obtained from 100-150 g fish. The species is found gravid in the wild during July-September. In recent years there were reduction in production due to various reasons like disease occurring due to both bacteria, e.g., *Edwardseilla tarda,* and due to the high incidence of endoparasites, resulting in slow growth and results in zoonosis, e.g., *Heterophyses* sp., *Chlonorchis* sp. and *Capillaria* sp. The study shows different groups of endoparasites and their stages in different seasons. Primarily eggs of *Ascaris* and Paragonium were found in the winter season by

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random sampling of both the fishes from their gut content. Further studies show that in the month of March to July i.e., summer to pre-monsoon, there is an abundance of adult nematodes, cestodes and trematodes in their gut content sometimes the number varies from 12-24 nos. in 100 µL isotonic solution of gut content seen under the microscope. Thus, the high incidence of these parasites results in a slow or no growth rate which can be controlled by the application of both herbal medicine and antibiotics thus restoring the loss in production.

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ABS-33

Surgical management of humerus fracture in rhesus monkey

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An 8-month-old male Rhesus Monkey (*Macaca mulata)* was presented at the Belgachia Veterinary Hospital with a history of blunt traumatic injury on right arm. Physical examination revealed soft tissue swelling and pain in the middle region of right arm. Radiographic examination disclosed an overriding transverse distal third diaphyseal fracture of right humerus. Intramedullary pinning was decided as a mean of management of the fracture. Surgical correction was performed using retrograde intra medullary pinning technique under Ketamine-Diazepam anaesthetic protocol. Post-operative radiograph revealed appropriate alignment of the fractured fragments. Postoperative therapy of modified Robert Jones bandaging for 10 days, oral administration of Amoxicillin Sulbactam @ 12.5 mg/kg B.W. for 5 days, Meloxicam @ 0.2 mg/kg B.W. for 3 days and calcium & vitamin supplementation for 50 days led to an excellent callus formation following which the Steinmann pin was removed on the 56th day after surgery.

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ABS-34

Surgical management of gravid hysterocele in a non-descript queen

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A non-descript queen (1.6 years) was presented in the ER with history of anorexia, abdominal pain, lethargy, right unilateral distended abdomen. The owner suspected that the cat might have mated 2 months ago. Physical examination revealed pyrexia, fluid filled thrill on lower abdomen palpation. Skiagram revealed presence of two fetuses located in right caudal abdominal pouch extending in right inguinal region. The patient was diagnosed with gravid hysterocele, herniorrhaphy and caesarean section was decided. Anaesthesia was induced with xylazine (0.5 mg/kg B.W.) - ketamine @20 mg/kg B.W combination IM, and maintained on ketamine (11 mg/kg B.W.) and diazepam (0.5 mg/kg B.W.) IV to effect. Oblique incision was made in retro-umbilical region for herniorrhaphy. Hernial content composed of intestinal loops, omentum, fat and

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portion of left uterine horn. Adhesions were removed to better expose the uterine horns and foetuses were detected as dead and an instant decision for ovariohystectomy was taken. The intestinal loops and omentum were tucked back into abdominal cavity. Two immature dead foetuses were recovered from the uterine horns and ovariohysterectomy was performed in routine manner. The peritoneum and muscles of hernial ring were closed using polypropylene 2-0 sutures. Fascia and subcutaneous tissue sutured in simple interrupted fashion using 2-0 polyglactin 910 sutures. Skin incision was closed using monofilament nylon 1-0 using horizontal mattress suture pattern. Post operatively wound was dressed with povidone iodine 5% lotion on alternate day and injection cefotaxime @ 25 mg BID was given IM for 5days. The recovery was uneventful.

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ABS-35

Surgical management of right iliac wing fracture in a dog

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A 2.6 year old Cocker Spaniel dog was presented in the emergency ward with signs of severe pain in the croup and rump region, non-weight bearing lameness in right hind limb, which in X-ray revealed fracture of the right iliac wing along with an extended fracture line upto the level of ischium. The dog was decided for internal reduction with DCP plate and fixation was performed using an eight-hole 3.5 dynamic compression plate, placed after contouring the anterior third of the plate to match the curvature of the iliac wing. Two stainless steel cortical screws of 18 mm, and a 14 mm screw were used proximal to the fracture line and two cortical screws of size 14 and 12 mm were used distal to the fracture line respectively. The anaesthesia was induced with Zolazepam (Zoletil 50, Virbac, France) @20 mg kg^{-1} or 2 mL, after administration of atropine sulphate and xylazine as pre-anaesthetic, @ 0.04 mg/ kg and @ 1 mg/kg body weight respectively and maintenance was done by administering one third of the induction dose as intermittent bolus. The Animal recovered uneventfully from anaesthesia. Immobilization of the hip using pelvic circumferential bandaging was done. Postoperative antibiotic, analgesic, anti-inflammatory coverage was given. The post-operative X-ray showed a good alignment of the fracture line and proper positioning of the plate. The animal was bearing weight after 72 hours of the surgery. The animal was observed for six months.

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ABS-36

Effect of sodium chloride on cooking qualities of rohu (*Labeo rohita*) stored in refrigerated condition (4±1°c)

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Fish is essential for people in underdeveloped countries like India to meet their nutritional needs and ensure their livelihood stability. Rohu or *Labeo rohita* (Hamilton, 1822) is one of the most important freshwater fish

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for trade and a favourite in India's system of carp polyculture. Since rohu deteriorates after death, lipid oxidation, autolytic degradation and microbial spoilage cause the quality of whole gutted rohu samples to decline with storage. Due to its antibacterial qualities, salt has historically been used widely in Indian cuisine for cooking fish. The goal of the current study was to evaluate the changes in cooking characteristics in entire gutted rohu fish samples that had been treated with salt and stored in refrigerators at 4±1^{O}C. Fish samples treated with salt showed a decreasing trend in cooking yield (CY) percentage compared to control samples. On the other hand, due to the osmotic mechanism that releases accessible water from inside the fish muscle, the cooking loss (CL) of the salt-treated samples revealed significantly higher values than control samples. One of the key cooking variables, shrinkage, displays a decreasing pattern for salt-treated rohu samples.

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ABS-37

Study on the impact of temperature change and vertical dissolve oxygen concentration (VDOC) on yellow fin tuna

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Yellow fin tuna is one of the commercially mostly exploited fish adding up to 37,488 tons of total catch in 2018 from India. But recently the capture has declined to 24,515 tons in 2021 due to over-fishing as well as migration in the deep sea towards the pole. Environmental factors like rise of sea surface temperature (SST) [0.15^{o}C/decade] and dropping of vertical dissolve oxygen concentration (VDOC by 2%) influenced greatly for migration. The significant rise of SST in Indian ocean due to global warming at 0.18°C/decade is also affecting the VDOC. This is the main reason for declining the capture in India by 3 - 4.5% (approximately). The migration could be slowed by decreasing overfishing through creating awareness among fishermen, implementation of rules and regulations like "reducing the annual catch of maximum sustainable yield (MSY ~ 300,000 tons)" enacted by Indian Ocean Tuna Commission and help in conservation of this species.

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ABS-38

Protective action of lactoferrin and dexamethasone sodium in ulcerative colitis in rats

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The present study was aimed to evaluate the protective effect of lactoferrin in acetic acid-induced colitis in *wistar* rats. The rats were divided into five groups *viz.* Group 1- sham. Group 2 - positive control. Group 3 - dexamethasone sodium @ 2 mg/kg b. wt. i/p from day 1 to 14. Group 4 - lactoferrin @ 200 mg/kg b. wt. p/o from day 1 to 14. Group 5 - dexamethasone sodium @ 1 mg/kg b. wt. i/p and with lactoferrin @ 100 mg/kg b.

