

and enhancement of monitoring, control and surveillance, and traceability systems.

Way forward

In the AMSs, the respective national authorities have enhanced the promotion of the MCS system for effective fisheries management and conservation of the fishery resources. Moreover, sub-regional and regional cooperation on MCS have also been strengthened with the aim of improving the governance of trans-boundary fishing and fighting against IUU fishing. Regional cooperation for combating IUU fishing has therefore been enhanced in the Southeast Asian region, through regional and sub-region platforms, *e.g.* APFIC, ASEAN, SEAFDEC, RPOA-IUU, AN-IUU, RFMOs, that provide for effective exchange of information across the countries.

Nonetheless, it is also necessary to provide human capacity building programs as these are essential elements for the AMSs to enhance their knowledge, especially improvement in the areas of policy and legislation, fisheries statistics and data collection, as well as in stock and risk assessments of the fishery resources to provide the scientific-based recommendations for the policy decision makers. Meanwhile, the promotion of MCS, PSM and risk analysis for combating IUU fishing would continue to support the AMSs, especially for the adoption of the technologies on MCS.

Coincidentally, the COVID-19 crisis has shown the need for the countries to accept new technologies to support the implementation of MCS and improve the effectiveness of fisheries management for the sustainability of the fishery resources in the fisheries sector. Reporting of catch from remote areas would benefit from such technologies as these would reduce the risks of spreading the virus, for example replacing the observers' program onboard by cameras. Moreover, and the effectiveness of fisheries management could also be enhanced more effectively through monitoring, control and surveillance (MCS), limiting the fishing effort, and increasing research activities.

6.1.1.6 Combating IUU Fishing in Inland Fisheries

Although the definition of IUU fishing in inland waters has not been established specifically and potentially, the definitions used for IUU fishing in marine fisheries could be referred to with appropriate and adequate adjustments in accordance with the characteristics of inland fisheries. IUU fishing practices, particularly in inland water fisheries, could therefore include: unfriendly fishing methods such as the use of toxic chemical substances, explosive materials, and prohibited gears and ways such as electro-fishing, and many other irresponsible practices (Ma *et al.*, 2018); fishing without license or quota for certain species; catching undersized fish or fish that are otherwise protected by

regulations; and fishing in closed areas or during closed seasons, among others.

A big portion of inland fisheries in Southeast Asia is dominated by the Mekong River Basin bordered by Myanmar, Viet Nam, Thailand, Lao PDR, and Cambodia; and also includes the Indonesian inland waters that comprise the Sundaland, Wallace, and Sahul Land. The Mekong River is considered as the largest inland fisheries producer on earth and provides a significant contribution to the economic growth of around one-half of Southeast Asian countries, namely: Myanmar, Viet Nam, Thailand, Lao PDR, and Cambodia (Hecht *et al.*, 2019). Meanwhile, in the lower part of the Mekong Basin (LMB), people rely heavily on fish which is important for their protein intake, making up 47–80 %, which is considered the highest inland fish protein consumption in the world (Hortle, 2007). This massive figure of inland fisheries in this region suggests that combating IUU fishing is essential and urgent for the sustainability of inland fisheries. In addition, in 2014, Indonesian inland capture fisheries produced 446,509 mt or equivalent to 2.17 % of the national total fish production or 6.96 % of total capture fisheries (SEAFDEC, 2014). Even with a tiny portion of inland waters compared to its marine areas, the inland fisheries of Indonesia have contributed substantially to the country's total fish production.

Recent management measures on sustainable fisheries, such as the imposition of closed season or prohibition of the use of certain fishing gears have also focused more on the marine fisheries sub-sector than in the inland fisheries. This has led to national fisheries policies and interventions skewed toward the marine fisheries sub-sector. Similarly, at the global level, attention on the depletion of fishery resources and on IUU fishing is focused predominately on marine fish stocks despite the importance of freshwater fishes around the world to local communities. As a result, inland fisheries are often underappreciated and undervalued in resource planning and decision-making.

IUU Fishing in Inland Waters

The most common illegal practices that destroy wild inland fishes include electro-fishing, and the use of toxic substances and explosive materials. Electric fishing or electro-fishing can kill not only the targeted fishes in terms of size and species but also other aquatic biotas from all stages of their aquatic life. Mature fishes that contribute to the release recruitment of young fish will die and non-hatched eggs are of no exception. Larval stages of fishes are easily killed by such unselective fishing practice. While the use of toxic substances and explosive materials could significantly demolish the fishery resources including the aquatic biotas, and such practices also contribute to habitats destruction. Toxic chemical materials used for fishing pollute the water and reduce the water quality, kill the aquatic plants that are important as nursery grounds, and

demolish the fish habitats, ultimately destroying fisheries. Regulations on the use of destructive fishing gears are commonly imposed in the Southeast Asian countries but surveillance remains a big challenge because of the nature of the region's fisheries, which are open access and people are fishing for subsistence.

