Bangladesh J. Fish. (2023) **35**(1): 13-23

Assessment of fish biodiversityin the Padma river fromFarakka Barragepoint to the Shampur Nagar Ghat, Rajshahi, Bangladesh

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Abstract. The Padmariver starts from the Himalayas and enters into Bangladesh through the district of ChapaiNawabganj. Farakkabarrage has resulted in a significant alteration in the richness of fish in thisriver. We assessed the fish biodiversity of the Padma river through river and local market visit. The current investigation yielded a total of 37 fish species, divided into 9 orders and 17 families. The highest number of fish belongs to order Cypriniformes (43%) followed bySiluriformes (19%), Perciformes (16%), Clupiformes (11%); whereas the threatened fish species encountered 35% (Vulnerable 8%, Endangered 24% and Critically Endangered 3%), based on IUCN Bangladesh (2015) criteria. The obtained result argued that the abundance of fish biodiversity at the Padma river is sharply declining and many fish species is now under threat due to anthropological effect.
Keywords: Fish biodiversity, Padma river, Farakkabarrage

Introduction

Bangladesh, a downstream country, is known for its freshwater fish, which may be found in a variety of rivers, canals, beels, lakes, and haors. The Padma,one of the greatest and spacious rivers contributes to increase this diversity of aquatic animal, particularly in freshwater species in the country. About 40% of the world's fish species are freshwater fish which have significant nutrient and economic value(Ghorbani*et al*. 2013). However, due to anthropological effect and other man-made reasons, this fish population size is going to shrink day by day. Farakka barrage was made for proper utilization of water in irrigation in India. However, this barrage affects significantly for the reduction of fish species in the Padma river, Rajshai. About 110 kinds of fish used to live in the Padma river in the 1980s, accounting for 42% of all fish species (Islam and Hossain 1983). Biodiversity has been harmed as a result of several man-made factors, and the region's fisheries are now threatened. Even back then, it was clear that the Padma river, which is home to 71 species of fish, is well-known for its freshwater fish and is vital to fish biodiversity (Joadder*et al*.2015). Another reason why the fishery of this area is significant is because there are 57 species of indigenous small fish which are very important in ecosystem (Samad*et al.* 2010).

Fish biodiversity in the region has been severely damaged in recent times due to the erosion of rivers. Earlier, various researches have been done on fish in different places of the Padma riverwhere it is easily accessible. Bhuiyan*et al.*(2008) found 73 species of fish in this riverwhich means that the biodiversity of the area is not so bad. More importantly, no work has been done on the Padmariverbiodiversity for the last several years. Considering these aspects, we work by selecting the most remote area where the biodiversity is severely damaged. In Rajshahidistrict and City Corporation Area (CCA), 69 species have been recorded in the previous survey (Mohsin*et al.* 2013).Note that the

https://doi.org/10.52168/bjf.2023.35.02

Padma river'sfish fauna is under threat for free fishing without following any rules and regulations and even underwater fishing is taken place at the risk of life (Parvez*et al.* 2017). According to the IUCN database, 64 species of fish are endangered in nature (IUCN Bangladesh 2015). Keeping this scale in mind, how many fishes in the Padma river is threatened and what is their fish composition, is completely unknown by the ichthyologist and fisheries researchers in Bangladesh. Therefore, this study was designed to get the answer of the following question: i) Annotated number of fish species in the stipulated area, ii) How many fishes are facing threat for extinction? andiii) Suggest formulation for the conservation of our valuable tasty fish species in the Padma river.

Materials and Methods

***Study area and duration*:**We collected the fish specimens from Farakka barrage to the Shampur Nagar Ghat(upper part of Ganges to the lower part of the Padma river inChapaiNawabganjand Rajshahi district of Bangladesh). Sampling spots were Char Lokkhipur, Vuglauri, Naraynpur under ShibgonjUpazila, ChapaiNawabgonj district (24.6485185N,88.1144227E);CharKhidirpur,RajshahiSadar (24.320164N,88.596990E); ShampurNagarghat, Katakhali,Rajshahi District (24.3450500N, 88.6696778E) (Fig. 1). This survey was carried out from December 20 to 27, 2020. During the fish collection temperature was around 15˚C and altitude was 22-27 m.

