COMMONWEALTH SCHOLARSHIPS

CSC Evaluation and Monitoring Programme

Preserving Marine Life and Livelihoods in Bangladesh through Innovative Research and Conservation

Prof Mohd Golam Quader Khan

Bangladesh is one of the world's leading fish producers, and aquaculture accounts for just over 50% of the country's total fish production.

According to the Bangladesh Ministry of Fisheries and Livestock yearbook of 2018-2019, more than 12% of Bangladeshis depend on fisheries for their livelihoods. Hilsa, a fish species designated as the national fish of Bangladesh, accounts for at least 12% of the volume of fish produced annually and contributes to 1% of the country's GDP. However, production of this popular fish has declined over time due to several factors including over-fishing, climate variability, and industrial pollution. While efforts have been made by the government of Bangladesh to implement measures to curb over-fishing and conserve the endangered species of fish, there is still inadequate information available on fisheries evaluation and management. To address these concerns, innovative research is required to identify more effective and sustainable measures to improve stocks of hilsa fish, and other fish species in Bangladesh. This will boost food and nutrition security, create jobs, and improve livelihoods. Professor Mohd Golam Quader Khan, a Commonwealth Alumnus who studied for a PhD in Aquaculture Genetics at University of Stirling in the UK, has been involved in ground-breaking research to understand the biology and genetics of fish, including hilsa, which are some of the key elements in breeding and improving fish populations, and in informing fish conservation strategies.

Sample collection by Hilsa Genome Team in Goalanda river, Rajbari.

Prof Mohd Golam Quader Khan was awarded a Commonwealth Scholarship in 2007 to study for a PhD in Aquaculture Genetics at the University of Stirling in the UK. He also received a Commonwealth Academic Fellowship in 2015, returning to the University of Stirling to pursue further advanced research in this area. He is currently working as a professor and researcher in the Department of Fisheries Biology and Genetics at Bangladesh Agricultural University. Most of his work is focused on understanding the biology and genetics of fish which are key elements in breeding and improving fish populations, as well as informing fish conservation strategies. He has been involved in innovative research aimed at understanding the genetics of the fish species Tenualosa ilisha, also known as hilsa, which is designated as the national fish of Bangladesh and is a popular food fish for both local consumption and export. He has also worked with the IUCN (International Union for Conservation of Nature) and contributed to the assessment of 15 crustacean and fish species which have since been added to the IUCN Red List of Threatened Species, and therefore identified as species requiring urgent conservation measures to prevent their extinction.

Building a Research Career in Fisheries Science

Mohd Golam's passion and motivation for conservation of fish and other aquatic organisms defined his career path well before he was awarded a Commonwealth Scholarship. Two years after completing his first degree in Fisheries Science in 2002, he went on to study for a Masters degree at Bangladesh Agricultural University with a focus on understanding Fisheries, Biology and Genetics. Being awarded a Commonwealth Scholarship in 2007 to study for a PhD in Aquaculture Genetics gave him an opportunity to further enhance his expertise in this area and to gain international research experience. Upon completion of his PhD in 2011, Mohd Golam returned to Bangladesh, where he seized the earliest opportunity to apply his sharpened knowledge in Fisheries Science based on his PhD research findings.

> 'Upon returning home [following the PhD award] I delivered a lecture on the research I conducted while in the UK at the Bangladesh Fisheries Research Forum, which is the biggest platform of the fisheries scientists. At this forum I was awarded the first prize for my presentation. I had already received two awards, in 2013 and 2015, from the Bangladesh Agricultural University Teachers' Association for producing the best publications. I was also featured in the Commonwealth newsletter when I was awarded the first prize in the second PhD research conference at the University of Stirling in June 2010.'

Prof Khan receiving a prize for the best presentation at the Aquaculture PhD Conference in 2010.

Upon completing his PhD studies, Mohd Golam continued to work for the Department of Fisheries, Biology and Genetics at the Faculty of Fisheries in Bangladesh Agricultural University as a lecturer and researcher. In this role he teaches theory and practical classes to undergraduate and graduate students on Fisheries Science as well as working as a distinguished scientist and researcher in fish genetics and other aquatic organisms. He worked on projects such as, 'Establishing Tilapia Breeding Nucleus' funded by FAO (2013), on updating Red List of Crustaceans and Fish (2014) funded by IUCN, as well as on 'Genetic selection and Population structuring' in several fish species of carps and catfish funded by institutional and national organisations, such as the Bangladesh Agricultural Research Council, and Bangladesh Agricultural University Research System. His current projects include analysing the distribution range, variation, population structure and identifying different strains of Tenualosa ilisha, commonly known as hilsa, the important 'national fish' that supports the livelihoods of more than half a million people in Bangladesh.

