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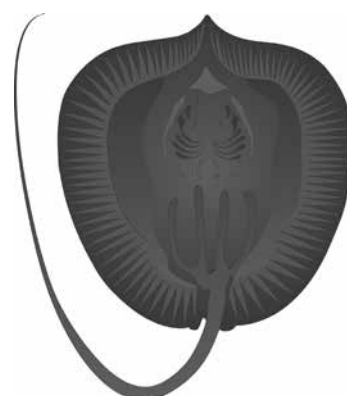
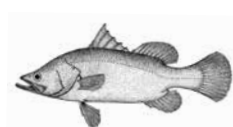
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Cover: A critically endangered giant salmon carp (*Aptosyax grypus*) caught from the Sesan River, a major tributary of the Mekong, in June this year (see page 36)

PHOTO: CHHUT CHHEANA / WONDERS OF THE MEKONG

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New **technologies** to monitor **water** and **fisheries** near **hydropower projects**

MRC extends water quality monitoring to site near Don Sahong hydropower project near Cambodia-Lao border and trials acoustic telemetry with tags to track movements of migratory fish species

The Mekong River Commission (MRC) has announced new technologies to see if big hydropower projects have significant impacts on water quality and flow as well as fish populations. In a statement released on

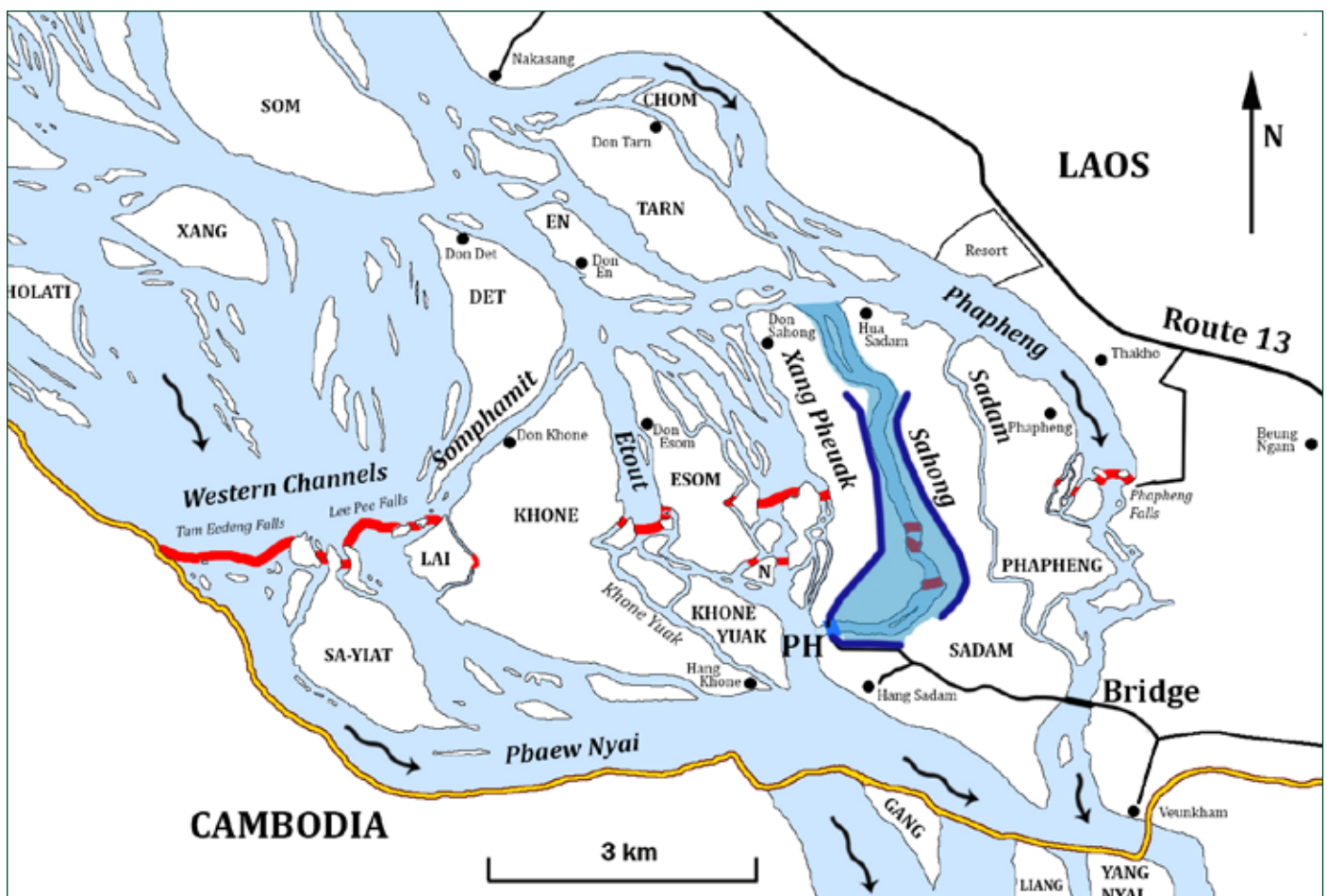
June 9 this year, the MRC said it showcased new sets of equipment two days earlier at Don Sahong Dam — less than two kilometres upstream from the Cambodia-Lao border.

The first will monitor water level and quality immediately below the dam in near real-time. "This is vital for the millions of fishing and farming families who rely on the Mekong, even for drinking water," the statement said. The second set of equipment involves an acous-



Don Sahong Dam, part of the second hydropower project on the mainstream of the Lower Mekong. The project is located in the Siphandone area of Champasak province – less than two kilometres upstream from the Cambodia-Lao border.

PHOTO: MRC



Location of the Don Sahong Dam in southern Lao PDR. Blue lines show the Don Sahong Hydropower Project embankments, which impound a headpond or small reservoir, shown in darker blue. Red lines indicate locations of the main cascades, waterfalls or rapids which obstruct fish migrating upstream. PH is the powerhouse. Islands are labelled in upper case, usually preceded by "Don" (Island).

MAP: KENT G. HORTLE

tic telemetry system with tags attached to migratory, transboundary fish species. As dams may disrupt fish migrations, developers are expected to install fishways allowing fish to typically move upstream to spawn and downstream to feed. "However, to date there's been no way to prove if the Don Sahong fish passage works as intended," the statement said. The new tagging system is expected to provide evidence, as it tracks fish movements up and downstream through several natural-like fishways. These include the Hou Sadam and Hou Xangpheuk channels, which the developer modified (see map above).

"Effective policies require accurate data," MRC Secretariat CEO Anoulak Kittikhoun said. "It's important for us to understand if and how the dam affects water flow and quality. Likewise, if the fish passage works. Then, if needed, we'll propose appropriate measures for the dam to adjust its operations," he said. Dr Anoulak noted tagging's value for future projects. "The findings

and recommendations can also be made for similar dams, so they can build one that doesn't just generate electricity, but also functions harmoniously with people's livelihoods – through fisheries resources and other river ecosystems," he said.

The MRC statement said the need to better monitor Mekong water quality had "grown obvious" over the years. Since launching its Water Quality Monitoring Network (WQMN) in 1985, the MRC was limited to measuring water quality manually on a monthly basis. Data was submitted only at year's end, with no warning of a sudden change in quality. "Moreover, the Don Sahong station wasn't even a WQMN member – so shared no data with the MRC," the statement said. But the Malaysian dam operator has now joined a pilot MRC Joint Environmental Monitoring (JEM) programme and water quality will be measured automatically every 15 minutes. Information will then be sent to the central MRC database in Vientiane and forwarded



A fish expert tags a fish to monitor its movements

PHOTO: MRC



Officials from the Lao Government, MRC Secretariat, and embassies in Vientiane in front of a signboard for the new Don Sahong station

PHOTO: MRC

to MRC members – Cambodia Lao PDR, Thailand and Viet Nam – as well as riverine communities.

“It’s important for all of us to understand the correlation between changes in water level and water quality – as quickly as possible,” Laotian Natural Resources and Environment Vice Minister Chanthanet Boualapha said. “This station is in a technically advantageous location to monitor this, as well as cost-effective, because both types of equipment fit into one house. The location is accessible year-round, which makes it easy for relevant agencies to maintain.”

As for monitoring fish movements through modified channels, delicate tagging of fish is required. If tagged fish aren’t locating or using the passages, “those details will help inform the dam developer,” the statement said. “They’ll then be expected to consider modifications or alternative solutions to facilitate fish migration.” If it tracks fish through the channels, tagging is expected to be applied elsewhere, expanding regional

knowledge of fish migration and spawning.

“There are many variables,” said Lee Baumgartner, a freshwater fish ecologist and professor at Charles Sturt University in Australia. “Some species of fish don’t like the tag,” Baumgartner said. “Some do like it. The environment is the most important factor. The technology works extremely well in big lakes, oceans, or deep rivers, but we’ll find out how well it works in small channels, shallow water, fast water, or water with a lot of rapids. We’ll know more in two or three months’ time.”

The MRC-JEM programme is funded by Members Countries and development partners including Germany and Australia. The fish-tagging system set up by the project is collaborating with a separate US-funded acoustic telemetry project on the Cambodian side of the border. The goal of collaboration is to provide information about when and where fish are moving across the border and to help inform management and conservation of transboundary fish populations (see page 40).



Scientists record **first** capture of **eel-tail catfish** along **Lao** stretch of the Mekong

Record shows that large individuals of the diadromous species – which is common in brackish waters of the Mekong Delta – may penetrate long distances into freshwater areas

Scientists have recorded the first capture of the eel-tail catfish (*Plotosus canius*) from Lao PDR. The 111 cm specimen was caught by Laotian fisherman Khamkeng Chanbualee from the Phapheng Channel – the most easterly anabranch of the Mekong in the Khone Falls system in the southern Lao province of Champasak – in 2016.

Mr Khamkeng was among 16 fishermen hired by Don Sahong Power Company Ltd to monitor fish and fisheries in the area between 2014 and 2020. During the period, the men caught some 260,000 fish from 179 species.

The capture of the diadromous fish – species that migrate between fresh and marine waters – has been documented in a note published by the journal *Ichthyological Exploration of Freshwaters* in June last year. According to the authors – Kent G. Hortle from Charles Sturt University in Australia and Somphone Phommanivong from Don Sahong Power Company – the capture location is about 2.5 km downstream from Phapheng Waterfall and about 2.1 km upstream from the Cambodia-Lao border (see map on page 5).

“As the location is about 720 km from the sea and at least 500 km upstream of any possible saline influence, this record shows that some large individuals of this diadromous species, which breeds in brackish waters, may penetrate long distances into freshwaters, where they feed on crabs and molluscs,” they write.

“*Plotosus canius* is apparently rarely caught at Khone Falls, given its extremely low incidence in our samples and based on its unfamiliarity to the 16 experienced full-time fishermen, none of whom had seen a specimen of this species before the capture in 2016.

“They all referred to it as likely to be a kind of ‘pa duk’, which is the Lao name for *Clarias* species (Clariidae), true freshwater catfishes which are somewhat similar in

general appearance to *Plotosus*. The fishermen subsequently heard some tentative reports that over many years of fishing at Khone Falls some of their friends may have caught one or two specimens of *P. canius*, which were however much smaller in size.”

More common in Cambodia than reported?

The authors note, however, that the species is “commonly caught in the Mekong River delta in Vietnam” from coastal brackish water to completely fresh water near the border with Cambodia, about 200 km inland.

They also note that databases compiled by the Mekong River Commission from 2003 to 2013 “also show *Plotosus canius* as a common record in the Mekong distributaries in the Vietnam delta, but it was very rarely recorded in the Mekong in Cambodia. However, *P. canius* might in fact be more common in Cambodia than reported by fishers who rarely or never see it, and who may misidentify it as a species of *Clarias*.”

The authors note that in a database of all catalogued specimens of fish from 76 museums worldwide (www.fishnet2.net), there are only 20 specimens of *P. canius* which are registered from freshwater localities; these are in Australia, Cambodia, India, Malaysia, Myanmar, Thailand and Vietnam, with records going back to 1865. Apart from six records from the Tonle Sap in Cambodia, the furthest inland record is from the Baram River in Sarawak in Malaysia, where two *P. canius* were collected about 260 km inland.

Given the hypothesis that diadromous fishes generally don’t survive where primary freshwater fishes are dominant, “further research to provide a more complete understanding of the abundance in freshwater and the geographic extent of freshwater penetration by *P. canius* and other diadromous fishes would be of interest,” they conclude.

Further reading

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Laotian fisherman Khamkeng Chanbualee with the eel-tail catfish he caught from the deep and sometimes hazardous waters of Phapheng Channel. The capture location is about 2.5 km downstream from Phapheng Waterfall and 2.1 km upstream from the Cambodian-Lao border. The fish was alive when caught. It was euthanized at the site laboratory and measured 1,111 mm total length (TL) and 1,060 mm standard length (SL). It weighed about 8.2 kg and was eaten by local fishermen who rely on daily catches for food.

PHOTO: KENT G. HORTLE



Stingray caught in Mekong breaks record as world's biggest freshwater fish

BY CHEA SEILA AND CHHUT CHHEANA *

Female grabs world title

On May 5 this year, fishermen from a small island community in northeast Cambodia caught a 180-kg giant freshwater whipray (*Urogymnus polylepis*) as they were fishing in the Mekong River. Located near the Lao border, the location of the catch in Stung Treng province is dominated by deep pools, which serve as dry-season refuge and spawning habitats for migrating fishes. The remote site, downstream from a wetland of international importance under the Ramsar Convention of 1971, is also believed to be a habitat for threatened giant fishes.

Since 2011, the International Union for the Conservation of Nature (IUCN) has assessed the giant whipray

as endangered which means it faces a “very high risk of extinction in the wild in the near future.” According to Swiss-based group, the species occurs across South-east Asia as well as Bangladesh and India. In 2021, IUCN estimated that the Cambodian population had slumped by 60 percent since 1995. In addition, it noted that steep declines in catches of the species and other freshwater rays had been reported from Thailand since the early 1990s.

The female individual caught in May was captured incidentally after it swallowed a smaller fish that had eaten a baited hook. A rescue team from an international scientific expedition – which happened to be working in the area at the time – was able to unhook the ray, weigh and



The 180-kg female giant freshwater whipray caught in May

PHOTO: CHHUT CHHEANA / WONDERS OF THE MEKONG



Close-up of the whipray's eyes

PHOTO: CHHUT CHHEANA / WONDERS OF THE MEKONG



measure it, and release it back to the river unharmed.

