Reducing Unwanted Catch from Trawl Fisheries:
Use of Juvenile and Trash Fish Excluder Devices as Fishing Technology Solution

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Selective fishing gears and practices have been promoted in the Southeast Asian region through demonstrations and experiments. Since trawling in shallow coastal waters could have adverse effect on the biodiversity and more directly on the irresponsible catch of juveniles and immature fishes that seek food and protection in the target waters, SEAFDEC through the Training Department has developed the Juvenile and Trash Excluder Devices (JTEDs) as by-catch reduction devices, and collaborated with the ASEAN countries for the conduct of demonstrations on the use of JTEDs in the region. The successful demonstration of the use of JTEDs in Calbayog City, Philippines had prompted the Philippine Government to issue a regulation on the use of JTEDs in all trawlers operating in the country.

One of the most serious problems in fisheries management in the Southeast Asian region is the large amounts of juvenile of commercially important fish species and trash fish catch that have possibly led to the present situation of the fish stocks being grossly over-exploited and where the unwanted catch has contributed to the acute reduction of the fish stocks. Recognizing that it is vital to enhance the fish stocks by selective harvesting to improve yield for the future generations, SEAFDEC through the Training Department has promoted the use of Juvenile and Trash Excluder Devices (JTEDs) that could release juveniles and immature fishes from trawling operations back to the sea. In fishing technology, bottom trawling in shallow waters can adversely affect the biodiversity of the fishing grounds and more directly on the juveniles and immature fishes that scavenge for food and nutrients, and seek protection in the coastal areas.

Although it is possible to selectively harvest mature and marketable size fishes, but the tropical, multi-species and multi-gear nature of fisheries in the Southeast Asian region involves diversity of the target species. In order to conserve the fisheries resources in the region, it has therefore become necessary to establish the most suitable JTEDs for the selective harvesting of the fish stocks. More advanced fishing technology emphasizes on the design of the by-catch reduction devices (BRDs) with the aim of selectively harvesting the target catch while reducing the level of undesirable catch in the form of juveniles, immature fishes and trash fish.

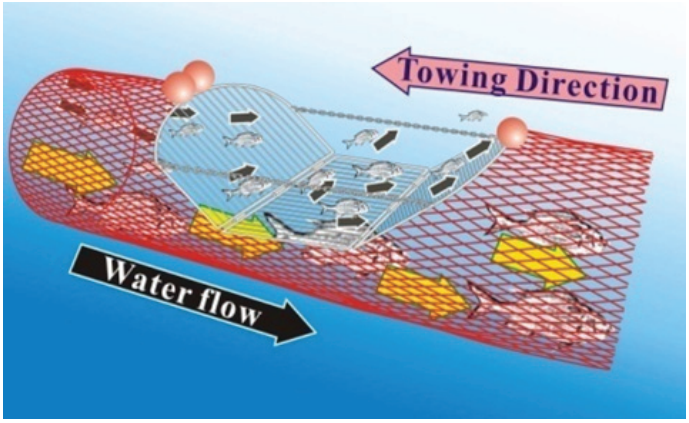
The untargeted capture of fish species and non-fish species, commonly termed by-catch and discards, has aggravated the problems associated with by-catch which include the capture of juveniles of ecologically important and economically valuable species, non-reporting of retained catches and discarded catches. In some fisheries and regions, there is an increasing trend towards retention of by-catch for human consumption or for utilization as aquafeeds and fertilizers. This is therefore a complex issue, requiring resource and biodiversity measures to address the concerns alongside with human needs, and involves a mix of policy, technical and community support aspects.

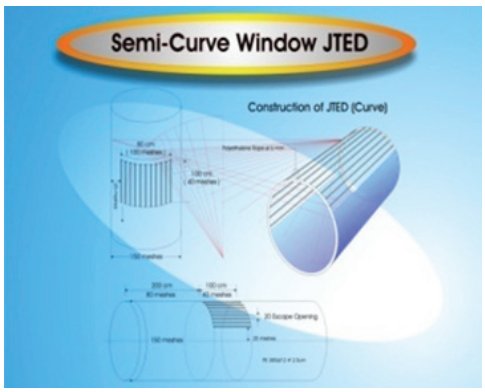
Catch of juveniles of commercially important species (above), from cover-end (top-right), and from cod-end (bottom-right)

