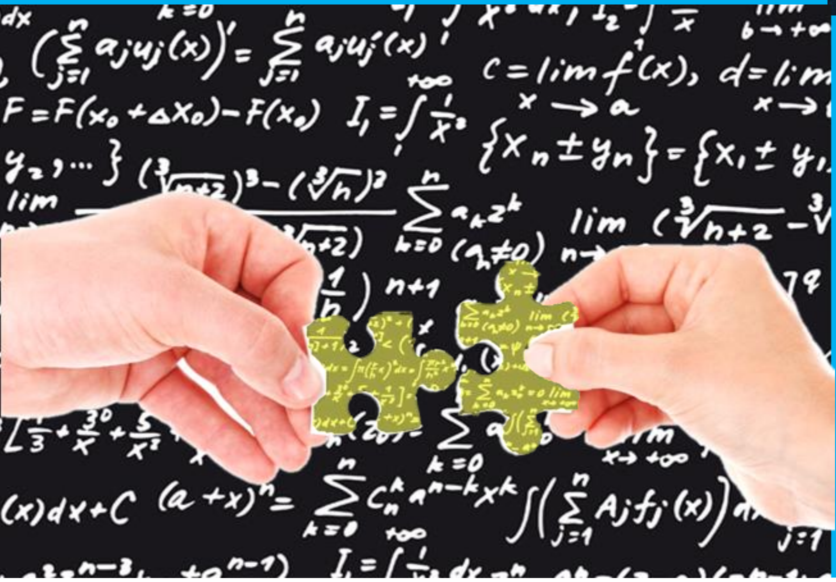
Non-tariff measures and sustainable development: The case of the European Union import ban on seafood from Sri Lanka



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Non-tariff measures and sustainable development: The case of the European Union import ban on seafood from Sri Lanka

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Abstract

Non-tariff measures (NTMs) can affect trade performance of trading partners. In addition to trade performance, the NTMs (including sanctions) may have direct and indirect linkages to capacity of trading partners to meet their commitments under Sustainable Development Goals (SDGs). The purposes of this research were to explore the performance of exports of seafood industry of Sri Lanka before, during and after the imposition of European Union's ban in January, 2015 and to develop indicators and measure the impact of the same ban on stakeholders of the seafood industry in Sri Lanka by looking through the prism of sustainable development. More specifically, this study applied composite indicator approach with min-max normalization, arithmetic mean aggregations and weighting techniques to assess the impact on several of SDGs. The principal component analysis was performed to identify the best sub-indicators for the composite indicator. During the period when the ban was in force, Sri Lanka seafood industry experienced lower revealed competitive advantage score, market concentration score and growth rate than at other times. Further, the findings revealed that the ban generated mixed effects on SDGs. Due to the ban, SDG 12 (responsible production) and SDG 14 (life below water) have been positively impacted while SDG 1 (no poverty) and SDG 8 (economic growth) were adversely affected. The research recommends that unilateral and ad hoc decisions should not be taken regarding NTMs because they have very sensitive and invisible linkages with SDGs. Furthermore, when there are legitimate needs to impose such NTMs, sufficient time should be given to the trading partners to put in place measures and actions for compliance with such NTMs.

Keywords: Fisheries, Seafood industry, NTMs, Import Ban, SDGs, Sri Lanka
JEL Codes: F13, Q01

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List of abbreviations

CC	Catch certification/catch certificate
EEZ	Exclusive Economic Zone
GSP	Generalized System of Preferences
IMUL	Multiday boat with inboard engine
IUU	Illegal, unreported and unregulated
NTM	Non-tariff measure
IOTC	Indian Ocean Tuna Commission
RCA	Revealed comparative advantage
SDG	Sustainable Development Goals
SPS	Sanitary and phyto-sanitary
TBT	Technical barriers to trade
UN	United Nations
VMS	Vessel monitoring system

1. Introduction

Ocean fauna is a common natural resource for the entire world as the oceans connect with each other and sea creatures' move all around the world disregarding man-made geopolitical boundaries. Because of that, ensuring sustainable use of seafood resources is critical for the entire world. Illegal, unreported and unregulated (IUU) fishing is a great threat to sustainable use of fishing resources. To eliminate the destructive fishing practices, whole value chain of fish trade should be well regulated. Trade-related policy measures have potential in contributing towards eliminating unsustainable fishing practices. The technical barriers to trade (TBT) are one of prominently applied non-tariff measures (NTMs) to regulate a sustainable production process. The European Union intensively works to block their fish market for seafood produced under IUU fishing practices. In one such case, the European Union temporarily banned all seafood imports from Sri Lanka until it addressed its persistent shortcomings to effectively regulate IUU fishing of its seafood industry. The study examines the effect of this ban in a holistic manner, tracing its effects along multiple dimensions of sustainable development.

Globally, NTMs are increasingly used to protect the consumers, encourage the adjustment of production and influence trade processes to ensure compliance with human rights and environment safeguards. However, some of the changes have triggered strong suspicions that food safety standards are being used as a non-transparent, trade impeding protectionist tools (Athukorala and Jayasuriya, 2003). The changes of tariffs and NTMs in a country can create negative and positive spillover effects on sustainable development. Policymakers may face difficult choices in reconciling domestic with the international objectives, and the short-term economic gains with longer-term sustainable development (OECD, 2016). There is growing demand for the evidence-based research on the impacts of NTMs, which can help stakeholders identify and maximise synergies, while mitigating trade-offs of sustainable development.

According to the FAO (2018a), the fish and fishery products are one of the most-traded segments of the world food sector where the value of global fish exports totalled $152 billion in 2017. FAO estimates that approximately two thirds of seafood products are exposed to international competition, that is, producers have to face competition from imports, or domestic consumers have to pay a higher price due to domestic producers exporting seafood to consumers abroad (FAO, 2018a). Value of fish trade has been increasing over the period between 2000 and 2017. The seafood industry is further important due to the following factors related to the sustainable development. First, in terms of the alleviation of poverty and hunger, fish can potentially be vital, as developing countries export 54% of fish and related product. Second, in terms of employment, since the employment in the fishing sector is relatively low-skilled, it is in many ways an occupation of last resort for poor communities. Finally, in terms of food security, fish sources provide the highest share of animal protein in the diet of poor communities (FAO, 2018b).