A few weeks later, the expedition — led by a USAID-funded project known as Wonders of the Mekong — received a call that local fishermen had caught a “much bigger” stingray on the night of June 13. And indeed it was. The 300-kg stingray’s weight made it bigger than the 293-kg Mekong giant catfish (*Pangasianodon gigas*) caught in Thailand in 2005, which previously held the record as the largest freshwater fish on the planet.

“The discovery of this world record stingray indicates the special opportunity we have in Cambodia to protect this species and its core habitat,” Cambodian Fisheries Administration Director-General Poom Sotha said. “In partnership with the Wonders of the Mekong project, and together with other countries in the Lower Mekong Basin, the Inland Fisheries Research and Development

Institute of the Cambodian Fisheries Administration will host a meeting to map out a regional species conservation action plan and solidify safeguards for the river, wildlife, fisheries, and local communities.”

For the first time ever in Cambodia, the scientists fitted the ray — which measured 398 cm from snout to tail — with an acoustic tag to learn more about its elusive behavior.

Zeb Hogan, a fish biologist at the University of Nevada, Reno who leads Wonders of the Mekong, said the stingray find was evidence that many of the world’s largest aquatic creatures remain understudied. “In 20 years of researching giant fish in rivers and lakes on six continents, this is the largest freshwater fish that we’ve encountered or that’s been documented anywhere worldwide,” said Hogan, who also hosts *National Ge-*



The even bigger female specimen caught in June that weighed 300 kg — a new world record for a freshwater fish

PHOTO: CHHUT CHHEANA / WONDERS OF THE MEKONG



Expedition members and local government officers handling the giant fish after it was caught

PHOTO: CHHUT CHHEANA / WONDERS OF THE MEKONG



Aerial view of the stingray before it's tagged

PHOTO: SINSAMOUT OUNBOUNDISANE/FISHBIO



Fitting Boramay with an acoustic tag to track her behaviour after she's released back into the Mekong

PHOTO: CHHUT CHHEANA / WONDERS OF THE MEKONG

ographic's "Monster Fish" television series. "This is an absolutely astonishing discovery, and justifies efforts to better understand the mysteries surrounding this species and the incredible stretch of river where it lives."

Although the giant freshwater whipray is venomous with a serrated stinger that can exceed 30 cm, Hogan said the species is typically a non-aggressive, inquisitive creature. He said he first came across the species when he was doing research in Cambodia more than 20 years ago.

Like the specimen caught in May, the new recorder holder was also a female. She was released back into the Mekong at dusk with the moon shining on the horizon on June 14. A crowd that gathered for the event decided to name her *Boramay*, the Khmer term for "full moon". Observers said she appeared strong and healthy as she descended into the murky depths of the river.

** Ms Seila is project manager for Wonders of the Mekong in Phnom Penh and Mr Chheana is the project's communications and outreach specialist. Mr Chheana is also graphic designer for Catch and Culture - Environment.*



Cambodia resumes annual Fish Day event

Prime Minister reiterates call for people to stop clearing flooded forest around Tonle Sap Lake

Cambodia resumed its National Fish Day ceremony on July 1 after a two-year hiatus caused by the Covid-19 pandemic. Thousands of villagers attended the ceremony at Trapeang Thmor Reservoir in Phnom Srok district in the northwestern province of Banteay Meanchey bordering Thailand. Rehabilitated with Japanese aid in

the early 2000s, the original reservoir inaugurated in 1977 was built almost entirely from manual labour involving an estimated 15,000 to 20,000 people during the Pol Pot regime (1975 to 1979).

Prime Minister Samdech Techo Hun Sen told the ceremony that the government remained committed to fisheries reforms enacted over the past two decades, although it had eased some restrictions related to a crackdown on clearing flooded forest around the Tonle



Prime Minister Samdech Techo Hun Sen releasing juvenile fish into Trapeang Thmor Reservoir in Phnom Srok district in Banteay Meanchey province on July 1. The hundreds of thousands of fingerlings released into the reservoir were native Mekong species notably red-tailed tinfoil barb (*Barbonymus altus*), silver barb (*Barbonymus gonionotus*), Hoven’s carp (*Leptobarbus hoevenii*), striped catfish (*Pangasianodon hypophthalmus*) and snakeskin gourami (*Trichopodus pectoralis*). Fingerlings of the critically endangered giant barb (*Catlocarpio siamensis*) were also released along with native turtle species.

PHOTO: CAMBODIAN FISHERIES ADMINISTRATION



Prime Minister Samdech Techo Hun Sen speaking at the National Fish Day event on July 1. “We have to replant the flooded forest,” he told the audience, referring to the forest around the Tonle Sap Lake used by migrating fish as nursing and feeding habitats during the wet season.

PHOTO: LEM SAMEAN



Members of the audience with posters promoting aquaculture for food security

PHOTOS: LEM SAMEAN



Agriculture, Forestry and Fisheries Minister Veng Sakhon (right) with Secretary of State Nao Thuok (left), a former Director-General of the Cambodian Fisheries Administration

PHOTO: LEM SAMEAN



Cambodian Fisheries Administration officers prepare to release fish from boats at Trapeang Thmor Reservoir

PHOTO: PO SOPHEA



Members of the audience (above left and right) and the plaque commemorating the event (right)

PHOTOS: LEM SAMEAN

Sap Lake – a crucial nursing and feed habitat for for migrating fishes – announced in December last year (see *Catch and Culture - Environment*, Vol 28, No 1). The easing was to help people “avoid the hassle of solving problems” related to land grabbing for dry-season cultivation of crops around the lake. “But I also beg our people not to continue clearing the flooded forest land,” he said. “We have to replant the flooded forest.” The Prime Minister also instructed the Ministry of Agriculture, Forestry and Fisheries to “look carefully into where to dig deep in the lake for the sake of fish species conservation.”

To promote the sustainable management of fisheries resources and counter illegal fishing, Agriculture, Forestry and Fisheries Minister Veng Sakhon told the ceremony that Cambodia now had 516 community fisheries of which 475 were located in freshwater bodies. “In addition, the Ministry of Agriculture, Forestry and Fisheries has promoted the development of aquaculture in all forms to farmers and investors to ensure the supply of fish, reduce imports, maintain market value chain, ensure quality and food safety for consumers as well as providing technical support to aquaculture farmers to increase their income,” he said.

According to the Food and Agriculture Organization of the United Nations (FAO), Cambodia had the world’s seventh-highest production of inland capture fisheries at around 410,000 tonnes in 2020. FAO statistics also show that Cambodia had the world’s tenth-highest in-



land aquaculture production of finfishes at 379,000 tonnes in 2020 (see page 32).

Further reading

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Vietnamese firm invests \$840 mln to develop green hydrogen plant in Mekong Delta

By TUONG THUY *

Facility in Ben Tre province expected to begin trial operations in first quarter of 2024

Ho Chi Minh City-based TGS Group Joint Stock Company is investing some \$840 million to develop a green hydrogen plant in the Mekong Delta province of Ben Tre. The project is the first of its type in Viet Nam as the country transitions to cleaner energy to achieve the goal of net-zero by 2050. The plant will cover almost 23 hectares in Bao Thuan commune, Ba Tri district (see map below). Construction was set to start in late June this year. TGS, a privately-owned clean energy developer, expects the facility to begin trial operations in the first quarter of 2024, the Vietnamese Government Portal said on May 25. The project is expected to im-

mediately create at least 500 jobs for local residents, and more later.

TGS (which stands for “The Green Solutions”) signed an agreement in March this year with German conglomerate Thyssenkrupp AG to cooperate in producing green hydrogen and green ammonia in Viet Nam. As a result, the plant in the Mekong Delta will use state-of-the-art German manufacturing technology.

In the first phase, the government portal said annual production capacity at the TGS plant was expected to be 24,000 tonnes of green hydrogen, 150,000 tonnes of green ammonia, and 195,000 tonnes of oxygen. In the second phase, annual capacity will more than dou-



TGS Group's green hydrogen plant will be located in the coastal commune of Bao Thuan (outlined in red) in Ben Tre province

IMAGE: GOOGLE MAPS



Developing green hydrogen and other renewable energy sources is expected to help Viet Nam minimize carbon emissions

PHOTO: TGS GROUP

ble to 60,000 tonnes of hydrogen, 375,000 tonnes of ammonia, and 490,000 tonnes of oxygen.

Viet Nam has been seeking to minimise carbon emissions with major investments in clean and renewable energy development to become carbon neutral by 2050. Its solar market is one of the fastest growing in the world and its wind market is among the most rapidly expanding in Southeast Asia. The regional manufacturing powerhouse expects to nearly double its total installed power generation capacity to 146,000 meg-

awatts by 2030, putting priority on renewable energy and reducing the country's dependency on coal.

This expectation is part of a long-discussed draft Power Development Plan VIII (PDP VIII), which has been amended many times with different capacity estimates because it includes a vision to 2045. Several issues have undergone analyses and assessments – like the structure and scale of power sources and the regional balance. The government was set to finalize PDP VIII in June.



Attracting both domestic and foreign investors

Although it still needs to reduce its dependence on coal, “Viet Nam is leading the transition to clean energy in Southeast Asia,” *The Economist* reported in its June 4 edition. In 2021, solar accounted for 11 percent of the country’s electricity generation, up from almost nothing four years earlier. “Not only was this a faster rate of increase than almost anywhere else in the world. It is a bigger share than larger economies such as France or Japan have managed,” the British weekly magazine observed. “By last year, Vietnam had become the world’s tenth-biggest producer of solar power.”

Viet Nam’s solar and wind capacity combined has quadrupled since 2019 – an “extraordinary achievement” reflecting political will and market incentives, according to a study led by economists from the Australian National University, the ASEAN Center for Energy, the National Economics University in Hanoi and the Norwegian Institute for International Affairs. The report notes the Vietnamese government’s “generous” feed-in tariffs for solar suppliers (compared with “insufficiently enticing” tariffs in other ASEAN countries) and reforms facilitating foreign investment. “Foreign investors in other Southeast Asian countries often find themselves draped in red tape, and must compete against domestic fossil-fuel companies, which enjoy chunky subsidies.”

As for the whole of Southeast Asia, Singapore’s *Business Times* has noted that the region was once regarded as a “slow starter” relative to the advanced economies in clean energy transition. But it “has sharpened its act and could emerge as a heavyweight in this multi-faceted race over the next decade,” the newspaper reported on June 6. But if Southeast Asia really wants to “swing the needle” on decarbonisation efforts, it should pay just as much attention to retiring its polluting fossil-fired plants. “It’s one thing to say a country will implement renewable energy,” KPMG Asia-Pacific Head of Infrastructure Sharad Somani was quoted as saying. “But it’s altogether different to say it will start to proactively retire the highest carbon-emitting power plants as early as possible. It’s better to do both things.”

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Prime Minister Pham Minh Chinh committed Viet Nam to a 2050 net-zero carbon emissions target at the United Nations Climate Change Conference in Glasgow last year as international consumer brands – many of which have supplier clusters in Viet Nam – make the reduction of supply chain emissions front and centre of their decarbonisation strategies.

Foreign investors entering the Vietnamese sustainable energy market include Southeast Asian companies such as AC Energy (ACEN), part of Ayala Corporation in the Philippines, the Singapore government affiliate Sembcorp Industries, and Singapore solar developer Sunseap, now part of Spain’s EDP Renováveis SA, the world’s fourth-largest renewable energy producer, and Singapore’s SP Group, a government-affiliated electricity and gas distributor. Other foreign investors include

South Korean conglomerate SK Group, the Spanish-German wind engineering venture Siemens Gamesa Renewable Energy, Électricité de France SA (EDF), UPC Renewables of the United States, Denmark’s top energy company Ørsted A/S and Copenhagen Infrastructure Partners (CIP), a fund management company.

In March this year, EDP Renováveis said it planned to invest up to SGD 10 billion (USD 7.3 billion) to establish a leading clean energy hub in Singapore following the Spanish company’s SGD 1.1 billion (USD 800 million) acquisition of Sunseap. The Singapore-based clean energy solutions provider also operates in Cambodia, Viet Nam and Thailand as well as China, Japan, Malaysia and Taiwan.

Ørsted, the world’s largest wind power company, pro-

IRENA sees 'seismic shift' as solar and wind power costs keep falling

Despite rising commodity and equipment prices in 2021, the International Renewable Energy Agency (IRENA) says electricity costs from newly commissioned solar photovoltaic and wind power projects continued to decline last year, especially for onshore wind. "Solar and wind energy, with their relatively short project lead times, represent vital planks in countries' efforts to swiftly reduce, and eventually phase out, fossil fuels and limit the macroeconomic damages they cause in pursuit of net zero," the Abu Dhabi-based agency said in a statement released last month.

According to IRENA's annual report on renewable energy costs published on 13 July, solar photovoltaic costs fell 13 percent from a year earlier to USD 0.048/kWh for utility-scale projects commissioned in 2021, based on the global weighted-average "levelised cost of electricity" (over the lifetime of a generator). The cost of offshore wind – which saw unprecedented expansion in 2021 – also dropped 13 percent over the same period to reach USD 0.075/kWh. Onshore wind costs declined a sharper 15 percent to USD 0.033/kWh. Viet Nam's contribution to onshore wind capacity (up 2.7 GW) was second only to Brazil (up 4 GW). In the volatile concentrating solar power sector, electricity costs were 7 percent higher at USD 0.114/kWh.

"The period 2010 to 2021 has witnessed a seismic shift in the balance of competitiveness between renewables and incumbent fossil fuel and nuclear options," the report said. For newly commissioned solar photovoltaic projects, average electricity costs have plunged by 88 percent since 2010. During the same period, IRENA said, costs have tumbled by 68 percent for onshore wind and concentrating solar power and 60 percent for offshore wind.