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wt. p/o from day 1 to 14. Intra-colonic administration of 2 ml of acetic acid (4 % v/v) on day 1 was given to groups 2, 3, 4 and 5. Tissue samples were processed for antioxidant, anti-inflammatory parameters. The antioxidant assay showed increased levels of thiobarbituric acid reactive substances and decreased activities of glutathione peroxidase, glutathione, catalase and superoxide dismutase enzymes, whereas lactoferrin treated group showed the opposite effect. The concentration of tumor necrosis factor- á and myeloperoxidase enzyme activity were increased and interlukin-10 concentration was decreased in acetic acid induced colitis group, whereas lactoferrin treatment reversed this effect. The results were suggested that, lactoferrin may be a potential therapeutic agent against acetic acid induced colitis in rats and promising nutraceutical compound for the treatment of colitis in rats.

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ABS-39

Oxidative stress in livestock due to thermal stress

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Various anthropogenic activities are the main reason for the increased levels of Co_2. The rise in Co_2 levels contributes to the increase of mean global temperature all around the world. Exposure of such high temperatures leads to alterations in biochemical pathways in animals. One such alterations involves increased generation of reactive oxygen species and subsequent damage to the lipids, proteins and nucleic acids. These elevated reactive oxygen species leads to oxidative stress conditions under elevated temperature. Thermal stress due to global warming can elevate oxidative damage with increase in redox capacity in animals. Elevated temperature may also make the animals susceptible to diseases that are aggravated under thermal stress. Continuous oxidative stress conditions cause abnormality in the physiology of the animals. The present review focusses on the various oxidative changes that occurs in animals due to climatic changes and various practices to be adapted to alleviate oxidative stress in the animals.

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ABS-40

Effect of dietary supplementation of Indian pennywort *Centella asiatica* leaf extract as a stress regulator on *Labeo rohita* (Hamilton 1822)

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The most severe impact of climate change on aquatic animal is stress. Stress biomarkers, including the level of blood glucose, cortisol, creatinine, alanine aminotransferase (ALT) and aspartate aminotransferase (AST) rise under stressful conditions. Several herbal components that act as anti-stressors may help to combat the

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situation. A well-known established herb in human medicine is *Centella asiatica*. It is rich in carotenoids, vitamins B and C, amino acids, phenols, flavonoids and triterpenoids. The purpose of the current study was to examine the impact of dietary supplementation with *C. asiatica* leaf crude chloroform extract (CCE) as a stress regulator on *Labeo rohita*. CCE supplemented feeds in different doses were fed to fish for 30 days at 3% body weight twice daily. Based on the assessment of stress biomarkers, CCE supplementation at 10 mg/kg feed was found reasonably the best. This finding shows the potentiality of *C. asiatica* in fish health management under challenging environmental conditions.

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ABS-41

COVID-19 pandemic's impact on the fisheries environment and consequences

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The disastrous effect of SARS-COV-2 poses a serious threat to human life and has a significant negative impact on livelihoods and food security, either directly or indirectly. The World Health Organization (WHO) declared COVID-19 as a pandemic and public health emergency of international concern. COVID-19 has resulted in both positive and negative impacts on the environment and human society. But, the sudden increase in plastics and medical trash during the COVID-19 disguised the positive effects and increased the risks of water pollution, particularly through microplastics, medical products as well as antimicrobial and personal care items. Drugs used during the pandemic affected the ecological system and also negatively impacted the aquatic animals and human health. Hence, it is the time to adopt dynamic strategies for appropriate use, disposal and waste management of pharmaceuticals to reduce environmental contamination by plastics and pharmaceutically active compounds in surface waters.

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ABS-42

Potential roles of lab-grown meat in combating global warming, soil erosion, water crisis and ensuring food security

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Livestock raised for meat use 30% of global ice-free terrestrial land. It consumes 8% of global freshwater, while produces 18% of global greenhouse gas (GHG) emissions which is more than the global transportation sector. Moreover, those farm animals grown on maize, wheat, soya etc are competitor of human-beings in food cycle. Methane emission from western cattle is nearly 100 times more than that of a human. Global meat consumption has quadrupled over last fifty years. The world produces more than 320 million tons of meat

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each year. Meat consumption is increasing at 4.7 million tons every year. 80 billion animals are slaughtered for meat. By 2050, meat consumption is projected to increase by 73%. Lab-grown meat has the potential to address some of the crucial environmental threats posed by traditional animal farming; additionally, reduces the risks of meat-borne zoonoses, facilitates fortification with essential nutrients as per human requirements.

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ABS-43

Issues and challenges faced by the fish farmer producer companies of Assam, India

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The revolutionized fisheries enterprises i.e., producer companies came out as one of the major ways to collectivize the strength of fish farmers in India. But in some selected states like Assam the fish producer companies are still in early stages of their operation even though some of the companies formed way back in 2014 and therefore this study was done in the state of Assam, India to highlight the issues and challenges faced by the member farmers and the office bearers of the fish farmer producer companies (FFPCs) of the state. The study was carried out in three most progressive districts in Assam in terms of availability of FFPCs i.e., Kamrup, Nagaon and Morigaon during the year 2021-2022. Ten FFPCs were selected purposively based on their years of existence and performance. From each of the 10 selected FFPCs 20 members were randomly selected for the study. Thus, a total of 250 respondents were selected for the study. Simple random sampling method had been followed for selecting members. The results revealed that majority (61.60%) of the respondents faced medium level of issues and challenges while being a member of the FFPCs, where some of the most severe issues included poor aggregation of farmers' production, unavailability of custom hiring services, lack of team spirit, unable to create brand value, lack of loan from banks, lack of storage facilities, lack of processing facilities and lack of processing plants etc. Ultimately the study suggested that the farmer members of the FFPCs can be benefited by their organization only when they will try to mitigate these challenges by working collectively for their FFPCs.

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ABS-44

Bio active compounds, role of microorganisms in its' utilisation

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Bioactive compounds are a collection of compounds that have certain effects on humans and animals that consume them. Since many bioactive compounds are beneficial to human health, they are attracting increasing attention in modern life, and their rising consumption stimulates the development of novel production modes that are more efficient than the traditional way, which relies on chemical synthesis or extraction from natural tissues. Among the emerging production techniques, biotechnology-based generation using fermentation of genetically engineered microorganisms shows great potential as an alternative to the current

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manufacturing systems, and has actually been applied for the industrial supply of some bioactive compounds. we highlight the microbial production of some typical bioactive compounds, including polyphenols, polysaccharides, amino acids and vitamins. Microorganisms are capable of producing a wide range of enzymes that can break down complex bioactive compounds into simpler compounds that can be easily absorbed and utilized by the body. For example, certain bacteria in the gut are known to produce enzymes that break down complex polysaccharides in plant-based foods, allowing humans to digest and absorb these compounds more efficiently. In addition to their role in breaking down complex compounds, microorganisms are also capable of producing their own bioactive compounds with various health benefits. These compounds include antibiotics, probiotics, and other compounds with anti-inflammatory, antioxidant and anti-cancer properties.

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ABS-45

Barilius barila (Boroli): 'The Hilsa of North Bengal' and rising price due to impact of climate change and anthropogenic activities

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The rivers of North Bengal are blessed with several nutritious and palate appealing fish species. Among them, the fish Boroli (*Baralius barila)* is the most popular one, found in Terai and Dooars region. The Boroli fish harvest numbers are dwindling due to fine mesh netting, water poisoning and industrial waste discharge. Natural disasters such as landslides, flood etc due to climate change has also led to heavy siltation in river beds. All these have destroyed their habitat and reduced their catch, raising its market price to exorbitantly high. Proper regulation of mesh size used and industrial waste discharge, prohibit use of pesticides, captive breeding, encourage local people's participation, develop protected areas and spread awareness are some of the measures that can be taken to conserve the native species.