The United Nations (UN) has introduced the Sustainable Development Goals (SDG) for the world in 2015. All the members of UN have committed to achieve these goals by 2030. As previously noted, the fisheries sector has sensitive linkages with many aspects of SDGs. Policy shocks in the fisheries sector can influence sustainable development of developing countries in different ways. Even though products in the fish sector are relatively more affected by sanitary and phyto-sanitary (SPS) measures, TBT and other NTMs compared to products belonging to non-fish sectors, there is very little literature available to explain how these NTMs affect sustainable development of stakeholders in the fisheries sector. Most of the studies analyse the impact of NTMs at a macro level and omit the sensitive consequences at the disaggregated producer level. To address the research gap, this study seeks to probe deeply into the consequences of NTMs relating to the fisheries sector, producers, and SDGs.

The main focus of this study is the European Union’s ban on imports of fish from Sri Lanka. The European Union bans seafood imports from countries that are unable to comply with its technical standards surrounding to prevention of IUU fishing. During the last few decades, the European Union has issued yellow card warnings and imposed bans on the fish exporting countries, which did not comply. The European Union is the largest export partner for Sri Lankan seafood accounting for more than 40% of Sri Lankan total seafood exports. Sri Lanka exported 26,548 metric tons of seafood to the world and 8,750 metric tons were exported to European Union countries in 2014. The European

Union imposed a fish import ban for Sri Lanka during 2015-2016 due to non-compliance with the standards of the Indian Ocean Tuna Commission (IOTC). Relatively few analyses have been carried out to assess the impacts of the IUU regulations on seafood trade flows, or to support implementation of the regulation through detection of trade flow anomalies related to potential IUU fishing activities (Mundy, 2018). This paper addresses how the ban affected local seafood market of Sri Lanka, strategies taken by fishermen to overcome the consequences of the ban and how the ban influenced Sustainable Development of stakeholders in the Sri Lankan fisheries sector.

2. Literature review

2.1 The seafood industry of Sri Lanka

Sri Lanka has a coastline, which extends over 1,700 km. It is studded with numerous coastal and marine ecosystems. Sri Lanka is entitled to reap the benefits of a significant marine resource endowment comprised of an Exclusive Economic Zone (EEZ), contiguous zone, territorial sea and historical waters, which altogether covers an area eight times the size of the country's land extent (Ministry of Fisheries and Aquatic Resources Development, 2018). Major economic activities based on the coastal and marine resources include fisheries and aquaculture, tourism, ports and shipping. Around 560,000 individuals make their living out of seafood industry (Ministry of Fisheries and Aquatic Resources Development, 2018). Marine fisheries in Sri Lanka have two major components i.e. coastal and offshore/deep-sea fishing. Fishing in inland water bodies contributes to only a small share of the total fish supply. The shallow sea in the continental shelf-area and lagoons are rich with numerous marine species including several economically harvested finfish, crustaceans, bivalve and other invertebrates. Small-scale fishery is prominent in coastal area of the sea and fishermen use outboard-engines on 6-meter length fibreglass boats and traditional wooden boats to catch fish. Almost 90% of the production is dedicated for local consumption. In 2016, the coastal fishing contributed to 51% of the total production (Ministry of Fisheries and Aquatic Resources Development, 2018). The share of coastal fishing has been decreasing due to the rapid growth of offshore/deep-sea fishing with the introduction of multi-day fishing crafts since the 1980s.

The length of an offshore fishery harnesses multiday fishing crafts (Multiday boat with Inboard engine called – IMUL) is usually more than 9 meters.

In 2017, seafood represented 2.2% of Sri Lankan total merchandise exports. The large pelagic finfish caught offshore are the major export product of Sri Lanka. The European Union is the largest export partner for Sri Lankan seafood. Rasanjala et al. (2017) report that Sri Lankan large pelagic finfish has great demand in the European Union market. Sri Lanka was the second largest exporter of fresh and chilled swordfish and tuna to the European Union in 2013 (European Commission, 2016a; Verite Research, 2015). Hence, the European Union ban's impact could potentially be more severe on offshore fisheries than coastal fisheries. Due to these reasons, this study focuses on offshore fishermen as a target population to study the impact of the European Union fish import ban.

2.2 The European Union fish import ban on Sri Lanka

The European Union represents the largest single market for fish and fishery products in the world, followed by the United States and Japan (FAO, 2018a). The 28 European Union countries together recorded $27.5 billion of imports in 2016 (EUMOFA, 2018). IUU fishing is estimated to be between 11 and 26 million metric tons per year, worth between $10 and $23 billion. In some cases, fisheries experts report that IUU fishing accounts for up to 40% of the total yearly catch (Agnew et al., 2009).

To combat IUU fishing and to ensure the sustainable use of marine resources, in 2008, the European Union enacted one of the most stringent legislation mechanisms in the world to prevent market entry of illegally caught fish. Among the legislations enforced to mitigate IUU, TBT is considered as the most effective policy approach. In order to comply with the TBT, the exporting country must issue Catch Certification/Certificate (CC), so that producers can prove their permission to catch fish. To strengthen implementation of the TBT, the European Union has installed a strong inspection framework through networking human capital and leveraging technology at airports, harbours and all other entry points. The European Commission has understood that some exporters are deficient of a sound legal framework to combat IUU fishing, improve control and monitoring actions or take a proactive role in the compliance of international rules such as the United Nations Convention on the Law of the Sea or the United Nations Fish Stocks Agreement. If the exporters fail to submit a valid CC continuously, they may be ‘carded’, which means that they could ultimately face sanctions to export their fish to the European Union market. Since the European Union’s illegal fishing laws came into force in 2010, a series of countries have been issued with warnings – so-called yellow cards – for failure to improve their fisheries management. The majority of these countries have undertaken robust reforms, and subsequently had the yellow cards removed. Others have failed to comply and were then issued with red cards, with resulting sanctions (European Commission, 2018). As shown in table 1, since 2012, the European Union has pre-identified IUU fishing in 25 exporting countries, of which six have been sanctioned and three of these six were able to have the red card withdrawn, including Sri Lanka.