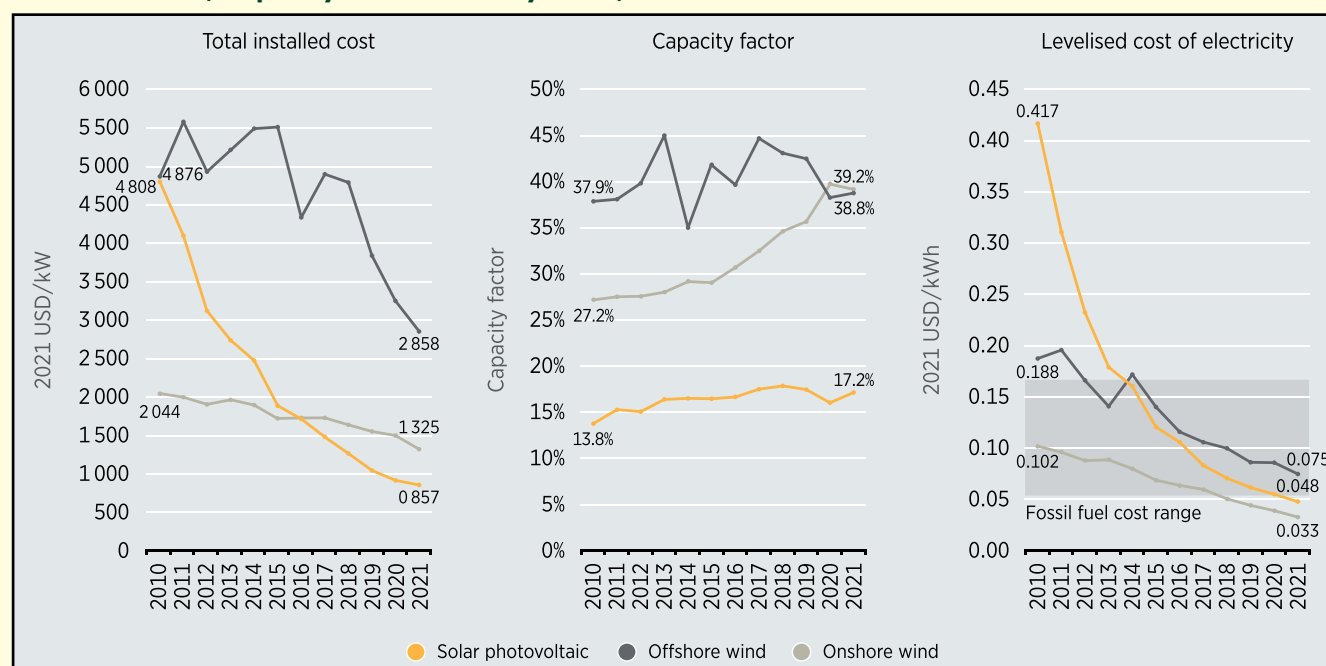
"Renewables are by far the cheapest form of power today," IRENA Director-General Francesco La Camera said. "2022 is a stark example of just how economically viable new renewable power generation has become. Renewable power frees economies from volatile fossil fuel prices and imports, curbs energy costs and enhances market resilience – even more so if today's energy crunch continues."

Further reading

IRENA. 2022. Renewable Energy Costs in 2021. Abu Dhabi: International Renewable Energy Agency.

IRENA. 2022. Renewable Energy Power Remains Cost-Competitive amid Fossil Fuel Crisis. 13 July, 2022. Abu Dhabi: International Renewable Energy Agency.

Installed costs, capacity and electricity costs, 2010-2021



SOURCE: IRENA



posed in late 2021 an offshore wind power plant in the northern Vietnamese port city of Hai Phong with an estimated investment of between USD 11.9 billion and USD 13.6 billion, and a total capacity of 3,900 MW. TGS Group and German wind turbine maker SkyWind GmbH meanwhile set up a joint venture in Viet Nam in May this year to commercialise SkyWind's two-blade wind turbine technology in the country. According to SkyWind, two blades give almost the same output as three blades. The advantages of only two blades include lower costs with lighter and simpler solutions, new installation technology, and twin-rotor systems where turbines can be closer together. SkyWind says the twin-rotor concept will result in reduced energy costs.

FDi Intelligence, a unit of the London-based *Financial Times* newspaper, notes that hydrogen's use as an energy fuel dates back to the nineteenth century. Now, in the twenty-first century, "the most abundant chemical element on the earth's surface can be used to decarbonize hard-to-abate sectors, at least if produced from renewables," it wrote in the *Switch Report* for 2022 published earlier this year.

'A bankable concept'

"Although it is today still predominantly produced using fossil fuels, the falling price of electrolyzers and the concomitant falling price of renewables-generated electricity have introduced the green production of hydrogen as a bankable concept – where wind and solar are used to power electrolysis," it said. Electrolyzers produce hydrogen through a chemical process known as electrolysis which separates the hydrogen and oxygen molecules that comprise water.

According to the *Switch Report*, the long-term policy



A two-blade wind turbine developed by German company SkyWind, which has formed a joint venture with TGS to commercialise the technology in Viet Nam. SkyWind erected this 3.4-MW prototype near the German town of Husum in 2019. According to Husum-Online, a local news service, SkyWind installed the 140 m tower and two blades spanning 100 m without a crane. "The first innovative feature is the tower, which was assembled from precast concrete parts up to a height of 80 meters," Husum-Online wrote at the time. "Only then was a tubular steel tower placed on top. The whole tower in turn served as a winch for the rotor. Steel cables, without the use of a crane, were used to bring the component, which weighs over 100 tonnes, into position. This form of installation is also an innovation. It could save a lot of costs in construction site logistics."

PHOTO: ARNTZEN/ WINDTESTFELD-NORD

commitment for governments "remains the enabling element for a technology whose competitiveness has yet to come of age." Starting with Japan in 2017, FDi Intelligence noted that more than 30 countries had issued hydrogen strategies, and that the value of the

existing pipeline of announced projects in green hydrogen had reached an estimated USD 500 billion through to 2030.

But the cost of producing green hydrogen – renewable electrolytic hydrogen – is still high, mainly owing to the cost of equipment and the large amount of energy needed per kg of hydrogen produced. “Nevertheless, economies of scale driven equipment cost reduction and cheaper and cheaper renewable energy could bring green hydrogen on par with fossil originated hydrogen well before 2030,” the report said.

Green hydrogen heats up in 2020-2022

FDi Intelligence said green hydrogen had emerged as a global phenomenon from the outset – at least with regards to deployed capacity – with a handful of mostly European countries the clear frontrunners in manufacturing electrolyzers. Of the USD 25.2 billion invested in 2021, 35 percent flowed into Europe, 24 percent went to Latin America and the Caribbean, 22 percent to Africa and 14 percent to the Middle East. Only 5 percent targeted the Asia-Pacific region.

“Some countries are pursuing a capital-intensive, exports-driven model that borrows a leaf from the oil and gas book,” the report said. “Others are adding the green hydrogen component to their ongoing renewable energy plans to meet domestic demand.”

According to FDi Intelligence, “the hydrogen hype has carried into 2022 with several countries now willing to leapfrog the green transition by going straight into renewable energy-based green hydrogen production.” Beyond large-scale, export-oriented projects – whose feasibility and business models have yet to be tested in real life – several developed countries had launched green hydrogen strategies balancing domestic needs with export opportunities or import needs, it said. For example, Australia had already signed deals to export hydrogen to both Japan and South Korea.

“It is still a glass half full for Europe as the region is the world’s main supplier of electrolyzers,” the report said, noting that its market share of installed capacity was 40 percent. According to the International Energy Agency (IEA) in Paris, global capacity of electrolyzers doubled over the previous five years to reach just over 300 MW by mid-2021 and could reach up to 54 GW by 2030. “The geography and level of feasibility of green hydrogen developments will heavily hinge also on the availability of its main production input – water.”

Green versus blue hydrogen

Citing a report by the Abu Dhabi-based International Renewable Energy Agency (IRENA), FDi Intelligence noted that hydrogen is a conversion rather than extraction business and therefore unlikely to yield the same sort of revenues and global trade dynamics as oil and gas today. Some companies have leaned on “blue” hydrogen – produced using natural gas where the carbon dioxide emitted is captured using carbon storage (although this step is far to be proven at the required scale).

“Others have committed the whole nine yards to green hydrogen at required scale, taking the blue hydrogen off the table of possible decarbonization options today,” the report said. “Under whatever shade, they are able to keep a foothold in the fossil fuel-adjacent camp of the future, retaining an industrial customer base, while separately developing renewable assets to supply clean electricity to the grid.”

Fossil fuel exporters are meanwhile “keenly aware of hydrogen’s potential and, due to their wind and solar potential, have looked towards green hydrogen development,” the *Switch Report* said. “However, the real feasibility of either option – green or blue hydrogen – eventually hinges on their competitiveness and technology readiness.

“While green hydrogen relies on tested renewable energy generation and hydrolyser technologies whose costs decrease with scale and efficiency, blue hydrogen depends on natural gas costs, currently under great upward pressure, as well as on the development of carbon capture and storage (CCS) technologies.”

The report noted that the world currently has only one commercial CCS project up and running – in Iceland. But its capacity is only a fraction of the capacity blue hydrogen projects would require. “Only when CCS becomes scalable at a competitive cost will blue hydrogen become a viable option,” it concluded.

* Mr Thuy is a journalist based in Ho Chi Minh City

Further reading

FDi Intelligence. 2022. *The Switch Report 2022*. London: Financial Times Ltd.

Skywind website: <https://skywind.de/solution/>

TGS Group website: <https://thegreensolutions.vn/en/home.html>



Viet Nam considers **reviving** stalled **plans** for two **nuclear** power plants

BY TUONG THUY *

'The plans were just suspended, not completely cancelled'

In 2009, Viet Nam's National Assembly adopted a resolution on developing nuclear power plants in two coastal districts in the south-central province of Ninh Thuan. Seven years later, the parliament decided to put the projects on hold after the Fukushima nuclear disaster in Japan in 2011. In May this year, however, the National Assembly's Economic Committee proposed reviving the two projects – with Russian and Japanese partners – given the country's transition to sustainable energy to achieve a net-zero goal by 2050.

Speaking to the National Assembly on May 30, Industry and Trade Minister Nguyen Hong Dien said developing nuclear power was an "inevitable trend" for Viet Nam even if the National Assembly had shelved the plans in 2016. Dien said authorities were now consid-

ering resuming plans to build the two proposed plants, with a combined capacity of 4,000 megawatts. "The plans were just suspended, not completely cancelled," the minister said.

Dien explained that current power supplies in Viet Nam generally came from coal-fired or hydropower plants. But coal-fired power has reached its limits and there's no room left for more hydropower, which has helped fuel soaring investments in renewable energy by both foreign and domestic companies. The minister noted that the United States and Germany started the process of putting an end to nuclear power a few years ago but were now developing nuclear power roadmaps for renewable energy development.

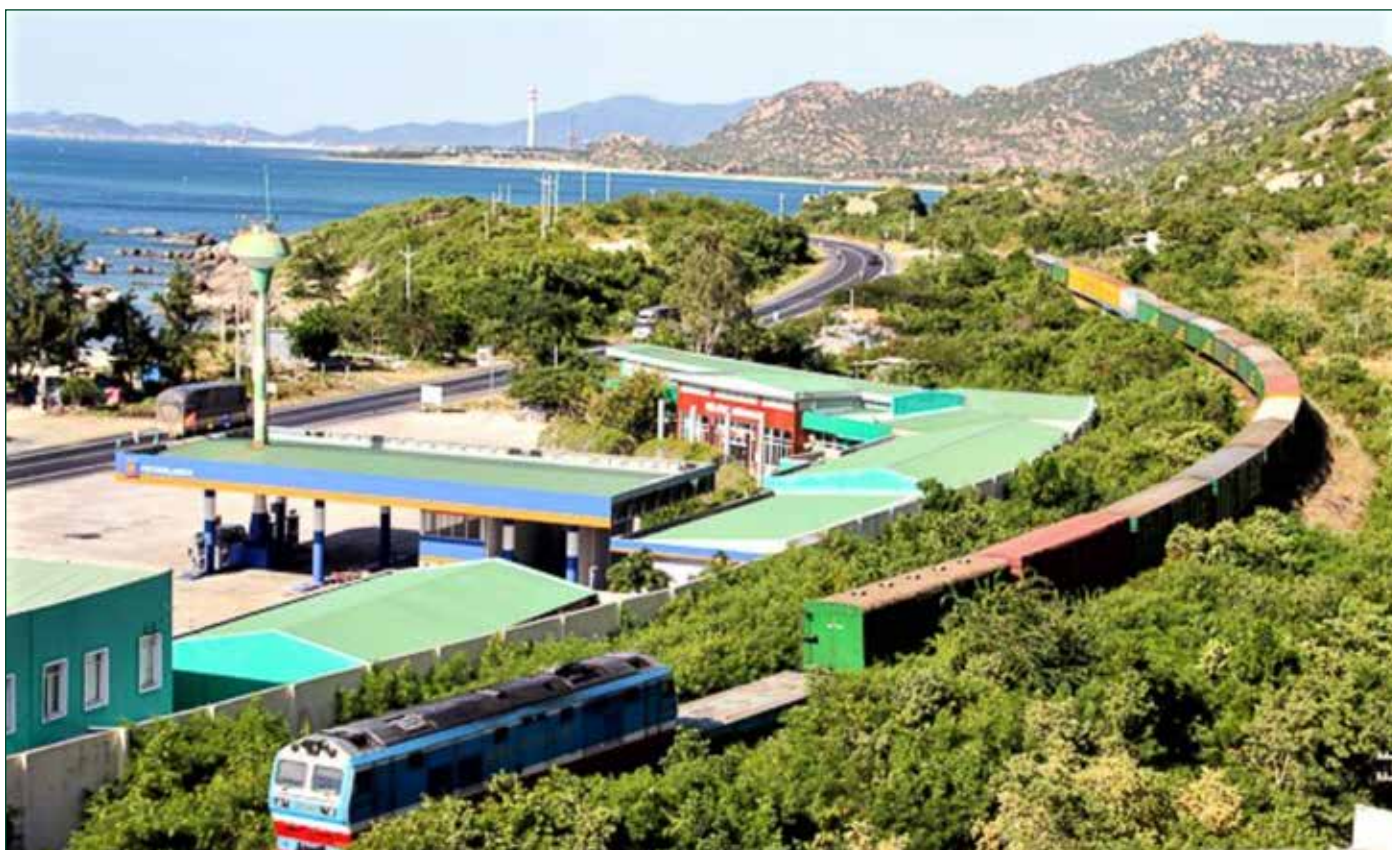
Dien noted that the Russian and Japanese partners along with Vietnamese government agencies had cautiously researched possible locations before selecting the two sites in Ninh Thuan province – Vinh Truong village in Thuan Nam district (Ninh Thuan 1 plant) and Thai An village in Ninh Hai district (Ninh Thuan 2 plant). However, contracts have not yet been signed with either partner.