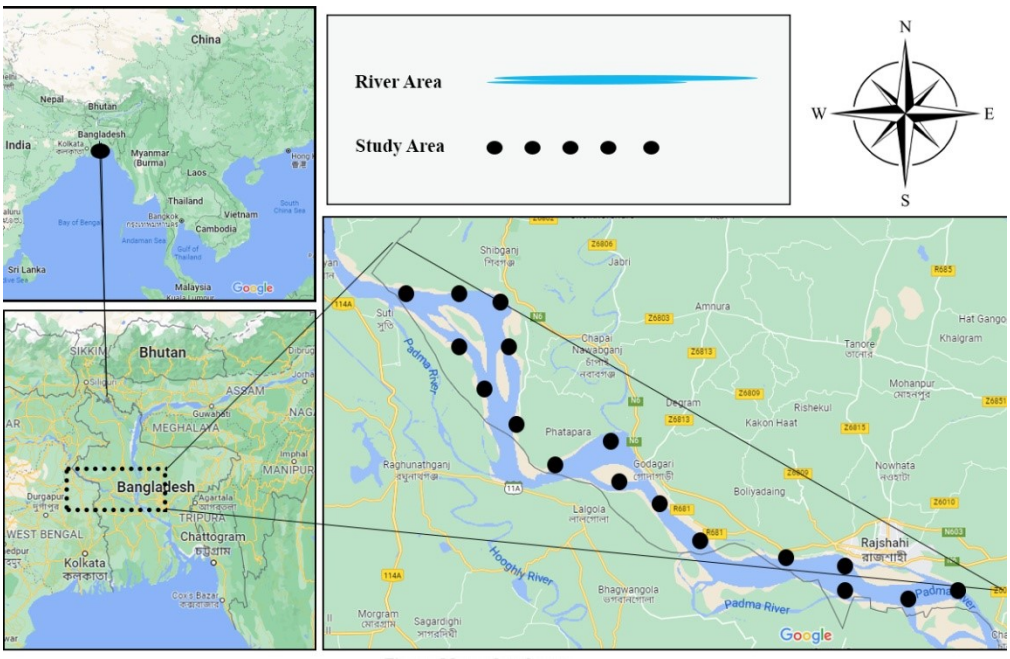

Fig. 1. Maps of the study area.

***Sampling frame*:**Every day from 6.00 am to 12:00 am, we collected fish from the fishermen at the Padma river bank. Usually, we went to the river in our own rented boat and collected fish from the fishermen while fishing. During our sampling, we took the help of experienced and local fishermen who involve in fishing in the river Padma long time.Seine net, push net, and cast net were used to catch the fish. Besides, we went to the local market in the evening. We tried to collect all kinds of fish from all over the places in ChapaiNawabganjandRajshahi districts. Because many times fishermen do not get proper market valueon spot. Therefore, they brought their collected fishes to the nearby market. In case of collecting fish from the local market, we have been confirmed by the local fishermen whether the fish is in the river Padma or not.

***Collection, preservation and identification of fish species*:** We collected the fish directly from the river where the fishermen were fishing. We photographed the fish specimens with a waterproof Nikon camera (model-OLYMPUS F2.0)having 18-55mm lens and another Nikon camera (model D5300 attached with AF-P DX NIKKOR 18-55 mm or 70-300mmlens; and then preserved them in a plastic jar with ethanol (99.99%) for collecting tissue for future genetics work. We brought the fish to the laboratory (Evolution & Diversity Laboratory) of Bangamata Sheikh FojilatunnesaMujib Science and Technology University and look at the morphometric and meristic characters following books and websites (Rahman 1989, 2005; online portal FishBase). We also checked our specimen and evaluated their IUCN status both nationally and globally (IUCN 2015 Bangladesh; The IUCN Red List of Threatened Species. V 2022-1).

Results

In the current study, we have found a total of 37 fish species, divided into 9 orders and 17 families. The highest number of fish belongs to order Cypriniformes (43%) followed by, Siluriformes (19%), Perciformes (16%), Clupiformes (11%); whereas the threatened fish species encountered 35% (Vulnerable 8%, Endangered 24% and Critically Endangered 3%), respectively based on IUCN Bangladesh (2015) criteria (Table I and Figs. 2 and 3).