Sri Lanka was highlighted by the European Commission as a country, which was not doing enough to combat illegal fishing. Starting in 2010, the European Union suggested corrective actions to resolve shortcomings such as lack of dialogue or lack of actions to address deficiencies in monitoring, controlling and surveillance of fisheries. Since the Sri Lankan Government failed to achieve significant improvements, a yellow card was issued to Sri Lanka, as well as seven other countries, on the 15th of November 2012 (European Commission, 2012). The European Union had given a reasonable time to respond and take measures to rectify the situation. The decision in 2012 had not entailed any measures affecting trade in between Sri Lanka and the European Union. After three years, according to the European Commission's assessment, Sri Lanka had not sufficiently addressed the shortcomings mentioned at the issuance of the yellow card. As a result, the European Commission enforced a ban on fisheries products caught by Sri Lankan vessels being imported into the European Union.

Table 1: Overview of third country authorisations to export seafood products to the European Union

	Yellow card pre-identification	Identification (Listing as a banned country)	Withdrawal (Delisting)
Number of the countries	25	6	3
Names of the Countries	Belize, Cambodia, Comoros, Curacao, Fiji, Ghana, Kiribati, Republic of Korea, Liberia, Panama, Papua New Guinea, Philippines, Guinea, Sierra Leone, Solomon Islands, Sri Lanka, St. Kitts, St. Vincent and Grenadines, Taiwan Province of China, Thailand, Togo, Trinidad and Tobago, Tuvalu, Vanuatu, Viet Nam.	Guinea Sri Lanka St Vincent and Grenadines Belize Cambodia Comoros	Guinea Sri Lanka Belize

Source: Prepared by the authors based on the list of banned and warned countries up to 2017 (European Commission, 2018)

In order to avoid disrupting commercial contracts, the full trade measures came into force in mid-January 2015 (European Commission, 2016a). Since then, the Sri Lankan Government has worked hard for two years to comply with the requirement stipulated by the European Union. As result of significant improvements to control IUU fishing, the European Union lifted the ban and delisted Sri Lanka on 12th of April 2016 (European Commission, 2016b). The conditions raised by the European Union and the actions taken by the Sri Lankan Government represented by the Ministry of Fisheries and Aquatic Resources Development as the responses for the recommendations are given in table 2.

2.3 NTMs in the European Union's import ban

NTMs include any policy measures other than ordinary customs tariffs that can potentially have an economic effect on international trade in terms of pricing and quantity of products traded (UNCTAD, 2010). There are numerous NTMs applied to different kinds of products. For ease of identification and analysis, United Nation Conference on Trade and development (UNCTAD) has introduced the NTM taxonomy (UNCTAD, 2015a). Under this taxonomy, NTMs are classified into measures affecting imports (Chapters A to O) and export measures (Chapter P). In this paper, our focus is on import-related NTMs. Under import-related NTMs, there are two main branches namely: technical and non-technical measures. Usually, fish and other agriculture products are highly targeted by technical NTMs (UNCTAD, 2002). In this case, the TBTs enforced by the European Union to prevent IUU fishing were categorized in two types such as catch certificates (B8) and labelling (B3) (see Annexure 1 for full details).

Table 2: Management measures taken by the Sri Lankan Government to respond to the European Union's requirement to remove the fish import ban

The European Union conditions	Sri Lankan responses
Take measures to control destructive fishing gears	Banning destructive fishing gears, penalties for users, regulation of craft inspection in harbour and sea were gazetted
Install a vessel monitoring system	Fixed transponders to 1,500 boats and established vessel monitoring station at the end of 2016, and licences for high seas have been only issued for crafts with vessel monitoring systems.
Control poaching from foreign sea territories	Penalty of a minimum of 1.5 million Rupees for poachers and cancellation of the fishing licences
Recruit official observers to fishing boats at sea	Recruit observers to cover 25% of largescale vessels (> 18 m)
Maintain a logbook in boat	Submission of a logbook by every fishing boat compulsory to enter fisheries harbours.
Increase IOTC compliance rate	The compliance rate exceeded 80% in 2017
Continues sampling fish catch	National Aquatic Resources Research and Development Agency continues projects to study fish catch

Source: Prepared by the authors based on DFAR (2015)

Within technical NTMs, there are several sub-groups such as SPS, TBT, pre-shipment inspection and other formalities. Because of high perish-ability and proneness to contamination, fish products have been subjected to SPS. On the other hand, countries such as the United States, Japan and the European Union implement technical measures such as TBT as they directly link to the sustainable use of marine resources. At the same time, the European Union implements measures to achieve legitimate policy objectives, such as the protection of human health and safety, or protection of the environment. The European Union has implemented catch certificate requirement as a TBT regulation to prevent IUU fishing. Under this, the export country should issue a catch certificate to assure their fish is caught under legal, regulated conditions. The fish import ban was imposed on Sri Lanka because Sri Lanka was unable to certify the origin and legitimacy of its fish harvest. Especially at the onset of the ban, fishermen did not have a mechanism to prove the location of fishing grounds and catch prevented from poaching foreign sea territories. The comprehensive descriptions related to particular NTMs are given in Annexure 1.

2.4 Do the technical barriers to trade affect SDGs?

The Sustainable Development Goals (SDGs) were approved by all 193 countries at the 70th General Assembly of the United Nations, held in New York on 25th September 2015 (United Nations, 2015). There are 17 goals and 169 accompanying targets prepared to cover three main pillars of sustainable development, namely economically viable, socially acceptable and environmentally friendly. The goals were included with a holistic set of objectives, which should be achieved in “2030 Agenda for Sustainable Development” (Sachs et al., 2016). The SDGs are intended to address sustainable development processes in both developed and developing countries, and to facilitate action at all levels and with all actors, including government, civil society, the private sector and the science community to strengthen the capacity of the state to achieve the desired outcomes.