According to the National Assembly Economic Committee, canceling the two projects would affect nuclear power development in the future and hurt relations with the Russians and Japanese. At the same time, however, the committee said authorities needed to work out measures to help local residents affected by planning for the two projects to stabilize their living conditions and



Industry and Trade Minister Dien

PHOTO: BAO CONG THUONG



A coastal neighborhood in Ca Na commune in Thuan Nam district, home to the site allocated for the Ninh Thuan 1 nuclear power plant in partnership with Russia if it goes ahead

PHOTO: BAO NINH THUAN



A grape grower in Thai An village in Ninh Hai district, the site allocated for the Ninh Thuan 2 nuclear power plant which would be built in partnership with Japan if it goes ahead

PHOTO: BAO NINH THUAN

protect their legitimate rights.

The committee meanwhile noted that the Ministry of Education and Training had worked with Russian institutions to provide nuclear power training for hundreds of Vietnamese students between 2010 and 2018. During this period, 447 Vietnamese pursued nuclear power studies in Russia including six who are still there, expecting to complete their studies by 2024. The remaining 441 have either already completed their studies or dropped out.

** Mr Thuy is a journalist based in Ho Chi Minh City*

Further reading

VNA. 2020. There is no ground to cancel nuclear power planning: Minister, May 30, 2022. Hanoi: Vietnam News Agency. <https://en.vietnamplus.vn/there-is-no-ground-to-cancel-nuclear-power-planning-minister/229414.vnp>



Time is ripe to transform the world's aquatic food systems

BY QU DONGYU *

FAO chief argues that moment couldn't be more opportune to make fisheries and aquaculture more efficient, inclusive and resilient

Despite significant previous progress, the world is off track to end hunger and malnutrition in all its forms by 2030. Degraded ecosystems, an intensifying climate crisis, and increased biodiversity loss are threatening jobs, economies, the environment and food security around the globe, all aggravated by the impacts of the Covid-19 pandemic, crises and other humanitarian emergencies. Today, 811 million people suffer from hunger and 3 billion cannot afford healthy diets.

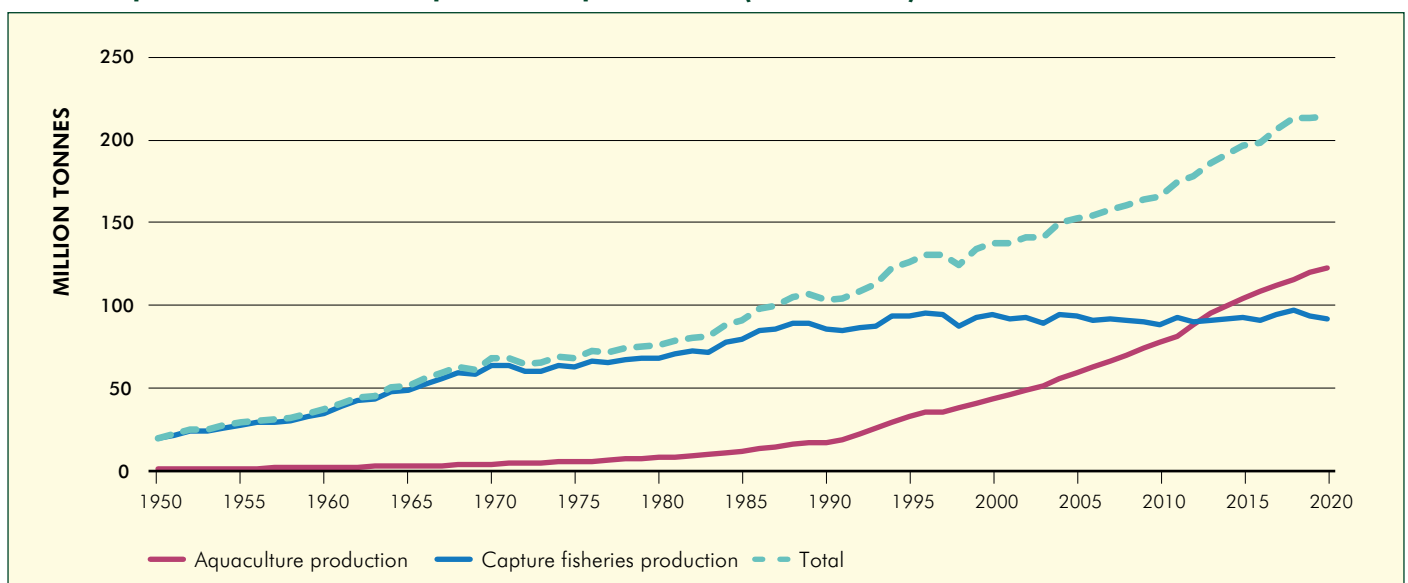
This has elevated the calls to urgently transform our agrifood systems to ensure food security, improve nutrition and secure affordable healthy diets for a growing population, while safeguarding livelihoods and our natural resources.

Aquatic foods are increasingly recognized for their key role in food security and nutrition not just as a source of protein, but also as a unique and extremely diverse provider of essential omega-3 fatty acids and bioavailable micronutrients. Prioritizing and better integrating fisheries and aquaculture products in global, regional and national food system strategies and policies should be a vital part of the necessary transformation of our agrifood systems.

'We are eating more aquatic foods than ever – about 20.2 kg per capita in 2020 – more than double our consumption rate 50 years ago'

Fisheries and aquaculture play a growing role in providing food, nutrition and employment. In 2020, fisheries and aquaculture production reached an all-time record of 214 million tonnes, worth about USD 424 billion. Production of aquatic animals in 2020

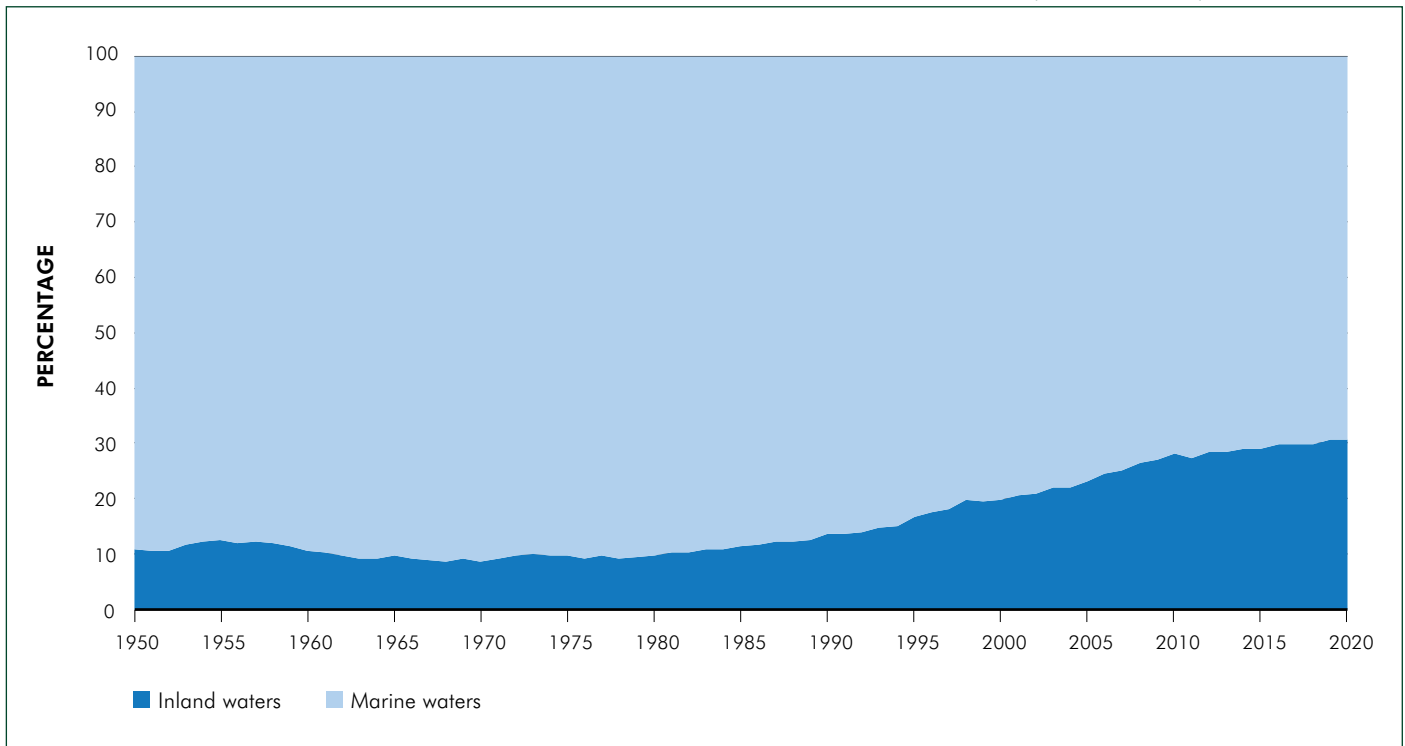
World capture fisheries and aquaculture production (1950-2020)



Note: Aquatic animals excludes aquatic mammals, crocodiles, alligators and caimans. "Algae" include multicellular macroalgae (e.g. seaweeds), unicellular microalgae (e.g. *Chlorella* spp.), and Cyanobacteria, not true algae but informally known as "blue-green algae" (e.g. *Spirulina* spp.) Data expressed in live weight equivalent.

SOURCE: FAO (2022)

Inland and marine shares of world fisheries and aquaculture production (1950-2020)



Note: excludes aquatic mammals, crocodiles, alligators, caimans and algae

SOURCE: FAO (2022)

was more than 60 percent higher than the average in the 1990s, considerably outpacing world population growth, largely due to increasing aquaculture production. We are eating more aquatic foods than ever – about 20.2 kg per capita in 2020 – more than double our consumption rate 50 years ago. Globally, aquatic foods provide about 17 percent of animal protein, reaching over 50 percent in several countries in Asia and Africa. The sector employs an estimated 58.5 million people in primary production alone – approximately 21 percent women.

Further changes are needed in the fisheries and aquaculture sector to address the challenges of feeding the world effectively, equitably and sustainably. Acceleration is required to achieve a sustainable, inclusive and efficient sector able to meet expectations, the urgent need to integrate sustainably harvested aquatic foods into national food system policies and programmes, and opportunities to contribute to restoring aquatic habitats and biodiversity.

The Declaration for Sustainable Fisheries and Aquaculture, unanimously endorsed in 2021 by the Thirty-fourth Session of the FAO Committee on Fisheries (COFI), concludes with a call to support “an evolving

and positive vision for fisheries and aquaculture in the twenty-first century, where the sector is fully recognized for its contribution to fighting poverty, hunger and malnutrition.” At the same time, three relevant United Nations decades – namely the Decade of Action to deliver the Global Goals, the Decade of Ocean Science for Sustainable Development, and the Decade on Ecosystem Restoration – are now being implemented along with the International Year of Artisanal Fisheries and Aquaculture 2022.

The policy landscape could not be more ambitious and the moment more opportune to transform towards more efficient, more inclusive, more resilient and more sustainable aquatic food systems to help achieve the Sustainable Development Goals.

** Mr Qu is Director-General of the Food and Agriculture Organization of the United Nations (FAO). The text above is based on his foreword to this year’s State of World Fisheries and Aquaculture report, a flagship publication of the FAO, released on June 29.*

Further reading

FAO. 2022. The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation. Rome, FAO. <https://doi.org/10.4060/cc0461en>



World's inland catches still historically high as aquaculture keeps growing

Extracts from the State of World Fisheries and Aquaculture report for 2022, published by the Food and the Agriculture Organization of the United Nations (FAO) on June 29

With fishing operations severely affected by Covid-19, global catches from inland waters fell 5.1 percent from a year earlier to 11.5 million tonnes in 2020. Lower catches in China compounded the decline. Yet inland catches remained at historically high levels and only marginally below the highest levels of 12.0 million tonnes recorded in 2019.

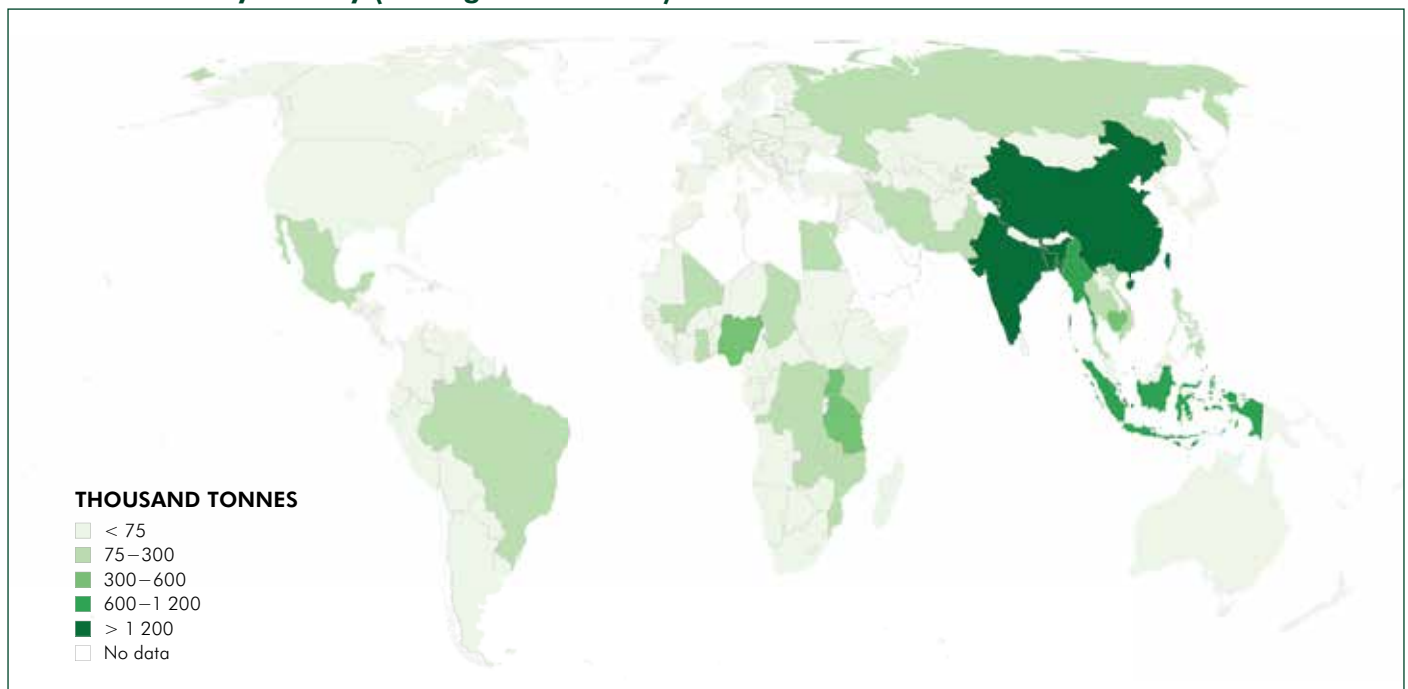
For the first time since the mid-1980s, China was not the top producer of inland water catches in 2020 and instead the highest catches were reported by India at 1.8 million tonnes. While China continues to be one of the largest producers of inland water capture fisheries, reported catches have decreased by over 33 percent from 2.2 million tonnes in 2017 to 1.5 million tonnes in 2020. This significant decrease is the result of re-

cently introduced policies by China's Ministry of Agriculture and Rural Affairs, most notably a ten-year fishing ban in the waters of the Yangtze River (see *Catch and Culture - Environment*, Vol 27, No 1).