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ABS-46

Status of farmer producer company (FPC): A case study in Tripura

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Bagma Agri. Producer Company Limited is established at Bagma, South Tripura. The company was established on 31st December, 2019 and promoted by NABARD. The company is involved in diary, apiculture, handicrafts and cattle feed making. The total turnover of the company reaches 1 crore. It is the Tripura state's most prosperous FPC. It produces 200-300 bag of cattle feed every month, 40-50 kg of honey per season and sales of 400 litres of milk every day. There are around 10000 members associated to this company and the members growth keeps on increasing indicates that farmers are eager to join the company to avail the benefits. The

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company has a profit of Rs. 31062 for the year 2020, Rs. 56611 for 2021 and Rs. 50135 during 2022. By the help of this company farmers are getting better and assured prices for their produce.

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ABS-47

Study on MGNREGS – Aquaculture convergence in Tripura

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Fish being an important constituent of daily diet of its population, the State Fisheries Department had strategized for both horizontal as well as vertical expansion of its aquaculture sector. It was in this light that the present study was conducted in Dhalai district of Tripura state during September 2018 - January, 2019 with one of its objectives to suggest on required management interventions for income enhancement of MGNREGS linked pond owners. Garrett Ranking revealed 'lack of systematic and timely supply of critical inputs from the Fisheries Department' and 'lack of training facilities' to be the first two top ranked perceived constraints. Hence, strategic interventions by the State Fisheries Department to devotedly organize *in situ* demonstrations and skill trainings along with providing ensured technical expertise and know-how support to the beneficiary pond owners of MGNREGS seemed essential for turning MGNREGS-Aquaculture convergence process in Tripura really successful.

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ABS-48

Communication behavior of fish farmers with regard to scientific fish farming: A case study from Purba Medinipur district of West Bengal

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An attempt has been made to examine the communication channels and information processing behaviour among randomly selected sample of 120 fish farmers in Purba Medinipur District of West Bengal by employing an Ex-post facto research design. The pre-tested interview schedule was used to collect the responses and it was found that personal localite channels, viz. fellow farmers (83.33%), local feed dealer (75%), neighbour and friends (57.5%); personal cosmopolite channels, viz. private experts and NGOs (91.67%), fishery extension officer and institutes (66.67%); impersonal cosmopolite channels, viz. mobile apps and internet (95.83%), television and radio (76.67%) were used as primary sources of information regarding scientific fish farming practices by the respondents. Study revealed that respondents mostly preferred personal localite channels for concerned issues like feeding, fertilizing and medicinal uses (79.17%) and general water and soil management (74.16%). For purchasing of improved seed variety (75.83%), better management practices (66.67%) personal cosmopolite channel was addressed by the respondents. It was observed that 95.85 per cent of respondents

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evaluated the information by discussion with fellow farmers (95.85%) followed by their past experiences (76.67%). It was also noticed that majority of respondents stored the farming information by memorizing (90.83%). So, enhancing extension networking systems, and maximizing mass media ensure well-informed decision-making among the end-users.

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ABS-49

Diversification of carp poly-culture with introduction of Pengba (*Osteobrama belangeri*) in West Bengal -An enormous possibility

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Freshwater fish *Osteobrama belangeri* (Pengba in Manipur), a medium-size cyprinid endemic to the eastern part of Manipur, India has attracted an enormous interest as an aquaculture species in many countries. The fish is highly relished and has a ready demand in the market due to its better taste alike Hilsa, meat quality and good source of protein. Recently, attempts have been made to incorporate pengba as potential candidate species into mainstream carp culture for diversification. In study-I, pengba fingerlings (9.4±0.26 cm; 10.6 ±0.33 g) were stocked either with catla or rohu (combined stocking density @ 6500 fingerlings ha^{-1}, ratio C/R : P 2:1) where incorporation of pengba did not affect survival of either catla or rohu (P>0.05). The total fish yields in both combinations were similar. In Study-II, additional incorporation of pengba @10 and 20% of the IMC density (6500 fingerlings ha^{-1}) did not affect survival and growth of any of the major carps. With 10% addition, pengba yielded relatively higher survival (P>0.05) as well as higher length and weight gains (P<0.05) than the 20% incorporation level. The two studies together indicated compatibility of pengba with the two IMC species. Thus, to increase the biomass yield in the major carp poly culture system, incorporation of pengba up to an additional 20% level above the IMC stocking density is advisable. Among the IMCs, catla showed better growth performance than rohu. Such results suggested feasibility of incorporating pengba in the major carp poly culture system.

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ABS-50

Impact of fishery based self help groups (SHGs) in improving socio-economic condition of rural women

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Self-help groups (SHGs) are informal associations of local women, often found in India and other countries in South and Southeast Asia. Fishery-based self-help groups are crucial in fostering community cohesion, promoting sustainable fishing practices, enhancing economic opportunities. Through a participatory and

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bottom-up approach, SHGs promote financial inclusion, capacity building, and entrepreneurship among rural women, leading to sustainable economic growth and improved living standards. The study was conducted in purposively selected two blocks of the Bankura district of West Bengal. Out of those blocks, 28 self-help groups (SHGs) were randomly selected, and a total of 280 respondents were chosen using simple random sampling. An Ex-Post facto research design was employed for the present study and primary data were collected by individual interview schedule and focus group discussion technique for assess the impact of fishery-based SHGs on the socio-economic conditions of rural women, focusing on various indicators such as income generation, financial inclusion, women's empowerment, and social well-being. The research also identifies certain challenges faced by fishery-based SHGs, such as limited market linkages, gender-based constraints, and inadequate infrastructure. As a result, they have improved the quality of their catch, gained access to higher-value markets, and experienced increased income, leading to overall socio-economic improvement.

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ABS-51

Innovative approaches for resilient and sustainable shrimp farming in the face of climate change

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Shrimp farming is facing challenges from climate changes, including rising water temperatures, ocean acidification, and changing precipitation patterns. These impacts affect shrimp growth, reproduction, and overall health, leading to decreased yields and economic losses. To address these challenges, shrimp farmers are implementing innovative practices. Efficient water management techniques like recirculating aquaculture systems and integrated multi-trophic aquaculture improve water quality, reduce environmental impact, and minimize disease outbreaks. Species diversification helps reduce vulnerability by integrating alternative species resilient to changing conditions. Advanced genetic selection methods are being used to develop climate-resilient shrimp strains that can withstand higher temperatures and resist diseases through selective breeding, genomic selection, and genetic engineering. Technological advancements such as precision aquaculture, remote sensing, and artificial intelligence aid in monitoring, predicting, and managing climate-related risks. By promoting sustainability and mitigation strategies, these approaches contribute to the industry's sustainable development, safeguarding both economic viability and ecological integrity.

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ABS-52

Behavioural response of fresh water crab *Barytelphusa cunicularis* with respect to seasonal changes

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Crab culture is the fastest-growing sector in aquaculture both in fresh and brackish water. It has good market demand due to its high nutritive value and peculiar taste. Crab is very hardy species which can tolerate wide

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range of environmental changes. It can survive outside the water for long time. Freshwater crab particularly, *Barytelphusa cunicularis* is widely distributed in Maharashtra. These crabs migrate for feed, shelter, gonadal development and spawning. It was observed that the crabs show behavioural responses to the seasonal changes. During rainy season they found abundantly with egg mass and rear in winter or summer season though water is available in these seasons. The study showed that during rainy season they attained full maturity and spawning began. After that gonads entered a quiescent period at the same time they moved away from the spawning ground till the next spawning. But it was also found that if favourable seasonal changes occurred (untimed rain) they again get ready to spawn and return to spawning ground.