In the sustainable development process, a country should maintain a dynamic equilibrium among development aspects. When a country or a second party introduces policy changes such as imposing or withdrawing NTMs, this equilibrium will change by shifting social, economic and environment structures into a new equilibrium. This policy changes may have synergetic spill over effects on SDGs or/and trade-offs among different stakeholders. Hence, prior to imposing trade measures, such measures should be assessed for all possible outcomes, which can generate systematic effects on the well-being of current and future generations.

Different empirical researches have shown evidence of both positive and negative influence of TBT on sustainable development (Burguet and Sempere 2003; Shimamoto 2008; UNCTAD, 2015b). OECD (2016) has compared tariff and non-tariff measures enforced by developed country importers on developing country exporters and found that developing countries have faced higher amount of trade barriers than developed countries. The restricted market access for developing countries' farmers has the potential to undercut their livelihoods. On the other hand, different strands of literature have found evidence that tariff and non-tariff measures do not always generate negative effects (UNCTAD, 2010). SPS restrictions, certification procedures, quantity control measures, technical regulations, and some other measures can generate positive outcomes relating to food safety and prevent introduction of invasive species (Beghin and Xiong, 2018). Flaaten and Schulz (2010) showed that under certain restrictions on renewable energy sources and concession on renewable energy driven sectors, there are positive economic, environmental and social impacts. A country can impose trade barriers on products, which are produced under environmentally destructive conditions and/or subjected to human right violations. Such sanctions may encourage producers to find new production process more environment-friendly, socially acceptable and economically viable. Among all the NTMs, the technical barriers directly address issues related to social and environment aspects of SDGs: food, nutrition and health, sustainable energy, sustainable production and consumption, climate change (UNCTAD, 2015b). At the same time, the NTMs have multilateral influence in different SDGs hence; one of the common challenges is to identify all impacts of an NTM policy change. This often is made more complicated as some impacts are visualized only in the long run and would remain latent in the short run. Some impacts are highly qualitative and are often difficult to quantitatively measure as indicators. Many impacts can be neglected at macro level studies and need micro level analyses to detect vital but less apparent impacts.

3. Empirical approach to evaluate the effect of the import ban on SDGs

NTMs can directly affect trade performance of the trading partners. In addition to trade performance, NTMs may have direct and indirect linkages with SDGs of the trading partners. The purposes of this research are to (1) explore the performance of the seafood exports industry of Sri Lanka before, during and after the European Union ban, (2) to investigate the producer level response of the European Union ban and (3) to develop indicators and measure the impact of the European Union ban on SDGs of the stakeholders in the seafood industry of Sri Lanka. To achieve the first objective, the trade performance indicators were computed. The second objective was achieved by conducting statistical analysis between selected producer level responses during and after the ban. The third objective was achieved through applying composite indicator technique.

Rosen (1991) explained that craftsmanship of a composite indicator belongs to the researcher, rather than universally acceptable indicators. This implies that the researcher has freedom to design their own indicators to reflect the research context than adapting to globally accepted indicators. With regards to models, the justification for a composite indicator lies in its fitness for the intended purpose and in peer acceptance (Rosen, 1991). Originally, composite indicators were applied to compare development performance among countries and were a useful tool in policy analysis and public communication. Such composite indicators provided simple comparisons of countries which can be used to illustrate complex and sometimes elusive issues in wide-ranging fields i.e. environment, economy, society or technological development (OECD, 2008).

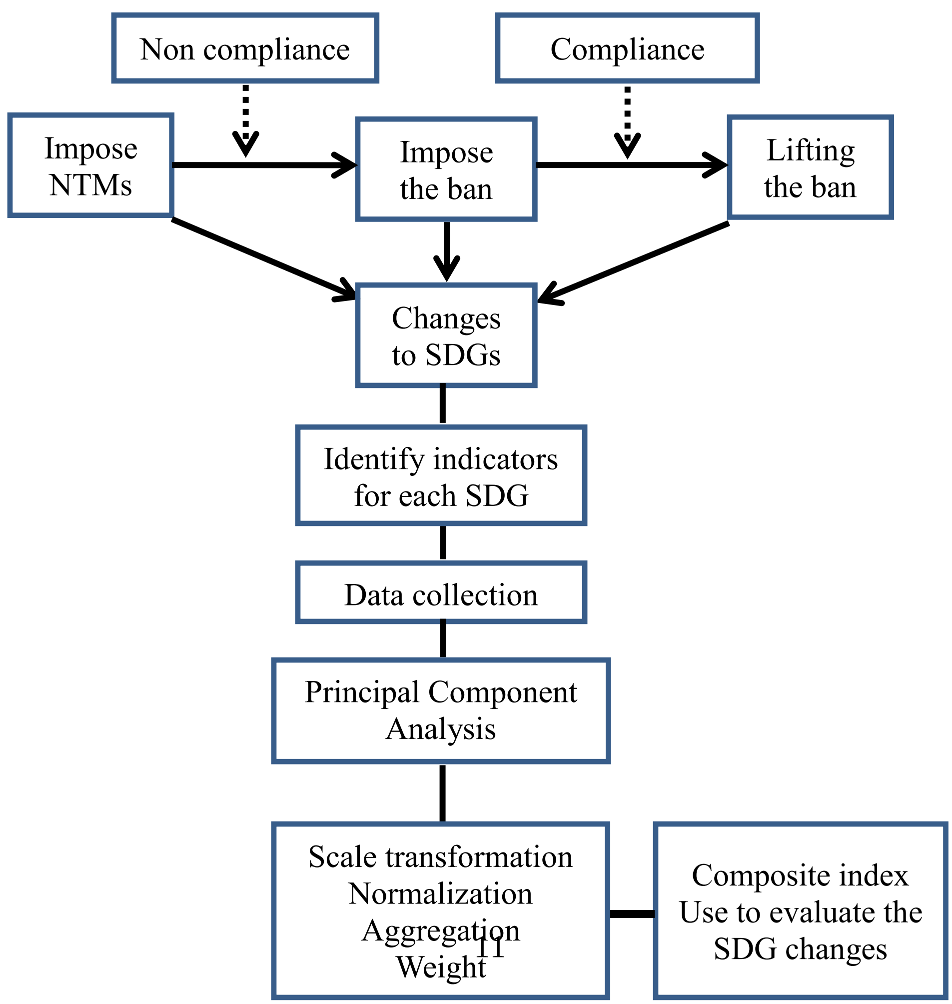
A sound conceptual framework is the starting point in constructing composite indicators. The framework should clearly define the phenomena to be measured and its sub-components, selecting individual indicators and weights that reflect their relative importance and the dimensions of the overall composites. This process should ideally be based on what is desirable to measure and not on which indicators are available. Figure