As well as offering Mohd Golam the opportunity to study for a PhD, the Commonwealth Scholarship has opened avenues for career progression, which he spoke of proudly.

> 'My Commonwealth Scholarship has had a huge impact on my career progression. With the Commonwealth Scholarship and Fellowship experiences, I received a Fulbright visiting Fellowship for a short-term programme in America where I worked on gene transfer technology in catfish growth and disease resistance. I used my expertise as a Commonwealth Scholar there in assisting the MSc and PhD students to carry out their research work smoothly.'

While on this second Fellowship, he conducted research on breeding biology of channel catfish and investigated the performance parameters of the treated fish with gene knock-out (where targeted genes are inactivated) and knock-in (altering the genetic sequence and adding foreign genetic material in the form of a new gene) technology, among others.

Upon his return from the United States, he organised several seminars for Masters students on topics like 'scientific report writing', 'preparing for higher studies', and 'project cycle management,' which are important skills that he had honed throughout his study journey.

Developing Ground-Breaking Research on Hilsa Fish

During his time working for the Bangladesh Agricultural University, Mohd Golam has been involved in various research projects aimed at understanding the genetics of aquatic organisms (including fish) to inform management practices and ensure sustainability of stocks, while enhancing variability of species and improving the human livelihoods that depend on them. His most recent research focused on understanding the genetics of hilsa fish in Bangladesh, which make up approximately 12% of total fish production of the country and supports the livelihoods of more than half a million Bangladeshis. Bangladesh is home to around 65% of the world's hilsa and although production has increased over the years, the quality of the product has declined, with fish stocks slowly diminishing due to over-exploitation.

It is therefore essential to develop innovative approaches to improve fish quality and to ensure sustainable exploitation and management of this important national resource, while meeting the demand of local and international markets. As part of the Hilsa Genome Team of Researchers, Mohd Golam has been involved in important research that has informed strategies on managing hilsa stocks in Bangladesh and beyond.

Hilsa Genome Team of Bangladesh Agricultural University decode genome for the first time in Bangladesh.

With the aid of a grant received from Bangladesh Agriculture Research Extension System to support research on hilsa fish, the Hilsa Genome Team of Researchers, including Mohd Golam and three colleagues (two of whom are Commonwealth Alumni), decoded the genome sequence and discovered important factors (DNA markers) that could play a critical role in the characterisation of biological traits and stock assessment.

The team has completed a whole genome sequencing and a new assembly of hilsa genome. As part of this work, they have also created genetic tools that are now being applied to this species for stock improvement and enhanced production. These tools are crucial to design sanctuaries, assess population structure of hilsa in different geographical regions (including Bangladesh, India, Myanmar, Pakistan, and the Middle East), and to undertake pragmatic management policies by the Government to enhance production and sustainable exploitation.

While conducting his research activities, Mohd Golam often draws from the knowledge and skills that were developed during his Commonwealth Scholarship and Fellowship. He also receives ongoing support from his collaboration with two other Commonwealth Alumni, who are now part of his research team for the Hilsa project.

> 'My PhD major was aquaculture genetics. And my postdoc was also on genetics. I learnt the techniques of molecular mechanism, and how molecular tools can be used in the sequencing of DNA. I did molecular research to enhance the fish production based on different types of genotyping. This Hilsa project was relevant to my postdoc and PhD work. We're a team of four from Bangladesh Agricultural University. And you will be delighted to know that three out of four are Commonwealth Alumni.'

In 2017, Mohd Golam and colleagues submitted their research findings on the complete Histology of Genomic Sequence of hilsa fish to the International Genome Database National Centre for Biotechnology where it can be accessed by other researchers, and relevant stakeholders. He added that these resources were a very important tool, serving as a springboard for new research initiatives by the world's geneticists and genomics scientists in developing a deeper understanding of the molecular mechanisms or different life history traits of commercially important species. These understandings can be very useful for a variety of reasons, for example, stock identification and improvement programmes, increasing productivity, and in sustaining yield by scientific management of stocks.

> 'I'm sharing with you how inspired we [the Hilsa Research Team] were after we were in the television channels and national dailies, being Commonwealth Scholars and Fellows working on these particular issues. This being a new challenge for us, we are very committed to advance our work with more scientific contributions in this field. We plan to disseminate the successful outcomes based on our developed genetic tools, to the policy makers so that they can take immediate actions to protect the fisheries and aquaculture of Bangladesh.'