Apart from India and China, other major producers of inland catches include Bangladesh, Myanmar and Uganda. Despite representing a relatively low contribution to global production, some countries supply important quantities to national or regional diets – in particular, Cambodia, Brazil, Viet Nam and Thailand.

Inland catches are more concentrated among major producers with important waterbodies or river basins. In 2020, 13 countries produced over 75 percent of inland catches compared with 20 countries for the marine catches (the 13 were India, China, Bangladesh, Myanmar, Uganda, Indonesia, Cambodia, Tanzania, Nigeria, Egypt, Russia, Brazil and DR Congo). For the same reason, the top inland producers are also more concentrated geographically and particularly impor-

Inland catches by country (average 2018-2020)



Note: data exclude shells and pearls, expressed in live weight equivalent

SOURCE: FAO (2022)

Data unreliable, sometimes non-existent

The long-term rising trend in inland fisheries production can partially be attributed to improved reporting and assessment at the country level. Nevertheless, many of the data collection systems for inland waters are still unreliable, or in some cases non-existent; furthermore, improvements in reporting may also mask trends in individual countries. Equally important, many countries do not report catches for inland fisheries, or they report only partial catches, while FAO estimates a proportionately higher amount of the total catches for inland waters compared with marine waters.

tant in terms of the contribution to catches in Asia, where they provide an important food source for many local communities. Asia has consistently accounted for around two-thirds of global inland water production since the mid-2000s, while the top four producers are all located in Asia and accounted for over 46 percent of total inland water catches in 2020.

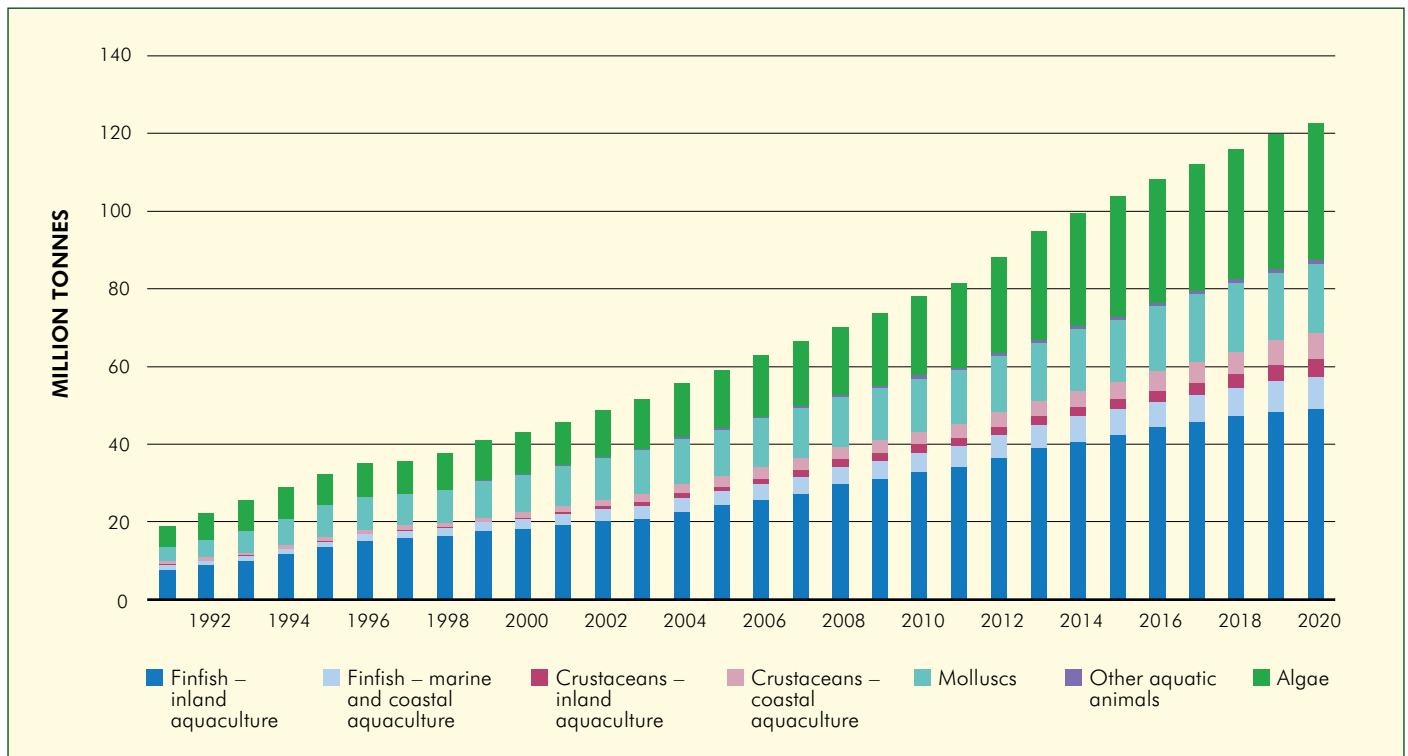
Three major species groups account for over 75 per-

cent of total inland water catches. The first group, “carps, barbels and other cyprinids”, has shown a continuous increase – rising from about 0.7 million tonnes per year in the mid-2000s to almost 1.9 million tonnes in 2020 – and explains most of the increase in catches from inland waters in recent years. Catches of the second-largest group, “tilapias and other cichlids”, have also started to increase in recent years from 0.7 million tonnes to 0.9 million tonnes per year. Catches of the third-largest group, “freshwater crustaceans”, have generally remained stable at between 0.4 million tonnes and 0.45 million tonnes per year; however, in 2020, catches fell to 0.3 million tonnes, mostly as a result of the decrease in China’s inland water catches.

Aquaculture

Global aquaculture production in 2020 comprised 87.5 million tonnes of aquatic animals mostly for use as human food, 35.1 million tonnes of algae for both food and non-food uses, 700 tonnes of shells and pearls for ornamental use, reaching a total of 122.6 million tonnes in live weight (see chart below). This represents an increase of 6.7 million tonnes from 115.9 million tonnes in 2018. The estimated total farm gate value was USD 281.5 billion in 2020, an increase of USD 18.5 billion from 2018 and USD 6.7 billion from 2019.

World aquaculture production (1991-2020)

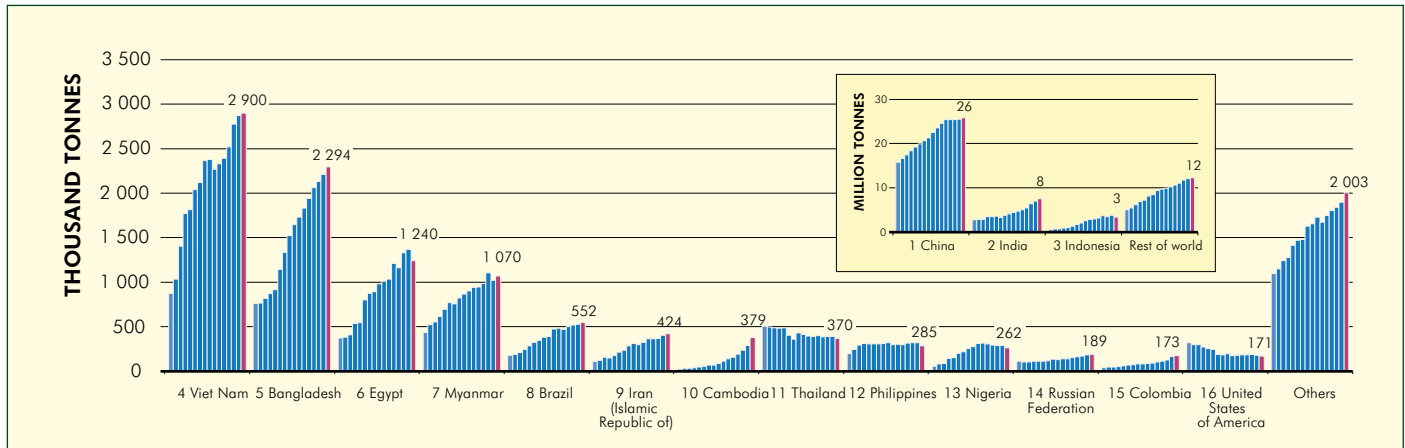


Note: data exclude shells and pearls, expressed in live weight equivalent

SOURCE: FAO (2022)



World inland aquaculture production by finfish (2005-2020)



SOURCE: FAO (2022)

For animal species, world production grew by 2.7 percent in 2020 compared with 2019, an all-time low rate of annual growth in over 40 years. However, the

net increase of 2.3 million tonnes in the same period was comparable to some years in the last decade. Finfish farming remained steady with minimal fluctua-

Genetic improvement in breeding programmes

Genetic improvement of farmed species can increase the efficiency of aquaculture and decrease its environmental footprint. High levels of genetic diversity and fecundity among species permit high selection intensities to improve commercially important traits. But as a relatively young food industry, aquaculture lags far behind livestock and crops where thousands of improved breeds and varieties have been developed.

The wider adoption of genetic tools in aquaculture is hindered by poor understanding of traditional

and molecular technologies. Other factors include limited capacity for their application, deficiency of scientifically informed, well-managed and long-term selective breeding programmes, and lack of broader private sector engagement.

Accelerating the development and uptake of genetic improvement of aquaculture farmed types with a focus on selective breeding is one of the four priority areas in a global plan of action for aquatic genetic resources (AqGR) developed by FAO:



1. INVENTORY, CHARACTERIZATION AND MONITORING
Establish and strengthen national and global characterization, monitoring and information systems for AqGR



2. CONSERVATION AND SUSTAINABLE USE OF AqGR
Promote the conservation and sustainable use of cultured and wild relative AqGR



3. DEVELOPMENT OF AqGR FOR AQUACULTURE
Accelerate the development and uptake of genetic improvement of aquaculture farmed types, with a focus on the expansion of selective breeding programmes



4. POLICIES, INSTITUTIONS AND CAPACITY BUILDING
Promote the development of AqGR-related policies, support the development of stakeholder institutions and build capacity to support the management of AqGR

Covid adversely affects Vietnamese production of striped catfish

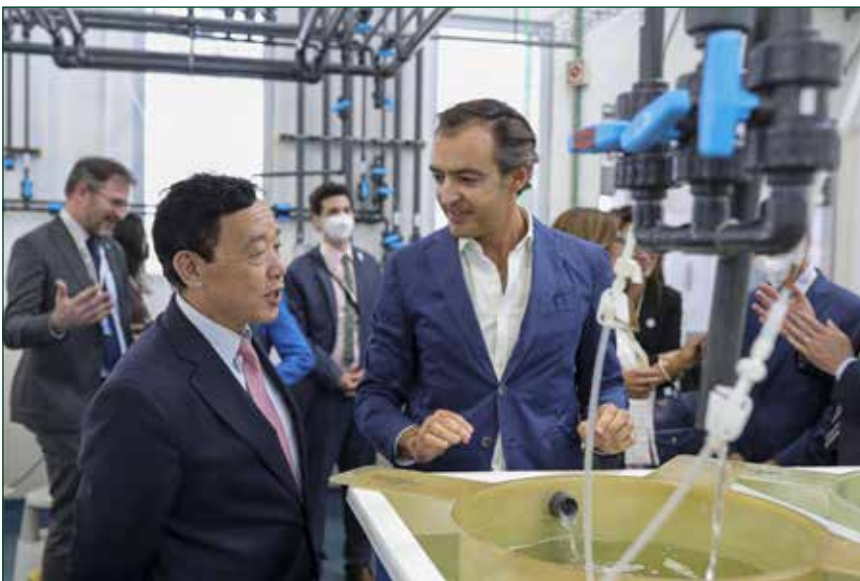
In 2021, production of striped catfish – the indigenous Mekong species known commercially worldwide as “pangasius” – suffered a downturn amid increased Covid-19 restrictions in Viet Nam. “The volume of pangasius trade has dipped considerably, as restrictions on people’s movement and factory capacity have been introduced in Viet Nam, by far the largest producer and exporter of pangasius,” the FAO publication *Globefish* reported in December last year. But “the overall value of trade has not been as heavily impacted, largely due to increased prices, especially in the United States.”

Globefish estimated that global production of pangasius would fall by 8 percent between 2020 and 2021. “This is largely due to lower Vietnamese pro-

duction which is expected to amount to 1,200,000 tonnes in 2021, down from 1,600,000 tonnes in 2020,” it said. “Production in other countries is generally destined for domestic consumption and is unlikely to see significant changes between 2020 and 2021. All three of the main producers in this category are expected see increases in volume, with Indian production rising to 600,000 tonnes (+4 percent), Bangladesh to 490,000 tonnes (+2 percent) and Indonesia to 450,000 tonnes (+6 percent).”

Further reading

Globefish. 2021. Pangasius trade takes a hit from renewed restrictions in Viet Nam. Rome: Food and Agriculture Organization of the United Nations.



FAO Director-General Qu Dongyu visiting a Portuguese mollusc farm on the sidelines of the United Nations Ocean Conference in Lisbon on June 30

PHOTO: FAO/PEDRO ROCHA

tion around 66 percent and accounting for the largest share of world aquaculture for decades.