1 shows the conceptual framework which was used for this study. The analytical process consisted of four major steps, which are given below.

Step 1: Identify suitable indicators

The indicators will be the backbone of monitoring progress towards the SDGs at the local, national, regional, and global levels. To motivate all the stakeholders, the United Nations has introduced a universal monitoring framework. In this monitoring process, most important step is developing effective and efficient indicators to detect the performance of each country. The United Nations (2015) has introduced appropriate indicators to monitor all 17 SDGs. In addition, the report has provided guidelines to researchers and policymakers to design their own innovative indicators when given indicators were not enough to explore sensitive changes of the SDGs. This research has collected majority of indicators from stipulated reports and when the report has not provided specific indicators, the authors developed their own indicators.

Figure 1: Conceptual framework to analyze the ban's impact on SDGs



Source: Prepared by authors

Step 2: Data collection

Monitoring the changes of SDGs requires many different types of data. Official statistics derived from surveys and other official administrative data will play a critical, preeminent role. They will be complemented by unofficial data, gathered by research agencies, universities and private companies. In the case of an absence of secondary data, The United Nations (2015) recommends collection of primary data from a sample from the target population. Our study has utilized multiple sources of secondary data and primary data via conducting interviews with both boat owners and crewmembers of 120 IMUL fishing crafts of Sri Lanka. The detail description of the data is given under data collection section.

Step 3: Principal Component Analysis

Under multivariate analysis, principal component analysis was performed as a dimension reduction technique. This approach helps the user to eliminate unnecessary sub-indicators from the system to maintain parsimonious conditions in the composite indicator.

Step 4: Data transformation, normalisation, aggregation and weighting

Heterogeneous data with different units cannot be combined together for computation or comparison. In addition, if the variations of values are very high, then data normalisation is performed to transform variation in to standard range (OECD, 2008). There are different types of normalisation techniques such as min-max normalization, z-score normalisation, decimal scaling, sigmoid, and median normalisation. Nayak et al. (2014) has compared different normalisation techniques, which can be used to transform time series data. Among them, min-max is simple and straightforward because it is a linear transformation technique and standardise data in to 0-1 range (see equation 1). Attention needs to be paid to extreme values i.e. outliers as they may influence subsequent steps in the process of building a composite indicator.

$$I_v^t = \frac{lnX_v^t - lnminX_v^t}{lnmaxX_v^t - lnminX_v^t} \qquad (1)$$

where X_v^t is the value of index *v* at time *t* is, $minX_v^t$ is the minimum value of the time series and $maxX_v^t$ is the maximum value of the time series. I_v^t has a value in between 0 and 1. Human Development Index (HDI) is one of the most popular composite indexes, which employs the min-max data normalisation (Alkire and Maria, 2011). Guijarro and Poyatos (2018) have done a similar study to our study in which they have developed different indicators to cover all the SDGs and compared the performance of the 28 European Union countries. They also used min-max normalisation method and additive aggregation method to develop the composite indexes. The difference between Guijarro and Poyatos (2018) and our approach is that we compare time series data of same population, whereas Guijarro and Poyatos (2018) compare cross-sectional data of different segments of the population.

The composite normalisation can only deal with cross sectional data but now with little modification, composite data can be used for time series data and cyclic data analysis (Mazziotta and Pareto, 2015). Ecosystem service studies frequently use composite indexes for temporal data to generate indicators to observe temporal changes of ecosystem services and to compare across different time periods. Arowolo et al. (2018) calculated percentage changes among the values of indicators in different time periods. Thomscha and Gergel (2016) used min-max normalisation technique for the indicators of fishing capacity to evaluate temporal changes of ecosystem servicer. Zaman et al. (2016) analysed panel data by using principal component analysis techniques to prepare a tourist development index.

Log transformation also has been used to prevent domination of an indicator which would contain large variations. In addition, log transformation can address the issue of skewed data. For an example, HDI calculations use log transformed income data for min-max normalization. For time series, monetary data should be deflated from the price index to address the issues of inflation. Some researchers use nominal values without transformation to stabilize variance (Walter, 2018). In a nutshell, log transformation is very important for composite indexes consisting of multi-dimensional variables (OECD, 2008).

The final important component of computations includes data aggregation and weighting. Weighing acknowledges the fact that in some composite indicators, there are important and less important sub-indicators. Weighting was used in this research to distinguish the differences among sub-indicators. There are two types of differences addressed here such as nature of impact and change of impact. When nature of the impact is considered, there are two types of impacts, one variable group represents positive impacts on SDGs such as income, compliance rate of environmental protection rules. The improvements of those criteria catalyse Sustainable Development. Opposite types of indicators inhibit the sustainable development such as usage of illegal fishing gears, exploitation, and number of respondents who are unable to settle debts. Both variable groups should not be aggregated in a similar manner. Due to this, we introduced compensation weight to distinguish inhibiting criteria and positive criteria. The inhibiting criteria were multiplied by negative one (-1) and the positive criteria were multiplied by positive one (+1). Another difference represents changes of variable. Because of the ban, some variable can increase while others decrease. The decreased variables were multiplied by negative one (-1) and increased variables were multiplied by positive one (+1). The final weighting factor of a particular variable was calculated by multiplying the weight of impact-nature and the weight of the variable-change. The overall weighting factor gives +1 when positive impacts (catalysers) increased or negative impacts decreased and the -1 gives when positive impact decreased or negative impact increased.