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ABS-53

Mapping the future of resilient fisheries: Geospatial technology as a key tool for assessing climate change impacts and guiding adaptive management

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Geospatial technology is emerging as a valuable tool in the development of climate change resilient fisheries models. These models integrate geospatial data, such as satellite imagery, bathymetry and oceanographic data with climate change projections to assess the impacts of climate change on fisheries to aid in the development of management strategies. By incorporating spatially explicit information, geospatial technology enables the identification of vulnerable areas, such as critical habitats and coastal zones susceptible to sea-level rise and ocean acidification. It facilitates the understanding of the complex interactions between climate variables, ecosystem dynamics and fish populations. Geospatial tools, such as geographic information systems (GIS) and remote sensing (RS) help in mapping and visualizing these relationships enabling decision-makers to develop targeted and adaptive management approaches. By leveraging geospatial technology, fisheries managers can enhance their understanding of climate change impacts and develop robust strategies to ensure the resilience and sustainability of fisheries in the face of changing environmental conditions.

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ABS-54

A sudden rise in population of ragged sea hare, *Bursatella leachii* in Mirya creek, Ratnagiri with respect to climate change scenario

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Bursatella leachii, commonly known as ragged sea hare belongs to the Opisthobranch mollusks within the order Anaspidae. The diagnostic characters are grayish-green to white-tan in colouration with dark brown blotches and spots on the body with distinct head and neck regions. Their occurrence is highly sporadic, encountered periodically at high densities. A sudden rise in population of ragged sea hare, *Bursatella leachii*

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in Mirya creek, Ratnagiri, Maharashtra was observed during December 2022 to February 2023. Such massive population outbreaks are probably attributable to favorable environmental condition. Population explosions most likely occur when there is a good larval supply, abundant dietary resources and environmental conditions like tides, currents and weather are favorable. Abundance of this species is among the most commonly reported responses to climate change. In a warming ocean, warm-water species are expected to increase and cold-water species to decline. The role of climate change nowadays is a major factor in marine biodiversity shift and should have been given considerable attention in marine biodiversity management, conservation and policy making.

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ABS-55

Seed production of *Etroplus suratensis* through environmental manipulation: A review

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The cichlid *Etroplus suratensis*, also known as pearl spot is one of the important candidate species for aquaculture. This fish can tolerate a wide range of salinity. Due to lack of induced breeding techniques for its inherent low fecundity, complex breeding behaviour and parental care, commercial aquaculture of pearl spot is hampered. Therefore, induced maturation and breeding of pearl spot in captive condition becomes the urgent need for the seed production of pearl spot. The breeding frequency and reproductive performance of pearl spot fish in captive system can be increased by manipulating parental care and salinity. During the breeding season, the possibility of spawning is considered more effective as interventions in the environment than the method of hormonal manipulations for induced breeding. For artificial breeding, artificial substratum such as earthen ponds, cement tanks or specialized raceways can be provided. The fish breeding through environmental manipulation methods are thus reviewed for continuous seed production under controlled conditions.

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ABS-56

A review on ecological importance of Mangroves

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Mangroves, one of the world's most fertile ecosystems, are currently under threat. They offer a wide range of products and services, some of which have direct value, but often have some obvious but indirect benefits as well. They are found between low and high tide level and are among the most threatened ecosystems in the world. They provide economic and environmental benefits to coastal communities. It protects coastal areas from storm surges, hurricanes, typhoons and tsunamis, protecting both people and property. The degradation

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of mangrove ecosystems in India is mainly caused by human interference such as the conversion of mangrove wetlands to aquaculture and the deforestation of mangrove forests. Mangroves are rapidly disappearing due to over exploitation, over-agriculture, aquaculture, tourism, and urban growth. The current review is mainly concerned with determining the condition and trends of the mangrove ecosystem in India, including the factors that led to its loss, its restoration and traditional conservation.

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ABS-57

Sustaining a climate-resilient aquaculture: Constraints in sustainability and adaptations

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Aquaculture sustainability is at risk due to the deleterious impacts of climate change which is a global imperilment. Climate change poses a serious threat to food security, biodiversity, ecosystems, and fish production by replacing fish stocks from their natural niche. Numerous abiotic stressors aggravate the drastic impacts leading to increase in temperature, rise in sea level, diseases and toxic algal blooms, changes in rainfall patterns and variations in sea surface salinity. Several adaptation measures are being carried out emphasizing on rising demands of low-cost protein. Government initiated climate change policies, selective breeding programme, diversification of species and aquaculture practices such as integrated multi-trophic aquaculture, recirculating aquaculture system are few of the widely adopted strategies. Further studies on intervention in quality enhancement of seed and feed, utilization of bioresource as well as genetic improvement vis-à-vis keeping up with adaptability could be the way forward in sustaining the aquaculture production.

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ABS-58

Eco-friendly and sustainable substrate based culture of pearl spot, *Etroplus suratensis* (Bloch, 1790) in enclosures

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Periphyton and biofilm plays a major role in aquatic food chain through the autotrophic and heterotrophic food availability that forms an important part of diet of various animals such as zooplankton, fishes and prawns. Substrate based biofilm or periphyton has a positive effect on the overall pond ecology. It supports low input cost aqua farming with the higher production. To evaluate effect of substrate-based integration, 120 days growth experiment was conducted using pearl spot, *Etroplus surantensis* fry (2-3 cm) in 1m X 1 m X 1 m enclosures. Etroplus were stocked @ 60 fry/m^3 with three treatments as without substrate, with natural substrate (bamboo poles) and artificial substrate (shade net) having three replicates covering 100% surface

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area of experimental unit. The natural submerged substrate significantly improved 25% and artificial substrate 15% of final body weight. Natural Substrate integration resulted in significantly lower feed conversion ratio compared to other treatments.

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ABS-59

Tilapia culture: Solution to climate change

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Food production systems on our planet are of more concern due to climate changes. Fish being a poikilothermic aquatic vertebrate is vulnerable to these climate changes. Fish culture system is also vulnerable to a combination of climatic factors, such as global warming, rainfall variation, flood, drought, temperature fluctuation, salinity changes etc. Considering the vulnerability of impacts of climate changes to the fish production, tilapia fish is one of the possible and profitable fish culture in pond, cages and recirculating system that can adapt climate changes. Compared to other fishes, tilapia can adapt to wide range of salinity fluctuation due to rainfall variation, flooding and low water level in drought conditions. Tilapia farming is possible in freshwater, brackish water, and saltwater conditions. Tilapia is ominous fish which can eat any kind of natural as well as artificial feed. This fish species is highly disease-resistant and can grow in high stocking densities and these all are critical factors to play important role in adapting it into present climate change scenarios. Recent study evaluated that the environmental sustainability of tilapia culture is appropriate for adaptation to environmental change.

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ABS-60

Isolation of *Weissella confusa*, a lactic acid bacterium from the gut of estuarine fishes of Pulicat Lake, Tamil Nadu

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Gut microbiota refers to the totality of microbial communities that resides in the gastrointestinal tract. Understanding the fish gut microbiome can be beneficial in developing strategies to enhance disease resistance in aquaculture. *Weissella confusa* is an asporogenous, gram-positive bacteria belonging to the Lactobacillaceae family. In several reports, *W. confusa* is considered a part of the microflora of healthy fish. Some strains of *W. confusa* are potential probiotics. The gut samples of different brackish water fishes captured from Pulicat Lake were analyzed to evaluate the presence of probiotics. *W. confusa* was isolated from deep-bodied sardine (*Sardinella albella)* and Mullet *(Mugil* sp.*)* in Man Rogosa and Sharpe (MRS) agar. Biochemical tests and

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16s rRNA gene sequencing confirmed the isolates as *W. confusa.* Both the isolates exhibited antibacterial activity against *Vibrio* sp. Thus, these *W. confusa* isolates can be used as potential probiotics to control *Vibrio* sp. infection.