A substantial challenge in the sustainable development of inland capture fisheries is on the collection and reporting of reliable data on wild-caught fish. There are limited port landing sites for inland capture fisheries and most of the harvested fish is consumed in households without entering the market chain. Therefore, data on inland fish catch are scattered and not well documented by government authorities. Fish catch and effort data are necessary as these are used to determine the total stock of fish in targeted water bodies. Without sufficient reliable data on catch and unit effort, authorities and scientists would not be able to determine the total allowable catch of particular fisheries, which could lead to possible overexploitation. The numbers of fishers and fishing gears are also not well recorded and remain unreported because the majority of inland capture fisheries involve small-scale and subsistence fisheries, while the numbers of on-ground fishery officers are minimal.

Issues and Concerns

In marine fisheries, port landings are crucial facilities as these are used for recording, licensing and monitoring the fishing activities. Data collected from the ports could also contribute to determining the fish stock and total allowable catch, and the development of appropriate policies to protect the fish population and sustain economic development. Expanding port landing sites in inland water bodies equipped with officers and facilities would be important to establish and facilitate capture data documentation. Inland fisheries ports can be designed based on the localities and should be capable of undertaking multi-purpose tasks of not only recording fish catch but also facilitating fishers' ability to sell fish and obtaining fair prices of their catch. While determining the fishing capacity is much easier in marine fisheries, this could also be easily determined in inland fisheries if the fish stocks are well assessed and the catch effort is well documented. Determining fish stocks in inland fisheries so far is mostly based on poor fish catch data which could lead to misrepresentation of the real status of inland fisheries and literally, translate to destruction of the fish population.

Logbook of fish catches and the involvement of observers in industrial marine fishing activities have been known to improve the reliability of the catch data in marine capture fisheries. The same method could also be implemented in inland fisheries by working closely with fishers, especially the permanent fishers who catch fish on a daily basis. The inland fishers themselves can serve as the observers and logbooks could be provided by local fisheries authorities.

Trust needs to be established between the fishers and officers, and the governments could consider providing subsidies for fishers who are able to document their fish harvests and catch efforts continuously.

Licensing and registration of marine fishing vessels and fishing gears are not relevant to inland fisheries because inland fisheries are dominated by subsistence and artisanal fishers, and mostly involve the impoverished people with limited capital. However, co-management, local wisdom, and the EAFM concept could be implemented in inland fisheries to monitor the fishing activities. The governments or authorities can work closely with the local people to socialize good fishing practices, instill the importance of sustainable fisheries, and teach fishers how to harvest fish wisely to allow adequate recruitment. Some local wisdom already exist in Indonesia, such as protecting the lubuk or the deepest area in the river during the dry season to allow fish to settle and save them during low water levels and prevent their overexploitation (Dian *et al.*, 2016). Promotion of such local wisdom could be strengthened and allowed to be adapted in other areas to protect the fishery resources.

Way forward

There are some key messages that can be implemented to protect inland fisheries and to combat illegal activities that can destroy biotas and habitats. Local communities' engagement would be useful to create trust between the fisheries authorities and local people. As inland fisheries continue to be open access and dispersed, the involvement of local people in data documentation and monitoring of illegal activities is the key. Also, to improve catch data documentation, expanding the numbers of small fish landing ports, either operated by the local community or the government, would be crucial for documenting the catch from fishing activities in inland waters. A good data on catch and effort should be targeted as these are crucial for determining the status of the stocks of commercially important inland water fish species.

6.1.1.7 Application of Innovative Technologies for Combating IUU Fishing

The application of innovations and technologies has been progressing, especially in support of the functions of MCS, for effective fisheries and habitat management, and combating IUU fishing in many countries. The technologies and tools for effective MCS system have been available and have been used (*e.g.* automatic identification system, vessel monitoring system, electronic catch reporting system or e-logbooks, CCTV, drone, satellite imagery, etc.) for monitoring and controlling of fishing activities in land, on ports, and at sea. The technologies have also been improved making them user-friendly, such as mobile applications, offline and what has now evolved into the artificial intelligence and machine learning.