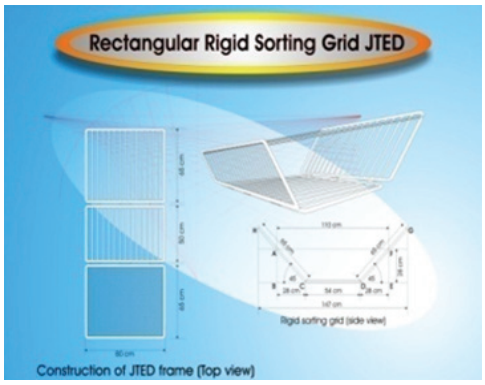
The SEAFDEC Training Department has been conducting activities to develop technology solutions with the main objective of reducing by-catch and discards from fishing operations. Based on the successful implementation of such activities, SEAFDEC was requested to serve as the technical collaborating partner for the 2002-2008 FAO/UNEP/GEF project on the "Reduction of Environmental Impact from Tropical Shrimp Trawling through the Introduction of By-catch Reduction Technologies and Change of Management or REBYC I". SEAFDEC has been approached again for the follow-up FAO/UNEP/GEF project which aimed to mitigate problems associated with by-catch in fisheries located within the Coral Triangle region of Southeast Asia. Known as REBYC II, this project will be based around multi-species trawling, where by-catch issues are among the most serious, with potentially significant effects on ecosystems and livelihoods. REBYC II specifically aims to address these challenges by promoting sustainable fishing, one of the measurement options of which is to encourage the adoption of best fishing practices, and providing a rational approach to delivering benefits from landed by-catch. Specific technological practices would be focused under REBYC II as well as the development of management plans in partnership with the private sector at both national and regional levels, including the preparation of "best practice guidelines for fishing operations". The use of JTEDs has been one of the approaches that would be promoted in the Coral Triangle under REBYC II, and considering the experience and expertise of SEAFDEC in the application of JTEDs in the Southeast Asian region, SEAFDEC would have a crucial role in the implementation of REBYC II.

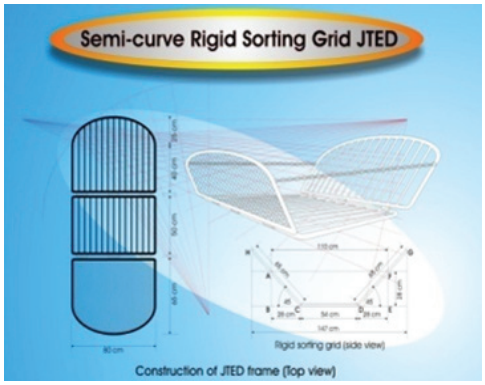
Evolution of JTEDs developed by SEAFDEC/TD for the Southeast Asian Region

A series of JTED designs have been developed by SEAFDEC/TD by taking into consideration the suggestions made by the participating countries in the Southeast Asian region after the series of trials conducted in the countries. Improvements of the designs have also been carried out for more efficient escape rate of the fish juveniles. The basic JTED designs developed by SEAFDEC/TD included the rectangular shaped window, semi-curved window, rectangular rigid sorting grid, and semi-curved rigid sorting grid.