In 2020, farmed finfish reached 57.5 million tonnes (USD 146.1 billion), including 49.1 million tonnes (USD 109.8 billion) from inland aquaculture and 8.3 million tonnes (USD 36.2 billion) from mariculture in the sea and coastal aquaculture on the shore. Produc-

tion of other farmed aquatic animal species reached 17.7 million tonnes of molluscs (USD 29.8 billion) mostly bivalves, 11.2 million tonnes of crustaceans (USD 81.5 billion), 525,000 tonnes of aquatic invertebrates (USD 2.5 billion) and 537,000 tonnes of semi-aquatic species including turtles and frogs (USD 5 billion).

China had the largest production of finfish from aquaculture in 2020 followed by India, Indonesia, Viet Nam and Bangladesh. Among other countries in the Mekong River Basin, Myanmar ranked seventh, Cambodia tenth and Thailand eleventh (see chart on opposite page).

Among both marine and freshwater finfishes farmed worldwide, striped catfish (*Pangasianodon hypophthalmus*) – which is native to the Lower Mekong – accounted for 5.1 percent of total production at 2.5 million tonnes in 2020. That compared with 2.1 million tonnes in 2015 and only 113 tonnes in 2020.

Further reading

FAO. 2022. The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation. Rome, FAO. <https://doi.org/10.4060/cc0461en>



'Constructive' outlook for sustainable bonds issued by emerging markets

Sustainable development needs are significant in emerging markets and developing economies

Amid economic and geopolitical turbulence, Moody's ESG Solutions forecast in May that global market for sustainable bond issues would be "flat" this year. According to the environment, social and governance investment unit of Moody's Investor Services, the conflict in Ukraine had "impaired global economic growth prospects, stoked existing inflationary pressures and heightened the prospects for accelerated monetary policy tightening." On 8 June, however, it issued a new report stating that the outlook for sustainable bond issues by emerging market economies "remains constructive" despite the economic and political headwinds.

In the first quarter of this year, global issues of green, social, sustainability and sustainability-linked (GSSS) bonds totalled USD 203 billion – down 11 percent from the fourth quarter and 28 percent from the first quarter of last year. But at USD 34 billion, issues by emerging market borrowers were "relatively strong" – up 22 percent and 13 percent from the corresponding quarters. Their share of the global market also rose, albeit mostly from 15 percent in the December quarter last year to 17 percent in the March quarter.

A breakdown of emerging market issues in the first quarter showed green bonds accounting for USD 18 billion, social bonds USD 1 billion, sustainability bonds \$10 billion and sustainability-linked bonds USD 6 billion. The latter were emerging as "the instrument of choice" for many emerging markets issuers, the report said, noting that the 52 percent share of green bonds was the lowest quarterly share on record. Moody's ESG concluded that this was a sign of increasing diversification as issuers seek to finance a wider array of environmental and social projects.

Such diversification "is just one potential growth driver in volumes in coming years," the report said. "We are also seeing diversification from a regional standpoint as robust issuance in relatively newer sustainable bond markets around the globe is increasingly complementing sustained growth in more seasoned markets, such

as China." From a regional standpoint, Asia Pacific issuers led emerging market issues in the first quarter with a 53 percent share.

Matthew Kuchtyak, the company's vice president for sustainable finance, reckons the recent surge in sustainable bond issues by emerging market economies will continue in the coming years. "Issuers in these markets tend to carry relatively higher exposure to environmental, social and governance (ESG) risks and have significant sustainable development needs," he said. "Although near-term market headwinds will likely temper growth in (emerging market) volumes on a temporary basis, growth should resume over the longer term given the significant challenges faced by issuers in these markets.

"Developing economies, for example, tend to be more highly exposed to the effects of physical climate

EVN unit makes first green bond offering

Vietnam Electricity unit EVNFinance has signed deals for the country's first local-currency internationally certified green bond amounting to VND 1,725 billion (USD 75 million). GuarantCo, part of the London-based Private Infrastructure Development Group, announced in July that it had provided a partial credit guarantee of VND 1,150 billion (USD 50 million) to support the deal. It said proceeds would allow the Vietnamese company to issue longer term loans for green infrastructure including the country's fast-growing solar sector. "EVNFinance's green bond issuance is expected to contribute to Vietnam's commitment to its transition to a low carbon economy and the company's strategy on green financing," chief executive Nguyen Hong Hai said.

Further reading

GuarantCo. 2022. GuarantCo provides EVNFinance a VND 1,150 billion (c. USD 50 million) partial credit guarantee to support the issuance of Vietnam's inaugural internationally verified green bond. London: GuarantCo.

Asia-Pacific consumers care as much about environment as European and American counterparts

Global awareness of environmental, social and governance (ESG) issues is growing rapidly. But “nowhere is it growing faster or more dramatically than in the Asia-Pacific region,” says Bain & Company, an American management consulting firm. In January this year, Bain surveyed more than 6,000 consumers in 11 countries in the region – Australia, China, India, Indonesia, Japan, South Korea, Malaysia, the Philippines, Singapore, Thailand and Viet Nam. The survey covered five consumer segments, namely environmental and socially conscious consumers, health conscious consumers, value seekers, quality conscious consumers and lifestyle seekers. Results were compared with consumer surveys in Europe last year and the United States this year.

Published in June, the survey findings debunked some long-held myths. “Our research determined that the region’s consumers are as concerned about environmental issues as those in Western countries and that they care more about health as a purchasing criterion,” Bain said. “Also, they are less concerned than their counterparts in Europe about social criteria.”

Another surprising discovery was that it’s not only consumers in richer countries that are motivated by environmental and social issues. In fact, the opposite is true – consumers in China, India, Indonesia, Thailand, Malaysia, the Philippines and Viet Nam are more conscious of environmental and social factors than those in Australia, Japan, South Korea and Singapore. “As an extreme example, the environmentally and socially conscious segment of con-

sumers is five times greater, on a percentage basis, in China than in Japan,” Bain said.

The survey shattered another popular myth – that only young and affluent consumers are truly sustainability conscious. Across the region, the percentage of consumers identifying as both environmentally/socially conscious and health conscious was roughly the same for survey participants aged 18 to 34 as it was for those 60 years and older. Similarly, sustainability-conscious consumers accounted for the same portion of low and high-income groups (14 percent for both).

“It’s fantastic to see consumers across Asia-Pacific demonstrating enthusiasm and demand for sustainable products, showcasing the vast opportunity brands have in front of them,” said David Zehner, the Asia-Pacific head of Bain’s consumer practice who co-authored the report on the survey findings. “By helping to educate consumers, improve availability and options, drive clearer, consistent information across all touchpoints like packaging and website, brands can take full advantage of this shopper inflection point and command the market going forward.”

Further reading

Bain. 2022. Asia-Pacific Consumers Embracing And Demanding Sustainability At Record Levels. 3 June, 2022. Hong Kong: Bain & Company.

Lightowler, Z., G. Mattios, J. Yang and D. Zehner. 2022. Unpacking Asia-Pacific Consumers’ New Love Affair with Sustainability. Boston: Bain & Company.

change,” Kuchtyak said, pointing to report by Four Twenty Seven Inc., a Berkeley-based climate change advisory firm which is now part of Moody’s ESG. The report found that nearly 50 percent of farmland in Cambodia, Lao PDR and Viet Nam would be exposed to flooding by 2040. Moreover, an estimated 70 percent of Cambodians, 49 percent of Lao people and 67 percent of Vietnamese would also be exposed to floods. “The exposure to floods and heavy rainfall in these areas means that such severe events may occur more often, or when they do occur, they will bring more inundation than historical floods which will affect national budgeting, the tax based and risk management practices,” the report said.

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Moody’s (2022) Sustainable bond issuance to be flat in 2022 amid market headwinds. 11 May, 2022. New York: Moody’s ESG Solutions.

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Critically endangered giant salmon carp caught in reservoir of Mekong tributary

BY CHHUT CHHEANA *

Rare specimen preserved in government laboratory for future research

The giant salmon carp (*Aptosyax grypus*) is endemic to the Mekong. It is relatively new to science, having first been described by the American ichthyologist Walter Rainboth in 1991. In his description of the species in a field guide published by the Food and Agriculture Organization of the United Nations (FAO) five years later, Dr Rainboth wrote that the fish could grow to 100 cm and was most common along the Lao-Thai border at the mouth of the Mun River, a major Thai tributary of the Mekong. But “its numbers have decreased drastically in recent years.” Moreover, “it is now extremely rare in Cambodian waters.”

In 2013, the International Union for the Conservation of Nature (IUCN) assessed the species as critically en-

dangered, meaning it faces an “extremely high risk of extinction in the wild in the immediate future.” According to the assessment, conducted by Thai ichthyologist Chavalit Vidthayanon in 2011, the population had plunged by more than 90 percent over the previous decade due to overfishing and habitat degradation. The fish was believed to be still resident in Lao waters but “possibly extinct” in Cambodia and Thailand.

On June 28 this year, however, a Cambodian fisherman caught a giant salmon carp in the upper part of the Sesan II hydropower reservoir on the Sesan River, a major tributary of the Mekong that originates in Viet Nam. The 88-cm specimen weighed 6 kg.

Chan Sokheng – Deputy Director of the Fisheries Technology Research Office at Cambodia’s Inland Fisheries Research and Development Institute (IFReDI) – arranged



The giant salmon carp caught in the Sesan II hydropower reservoir in June

PHOTO: CHHUT CHHEANA/WONDERS OF THE MEKONG



The specimen weighed 6 kg and had a total length of 88 cm

PHOTO: CHHUT CHHEANA/WONDERS OF THE MEKONG

to transport the fish from Stung Treng province to Phnom Penh, where it was preserved to keep in a laboratory.

“I’ve been working in the Mekong region for almost 30 years. I go back and forward to work in the upper part of the Cambodian Mekong and this is the second time I have seen a pasanak,” he said, using the Khmer term for the fish which is derived from the Lao and Thai name (see box). Mr. Sokheng said he first saw the species at a market in Stung Treng in 2020, after a fisherman caught a 20-kg specimen from the same reservoir. But he was unable to purchase the specimen as he was outbid by a rival buyer.

Chaiwut Grudpan, from the Department of Fisheries of Ubon Ratchathani University in northeast Thailand, expressed surprise at the salmon carp’s presence in the reservoir. “Its numbers are poorly recorded because it is not a target fish for fishermen. Its presence is surprising and very interesting to me,” he said.

Between 2008 and 2009, Dr Chaiwut accompanied

‘Nutcracker fish’

In the Lao and Thai languages, *sanak* are cutting tools used by people who consume betel leaves or nuts from the areca palm. According to Dr Chaiwut, the mouth of the giant salmon carp is said to resemble such implements, which are commonly referred to as “areca nutcrackers” in English. The words *pa* and *pla* mean “fish” in Lao and Thai. Cambodians employ the Lao term *pa sanak*, to which they add *trey*, their own word for fish, hence the name *trey pa sanak* in Khmer. Such fusion of Khmer and Lao names is common in northeast Cambodia, where many local fish species are not widely found in other parts of the country.

retired Japanese professor Yoshio Tomoda to do surveys of the species with local communities in Ubon Ratchathani and the southern Lao province of Champasak.



Inland Fisheries Research and Development Institute (IFReDI) officer Pich Sereyath displays the giant salmon carp before preservation

PHOTO: CHHUT CHEANA/WONDERS OF THE MEKONG



Checking the gill rakers before preservation

PHOTO: CHHUT CHHEANA/WONDERS OF THE MEKONG

According to Dr Chaiwut, research has indicated that the species migrates into deep pools in the Mekong River during cooler months, generally from November to January. During the migration period, the fish often jumps out of the water, making it an easy catch for fishermen. Because of this behaviour, fishermen in Thailand refer to it as a “stupid fish”, Dr Chaiwut said.

Mr Sokeng said discussions with Cambodian fishermen on the Srepok River – a tributary of the Sesan also originating in Viet Nam – led him to the same conclusion that the species migrates to deep pools and that individuals may now be trapped in the reservoir. Assuming that some giant salmon carps are still present, he is keen to conduct research in the area to conserve the habitat.

* Mr Chheana is the Wonders of the Mekong project's communications and outreach specialist and also graphic designer for Catch and Culture - Environment.

Further reading

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Acoustic telemetry **survey** in **Cambodia** complements MRC fish **monitoring** in **Lao PDR**

BY PATRICK O'BRYAN *

US fisheries and environmental consulting company teams up with local partners to track fish movements in northern Cambodia

As part of an international effort to study the migratory behaviors of important Mekong fish species, the first ever acoustic telemetry receiver network has been deployed in the Cambodian Mekong. During a rigorous two weeks working in the field in June 2022, biologists from FISHBIO worked with collaborators from Young Eco Ambassadors (YEA) and officials from the Inland Fisheries Research and Development Institute (IFReDI) to deploy a network of acoustic receivers throughout the mainstem Mekong River and Sekong, Sesan, and Srepok (3S) rivers of northeastern Cambodia. This effort is part of the Wonders of the Mekong project funded by the US Agency for International Development (USAID).

What is acoustic telemetry?

Acoustic telemetry is a technology utilized by fisheries researchers to track both large and small scale movements of fish. The migratory behaviors of fish that are surgically implanted with an acoustic tag and released back into the watershed are recorded by a network of acoustic receivers. These receivers detect the unique codes emitted by each acoustic tag, and when placed throughout a river system they can provide valuable data on fish movement patterns and survival. Each acoustic receiver can only detect tags at a limited range, so it is critical to strategically place receivers to maximize the likelihood of tag detection across the entire width of a river channel and ensure tagged fish are recorded while moving through large watersheds. In a river as large as the Mekong, this required meticulous site surveys and identification of areas suitable for receiver deployment.

Our study's acoustic receiver network

The acoustic network installed by FISHBIO, YEA, and IFReDI encompasses a large portion of the Mekong River in Cambodia from the border with Lao PDR, near the village of Preah Romkel, south to Kampong Cham, a city about 300 kilometers downstream. There are

also multiple receivers in the Sekong, Sesan, and Srepok rivers, three major tributaries that join the Mekong near the city of Stung Treng.

In total, 32 acoustic receivers were deployed throughout the basin at suitable locations that had been identified during scouting surveys conducted in early 2022. Four of these receivers were attached to existing docks and floating homes along the Mekong's edge, while the other 28 were mounted on floating platforms that were custom built by local communities in Preah Romkel and Stung Treng. These floating platforms were constructed using plastic barrels or jugs and secured in place using lengths of rope attached to anchors on the river bottom.