The results of this genomic research have also been presented at two international conferences, the 26th International Plant and Animal Genome Conference at San Diego in the USA in 2018, and the International Conference on Biotechnology in Health and Agriculture in University of Dhaka in 2017. Informed by the findings from this research, the Department of Fisheries in the Ministry of Livestock and Fisheries in Bangladesh is currently working on formulating policies to support sustainable production and management of hilsa.

> 'One of the significant impacts of my Fellowship and Scholarship awards has been advancing science in animal genomics. The example is our hilsa genomics work where our team decoded the whole draft genome for the first time in Bangladesh and elsewhere with the co-ordinated efforts of Bangladeshi experts from different disciplines. The development of local capacity for doing such research is a milestone in advanced molecular research.'

Sample collection by Hilsa Genome Team in Meghna river.

His research work on hilsa has been widely recognised by scientists and other stakeholders and has seen him scoop the 2018 award on Resource Development from the Rural Development Foundation for his publication on hilsa genome sequencing. Overall, Mohd Golam has a total of 24 publications from his research work on aquatic organisms.

> 'I have some good memories about the UK, because I published a number of very good papers from my work while in the UK, in high impact journals, such as the PLOS ONE, BMC Genomics and Aquaculture.'

Identifying Endangered Crustacean Species

Apart from Fisheries Science, Mohd Golam's research work expands to crustaceans (which include crabs, lobsters, crayfish, shrimp, krill, prawns, among others) where he has been involved in investigating and identifying endangered species (species at risk of extinction). This work has been carried out as part of a project with the International Union for Conservation of Nature (IUCN), an organisation that aims to influence societies to conserve the integrity and diversity of nature and sustainable use of natural resources.

Working in collaboration with other researchers to assess the biodiversity of this group of organisms, 141 species of crustaceans were investigated as part of this work, and the species identified as being endangered have been added to the IUCN Red List, which is an inventory consisting of a list of species and their status. This is a powerful tool that is used to inform nature conservation activities, strategies, and policies to ensure sustainable use and protection of natural resources.

> 'In Bangladesh we worked on 141 crustaceans from 2014 to 2015. Out of these, I worked on 15 crustaceans on my own. We assessed their biodiversity, and the abundance of these species in Bangladesh. It is very important to highlight that we have found that out of 141 crustacea, 14 are threatened to be endangered.'

Apart from crustaceans, he has also investigated the status of fish to identify endangered groups that can be added to the IUCN Red List, assisting efforts to help save the critically endangered to vulnerable species.

> 'It's very alarming that out of 138 mammals we investigated, 11 are extinct and 17 are critically endangered. For birds, out of 56 species that we worked on, 19 birds are already extinct and ten are critically endangered. Among the reptiles, out of 167, one is already extinct. The Red List status of species in Bangladesh is very important to understand for the biodiversity monitoring approach.'

Upon completion of the research work with IUCN, Mohd Golam has conducted national and international seminars to deliver knowledge on the status of species to inform government initiatives to protect these species from becoming critically endangered and ultimately extinct.

> 'My assessment of species [which were published by IUCN in 2015] will help policy makers understand the recent species identification and abundance for undertaking national and international biodiversity monitoring programmes.'

In addition, his research work with IUCN has generated information to fill in the knowledge gaps in this area, and has created awareness among stakeholders, giving direction on the necessary steps that can be taken to conserve biodiversity, and ensure sustainable management of stocks.

Teaching and Training Students on Research Techniques

As part of his work at Bangladesh Agricultural University, Mohd Golam teaches theory and practical classes to undergraduate and graduate students on Fisheries Science, including courses on Fish Population and Conservation Genetics, Genetics and Fish Breeding, and Fish Genetic Engineering among others. Following his Commonwealth Scholarship, he has improved his teaching techniques, and contributed to an overhaul of the curricula. He has incorporated a need-based curriculum and internships to improve student learning in his Department of Fisheries Biology and Genetics.

> 'I would say the Commonwealth Scholarship and Fellowship has tremendously helped me to engage students in learning procedures, not only teacher-centred, but it's a two-way channel. We have increased the interactions between students and the teachers. We have re-shuffled the whole undergraduate and graduate curricula recently and I have actively worked as one of the faculty members to develop (and implement) course curricula based on students need.'

This development of the curricula has enabled students to gain access to new resources and develop their skills in terms of both technical and generic skills. The new curricula has also been used as a model for other Agriculture Universities in Bangladesh.

Drawing from his experiences and interactions with his lecturers and supervisors as a Scholar in the UK, he has implemented some of their teaching techniques upon returning to his home university.

> 'I would say that what I learnt from my supervisors has been very useful, now I am a supervisor of a good number of MSc students here. I train them to be international level scientists in a similar way. I am actively engaged with them to produce a world class scientist group of students who can be very competitive in research.'