Box 1. JTEDs Demonstration Activities in Southeast Asia

Country (Area)	Year(s) Conducted	Design of JTEDs Used	Results/Remarks
Brunei Darussalam (waters off the coast of Muara town using the M.V. Tenggili in cooperation with the Department of Fisheries)	2000, 2003	Semi-curved rigid sorting grid (bar spacing 30 mm) Two cover cod-end type (50/35 mm cod-end mesh size)	Target species, the threadfin bream (*Nemipterus* sp), 13.0 cm body length has high recovery rate in the cod-end than in two cover cod-end. This implies that the sieving grid of the JTED depends on the design of the releasing device, grid bare spacing and cod-end mesh size as well as the swimming ability of the species in the net.
Cambodia (waters of Sihanoukville using commercial trawler in cooperation with the Fisheries Administration (FiA))	2004	Rectangular shaped window Semi-curved window with 1.0 cm bar spacing Rigid sorting grid (1.0, 2.0 cm bar spacing)	The semi-curve performed the highest ability to release unwanted catch. Specifically, the 1.0 cm bar spacing of the rigid sorting grid has the least escape rate and thus, is the most suitable type. However, spacing of the rigid sorting grid should be adjusted to suit the average size preferred by the countries and needs of the local fishers, which in most cases do not want to use the device with high-escape rate in their trawls.
Indonesia (Bintuni Bay, Arafura Sea using commercial double-rigged trawler with the cooperation of the Department of Fisheries)	2002-2006	Rectangular shaped window Semi-curved Rigid sorting grid with 40 mm bar spacing	The 40 mm bar spacing has shown the best results for releasing the non-target catch and could maintain the maximum catch. Although the rigid sorting grid gave escape level of about 79% while it was 21% for the semi-curve and rectangular type, the semi-curve provided the highest ability in terms of shrimp retention ratio. It should be noted that the 40 mm bar spacing did not benefit the shrimp trawl fisheries in the fishing area especially the rigid sorting grid which had the highest escape level of shrimps which the target species while the semi-curve could be the more suitable design for the particular fishing ground. Thus, there is a need to modify the rigid sorting grid in order to improve the performance of shrimp trawls.
Malaysia (waters of the coast of Alor Setar, Kedah State using fish trawlers in cooperation with the Department of Fisheries Malaysia)	2001, 2007	Rectangular rigid sorting grid, 12 mm and 20 mm bar spacing Semi-curved rigid sorting grid	The 12 mm bar spacing was suitable to save the juveniles and small fishes including trash fishes for sustainable fishing due to its high selectivity. However, it was also noted that the 12 mm bar spacing may not suit any country where the fishing ground still has abundant fish stocks.
Myanmar (off the coast of Thandwe City in northwestern Myanmar using a 97-ton, 36 HP double rig shrimp trawler, overall beam – 6 m and length - 20 m in collaboration with the Department of Fisheries of Myanmar)	2004-2005	Semi-curved rigid sorting grid with 1.0, 2.0, 3.0 cm bar spacing Rectangular shaped window Semi-curved	The fishery resources in Myanmar waters is still rich as indicated in the average CPUE of trawl net at 100 kg/hr/haul, second highest value in Southeast Asia after Brunei Darussalam (283 kg/hr/haul). It was observed that the JTEDs affected the catch of the trawl net since the total catch of the trawl net attached with JTEDs was reduced by about 38%. The escape rate of demersal fishes in 1.0 cm bar spacing was 10%, which increased to 25% for the 2.0 cm and to 50% for the 3.0 cm. The escape rates of the groups from the window shape and semi-curved were the same as the rigid sorting grid with bar spacing of 2.0 cm.
Philippines (Manila Bay using shrimp-trawl nets on two Philippine trawlers)	2003-2006	Semi-curved rigid sorting grid	All JTEDs could be used in shrimp trawls because most large shrimps caught are retained in the cod-end. However, fishers do not favor the use of JTEDs because they do not want to lose profit by allowing fishes to escape. The rigid sorting grid with 1.0 cm bar spacing (escape rate 33%) could be more suitable selective device that the others (escape rate of 45%). The selectivity rate increased from the rigid sorting grid with 1.0, 2.0, 3.0 cm bar spacing to semi-curved and rectangular shaped window which means that the rigid sorting grid 1.0 cm bar spacing has a good efficiency which decreases in the 2.0 and 3.0 cm bar spacing of the semi-curved and rectangular shaped window.
Thailand (waters off the coast of Prachaub Kirikhan and Chumphon Provinces using the M.V. Promong No. 1 in cooperation with the Department of Fisheries of Thailand)	1998	Rectangular shaped window (8, 12, 16, 24 cm escape opening) Semi-curved (4, 6, 8, 12 cm escape opening)	Percentage of escape of commercial fishes by weight, of the trawl net attached with the rectangular shaped and semi-curved with different escape openings did not give significant selectivity of the device. However, the percentage of escape by number, of juveniles and young commercial species clearly showed that the escape rate using the semi-curved is 7 times higher than that of the rectangular shaped window.
Vietnam (coastal areas of Vietnam in collaboration with the RIMF)	2001, 2005	Rectangular rigid sorting grid with bar spacing 2.0, 3.0 cm	The escape rate using the rigid sorting grid ranged from 12 to 28% of trash fish, and from 10 to 40% for other kinds of fishes, suggesting that the rigid sorting grid has a better separating performance that than of the rectangular window shaped and semi-curved JTEDs for reducing unwanted fish.