For sub-indicator aggregation, different mean calculation techniques were used such as additive (arithmetic mean), geometric mean, harmonic mean etc. Talukder, Hipel and Loon (2017) conducted an agriculture sustainability assessment and the author compared different aggregation and weight techniques, which could be used to compare sustainable indices. From this exercise, authors came up with unique advantages and disadvantages of different aggregation methods.

Often, geometric mean is used for aggregation, as it is not affected by extreme values as well as by sample size or the number of variables taken into aggregation. Harmonic mean has been recommended for equal weights for all the variables. However, geometric mean cannot handle negative values and harmonic mean cannot handle zero values. However, arithmetic mean can handle both negative values and zero values. The composite indicator of this research consists of positive, negative and zero values. To address the issue of negative values and zeros, arithmetic mean was used as an additive technique.

When arithmetic mean is used, the extreme values would generate large deviations from the real mean, but it will not be a problem for this research as we have used normalised data to calculate arithmetic mean.

This is a mixed method research, which integrates primary and secondary data. In-depth interviews with field experts generated a collection of indicators that can be used to observe SDG changes, which occurred as result of the European Union import ban. Through the literature survey, another set of indicators were gathered for the same purpose. Based on all the available indicators, most effective indicators were selected. The data for some of the indicators were already available in local and international secondary databases. Primary data was collected only for the indicators in which secondary data was not available.

Offshore fishermen were selected as the target population because they were the fisheries group directly affected by the European Union import ban. Furthermore, offshore fishermen have a high preference towards tuna, sword fish and other finfish meant for export market. The offshore fishermen used 28 to above 60 feet long IMUL boats, which have facilities to stay multiple days at sea. The survey data was gathered through face-to-face interviews with crewmembers and boat owners of 120 IMUL boats, which were randomly selected, from eight fisheries harbours in Sri Lanka from August to October 2018. The IMUL boats registered list under the Ministry was taken as the sample frame. The total population size is 3,952 (Ministry of Fisheries and Aquatic Resources Development, 2018) and we collected data from 120 offshore fishermen. Salvanes and Steen (1994) and Squires and Kirkley (1999) have observed different length group of crafts significantly differ in terms of fishing gear types, target fish species and fishing grounds. To address these heterogeneous characters, we have used stratified samples based on craft lengths. The selected craft length groups were 19-32 feet, 32-45 feet and above 45 feet. Forty boats were selected from each length group.

As a main source of secondary data, we used United Nations Comtrade Database for the fish export data in both Harmonized System (HS) four and six digits. The data related to NTMs were taken from the UNCTAD TRAINS database and reported for a period of seventeen years, i.e.2001 to 2017, at the HS six-digit level for each trading partner. The local fish production, number of registered boats was taken from statistics yearbooks of the Ministry of Fisheries and Aquatic Resources Development of Sri Lanka. Annexure 2 includes all the details about the data and their sources.

3.1 The sub-indicators

The set of indicators were developed to represent all the SDGs, which could be potentially impacted by the European Union ban, namely: no poverty (1), zero hunger (2), good health and well-being (3), quality education (4), decent work with economic growth (8), industry, innovation and infrastructure (9), responsible consumption and production (12) and life below water (14). Table 3 displays the indicators related to each SDG. Notably, some impacts would be highly concentrated for certain stakeholders, namely fishermen. As such, while some impact on the Sri Lanka's overall SDG implementation may be limited, as the Report on the Inter-Agency and Export Group on SDG Indicators,[1] SDG indicators should be disaggregated, where relevant, by income, sex, age, race, ethnicity, migratory status, disability and geographic location, or other characteristics.

Some of the criteria mentioned in that table could catalyse the SDG improvement and some of them could inhibit the SDG improvement. The plus, and minus signs were distinguishably denoted the catalysing or inhibiting nature of each indicator. In this paper, we are mostly interested in studying the impact of trade due to NTMs hence we included trade performance measuring indicators used in Trade-map of international trade division and descriptive NTM analyses from UNCTAD (2019). The equations used for studying the trade patterns are given in table 4. All the indicators were calculated for each year and a time series of indicators were prepared to eventually compute the temporal composite index.

[1] (E/CN.3/2016/2/Rev.1)

Table 3: Sub-indicators selected for the composite indicator

SDG		Sub-indicator	Impact on SDG
1	No Poverty	Number employed	+
		Annual income per boat	+
		Compensate household expenditure	-
		Borrowing loans and mortgage properties	-
2	Zero Hunger	Availability of fish for local consumption	+
		Fish consumption from take away catch	+
		Compensate food expenditure	-
3	Good Health and Well-Being	Spending on family health	+
4	Quality Education	Compensate expenditure for education	+
8	Decent Work and Economic Growth	Export growth rate	+
		Export concentration index	-
		Market competition	+
		NTM prevalence score	-
9	Industry, Innovation and Infrastructure	Provide subsistence to improve facilities for IMUL boats and develop fisheries harbours	+
12	Responsible Consumption and Production	Number of boats using VMS and logbook	+
		Percentage of boat inspected	+
		Product quantity export with catch certificate	+
14	Life Below Water	Number of fishers arrested in foreign sea territories	-
		Compliance rate	+
		Sustainable fishing gear	+