'Initial readings suggest that the receiver stations should provide excellent coverage of the river channels where they are deployed'

Four additional receivers were scheduled to be deployed by YEA and IFReDI staff in late July 2022, further expanding the coverage of the receiver network. Two of these receivers were to be deployed further upstream on the Sekong River in Siem Pang using floating platforms. The other two receivers have an acoustic-release mechanism, and were to be deployed by sinking them to the bottom of deep pools using a heavy anchor. These sunken receivers are later retrieved by sending an acoustic signal that triggers the release mechanism and allows them to detach from their anchor and float to the surface.

Special attention was given when selecting areas to install receivers near the Cambodian border with Lao PDR in order to collaborate with a team conducting a simultaneous acoustic telemetry study in that country. The Mekong River Commission's (MRC) Joint Environment Monitoring (JEM) programme recently deployed their own network of acoustic receivers on the Lao side of the border (see page 4). The goal of collaboration between these two acoustic telemetry studies is to provide information about when and where fish are mov-



SOURCE: FISHBIO

ing across the border and to help inform management and conservation of transboundary fish populations.

Fish tagging and release

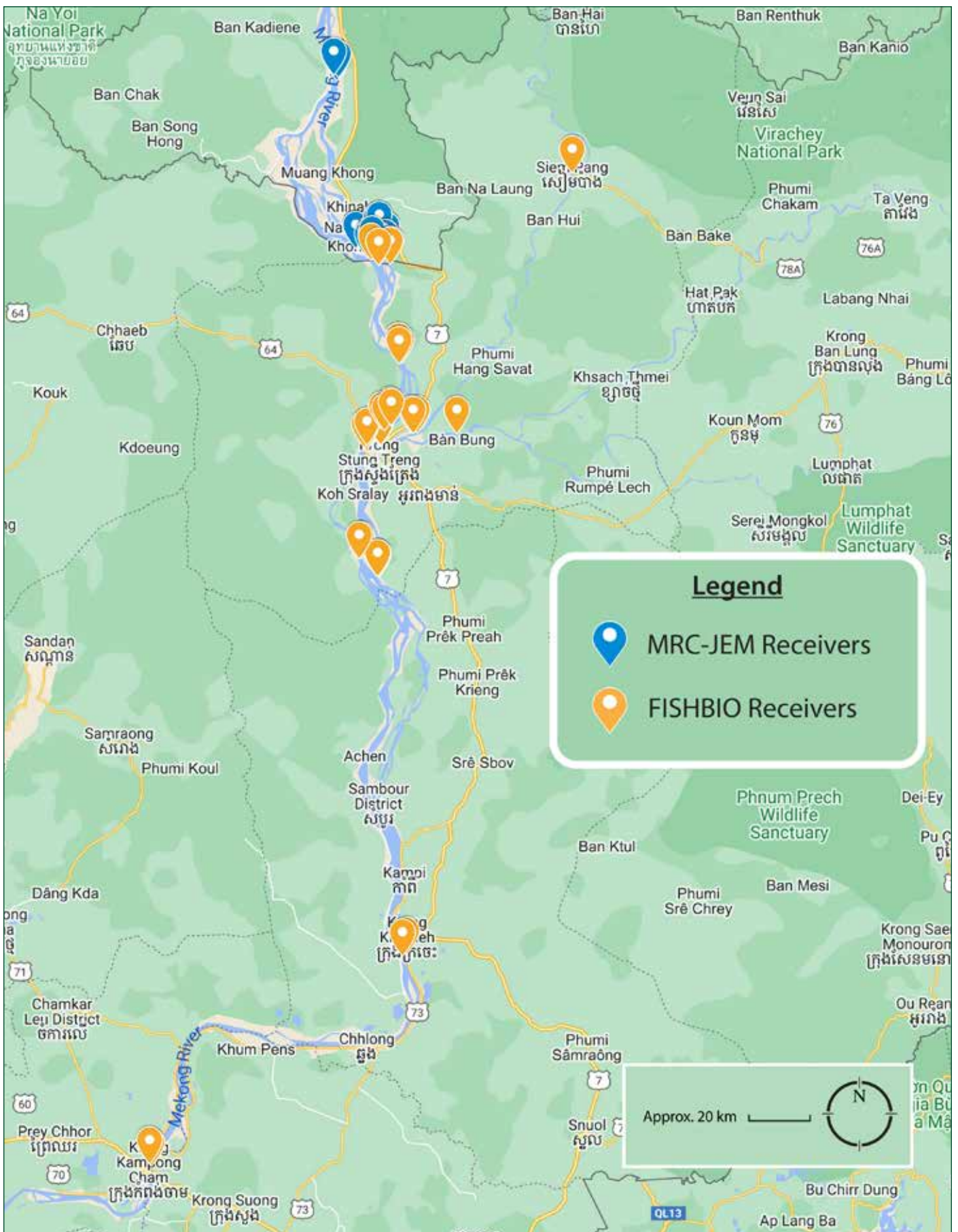
The MRC-JEM team has already begun tagging and releasing fish in southern Lao PDR, and to date has released approximately 70 tagged individuals in the vicinity of the Khone Falls on the mainstream Mekong. FISHBIO personnel are currently planning a tagging event for the start of the dry season in early December that will focus on tagging and releasing large numbers of fish in the Cambodian Mekong as well as the 3S rivers.

FISHBIO has also conducted two acoustic tag surgery training sessions: one large event with students from the Royal University of Agriculture in Phnom Penh, scientists from the Fisheries Administration, and YEA; and a subsequent refresher training with IFRaDI and YEA staff who will begin conducting initial fish tagging ef-

orts in July and August. Acoustic tagging of fish will continue for the lifetime of this study (through 2024), as each tag has a battery life of approximately one year.

Preliminary range testing during receiver deployment indicated that receivers were able to detect tags from over 300 meters away at the Preah Vihear province site near the Lao border, and from over 500 meters away at the Kaoh Hib site north of Stung Treng. Although available data do not allow for calculation of precise detection efficiencies, these initial readings suggest that the receiver stations should provide excellent coverage of the river channels where they are deployed.

During their trip to install the receiver network, FISHBIO opportunistically tagged a giant freshwater whipray (*Urogymnus polylepis*) weighing 300 kg and measuring 398 cm from the tip of the snout to the tip of the tail. This is currently regarded as the largest



MAP: FISHBIO

true freshwater fish on record. The fisher who caught the individual informed Wonders of the Mekong project scientists of the catch while the acoustic receiver deployment team was just 30 kilometers upstream in Stung Treng, allowing for an opportunistic tagging of this ray, which belongs to a poorly studied and endangered species. Biologists from FISHBIO measured, weighed, surgically tagged, and released the ray in the vicinity of where it was captured, and subsequently deployed four acoustic receivers near the capture site in hopes of tracking the movement of both the stingray and other fish that will be tagged in the region.

Community outreach

Collaboration with local communities along the Mekong has been a critical component of this acoustic telemetry study. FISHBIO, YEA, and IFRaDI have conducted meetings with villages and local communities near the areas where receivers are being deployed, and have also met and coordinated with officials from local Fisheries Administration cantonments.

The meetings helped to inform locals about the study, and community members have provided extremely useful information about hydrologic patterns, key habitats, local knowledge of fish migration behaviors, and potential sources of healthy wild fish for future tagging efforts.

Community members also played a crucial role in the construction and deployment of the receiver network, and will continue to monitor receiver stations throughout the wet season as debris and heavy flows make their way downstream. Having informed stakeholders at study sites year round in the form of community leaders and fishers greatly improves the likelihood of project success.

Why study fish migrations?

As human-driven alteration of the watershed and climate change continue to change the landscape and hydrology of the Mekong River basin, migratory fish behavior may be changing as well, and migratory species may be further threatened. The ability to track migratory behaviors with the newly deployed acoustic telemetry network in the Cambodian Mekong will provide valuable data to researchers as to when and where fish are moving through the watershed.

The Mekong River is home to a wide diversity of migratory patterns expressed by the many different species of fish that reside there. Migrations range from short

swims into seasonally flooded forest, to long distance journeys up and down the length of the Mekong River and even to the ocean. This study hopes to improve understanding of migration timing, routes, and distances in the Mekong River basin, as well as the location of important habitats. This information may in turn help guide and target conservation of key spawning and rearing habitats, as well as important migratory corridors. A better understanding of Mekong fish migrations is critical for ensuring essential habitat areas remain connected for fish to complete their life cycles.

A major focus of this study as well as the collaborative efforts of the MRC-JEM team is to document transboundary fish migrations between Lao PDR and Cambodia. Managing and conserving fish populations across international borders can be challenging, and using acoustic telemetry to gather empirical evidence of fish migrations between the two countries may help emphasize the need for international cooperation in efforts to conserve Mekong fisheries.

The Don Sahong hydropower plant on the Lao side of the border with Cambodia, which started operating commercially in 2020, represents a recent change to the important migratory corridor through the Khone Falls region, and the ability of fish to move through this newly impounded reach of the river is one of the driving questions that this acoustic telemetry study seeks to address.

The collaborative acoustic networks between FISHBIO and the MRC-JEM program will be leveraged to determine what paths fish are taking to cross between Cambodia and Lao PDR. By sharing data collected from their respective receivers, FISHBIO and the MRC-JEM team may better understand how migratory fish populations are responding to hydrological changes from dams.

By implementing acoustic telemetry to study fish migrations in the Cambodian Mekong, FISHBIO and project partners hope to provide a valuable first look at fish movement on a massive geographical scale. Understanding the impact that humans have had on the Mekong, and the response to those changes by migratory fish, is crucial to ensuring sustainable fisheries and a functional ecosystem into the future. Thanks to the cheerful and determined support from local communities, this project is well poised to provide a treasure trove of data to fisheries managers in the Cambodian Mekong.

* Mr O'Bryan is a fisheries technician at FISHBIO. For further information: danalee@fishbio.com and jackschenroeder@fishbio.com.



Viet Nam at ‘crossroads’ with Mekong Delta at ‘great risk’ from climate change

World Bank warns that economic cost of saltwater intrusion alone could hit USD 17 billion by 2030. The following extract from a report published on July 14 focuses on protecting vulnerable assets and improving disaster risk management in the Delta – home to half the country’s rice output, two thirds of its aquaculture and almost three quarters of its fruit production.

The Mekong Delta contributes 50 percent of Viet Nam’s rice production and 95 percent of rice exports, 65 percent of aquaculture production and 60 percent of exported fish, 70 percent of fruit production, and a third of Vietnam’s agricultural GDP. The early eco-

nomics success of the region has, however, come at a huge cost.

Delta’s natural systems ‘exhausted’

Rice intensification and the necessary massive water regulation infrastructure systems have exhausted the delta’s natural systems and created a whole host of issues including: increased inundation in the downstream provinces in the flood season and increased salinization in the coastal provinces in the dry season; declining fishery resources; degradation of surface water quality; overexploitation and pollution of groundwater resource; land subsidence induced by excessive groundwater extraction, sand mining in waterways and reduced sedimentation due to impoundment in dams

Regional approach with other riparian countries

The World Bank report outlines the need for five priority packages including a coordinated regional program for the Mekong Delta. “Strong coordination will be required with other riparian countries of the Mekong River Basin to ensure a proper flow of the river and reduce impoundment of sediment by river dams in the upper river basin,” it says.

The bank says the program should focus on stemming land subsidence and saltwater intrusion by curtailing sandmining and groundwater extraction, adapting farming practices, increasing freshwater flow and aquifer recharge, and restoring mangroves.

Existing physical assets should also be retrofitted to become less vulnerable to inundation, while the Land Law, including on land use planning, should be amended to prevent further encroachment on natural vegetation cover. Moreover, new developments should account for climate risks through systematic environmental assessments.

All measures will require strengthening regional coordination and correcting the “defi-

cit in public investment” of the recent past. “They will also involve revising existing transfers from the central to local governments, while encouraging the use of specific instruments, such as green bonds, to finance new projects,” the report says.



Mining sand from the Cambodian stretch of the Mekong in 2019. According to the Washington-based Global Environment Facility (GEF), “trans-boundary cooperation is essential for addressing groundwater related concerns, including water security and land subsidence” in the Mekong Delta (see *Catch and Culture - Environment*, Vol 26, No 3).

PHOTO: LEM SAMEAN

higher up in the water basin; environmental and ecosystem degradation including loss of the coastal mangrove belt; loss of Delta culture and out-migration.

‘Without adaptation measures, around 45 percent of the Mekong Delta area will be affected by salinity’

All available evidence suggests that, the Mekong Delta is at great risk from climate change. If sea levels rose by 75–100 centimeters relative to 1980–1999 levels, almost half of the delta area would be inundated. A meter of sea-level rise would inundate 79 percent of the total area of Ca Mau province and 76 percent of Kien Giang province. Without adaptation measures, around 45 percent of the Mekong Delta area will be affected by salinity, at an economic cost of about \$17 billion by 2030.

Over recent decades, the frequency and intensity of disasters such as flooding, drought, coastal and riverbank erosion, and salinization have increased significantly. These have caused human and property losses, damaged socioeconomic and cultural infrastructure, and negatively impacted living conditions (as evidenced by the fast and accelerating out-migration from the Delta region).

Important political initiative

In 2017, the Prime Minister issued the resolution on “Sustainable and Climate-Resilient Development of the Mekong Delta of Vietnam” (Resolution No. 120/NQ-CP) that could be considered the most important and transformative political initiative movement towards an integrated and adaptive approach to delta management. It particularly focused on (i) establishing ecological subregions and developing land use plans in accordance with natural characteristics; (ii) developing an integrated master plan to guide socioeconomic development of the whole region; (iii) building an economic structure based on aquaculture-horticulture-agriculture, green industries, and eco-tourism; (iv) ensuring regional coordination and connectivity; and (v) identifying breakthrough mechanisms and policies to attract non-budget capital resources, especially from the private sector. In February 2022, the first regional masterplan was approved for the Mekong Delta building the way toward investment planning and implementation.