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ABS-61

Isolation and characterization of a probiotic *Bacillus megaterium* isolate from a fish biofloc system

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Biofloc fish culture systems consist of microbial aggregates that are the source of various beneficial bacteria which improves fish health status and disease resistance. This research was conducted to isolate and characterize probiotic microbes from a tilapia biofloc culture system. Bacillus differentiation agar was used for bacterial isolation and 14 different isolates of *Bacillus* sp. were morphologically and biochemically identified. Further confirmation by 16S rRNA sequencing confirmed that the bacterial strain BFT1 isolated from the microbial floc was *B. megaterium*. *In vitro* antibacterial property of the strain BFT1 against *Aeromonas* sp. was evaluated by disc diffusion method. The result showed that the strain exhibited effective antibacterial activity against *Aeromonas* sp. Hence, this strain can be used as a potential probiotic to control *Aeromonas* sp. infection in fish culture systems.

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ABS-62

Pathogenicity of a virulent *Shewanella putrefaciens* isolate infecting Nile tilapia *Oreochromis niloticus*

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Shewanellosis is an emerging disease of tilapia, which is caused by *Shewanella* sp. and considered to be an emerging threat to the aquaculture industry. *Shewanella putrefaciens* was isolated from the diseased *Tilapia* sp. and characterized by biochemical tests, confirmed by 16S rRNA PCR and nucleotide sequence analysis (Accession No MW341434). Intraperitoneal injection of *S. putrefaciens* (4SK/SRLFDA/19) in Nile tilapia, *O. niloticus* resulted in LD50 at 1.41×10^4 CFU/mL. Histopathological changes caused by *S. putrefaciens* in Nile tilapia was studied in brain, eye, gill, liver, kidney, intestine and muscle. Brain of infected fish showed spongiosis, gills exhibited congestion and dilation in blood vessel additionally with mild mononuclear infiltration. Congestion was observed on liver of infected *O. niloticus*. Congestion and degeneration of tubular epithelial cells were observed from kidney. Intestine of infected *O. niloticus* showed fusion of villi, mild goblet cell hyperplasia and mild mononuclear infiltration in mucosal layer whereas healthy control fish depicted no pathological changes. The results concluded that the *S. putrefaciens* isolate (4SK/SRLFDA/19)

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from *Tilapia* sp. is a virulent pathogen causing disease and mortality in *O. niloticus*.

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ABS-63

Isolation and identification of *Shewenella* sp. from a diseased Koi carp, *Cyprinus carpio*

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The present study reports the isolation and identification of *Shewanella* sp. in Koi carp (*Cyprinus carpio. koi*). During our disease surveillance activity in Kolathur, an ornamental hub of Tamil Nadu, a diseased koi carp with the clinical symptoms of lethargy, loss of scales, fin erosion, morbidity, and haemorrhage in the internal organs viz., kidney, liver, and spleen was collected and subjected to bacteriological diagnosis. *Shewanella* sp. *SN/SP/SRLAAH/2023* was isolated from the kidney on Nutrient agar as yellow mucoid colonies. The isolate was characterized by biochemical tests and further confirmation was done by PCR with the published *Shewanella*-specific primers and protocols. More recently, shewenellosis is considered an emerging pathogen in fishes. The isolation of *Shewanella* sp. from ornamental fish in kidney from kolathur, suggests that the infected fish may serve as a reservoir for this bacterium which is also indicated to cause disease in humans due to its zoonotic nature and highlights the potential presence of this bacterium in the fish population.

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ABS-64

Assessment of pesticide toxicity in fishes: A brief review

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Pesticides are chemicals such as insecticides, herbicides, fungicides, and rodenticides used to control pests, weeds, fungi and rodents. In general, pesticides are utilised extensively in forestry, agriculture, public health, and veterinary practices. Large quantities of pesticides enter the aquatic environment, primarily through agricultural runoff, industrial effluent, aerial spraying and transport from soil treated with pesticide, urban sewage and municipal effluent. Several studies have been investigated that pesticides are potentially harmful not only to target organism instead they are affecting various aquatic organisms in the food chain, including fish. In severe situations, acute amounts of different pesticides killed fish, whereas sublethal effects were seen when these pesticides were employed in smaller amounts. This review highlights some of the most important toxicological effects of pesticides on fish, including bioaccumulation, growth performance, behavioural changes, enzymatic alteration, immune system, genotoxicity, histopathological damages, and haematological alteration. We also suggest several potential mitigation strategies for these effects.

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ABS-65

Climate-smart fisheries and aquaculture in India

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The nation's agriculture and allied businesses are vulnerable to climate change and variability and disproportionately affect poor and marginalized groups. Climate factors include gradual variations in water temperature, acidity of water bodies, changes in ocean currents and sea level rise. It alters aquatic ecosystems, which also has an effect on the productivity of fisheries and the availability of food. Aquaculture must: protect the populations that depend on resilient aquatic systems so that the industry may continue to contribute to sustainable development; increase fish and aquatic food output while utilizing fewer natural resources; learning how to make them less vulnerable who are most likely to experience negative consequences from climate change. To quickly and effectively address climate change in the fisheries and aquaculture sector is a basic strategic and operational concern. Practical measures must be put in place to guarantee that the most vulnerable nations, production systems, communities and people can create and use reliable climate-smart techniques.

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ABS-66

Effects of *Gracilaria* sp. seaweed supplementation on haematological parameters in GIFT (*Oreochromis niloticus*) infected with *Aeromonas hydrophilla*

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An experimental trial was conducted to study the effect of *Gracilaria* sp. seaweed supplementation on haematological parameters in GIFT. Fishes were fed with diets containing 0, 5, 10 and 15% of red alga *Gracilaria* sp. seaweed meal for 60 days. Haematological parameters of the fish were analysed at the end of growth performance period. The results showed that the highest weight gain was observed in fish fed with dietary seaweed meal of 10% after 60 days of feeding trial. Haemoglobin, haematocrit, red blood cells, total protein were also highest in fish fed with 10% diet. Exposure of the fish to the bacterial species, *Aeromonas hydrophila*, revealed that fish fed with the *Gracilaria* sp. seaweed meal displayed increased levels of blood and serum biochemical parameters than the control group. Hence the result shows that supplementing the diet of GIFT with *Gracilaria* seaweed meal up to 10% can have considerable resistance to *Aeromonas hydrophilla*.

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ABS-67

Report of natural co-infection with tilapia lake virus and *Aeromonas veronii* associated with mortality of Mozambique tilapia *Oreochromis mossambicus* (Linnaeus 1758) in India

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Tilapia lake virus (TiLV) has emerged as an important viral pathogen affecting wild and farmed Tilapia worldwide. The present study reports outbreaks of Tilapia Lake virus in wild populations of tilapia in the waterbodies of Salem and Virudhunagar districts of Tamil Nadu, South India. The infected fish showed lethargy, abnormal swimming behaviour, exophthalmia and red erosions on the skin causing upto 80% mortalities. TiLV infection was confirmed by PCR amplification and nucleotide sequencing targeting segment 3 of the virus. The co-infecting bacteria with TiLV, *Aeromonas veronii* has been isolated from infected Tilapia samples which were confirmed by biochemical characterization, PCR amplification and sequencing. Histopathological analysis of the infected liver tissues showed multiple lesions, necrosis and syncytial cell formation. This study shows that TiLV is present in the wild population of Tilapia in Tamil Nadu.