Assessment and evaluation of the use of JTEDs

Experiments on JTEDs attached to the cod-end of the bottom trawl net were conducted in the Southeast Asian countries (**Box 1**). The results indicated that almost all kinds of JTEDs can release the juveniles and small fishes, and retain the larger sizes of fish in the cod-end. In order to assess the impacts of the use of JTEDs in fishing operations, questionnaire surveys were conducted in the participating countries, the results of which were confirmed through interviews with the concerned fishers. Based on the results of the questionnaire surveys as well as from the interviews of the fishers, the observations have been compiled (**Box 2**), and used as basis for the further improvements of the designs of the JTEDs.

Box 2. Observations of fishers on the impacts of the use of JTEDs in their fishing operations

Thailand
- Agreed on the advantages of the use of JTEDs in order to sustain the marine resources.
- But not willing to install JTEDs on their trawls at the moment, as needs more demonstration and experiments.
- May increase amount of fuel used when JTEDs are installed in trawls, and the result could be decreasing amount of the target catch.

Indonesia
- Agreed on the advantages of the use of JTEDs in order to sustain the marine resources.
- Increasing amount of fuel is used when JTEDs are installed in trawls, and the result could be decreasing amount of the target catch.
- Difficulties in gear preparation and operation, and that the period of net hauling could take longer time.

Malaysia
- No difficulty during the gear preparation and operation.
- The design of the device could be more applicable if further modifications could be made.

Philippines
- The design of the rigid sorting grid with 1 and 1.5 cm JTEDs were the most suitable devices.
- The escape rate was acceptable.
- Agreed on the use of JTEDs.
- Fishers willing to install the JTEDs on their trawls.

Generally, however,
- Semi-curved rigid sorting grid JTEDs has better performance in maximizing the escape rate of juveniles, the comparison of the escape rates are shown in **Box 3**.
- Continuing modification should be considered with relevance to the updated fishery information in each country.
- Fishers should be informed and made to understand the results of the experiments, and should be encouraged to change their attitudes for improved fishing operation.
- Learning from Calbayog City (Philippines) adoption process of JTEDs, such approach could be applied to other area in the region.
- Based on interviews of fishers, the following general observations were also noted:
  - The fishers understand the impact of catching juveniles
  - The fishers are willing to use JTEDs provided that these do not harm/reduce their target catch, convenience to install and operate, and must not lead to increased fuel costs.
- Discussion among core experts, fishing gear technologists and operators should be regularly conducted.

"The JTED-Changeable Grid Selection"

Based on the feedback of the fishers, one of the most recent improvements of the JTED design made by SEAFDEC/TD is the use of an interchangeable grid selection in the JTED (**Fig. 1**). This design has recently been promoted by SEAFDEC/TD in the Southeast Asian countries.