Table I. List of collected fish specimens with their IUCN status

Voucher no.	Order	Family	Scientific name	English name	Local name	Conser-vation status Local (Global)
MHBSFMSTU-6340 Fish 01	Cyprini-formes	Cyprinidae	*Securicul agora*	-	Chela	NT (LC)
MHBSFMSTU-6340 Fish 02			*Crossocheiluslatius*	GangeticLatia	Kalobata	EN (LC)
MHBSFMSTU-6340 Fish 03			*Amblypharyngodonmola*	MolaCarplet	Mola	EN (LC)
MHBSFMSTU-6340 Fish 04			*Labeobata*	Bata	Bata	LC (LC)
MHBSFMSTU-6340 Fish 05			*Osteobramacotio*	-	Dhela	NT (LC)
MHBSFMSTU-6340 Fish 06			*Puntiusconchonius*	Rosy Barb	Kanchan puti	LC (LC)
MHBSFMSTU-6340 Fish 07			*Labeoboga*	-	Bangonbata	CR (LC)
MHBSFMSTU-6340 Fish 08			*Aspidopariamorar*	-	Morari	VU (NE)
MHBSFMSTU-6340 Fish 09			*Salmostomasardinella*	SardinellaRazorbelly Minnow	Chela	DD (LC)
MHBSFMSTU-6340 Fish 10			*Salmostomabacila*	Large Razorbelly Minnow	Chela	LC (LC)
MHBSFMSTU-6340 Fish 11			*Salmostomaphulo*	FinescaleRazorbelly Minnow	Phul chela	NT (LC)
MHBSFMSTU-6340 Fish 12			*Crossocheiluslatius*	GangeticLatia	Baluchata	EN (LC)
MHBSFMSTU-6340 Fish 13			*Cirrhinusreba*	Reba Carp	Aikhor	NT (LC)
MHBSFMSTU-6340 Fish 14		Psilorhyncidae	*Psilorhynchussucatio*	River Stone Carp	Titari	NT (LC)
MHBSFMSTU-6340 Fish 15		Cobitidae	*Botialohachata*	Reticulated Loach	Bou	EN (NE)
MHBSFMSTU-6340 Fish 16			*Botiadario*	Queen Loach	Rani	EN (LC)
MHBSFMSTU-6340 Fish 17	Siluri-formes	Schilbeidae	*Clupisomagarua*	GaruaVacha	Ghaura	EN (NE)
MHBSFMSTU-6340 Fish 18			*Eutropiichthysvacha*	BatchwaVacha	Bacha	LC (LC)
MHBSFMSTU-6340 Fish 19			*Ailiacoila*	GangeticAilia	Kajuli	LC (NT)
MHBSFMSTU-6340 Fish 20			*Siloniasilondia*	Silond Catfish	Shilong	LC (LC)
MHBSFMSTU-6340 Fish 21		Siluridae	*Ompokpabda*	Pabdah Catfish	Pabda	EN (NT)
MHBSFMSTU-6340 Fish 22		Bagridae	*Rita rita*	Whale Catfish	Rita	EN (LC)
MHBSFMSTU-6340 Fish 23		Sisoridae	*Gangraviridescens*	HuddahNangra	Gang tengra	LC (LC)
MHBSFMSTU-6340 Fish 24	Clupei-formes	Clupeidae	*Tenualosailisha*	Hilsa Shad	Ilish	LC (LC)
MHBSFMSTU-6340 Fish 25			*Gudusiachapra*	Indian River Shad	Chapila	VU (LC)