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ABS-68

Jaggery based biofloc powder incorpotion enhance the disease resistance of *Penaeus vannamei* reared in recirculatory aquaculture system

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Fishmeal has historically been used in aquaculture to create nutrient-balanced meals. Fishmeal prices have been rising steadily and there is a shortage. The ingredients used in shrimp feed must induce the growth and enhance the resistance against various diseases which has prompted research into the most nutritious, immuno stimulating feed ingredients for sustainable aquaculture. To find the alternative feed ingredients this study was performed 60 days in recirculatory aquaculture system with different jaggery based biofloc powder incorporated feed viz., 0% (B0), 5% (B5), 10% (B10), 15% (B15), 20% (B20) in *Penaeus vannamei* diet. Among the treatment groups, 15% (B15) biofloc powder diet showed the highest weight gain 19.48±0.09 (g) and showed higher disease resistance against *V. parahaemolyticus* with high survival rate and it significantly differs from other treatments and control. This study confirmed that the jaggery based biofloc powder at 15% in shrimp feed could enhance the growth performance, and disease resistance in recirculating aquaculture based system.

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ABS-69

Balantidium coli infection in pigs of Meghalaya: A zoonotic protozoan parasite

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Balantidium coli ciliated protozoan parasite family Balantidiidae, order Vestibuliferida, class Litostomatea, phylum Ciliophora and kingdom Protista. Main reservoir host is pig, other animals or humans acquire infection mainly by the ingestion of food or water contaminated with pig feces. 1254 numbers of fecal samples of pigs collected from Umling and Umsing blocks, RiBhoi, Meghalaya, January to December 2022 and examined by wet mount and Mc Master technique. *B. coli* infection recorded in 39.55% pigs. Age wise infection was 6-12 months (19.70%), <6 months (13.16%) and >12 months (6.69%). The cyst per gram (CPG) of feces ranges from 50-4150. Molecular confirmation done by PCR. Amplification of 18S rRNA revealed 1543 bp band size. Oxytetracycline and metronidazole @ 10 mg/kg body weight and 20 mg/kg body weight respectively are found to be effective in infected animals. Thus, preventive measures should be taken to reduce exposure of pig handlers and veterinarians with infected pigs.

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ABS-70

Effects of Chlorpyrifos Insecticides on physiological parameters of striped catfish, *Pangasianodon hypophthalmus* (Sauvage, 1878) Fingerlings

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This study aimed to evaluate the lethal toxicity of chlorpyrifos and its effect on food consumption, oxygen consumption, ammonia excretion, and O: N ratio of *P. hypophthalmus*. The acute bioassay test was performed by adopting the static renewal method. Results showed that the median lethal concentration (LC_{50}) of Chlorpyrifos for 96 hrs was 0.1060 mg L^{-1}. One-fifth T1 (0.0212 mg L^{-1}) and one-tenth T2 (0.0106 mg L^{-1}) of LC50 values were selected for sub-lethal studies for 45 days revealed that the food consumption rate, oxygen consumption rate and O: N ratio decreased significantly ($p<0.05$) while ammonia excretion rate increased significantly ($p<0.05$) at both the concentrations as compared to control. The results obtained in this study proposed that measurements of food consumption rate, oxygen consumption rate, ammonia excretion and O:N ratio can be useful indicators of stress.

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ABS-71

Anti microbial and anti oxidant properties of pomegranate peel extract

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Today's consumers prefer food preservation methods that are natural, as a result of the potential health risks associated with strong chemical additions. So, natural products, especially natural antioxidants, and antimicrobial agents such as Pomegranate (*Punica granatum* L.) has gained popularity in recent years due to its multifunctionality and nutritional benefit in the human diet. Pomegranate peel and peel extract (PPE) have higher biological activity including antioxidant, antimicrobial, free radical scavenging, antiatherogenic and antimutagenic properties. The present study was aiming at evaluating the antioxidant efficiency and antimicrobial property of PPE. The total phenolic content of Pomegranate peel extract (the ratio of peel: solvent, 1:10 w/v) found in PPE sample was 174.029 mg gallic acid equivalent/g (OD value 0.69) indicating sound antimicrobial and antioxidant activity. DPPH radical scavenging assay was carried out to evaluate the antioxidant properties of Pomegranate peel extracts at different concentrations (i.e., 1%, 1.5% and 2% v/v). 2% level revealed best antioxidant activity among the three extracts and its radical scavenging activity was closer to the commercial antioxidant used (BHT). A broad-spectrum antimicrobial activity of PPE was observed against two gram-positive bacteria – *Staphylococcus aureus* (MTCC-7443), *Bacillus subtilis* (MTCC-2389) and two-gram negative bacteria – *Escherichia coli* (MTCC-443), *Klebsiella pneumoniae* (MTCC-3384). Maximum inhibition was observed against *B. subtilis* followed by *S. aureus*, *E. coli*, and *K. pneumoniae.* Gram-positive bacteria were more susceptible to PPE than gram-negative bacteria. Thus, PPE can be a good option as a bio-preservative for increasing the shelf-life of fish fillets due to its promising antimicrobial and antioxidant properties.

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ABS-72

A comparative evaluation of storage stability and quality changes of fish muscle (*Pangasianodon hypothalamus*) as preserved in a fabricated portable solar cooler and domestic refrigerator

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This study was conducted to evaluate the quality changes and storage stability of fish muscle (*Pangasianodon hypothalamus*) preserved in a fabricated portable solar cooler and domestic refrigerator. Fish muscle from *Pangasianodon hypothalamus* were studied and kept it in a fabricated portable solar cooler and in a domestic refrigerator at 5±1°C to compare the shelf-life and quality of fish muscles. The fish muscles were packed separately in LDPE (low density polyethylene) packets and stored in a solar cooler and domestic refrigerator up to 7 days. It is to compare the different physico-chemical, microbiological and sensory parameters on 0th, 3rd and 7th day. The results revealed that there were no significant changes (P>0.05) of different parameters

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during the storage periods in compare to solar cooler and domestic refrigerator. Finally, from the present study it can be concluded that the preservation of fish in a portable solar cooler system is thus economically suitable, feasible and acceptable up to 7 days in domestic refrigeration method at controlled temperature of 5±1°C. The system should be elaborately studied in future to find out a suitable alternative means of cold preservation using green energy particularly off grid areas of villages in particular.

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ABS-73

A study on performance of Garole sheep in some part of its rearing tract

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The present study compared the productive performance *viz.* body weight, body measurement, reproductive traits, carcass characteristics, meat quality and acceptability of Garole sheep of Sundarbans delta region of West Bengal, India reared under semi-intensive system and traditional system (free range system). Each group comprised of 10 sheep (n=20), and at the age of 12 months 6 sheep from each rearing system were evaluated for the pre- and post-slaughter characteristics (total n=12). Carcass characteristics like pre-slaughter weight, dressing % and carcass weight varied significantly ($p<0.05$) between sheep reared under different management systems. The major primal cuts showed significant ($p<0.05$) differences among different groups of Garole sheep. Meat quality parameters like WHC showed significant ($p<0.05$) higher value in semi-intensive system than that of traditional rearing system, whereas pH, muscle fibre diameter and cooking yield showed non-significant ($p>0.05$) differences between the groups. The proximate analysis showed that meat protein and carbohydrate content were significantly ($p<0.05$) higher, whereas the moisture content was significantly ($p<0.05$) lower for mutton obtained from semi-intensive system. But, there were no significant ($p>0.05$) differences in the fat and ash contents of meat of both the groups. It was revealed from the sensory evaluation that colour, appearance, juiciness and flavour scores were significantly ($p<0.05$) higher for meat from semi-intensive system than that of traditional rearing system. However, this study concluded that Garole sheep meat, especially reared under semi-intensive system, served the best quality meat in terms of nutritional as usual as in organoleptic characteristics.