Apart from teaching Fisheries Science-related subjects, Mohd Golam also leads training on other transferable skills for his students.

> 'We have given emphasis to learning transferable skills for students that are common to almost all complex endeavours including communicating, problem-solving, and creating (knowledge). We believe this opens employment opportunities for Bangladesh Agricultural University students in public and private organisations after their graduation.'

He has organised training sessions and seminar programmes for university students on topics such as International English Language Testing System (IELTS) tips and preparations, Preparing your CV, Technical Academic Writing, and Higher Education opportunities for Bangladeshi students.

> 'I believe the Commonwealth Scholarship and Fellowship awards have played a very inspiring role for undertaking such programmes and initiatives [employment skills training].'

In addition, Mohd Golam has been involved in training students at the Graduate Training Institute, which provides academic foundation training for the students and staff at Bangladesh Agricultural University. At this institute, he delivers lectures on scientific report writing, project cycle management, among other subject areas.

As a scientist who has been exposed to laboratory activities and procedures before and during his Commonwealth Scholarship and Fellowship, he has become an expert in the application of more efficient and advanced laboratory tools, equipment, and procedures. As a result, he has implemented several changes and produced guidelines to improve the Laboratory of Fish Genetics and Biotechnology at the Bangladesh Agricultural University.

> 'As a faculty member, I worked (and continue to work) to develop some working procedures in the laboratories of the Faculty of Fisheries, particularly in the Laboratory of Fish Genetics and Biotechnology. There were no strict biosafety regulations maintained in the laboratory. Now we are producing some very important documents [outlining laboratory safety regulation] based on teaching and learning in the UK during my Commonwealth Scholarship and Fellowship, and this will be very helpful for the Masters and PhD students here.'

In addition, he has initiated and implemented some improvements to laboratory infrastructure and equipment at his university following his Scholarship and Fellowship.

> 'This happened [the changes] particularly when I came back from UK, we didn't have any furnished laboratory to work with the molecular aspect. But in 2013, we renovated our lab and renamed it as the Fish Genetics and Biotechnology Lab.'

Outside of his teaching and research, Mohd Golam supports his students and other staff with scholarship applications to advance their education. As a recipient of a Commonwealth Scholarship and Fellowship and having witnessed the impact of his studies on developing his career, as well as the benefits to the wider community based on his teaching and research activities, he is strongly motivated to help others attain higher education qualifications and realise further development impact.

> 'Several students and colleagues from Faculty of Fisheries applied for the Commonwealth Scholarships this year under my guidance. One of them (from my department) has very recently (2021) been selected by the CSC which we are proud of. I have also been helping our junior teaching fellows to apply for higher education overseas programmes. My advice to prospective scholars is that this is a very prestigious Scholarship and having a sound academic background is the most important thing. And doing some research relevant to your proposal work is important.'

Taking Forward Research on Hilsa Fish and Other Aquatic Organisms

Despite facing pressing challenges such as the impact of climate change on Bangladesh's fisheries and aquaculture system, which has caused a rise in temperatures, more frequent and destructive cyclones and floods that could alter the hydrological atmosphere, and therefore the hilsa habitat, Mohd Golam is determined to continue his research on understanding the genetics of hilsa and other aquatic organisms to inform and influence sustainable management practices.

Apart from research collaborations with other Commonwealth Alumni, Mohd Golam is very often in contact with his former PhD and Fellowship supervisor in the UK, sharing ideas and gaining advice on research, personal and professional development. He also has important academic contacts at Edinburgh University, with whom discussions are underway regarding a possible collaboration and funding to support the research project on hilsa fish.

> 'I am working towards research collaborations with University of Edinburgh, and I want to continue this work for a longer time. This work is very important in the perspective of aquaculture productivity using fish genomics tools and technologies. We will continue to engage with UK partners for a long-term collaboration for this species.'

Acquiring more funding will help Mohd Golam and his colleagues to build on their current research work, discovering the genes responsible for different characteristics or biological traits of hilsa fish, allowing them to contribute to the conservation of this vital source of nutrition and economic wellbeing for the people of Bangladesh.

More about Prof Mohd Golam Quader Khan's work

https://www.dhakatribune.com/science/2018/09/09/bau-scientists-decode-ilish-genome-sequence

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https://www.iucn.org/content/red-list-bangladesh-volume-6-crustaceans

http://www.fspublishers.org/published_papers/59457_..pdf

https://www.daily-sun.com/arcprint/details/334782/Bangladeshi-scientists-decode-hilsa-genome/2018-09-09

https://www.sciencedirect.com/science/article/abs/pii/S0044848620320986?dgcid=rss_sd_all

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