MHBSFMSTU-6340 Fish 26			*Gonialosamanmina*	Ganges River Gizzard Shad	GoniChapila	LC (LC)
MHBSFMSTU-6340 Fish 27		Engraulidae	*Setipinnataty*	Scaly Hairfin Anchovy	Teli pasha	LC (NE)
MHBSFMSTU-6340 Fish 28	Perci-formes	Mugilidae	*Rhinomugilcorsula*	Corsula Mullet	Urul	LC (LC)
MHBSFMSTU-6340 Fish 29		Gobiidae	*Glossogobiusgiuris*	Tank Goby	Bele	LC (LC)
MHBSFMSTU-6340 Fish 30			*Awaousgrammepomus*	Scribbled Goby	Bele	VU (LC)
MHBSFMSTU-6340 Fish 31`		Channidae	*Channapunctata*	Spotted Snakehead	Lachata	LC (LC)
MHBSFMSTU-6340 Fish 32		Nandidae	*Nandusnandus*	GangeticLeaffish	Meni	NT (LC)
MHBSFMSTU-6340 Fish 33		Ambassidae	*Chandanama*	Elongate Glass Perchlet	Chanda	LC (LC)
MHBSFMSTU-6340 Fish 34	Synbranchiformes	Mastacembe-lidae	*Mastacembelusarmatus*	ZigZag eel	Baim	EN (NE)
MHBSFMSTU-6340 Fish 35			*Macrognathuspancalus*	Barred Spiny Eel	Chirka	LC (LC)
MHBSFMSTU-6340 Fish 36	Anguili-formes	Ophichthidae	*Pisodonophisboro*	Rice-paddy Eel	Bamush	LC (LC)
MHBSFMSTU-6340 Fish 37	Beloni-formes	Belonidae	*Xenentodoncancila*	Asian Needlefish	Kakila	LC (NE)

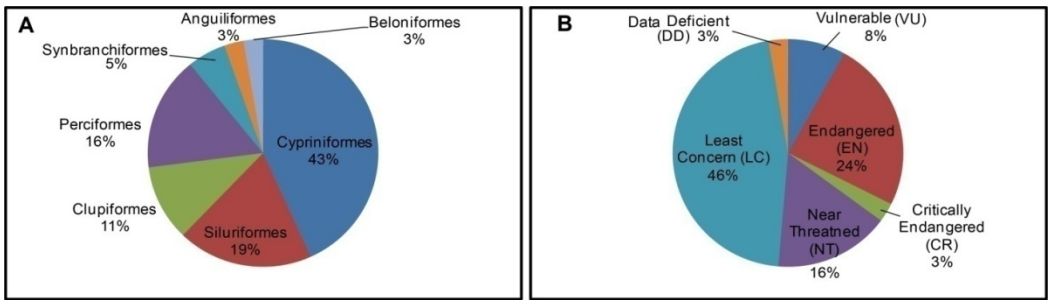

Fig. 2.A) Order wise species distribution (%) and B) Threatened and non-threatened species distribution based on IUCN Bangladesh (2015) tier.

MHBSFMSTU-6340 Fish01(*Securicula gora*)

MHBSFMSTU-6340 Fish02 (*Crossocheilus latius*)

MHBSFMSTU-6340 Fish03 (*Amblypharyngodon mola*)

MHBSFMSTU-6340 Fish04 (*Labeo bata*)

MHBSFMSTU-6340 Fish05 (*Osteobrama cotio*)

MHBSFMSTU-6340 Fish06 (*Puntius conchonius*)

MHBSFMSTU-6340 Fish07 (*Labeo boga*)

MHBSFMSTU-6300 Fish08 (*Aspidoparia morar*)

MHBSFMSTU-6300 Fish09 (*Salmostoma sardinella*)

MHBSFMSTU-6300 Fish10 (*Salmostoma bacila*)

MHBSFMSTU-6300 Fish11 (*Salmostoma phulo*)

MHBSFMSTU-6212 Fish12 (*Crossocheilus latius*)

MHBSFMSTU-6212 Fish13 (*Cirrhinus reba*)

MHBSFMSTU-6340 Fish14 (*Psilorhynchus sucatio*)

MHBSFMSTU-6300 Fish15 (*Botia lohachata*)

MHBSFMSTU-6290 Fish16 (*Botia dario*)

MHBSFMSTU-6340 Fish17 (*Clupisoma garua*)

MHBSFMSTU-6340 Fish18 (*Eutropiichthys vacha*)

MHBSFMSTU-6340 Fish19 (*Ailia coila*)

MHBSFMSTU-6340 Fish20 (*Silonia Silondia*)

MHBSFMSTU-6300 Fish21 (*Ompok pabda*)

MHBSFMSTU-6300 Fish22 (*Rita rita*)

MHBSFMSTU-6290 Fish23 (*Gangra viridescens*)

MHBSFMSTU-6340 Fish24 (Tenualosa ilisha)

MHBSFMSTU-6212 Fish25 (*Gudusia chapra*)

MHBSFMSTU-6300 Fish26 (*Gonialosa manmina*)