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ABS-74

Conservation and development: A study of east Kolkata wetlands of West Bengal

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East Kolkata Wetlands is one of the rare examples of a natural and man-made ecosystem engaged in resource recovery practices, which are both efficient and environmentally sustainable. Several factors coincided

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together to create a rare opportunity of treating wastewater from the city via sewage-fed fishery practices. This correspondence has culminated into a typical livelihood pattern in terms of a set of interdependent vocations in the area that has made the ecosystem of Kolkata and East Kolkata Wetlands (EKW) complementary to each other. But in the last few decades, illegal land acquisition, wetlands conversion, aquatic species depletion, and siltation have been experienced in different parts challenging the survival of the EKW and adversely affecting the livelihood of the populace which depends on it. In such a scenario, the focus of the study was to investigate the changes in land use/ land cover from 1991 to 2021 in the East Kolkata Wetlands to understand the present underlying causes and consequences to develop conservation strategies for its sustenance. The methodology includes preparing a land-use map from 1991 to 2021 using Landsat images, and Key Informant Technique (KIT) was used in the non-sampled area to know the suggestions for the conservation and development of EKW to sustain the livelihood of these traditional sewage-fed fish farming community. The analysis showed that the area under the settlement build-up has increased from 22.59 sq. km in 1991 to 35.29 sq km in 2021 due to population growth with a consequent decrease of open spaces and water bodies from 12.11 sq. km in 1991 to 4.13 sq. km in 2021 due to urbanization and developmental activities. For conservation and development practices, 'Abundance supply of sewage-water to promote sewage-fed fish farming' ranked 1st (86.23) in the RBQ test among eight selected statements regarding conservation and development practices. The conclusion highlights that, by striking a harmonious balance, it is possible to harness the wetlands' ecological potential while improving the quality of life for local communities and safeguarding the future of this invaluable natural resource.

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Synopsis of the symposium

Indian Journal of Animal Health, published by the West Bengal Veterinary Association, organized a National Symposium on *Emerging Practices in Animal Husbandry and Fisheries vis-à-vis Climate Change* on 1st July 2023 at Vivek Bhavan, West Bengal University of Animal and Fishery Sciences, Kolkata on the occasion of National Doctors' Day.

Technical Session Chaired by Prof. C. S. Chakrabarti, Former Vice Chancellor, WBUAFS, Co-Chaired by Dr. P. S. Banerjee, In-charge, ICAR-IVRI (ERS), Kolkata and renowned speakers (right to left)

The programme was designed by organizing two technical sessions. The first session was a poster session. Scientists, faculty members and scholars from different sectors of veterinary sciences, fishery sciences and dairy technology displayed their research findings on the theme as posters. A total of 50 posters, out of the submitted 73 abstracts, were presented in session-I, of which 12 selected posters were also presented digitally. The poster session was chaired by Prof. Dr. Tamonas Chaudhuri, former Editor of the Journal of the Indian Medical Association and Co-Chaired by Prof. Dr. S. Batabyal, Dean, Faculty of Veterinary and Animal Sciences, West Bengal University of Animal and Fishery Sciences, Kolkata. Two different panels of judges assessed the posters presented by the participants in two separate categories (physical and digital), and those who secured 1st, 2nd and 3rd positions in both the categories were awarded conferring medals and certificates.

Keynote address presented by eminent physiologist Padmashree Dr. M. L. Madan

In technical session-II, the Keynote address was presented by an eminent physiologist, Padmashree Dr. M. L. Madan, through online mode. Three renowned speakers from different fields of sciences, namely Dr. U. K. Sarkar, Director, ICAR-National Bureau of Fish Genetic Resources, Lucknow; Dr. S. M. Deb, Head of Eastern Regional Station, ICAR-National Dairy Research Institute, Kalyani and Dr. G. C. Debnath, Former Deputy Director, Regional

A section of audience in the symposium

Meteorology Centre, GoI, Kolkata, delivered their speech on different relevant topics related to the theme of the symposium. The session was chaired by Prof. C. S. Chakrabarti, former Vice Chancellor of West Bengal University of Animal and Fishery Sciences, Kolkata and Co-Chaired by Dr. P. S. Banerjee, In-charge of Eastern Regional Station, ICAR-Indian Veterinary Research Institute, Kolkata.

The impact of global warming coupled with climate change affecting the production processes in animal husbandry leads to a crisis in food security was elaborated in both the sessions. Speakers threw light on the possible ways to mitigate the issues and preventive measures to alleviate the causes of climate change. The symposium categorically pointed out and resolved the role of technocrats, planners, research institutions, industrialists and farmers.

The welcome address was given by the Chief Editor of the journal, Prof. Barun Roy, Prof. Subhasish Biswas, a Senior Editorial Board member of the journal, delivered a speech on the theme of the symposium. After that, Dr. Partha Sarkar, General Secretary of WBVA, addressed the audience on the perspective of the symposium. A creative presentation was also performed on the theme of the symposium by Dr. Sourav Chandra and Mrs. Anyanya Chandra, which was highly appreciated by the audience. A total of 210 participants took part in the symposium.

Young researcher was encouraged conferring medal and certificate

A fruitful interaction happened between the speakers and the audience in the plenary session. At the end of the sessions, the recommendations and summing-up report were presented by the journal Editor Prof. Pradip Kumar Das. Prof. Siddhartha Narayan Joardar, Associate Editor of the journal and Prof. Lopamudra Haldar, Editorial Board member, conducted the entire symposium nicely. Dr. Aloke Mukherjee, Chairman of the Publication Board of the journal, delivered the Vote of Thanks, and the programme ended with the National Anthem.

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National Symposium - 2023
on
Emerging Practices in Animal Husbandry and Fisheries vis-à-vis Climate Change

Recommendations

Global warming leading to climate change is one of the greatest threats of the present time so much so that the earth's existence is at stake. Livestock and fisheries have been identified as the one of the major responsible avocations, apart from deforestation, and considered to be the contributory factor for such an alarming climate change situation. Therefore, refinement of the involving technology in these aspects should be reviewed in light of their capability for mitigation and sustainability. Presently, we are concerned about anthropogenic climate changes. The most important aspect of man-made climate change is the combined effect of industrialization, deforestation, urbanization, intensive agricultural activities, fossil fuel burning, gases, mining excavation, forest fire and excessive groundwater use. The present symposium has categorically emphasized these issues. The deliberation by the esteemed speakers, Chairs and Co-Chairs of the sessions and the relevant posters and abstracts presented by the scientists/researchers have well-defined the various aspects, which could be summarized in the form of recommendations are presented below-

A. Recommendations for livestock production and health under changing climate conditions

1. Impact assessment and strategy

- There is an urgent need to assess the impacts of climate change, even at a micro level, on livestock production systems to deal with climate variability and identify appropriate options to help livestock keepers.
- A long-term horizontal study could be a strategy for establishing a cause-and-effect relationship and mitigating the adverse effects of climate change.

2. Protection of poor's asset

- Under climate threat, the livestock assets of low-income people are to be protected through public sector support. Technological, policy and institutional innovations will inevitably be required for it. Full food bio-security should be implemented and monitored.

3. Livestock management, health coverage and development of potential genetic resources

- Greenhouse gases emission from livestock can be reduced by decreasing the number of livestock required per unit product and by increasing the energy density of the diet.
- To ensure healthy, disease-free animals, multiple vaccine doses are needed so that all animals with farmers are covered under a state programme.

- Fertility programmes and measures for optimum reproduction may be adopted, and based on genomic selection, breeds/animals having the better capacity to withstand adverse climates should be selected in the National breeding programme.

B. Recommendations for the conservation of aquatic genetic resources

1. Sustainable utilization of biodiversity for livelihood development and conservation

- Trade-offs between biodiversity and livelihoods/human well-being need to be settled in a progressive manner.
- Community aquaculture centres for potential fish species prioritization of region-wise species diversity.
- All kinds of Natural water bodies should be preserved and be made free from pollutants including plastic items.

2. Genetic approach

- Stock-specific replenishment of endangered fish species - Genetic stock structure analysis before river ranching. Potential climate resilient management strategies must be adopted to cope with the adverse impact of climatic variability and associated stressors and to conserve fish genetic resources.
- The fish species identified as climate-resilient fishes from the Ganga basin using reproductive vulnerability framework and modelling can be included in aquaculture for increased profitability.
- More research emphasizes live gene bank resources, captive breeding, resilient conservation tools, carbon sequestration and greenhouse gas emissions in aquatic systems.