Recommendations

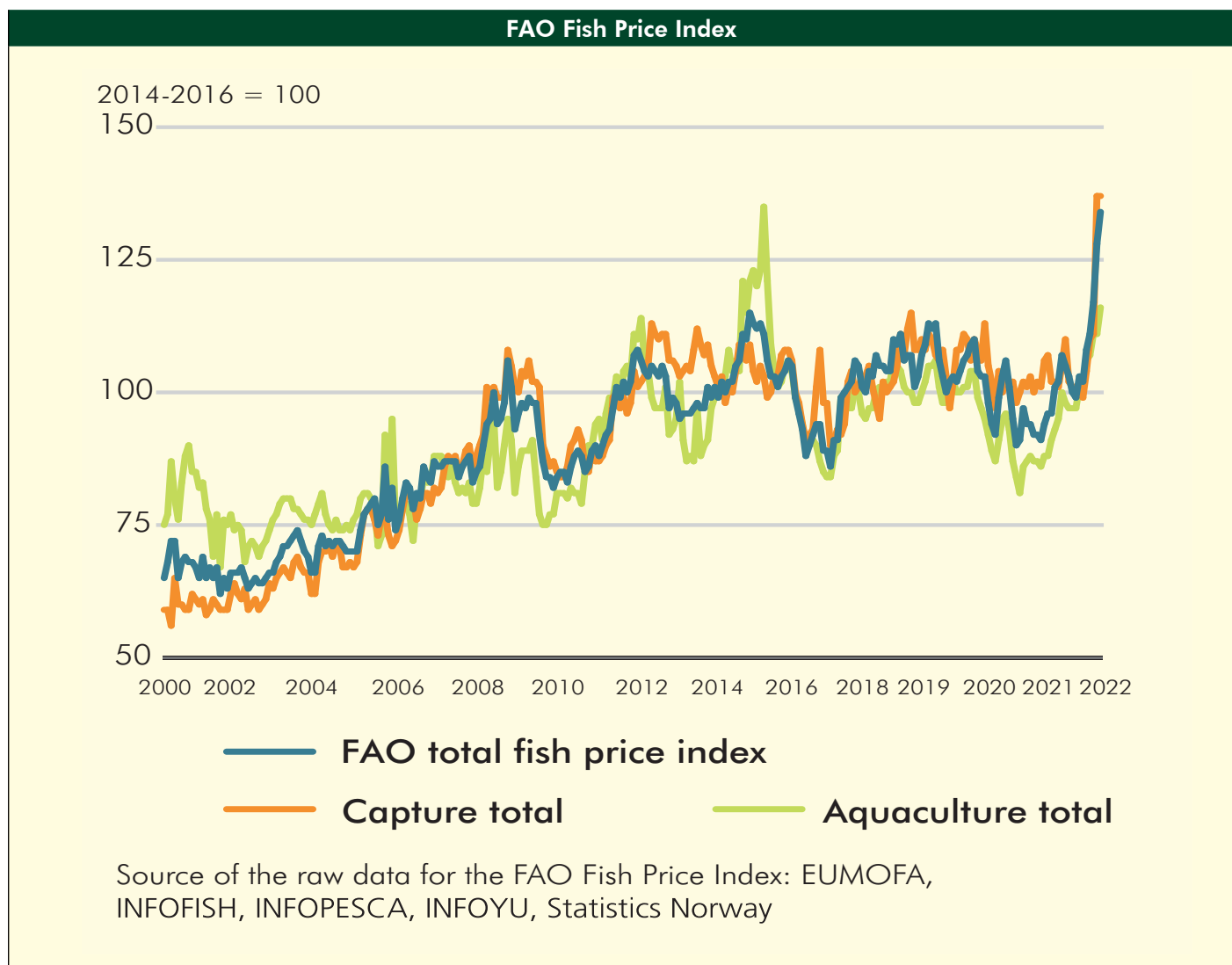
- Implement and enforce conservatory measures. The

list includes curtailing sandmining and groundwater extraction that cause land subsidence, which is currently a more significant factor of inundation of the Delta than sea-level rise; widening the adoption of farming practices that are better adapted to increasing salinization (e.g., mixed rice and shrimp farming); increasing freshwater flow and aquifer recharge to offset saltwater intrusion; and protecting and restoring mangroves that protect the land against storms and produce ecological and livelihoods benefits.

- Implement, with urgency, a coordinated regional investment program in the Mekong Delta: The Regional Coordination Council (RCC) could play this role, but it does not yet have the mandate to prioritize or implement these investments. Investments could include, but not be limited to, restoration of wetlands to manage flood and droughts; dikes, wave breakers, and mangrove belts to protect from sea-level rise; and alternative livelihoods investments for those affected by salinity intrusion.
- Correct the deficit in public investment that has built up in recent years in the Mekong Delta: One way is to introduce special provisions in the Public Investment Law to allow streamlining of approvals. In addition, funds should be made available to prepare project proposals, and the approval processes (such as contracting consultants to prepare the Project Investment Policy/Pre-Feasibility Studies/Feasibility Studies) should be streamlined. Such actions would help minimize delays in preparation and subsequent approval and implementation of investments.
- Adopt innovative instruments that can help further mobilize additional resources. These include risk sharing instruments such as guarantees in which public money is blended with private capital through a risk sharing mechanisms; green banking and green loans that make financing available for projects that are considered to contribute to climate-resilient development; and green bonds in which proceeds will be exclusively applied to finance or refinance eligible projects that contribute to adapting to climate change.

Further reading

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Production, trade, utilisation and consumption FAO Food Outlook, June, 2022	2020	2021 Estimate	2022 Forecast	Change 2022/2021
	Million tonnes			%
Production	177.8	181.8	184.6	+1.5
Capture fisheries	90.3	92.2	92.4	+0.2
Aquaculture	87.5	89.6	92.2	+2.9
Trade value (exports USD billion)	150.1	173.3	178.1	+2.8
Trade volume (live weight)	59.8	61.4	60.2	- 1.9
Total utilisation	177.8	181.8	184.6	+1.5
Food	157.4	161.7	164.2	+1.6
Feed	16.4	16.0	16.3	+1.6
Other uses	4.0	4.0	4.0	-0.1
Consumption per person				
Food fish (kg/year)	20.2	20.5	20.6	+0.6
From capture fisheries (kg/year)	9.0	9.2	9.1	+1.1
From aquaculture (kg/year)	11.2	11.4	11.6	+1.9
FAO Fish Price Index (2014 – 2016 = 100)	2020	2021	2022	Change
	95.0	102.0	122.6	Jan-Apr 2022/Jan-Apr 2021
				+24.5

Thailand Talaad Thai Wholesale Market, Pathum Thani Province		THB per kg	
		May, 2022	July, 2022
Item		Price	
Chinese edible frog (<i>Haplobatrachus rugulosus</i>) (small)	กบนา (เล็ก)	120 - 125	100 - 105
Asian redbtail catfish (<i>Hemibagrus wyckioides</i>)	ปลากัดคั้ง	140 - 240	140 - 250
Yellow mystus (<i>Hemibagrus filamentus</i>)	ปลากัดเหลือง	145 - 260	125 - 150
Tire track eel (<i>Mastacembelus favus</i>)	ปลากะทิง	145 - 260	145 - 260
Clown featherback (<i>Chitala ornata</i>)	ปลากทราย	190 - 300	190 - 300
Iridescent mystus (<i>Mystus multiradiatus</i>) (large)	ปลาแขยง (ใหญ่)	180 - 200	150 - 160
Iridescent mystus (<i>Mystus multiradiatus</i>) (small)	ปลาแขยง (เล็ก)	120	100 - 130
Wallago (<i>Wallago attu</i>) (large)	ปลาเคี้ยวขาว (ใหญ่)	150 - 180	180 - 200
Wallago (<i>Wallago attu</i>) (small)	ปลาเคี้ยวขาว (เล็ก)	120	120
Bronze featherback (<i>Notopterus notopterus</i>)	ปลาฉลาด หรือ ปลาฉลาด	90	90
Farmed giant snakehead (<i>Channa micropeltes</i>) (large)	ปลาชะโด เลี้ยง (ใหญ่)	130 - 150	95 - 100
Farmed giant snakehead (<i>Channa micropeltes</i>) (small)	ปลาชะโด เลี้ยง (เล็ก)	100	60 - 80
Farmed North African walking catfish hybrid (<i>Clarias spp.</i>) (large)	ปลาดุก เลี้ยง (ใหญ่)	42 - 44	42 - 44
Farmed North African walking catfish hybrid (<i>Clarias spp.</i>) (small)	ปลาดุก เลี้ยง (เล็ก)	38 - 40	38 - 40
Siamese red catfish (<i>Phalacroonotus bleekeri</i>) (large)	ปลาแดง (ใหญ่)	300 - 350	300 - 350
Siamese red catfish (<i>Phalacroonotus bleekeri</i>) (small)	ปลาแดง (เล็ก)	140 - 170	140 - 170
Silver barb (<i>Barbonymus gonionotus</i>) (large)	ปลาตะเพียนขาว หรือ ปลาตะเพียนเงิน (ใหญ่)	48 - 50	48 - 50
Silver barb (<i>Barbonymus gonionotus</i>) (small)	ปลาตะเพียนขาว หรือ ปลาตะเพียนเงิน (เล็ก)	30 - 35	30 - 35
Red tilapia hybrid (<i>Oreochromis spp.</i>) (large)	ปลานิลแดง (ใหญ่)	80 - 90	80 - 90
Red tilapia hybrid (<i>Oreochromis spp.</i>) (small)	ปลานิลแดง (เล็ก)	60 - 65	60 - 65
Nile tilapia (<i>Oreochromis niloticus</i>) (large)	ปลานิล (ใหญ่)	50 - 55	50 - 55
Nile tilapia (<i>Oreochromis niloticus</i>) (small)	ปลานิล (เล็ก)	30 - 38	32 - 38
Whisker sheatfish (<i>Kryptopterus spp.</i>) (large)	ปลาชากไก่ (ใหญ่)	250 - 340	350 - 400
Whisker sheatfish (<i>Kryptopterus spp.</i>) (small)	ปลาชากไก่ (เล็ก)	120 - 140	120 - 140
Common carp (<i>Cyprinus carpio</i>) (large)	ปลาไน (ใหญ่)	35 - 40	35 - 40
Mekong giant catfish (<i>Pangasianodon gigas</i>)	ปลาบึก	60 - 65	60 - 65
Boeseman croaker (<i>Boesemania microlepis</i>)	ปลาฆ่า	200 - 350	200 - 350
Horse-face loach (<i>Acantopsis choirohynchus</i>)	ปลารากกล้วย	140 - 150	140 - 150
Giant gourami (<i>Osphronemus goramy</i>) (large)	ปลาแรด (ใหญ่)	90	90
Siamese mud carp (<i>Henicorhynchus siamensis</i>)	ปลาสร้อยขาว	50 - 60	32 - 35
Snakeskin gourami (<i>Trichopodus pectoralis</i>)	ปลาสลิด	100 - 190	100 - 190
Striped catfish (<i>Pangasianodon hypophthalmus</i>)	ปลาสาวย	26 - 30	26 - 30
Spot-fin spiny eel (<i>Macrogathus siamensis</i>) (large)	ปลาหลดจุด (ใหญ่)	150	200
Spot-fin spiny eel (<i>Macrogathus siamensis</i>) (small)	ปลาหลดจุด (เล็ก)	200	150
Rice-field eel (<i>Monopterus javanensis</i>) (large)	ปลาไหลนา หรือ ปลาไหลบึง นาข้าว (ใหญ่)	250 - 270	250 - 270
Rice-field eel (<i>Monopterus javanensis</i>) (small)	ปลาไหลนา หรือ ปลาไหลบึง นาข้าว (เล็ก)	300 - 320	300 - 320
Pond snail (<i>Filopaludina martsensi</i>)	หอยขม	60 - 80	45 - 130

Viet Nam Vietnam Association of Seafood Exporters and Producers (VASEP) Dong Thap in the Mekong Delta except black tiger shrimp (Da Nang)			VND per kg unless otherwise stated	
			February, 2022	July, 2022
Item	Size		Price	
Pangasius (<i>Pangasianodon hypophthalmus</i>) (white flesh)	Cá tra thịt trắng	0.7 - 0.8 kg	29,000 - 30,000	29,000 - 30,000
Pangasius fry (<i>Pangasianodon hypophthalmus</i>)	Cá tra bột	Per fry (bột)	1.2 - 1.5	1.6 - 2.0
Pangasius fingerlings (<i>Pangasianodon hypophthalmus</i>)	Cá tra giống	28 - 35 con/kg	37,000 - 40,000	27,000 - 28,000
Red tilapia (<i>Oreochromis spp.</i>)	Cá điêu hồng	> 300 g - 1,000 g	31,000 - 31,500	36,000 - 39,000
Red tilapia fingerlings (<i>Oreochromis spp.</i>)	Cá điêu hồng giống	35 con/kg	23,000 - 24,000	28,000 - 29,000
Snakehead (<i>Channa spp.</i>)	Cá lóc nuôi	1.0 - 1.2 kg	29,000 - 30,000	36,000 - 38,000
Snakeskin gourami (<i>Trichopodus pectoralis</i>)	Cá sặc rằn	4 - 5 con/kg	28,000 - 30,000	31,000 - 35,000
Climbing perch (<i>Anabas testudineus</i>)	Cá rô đầu vuông	8 con/kg	30,000 - 32,000	33,000 - 35,000
Japanese wrinkled frog (Thai strain) (<i>Glandirana rugosa</i>)	Ếch Thái	3 - 5 con/kg	37,000 - 40,000	42,000 - 45,000
Japanese wrinkled frog fry (Thai strain) (<i>Glandirana rugosa</i>)	Ếch Thái giống	120 - 140 con/kg	450 - 455	400 - 450
Giant freshwater prawn (<i>Macrobrachium rosenbergii</i>)	Tôm càng xanh	15 - 25 con/kg	170,000 - 200,000	180,000 - 200,000
Giant freshwater prawn (<i>Macrobrachium rosenbergii</i>) P/L	Tôm càng xanh post	80,000 - 90,000 con/kg	70 - 80	NA
Black tiger shrimp (<i>Penaeus monodon</i>)	Tôm sú	15 con/kg	450,000	440,000
Black tiger shrimp (<i>Penaeus monodon</i>)	Tôm sú	25 - 30 con/kg	300,000	240,000
Black tiger shrimp (<i>Penaeus monodon</i>)	Tôm sú	40 con/kg	250,000	180,000



PHOTO: SINSAMOUT OUNBOUNDISANE/FISHBIO

Meet the world's largest freshwater fish. This giant freshwater whipray (*Uragymnus polylepis*) was caught from the Mekong in northern Cambodia in June this year. At 300 kg, the stingray's weight made it bigger than the 293-kg Mekong giant catfish (*Pangasianodon gigas*) caught in Thailand in 2005, which previously held the record as the largest freshwater fish on the planet (see page 10).



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