Source: Prepared by authors

Table 4: Equations for market performance indicators

Definition	Formula	Remarks
Revealed competitive Advantage/Balassa Index - The ratio of share of export of a particular product to total value of export of the country under consideration to that of the rest of the world.	$RCA_{d,i,t} = \frac{\frac{X_{d,i,t}}{X_{d,t}}}{\frac{X_{w,i,t}}{X_{w,t}}}$	d – Sri Lanka, w - world, i - fresh fish, t - year and $X's$ are the value of exports
Market Concentration Index/Herfindahl Hirschman Index - The size of firms (share of firm) in relation to the industry and indicator of the amount of competition among them.	$H_i = \frac{\sqrt{\sum_{i=1}^{n}\left(\frac{X_{d,i,t}}{X_{d,t}}\right)^2} - \sqrt{1/n_t}}{1 - \sqrt{1/n_t}}$	$X_{d,i,t}$ - Value of fish export from Sri Lanka to the European Union in given year, $X_{d,t}$ -Value of all export from Sri Lanka to the European Union in Given year, n - number of products
Compound growths - The rate of return that would be required for an investment to grow from its beginning balance to its ending balance	$Gro = \left[\left(\frac{X_d^t}{X_{d,i}^{t_0}}\right)^{\frac{1}{(t-t_0)}} - 1\right] * 100$	X_d^t - Sri Lankan fish export to the European Union in present year, $X_{d,i}^{t_0}$ - Sri Lankan fish export to the European Union in previous year
Diversification index - The average of market share difference of market share of the country and world	$S_{jt} = \frac{\sum_t [h_{it} - h_t]}{2}$	h_{it} - Share of Sri Lankan fish export in total export of Sri Lanka in year t, h_t – Share of fish in world market in year t
Prevalence score (*PS*) - Average number of NTMs applied to products within given year.	$PS_{i,t} = \frac{\sum_{k=1}^{hs} \#NTM_{i,k,t} D_{i,k,t}}{\sum_{k=1}^{hs} D_{i,k,t}} * 100$	$\#NTM$ is the number of NTMs in given year, $D = 1$ if country i imports any quantity of product k *in* time t, and 0 otherwise

Source: Prepared by authors based on Trade map guidelines and UNCTAD (2019)

4. Results and discussion

The first part of the section discusses how the European Union ban affected the fish exports local market of Sri Lanka. The second section explores how producers (fishermen) responded to the European Union ban. The third section explains the direct and indirect linkages of NTMs to the SDGs and quantitatively assessed impacts of NTMs through composite index techniques.

4.1 The impact of the European Union ban on local market and fish trade of Sri Lanka

As illustrated in figure 2, after the tsunami in 2004, Sri Lanka continuously increased the supply of fish products to the European Union until 2009. During this phase, Sri Lankan fish exports to the European Union grew in value by 73%. The trade has declined subsequently because the European Union removed Generalized System of Preferences (GSP)+ tariff concession in 2009, accusing actors in Sri Lanka of human rights violations at the end of the civil war. The largest drop in growth experienced by Sri Lanka was during 2015 - 2016 because the European Union enforced the ban on Sri Lankan fish imports. According to the agreement among all the European Union countries, they had to completely stop fish trading with the banned countries. Nevertheless, Mundy (2018) provided evidence that some of the European Union countries have continued to import fish products from Sri Lanka during the ban period. Sri Lankan fish trade has once again enjoyed robust growth because the European Union lifted the ban and offered the GSP+ concession again. A similar depiction can be seen in figure 3 where the market share of fish exports from Sri Lanka to the European Union also has decreased during the ban period. Out of the total fish imports for the European Union market, Sri Lanka is a minor supplier. Sri Lankan fish exports have occupied 0.52% of the market share in the European Union ranking the 36th largest exporter in 2009 (figures 4 and 5). Due to the ban, market share of Sri Lanka in the European Union fish export market dropped down to 0.06% and its rank dropped to the 74th place. Even though Sri Lanka is a minor supplier for fish exports to the European Union, for some specific products, the role of Sri Lankan products is highly noticeable than other seafood products. For example, frozen, fresh or chilled fish fillets and meat of yellow-fin tuna (At HS six-digit level: 030349, 030487, 030499 and 030232). The export destination matrix (table 5) was prepared based on the evaluation of market shares of Sri Lankan export destinations from 2012 to 2017. The European Union has remained in the first place until 2014. Even though the fish import ban was not fully executed by some of the European Union countries, fish imports from Sri Lanka still substantially decreased since the warning (yellow card) was issued by the European Union in 2012.

Figure 2: Change in value of fish exports from Sri Lanka to the European Union

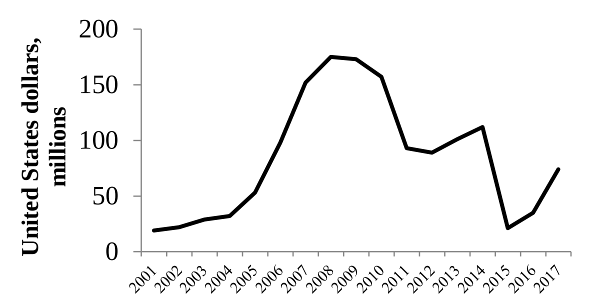


Figure 3: Change in market share of fish exports from Sri Lanka to the European Union

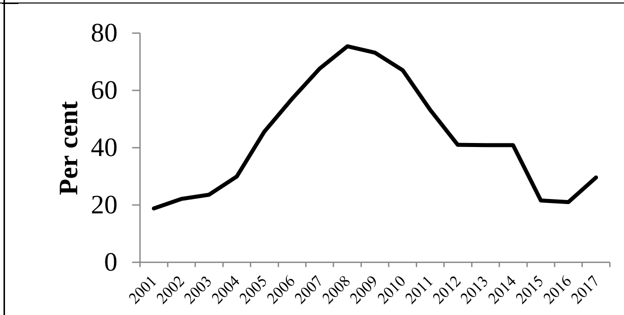


Figure 4: Change in market share of fish imports to the European Union from Sri Lanka