3. Upholding Commitment

COP15 - 30 by 30 deal (December 19, 2022)- 200 countries agreed at the United Nations biodiversity summit to protect 30 per cent of land and marine areas by 2030, up from the currently protected 17 per cent of terrestrial and 10 per cent of the marine regions.

C. Recommendations for emerging practices in animal husbandry to adapt climate change

1. No single strategy can ensure livestock adaptation to climate change. Emphasis is to be given to for reducing greenhouse gas production from livestock through management of the ruminal function, waste management and enhancing feed conversion efficiency. Simultaneously, enhancing resilience in livestock against heat stress and disease resistance is to be achieved.
2. Ameliorative measures to help livestock to survive and perform under climate changes are:

- Environmental modification and thermal comfort through well-built shades, adequate ventilation and an eco-friendly cooling system
- Nutritional interventions and management by reducing fibrous diets, increasing concentrate, feeding by-pass fat, supplementing buffers and anti-oxidants, and *ad libitum* water
- Farmers are to be educated about the management of domestic and farm animals and birds in their houses to check species-specific and zoonotic diseases.

- Animal health management by enhancing existing and emerging pathogen surveillance, quick response and adoption of *One Health* strategy to formulate a mitigation strategy to reduce the occurrence of pandemic zoonoses

3. Enhancing resilience in livestock through genetic selection for thermotolerance and disease resistance in livestock employing conventional and genomic selection, gene-editing, transgenesis, etc.

D. Recommendations for a green environment to mitigate the issues of climate change

1. Transforming food production systems and consumption habits are undeniable solutions that must be part of the global roadmap to minimize greenhouse gas emissions.
   - Protecting and conserving green spaces like local parks, ponds or community gardens is of utmost need as they absorb carbon dioxide and are associated with lower levels of air pollution, can reduce flood risk by absorbing surface rainwater and can provide important habitats for a wide variety of insects, animals, birds and amphibians besides regulation of temperature.
   - Only green plants on the earth and water bodies can utilize carbon dioxide for food production. So, plants must be conserved at any cost. Usually, plants are present around the farmers' settlements. Rules should be framed for compulsory plantation and upbringing of plants in urban housing areas, hospitals, educational institutions and even congested places. The plantation is to be done by the sides of all urban and rural roadsides.
2. Switching over to renewable energy sources, such as wind or solar from oil, gas or coal-powered energy, besides using electric vehicles can reduce carbon footprint by a considerable amount.
3. All the countries — especially the wealthy countries that generate the most emissions — must create more ambitious climate action plans and must follow the plan maintaining a time frame to eliminate emissions.

National Symposium on *Emerging Practices in Animal Husbandry and Fisheries vis-à-vis Climate Change* on 1st July 2023 at Vivek Bhavan, West Bengal University of Animal and Fishery Sciences, Kolkata

Glimpse of the Symposium

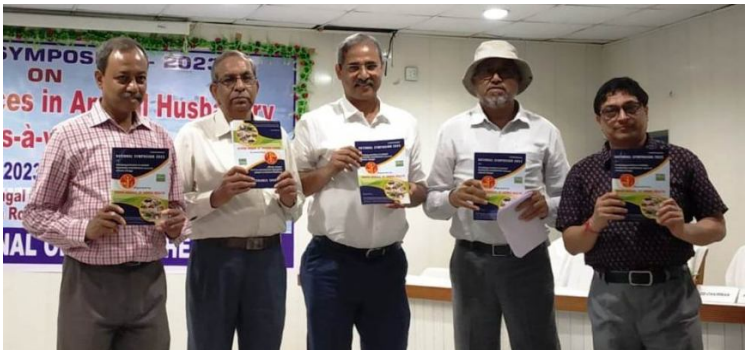
Dr. U. K. Sarkar, Director, ICAR-NBFGR, Lucknow delivering the speech

Dr. S. M. Deb, Head, ICAR-NDRI (ESR), Kalyani delivering the speech

Dr. Partha Sarkar, General Secretary of WBVA, addressed the audience on the perspective of the symposium

Dr. G. C. Debnath, Former Deputy Director, Regional Meteorology Centre, GoI delivering the speech

Poster Session chaired by Prof. (Dr.)Tamonas Chaudhuri, former Editor of the Journal of the Indian Medical Association



Compendium of the symposium was inaugurated by Prof. (Dr.) Tamonas Chaudhuri, Former Editor, JIMA (centre) in presence of Prof. P. K. Das, Editor, IJAH, Dr. A. Mukhopadhyay, President, Publication Board, IJAH, Prof. B. Roy, Chief Editor, IJAH, and Prof. S. Batabyal, Dean, Veterinary & Animal Science, WBUAFS (from left to right)

June 2023 Issue (*Vol: 62, No: 1*) of the IJAH was inaugurated by Prof. C. S. Chakrabarti, Former Vice Chancellor (centre) in presence of Prof. P. K. Das, Editor, IJAH, Prof. B. Roy, Chief Editor, IJAH, Dr. G. C. Debnath, Eminent Speaker, Dr. S. M. Deb, Eminent Speaker, Dr. U. K. Sarkar, Eminent Speaker, and Dr. P. S. Banerjee, In-Charge, ICAR-IVRI (ERS) (from left to right)

Evaluation of presented posters

Climate change and Green House Gases

About 14.5 percent of all human-caused greenhouse gas emissions come from livestock-related activities. This amount is equivalent to 7.1 gigatons of CO_2 per year. Control of methane generation on the earth is significantly important for four main reasons, namely: methane traps 84 times more heat than CO_2, accounts for 1/3 of climate forcing, responsible for half of the observed rise in ozone level and is a short-lived climate pollutant with an atmospheric life span of 12 years. About 40 per cent of the anthropogenic source of methane is a natural source and 60 per cent of human activity is mainly enteric fermentation, manure, rice fossil fuel, land filling, biomass burning, wastewater etc. If global emission intensities are categorized species wise, the highest emission has resulted from cattle (2495 million tons of CO_2 equivalent), followed by dairy cattle, pigs, buffalo, chicken, and small ruminants (494 million tons of CO_2 equivalent). These emissions are related to agroecological conditions, farming practices, and supply chain management. However, it must be borne in mind that 70 percent of the methane emission is from agriculture, and the rest is from the livestock sector. The existence of El-Nino and the genesis of different winds and depressions in deep seas should also need elaborate study which is currently considered as one of the major contributing factor in climate change.

Best places to live to avoid climate change in 2023

Climate change has disproportionate impacts on different countries. A recent paper published by the Anglia Ruskin University (UK) has identified five countries to be less touched by the effects of climate change. They are: New Zealand, Iceland, the United Kingdom, Australia, and Ireland. The results are based on the analysis of the countries' carrying capacity, isolation, and self-sufficiency. In terms of carrying capacity, all these countries with the exception of the UK, have a small population, a high fraction of agricultural land, and direct access to seas. This indicates that they are rich in terms of food resources.When it comes to isolation, these five nations are mostly detached from heavily populated landmasses. Lastly, in terms of self-sufficiency, these countries mostly have abundant renewable energy and non-renewable energy sources, showing their high potential of being energy-wise independent.

Marine protected areas

More than 2 lakh species are present in an ocean. Marine ecosystem is under threat as 89% of fishes are now 'fully fished' or 'overfished'; 30% of sea grass and 50% coral reefs have been destroyed. Marine protected areas are conservation zones, constructed by European Commission which protects the ocean from harmful human impact. It can help to protect the marine species where the species can reproduce and adapt climate change. The place can also be used for eco-tourism.

On behalf of West Bengal Veterinary Association
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