MHBSFMSTU-6340 Fish27 (Setipinna taty)

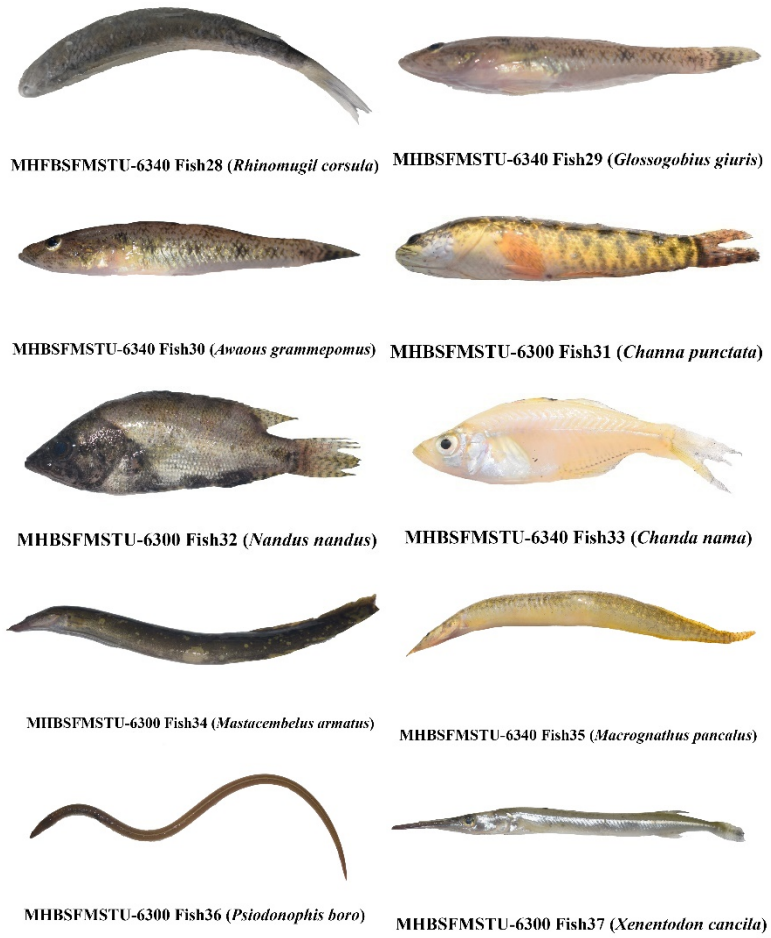

Fig. 3. Picture of collected fish specimens which corresponds to Table I.

Discussion

***Population swing*:** In a recent literature survey, it has been proved that the abundance of fishes in the river Padma is continuously declining. Around 110 fish species were found inthe Padma river(Islam and Hossain 1983) in 80th decades and laterBhuiyan*et al.* 2008 reported 73 species in the river Padma. Rahman *et al.* (2012) described 80 species on his report which they survey in 2009-2010 in the same area of the Padma river. Mohsin*et al.* 2013 later studied the number of fishes in the Padma river again and noticed that the number of fishes had dropped drastically to 69.The latest study found that 71 species of fish are recorded here(Joadder*et al.* 2015). Although we did not cover all the areas previously explored by the researchers and less duration, eventually our findings (37 fish species) is quite lower compared to any previous study. Population swing is a major concern in the aquatic biodiversity in Bangladesh. The abundance of fishes in the river, beel, haor, baoretc. are significantly trending downward. In our recent survey in the Old

Brahmaputra river (Hasan and Tripti 2021) and the north-east Bangladesh (Hasan*et al*. 2022a) also showed the similar results. Highest number of fishes of the present study belongs to Cypriniformes and the threatened fish species is 35% (Vulnerable 8%, Endangered 24% and Critically Endangered 3%), based on IUCN Bangladesh (2015) criteria. Similar results were obtained by Joadder*et al*. 2015 in the river Padma. In addition, Sarker*et al*. (2021) also revealed similar level of fish diversity and extinction rate in the protected area NijhumDweep National Park, Hatiya, Noakhali. Mohsin*et al*. (2013) studied the seasonal variation of finfish in the river Padma where he commented 35% fish in the threatened level which is also fit with the present result. Considering all the researchers comment and argument, it has been recommended that the fish diversity of the river Padma is declining day by day i.e. more than one third of population is under threat (threatened level).