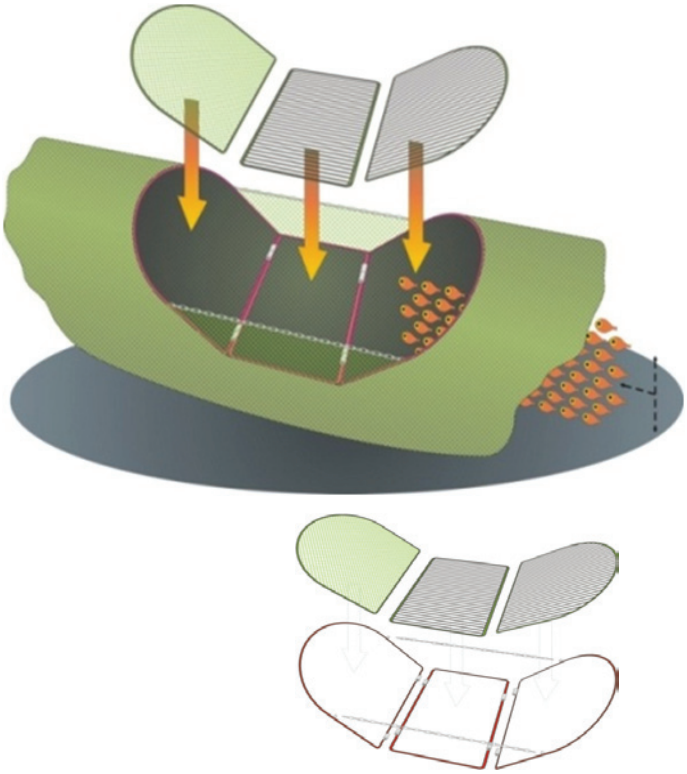


Fig. 1. JTEDs interchangeable grid selection adapted by SEAFDEC/TD

Adoption of JTEDs in Calbayog City, Philippines: A success story

Considering that reducing by-catch has been a new initiative in the Southeast Asian region, pilot demonstrations on the use of JTEDs had been conducted in the region to demonstrate the adoption of JTEDs as a technical tool and as a platform to initiate other management measures. In order that the adoption of JTEDs in the region could be sustained, it was envisioned that the countries in the region would be able to establish their respective national policies on the use of JTEDs.

Calbayog City in Samar, eastern Philippines (**Fig. 2**) was chosen by SEAFDEC as the pilot site for the conduct of

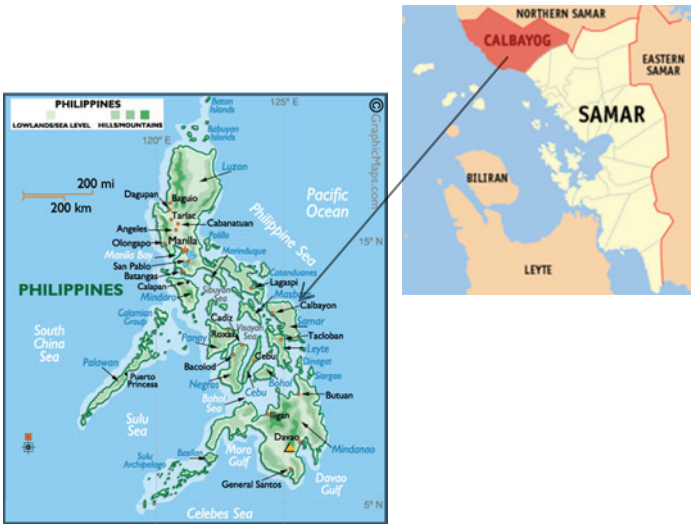


Fig. 2. Map of Philippines showing Calbayog City

JTED trials in the Philippines upon the recommendation of the Philippine Bureau of Fisheries and Aquatic Resources (BFAR). With BFAR as the main implementing office and the Calbayog Local Government Unit as co-proponent, JTED trials were carried out to build awareness of the stakeholders on the impacts of JTEDs in conserving the fisheries resources, train the stakeholders in the construction of the most-suitable design of JTEDs, and formulate a practical management framework and national regulation on the adoption of JTEDs in the Philippines.

The activity in Calbayog City started with a series of consultations conducted by BFAR with the stakeholders, specifically to explain the need to reduce the catch of juvenile fishes and reject trash fish in order that the future generations would have fish on their tables. BFAR also reached out to the academe to demonstrate the technical feasibility of the use of JTEDs as one of the management interventions in sustainable fisheries development. BFAR also proposed to the Philippine Government authorities for the possibility of formulation a national regulation on the use of JTEDs for the sustainable management of the country's fisheries resources.

In the process, BFAR discussed with the local government unit (LGU) of Calbayog City, for the unit to serve as the co-proponent of the activity with BFAR as the implementing agency, forming the JTED Project Team. The main responsibilities of the LGU included: making arrangements for the authorized/acceptable implementation of the pilot project; ensuring the participation of selected Commercial Fishing Boats (CFBs) in Calbayog City and for the CFBs to be operated only in designated fishing areas; prescribing and enforcing a color coding (boat color-orange), use of Global Positioning System (GPS) and issuance appropriate permit to participating CFBs; providing complement staff in the enforcement of related laws/regulations, provide support (in kind) and necessary assistance to the JTED Project Team; providing financial support for the conduct of relevant activities; and providing JTEDs to be used in the pilot project implementation. BFAR on the other hand, was responsible for the technical requirements and support during the entire implementation of the project in collaboration with SEAFDEC. In order to strengthen the implementation of the experiments, a working group was established comprising the LGU Calbayog City, BFAR Regional Fisheries Office in Region 8, BFAR Fisheries Training Center in Region 8, members of BFAR Project Team, the government and non-government organizations in Samar, and the fishing boat owners/operators in Samar. The responsibilities of the working group are to plan, coordinate and ensure proper pilot project implementation, monitor/assess progress and results of implementation, and recommend procedures and direction regarding implementation of the activity.