***Farraka barrage and the Padma river fisheries resources*:**After commissioning Farakkabarrage in 1975, it has been continuously affecting the natural ecosystem particularly the water sharing between Bangladesh and India of the oldest river basin Ganges. This is a long-lasting unresolved issue which still exists and ultimately the fisheries resources affecting largely (Kawser and Samad 2016). It has been learnt that day by day the number of fishes in the river Padma is sharply declining due to siltationand lack of proper water navigation. India uses Farakka barrage in her own benefit neglecting the interest of Bangladesh side. Our agriculture as well as fisheries resources are largely influenced by the vast water resources of Ganges (the Padma river). Although, Bangladesh and India sharing almost 54 rivers, however this Farakka barrage is one of the significant and burning political issue after independence of Bangladesh in 1971. This issue should be dispute immediately not only for peace, but also for the betterment of the neglected people who live near and around the Farakka barrage specifically in the Shibganj area, ChapaiNawabganj, Rajshai division. From our own study and observation, it has been argued that many people who live near the bank of the river Padma need to go another place immediately after the over flood or poor navigation in dry season. They partly live inside the islands (locally known as Char) of the river Padma for cultivation and grazing the cows, goats, buffalo etc. These unblessed people can be uplifted their life if governments solve the Farakka issue particularly equal water sharing between two neighboring countries. All of these facts can significantly affect the increase the production of fishes in this river which can play vital role for the change of fate the poor people who live near of this river.

Threats:We have seen a variety of nets used for fishing, including cast nets, seine nets, drag nets and other fishing traps. Fishermen are free to fish there, and there are no fishing regulations. We saw a new fishing trap called "China bair" by the locals. Because the mesh size of this trap is very small, it traps a variety of fish and aquatic species, posing a threat to the ecosystem. This fishing equipment is made in such a way that it kills other aquatic species as well. According to local fishermen, thisnet is drastically destroying the local aquatic biodiversity.Several snakes and tortoises were trapped and killed by the local poachers. Although there is a legal restriction on dangerous nets, but no legal ban

has been enacted to the trap. As a result, the area's ecology is under jeopardy due to the trap's extensive use.In addition, the Padma river is important for hilsafish migration and spawning.Butwe also didn't notice any fishermen raising their eyebrows while catching jatkahilsa or mother Hilsa.Padma hilsa, on the other hand, is in high demand all over the world, generating foreign money for Bangladesh.

The flow of water near the end of Bangladesh reduces in the winter due to the retention of water through the Farakkabarrage, and the river water dries up, resulting in a large number of islands. For agricultural purposes, people utilize a range of chemicals, including a number of pesticides. The islands submerge during the monsoons, spilling pollutants into the river, posing a major hazard to aquatic life. The unfettered movement of humans obstructs the usual movement of other animals. We have also noted that the Padma river's channel varies dramatically every year as a result of the Farakkabarrage. They frequently lose their territory and seek safety in other areas that were once wildlife sanctuaries (Hasan*et al*. 2022b).

Despite the fact that several regions of the Padma river have been examined in the past, we chose a significant location that was previously unexplored due to its remoteness. Through our investigation, we have come up with an idea of the annotated number of fish species in thestudied area.Based on our current study, we have discussed the current number of fish species, the status of what fish are lost and what species are under threat in nature. By applying the current laws (The Protection and Conservation of Fish Act1950), stopping to throw the polyether and affluent chemicals in to the river Padma and proper navigation might be the core way of solution to protect fisheries biodiversity in this river. Further, the water sharing issue through Farraka barrage between Bangladesh and India must be resolved immediately to uplift the dignity of aquatic fauna of this river. In addition, legislation must be enacted to prohibit the development of new dangerous fishing gear like “China bair”. In summary, it is recommended that the dignity of fisheries biodiversity of the Padma river is fragile (more than one third population is under threat) and need to immediate action to restore its ecosystem for facilitating shelter and natural growing of fishes in their own naive habitat.

Acknowledgement: The authors are grateful to Japanese government for partial funding. The grant name and numbers are "Japan Society for the Promotion of Science (JSPS) KAKENHI” and “26291080 and 18H02497”, respectively to AK.

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(Manuscript received 03 June 2023)