The participation of the boat owners and fishers was noteworthy, being responsible in ensuring the full compliance and cooperation in the implementation of the activity, using JTEDs in accordance to the proper deployment and schedule of the fishing operations, providing data and other requirements (*i.e.* logbooks), allowing and accommodating researchers/observers onboard, and adopting a color coding scheme (Orange) and compulsory use of GPS onboard, and securing the appropriate permit from the LGU of Calbayog City.

Box 3. Comparison of escape rate between juveniles and commercial target groups

	Rigid sorting 1 cm	Rigid sorting 1.2 cm	Rigid sorting 2 cm	Rigid sorting 3 cm	Rectangular 1 cm	Semi-curved 1 cm
Escape rate of juveniles (%)	56.69	71.00	77.00	74.31	68.52	61.09
Escape rate of target group (%)	9.72	11.00	16.00	50.33	46.75	47.31
Difference in values of escape rate of juveniles and escape rate of target groups (%)	46.97	60.00	61.00	23.98	21.77	13.78
Percentage of different values of escape rate between juveniles and commercial target catch (%)	20.64	26.37	26.80	10.54	9.57	6.06

The successful collaborative efforts among the various stakeholders in the implementation of JTEDs in Calbayog City was seen by the Philippine Government as a practical fisheries management framework. As a result, the Philippine Government had issued a regulation on the use of JTEDs in all trawlers operating in the country.

Conclusion

Results of the experimental trials and demonstrations on the use of JTEDs in selected Southeast Asian countries indicated the need for continuous improvement of the design of the device in order to be able to maximize its selectivity function. Specifically, the design must be suitable to both the target species and the fishing ground where the trawlers installed with the device operate. Considering that in the Southeast Asian region, the fishers aim for multi-target species with varying commercial sizes, it has become difficult to select the most appropriate size of the grid interval. A recent improvement of the JTEDs made by SEAFDEC/TD is the interchangeable grid selection, which is now being tried in the Southeast Asian region. This is aimed at addressing the limitations when there are more than two target species and where commercial sizes of the target species differ, which entails the need to select the correct bar spacing.

The demonstrations and experiments on the use of JTEDs conducted by TD in Southeast Asian countries

The project of SEAFDEC/TD promoting the use of JTEDs in the Southeast Asian region is also envisaged to encourage the fishers to change their frames of mind and understanding the need to operate responsible fishing for the conservation of the fisheries resources. SEAFDEC/TD for its part would continue to improve the design of the JTEDs in order to achieve the levels of sustainability that can be beneficial to the fishers as well as the resources.

Way Forward

While the implementation of JTEDs in the Southeast Asian region is continuing and while SEAFDEC/TD is improving the designs of JTEDs that would be suitable for the fisheries in the region, the following issues should be taken into consideration by SEAFDEC and the Member Countries in further promoting the use of JTEDs as a conservation measure and fishing technology solution in reducing unwanted catch from trawl fisheries:

- By-catch reduction devices like JTEDs reduce the catch of juveniles and trash fish;
- Regular dialogues and involvement of stakeholders (participatory approach) in the project implementation (planning, implementation, monitoring) could build up awareness and cooperation;
- External participation (*i.e.* SEAFDEC) contributed to the improved/enhanced project implementation;
- Clear objectives lead to effective project implementation;
- Well defined performance indicators contribute to smooth implementation of the project;
- Sharing of experiences and information among participating countries and organizations is important;
- Socio-economic study on the impacts of the installation of JTEDs in trawlers should be conducted; and
- Need for scientific data on the effect of the installation of JTEDs in trawlers on the fuel utilization of the fishing vessels.

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