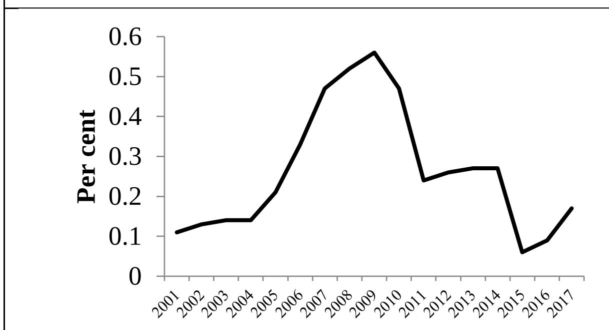
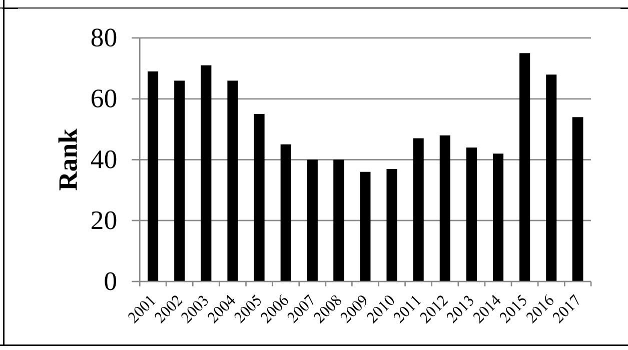


Figure 5: Change in rank of Sri Lanka as an exporter to the European Union



The compound growth rates were calculated for all the fish exporting countries. Among them, the United Kingdom, France, Italy and the Netherlands, which strictly controlled Sri Lankan fish imports, showed significant negative import growth rates. Under the pressure of the European Union ban, Sri Lanka had to find new markets. As result, Sri Lanka increased supply volume to the non-European Union countries. The United States became the largest importer of fish products from Sri Lanka during the European Union ban period. In addition, Sri Lanka found some emerging markets in the Russian Federation, Saudi Arabia, the United Arab Emirates and Canada. Table 6 shows the top five countries with recorded negative growth rates of fish products imports from Sri Lanka, and the top 5 of positive growth recorded countries.

Table 5: Top 10 export destination of Sri Lanka

Economy	2012	2013	2014	2015	2016	2017
European Union	1	1	2	2	2	1
United States	3	2	1	1	1	2
Japan	2	3	3	3	3	3
Hong Kong, China	4	5	6	6	6	6
Taiwan Province of China	6	4	5	5	5	7
Canada	5	6	4	4	4	4
Viet Nam	9	7	8	7	7	5
Saudi Arabia					8	8
Israel	8	9		10	9	9
United Arab Emirates			9	8	10	10
Singapore	7	8	7	9		
Thailand	10	10	10			

Source: Calculated by authors based on Comtrade database

Table 6: Changed in Sri Lankan fish export growth rate

	2010-2011 %	2011-2012 %	2012-2013 %	2013-2014 %	2014-2015 %	2015-2016 %	2016-2017 %
Top five countries with negative export growth rate changes during banned period							
Japan	87	36	-10	-14	-39	-6	10
Netherlands	3	7	2	5	-40	24	19
Italy	8	-34	39	26	-81	33	149
France	-39	-43	42	47	-80	23	229
United Kingdom	-38	-20	35	-15	-76	-20	193
Top five countries with positive export growth rate changes during banned period							
United States	71	130	9	21	5	8	11
Canada	157	-9	90	16	24	9	11
Saudi Arabia	38	-29	-47	803	193	203	44
UAE	103	6	60	367	126	-56	34
Russian Federation	100	-48	24	61	403	13	51

Source: Calculated by authors based on Comtrade database

To explore the changes of competitive product mix, Revealed Comparative Advantage (RCA) indices were calculated for the entire fish product exported by Sri Lanka at HS six-digit level from 2001 to 2007, are presented in figure 6. Fish is a highly diversified product category at HS six-digit level because fish and fishery product category is a combination of different species and different processing levels. Fish products are categorized into eight major groups at HS four-digit level. In these eight categories Sri Lanka performed well in frozen whole fish (0303), frozen or chilled fish meat and fish fillet (0304) fresh or chilled fish (0302) and Crustacean (0306) product categories.

On average from 2001 to 2007, these four categories represented 85% of total fish exports from Sri Lanka. When concerning products at the HS six-digit level, frozen yellow-fin tuna (030349) has historically proven the most competitive fish product because Sri Lanka's largest trade partners (European Union, Japan and the United States) highly demand these expensive fish species. However, during the European Union ban, Sri Lanka found a new export product i.e. chilled Skipjack tuna (030233) to challenge the ever-competitive supremacy of yellow-fin tuna. The price of Skipjack tuna is relatively lower than yellow-fin tuna. However, it is more abundant in the Sri Lankan sea than yellow-fin tuna. With this new product focus, Sri Lanka had the ability to penetrate new markets such as Taiwan Province of China, Hong Kong, China and Thailand. As a result of the ban, Sri Lanka tried to find new markets with new products. In addition, crustacean products (crabs, lobster and shrimp) enhanced their product competitiveness against the fresh and chilled finfish products.

Figure 6: Most competitive product mix

HS codes	2017	2016	2015	2014	2013	2012
030349	1	2	2	1	1	1
030233	2	1	1			
030232	3	3	3	2	2	2
030247	4	4	9	10		5
030579	5	9			10	7
030445	6	5		6	4	3
030449	7	7	10	9	3	6
030692	9	8	7			
030259	10		6	7	9	4
030571			5	3	6	8
030614	8	6	4	5	7	
030499			8	4	5	9
030617		10		8	8	10

Years

Source: Calculated by authors based on Comtrade database

Export diversification is a good measurement to analyse export performance. However, as a proxy measurement for export diversification, Herfindahl-Hirschman Index (HHI) is calculated most frequently. HHI measures export concentration and its reciprocal value revealed market diversification. Sri Lankan fish export market share is highly concentrated into a few products. As a single country, Sri Lanka has exported 166 fish products at HS six-digit level but 64% of the export shared in value is concentrated in to five products namely; 030349, 030232, 030617, 030614 and 030499. Figure 7 illustrates highly concentrated nature of fish export market of Sri Lanka. A modified HHI was used to calculate the export concentration ratio. When studying data from the last 17 years in figure 7, it is clear that Sri Lanka experienced it highest diversification scores during the European Union ban period. Since the European Union became unavailable, Sri Lanka has managed to diversify its exports into other countries (As shown in tables 5 and 6).

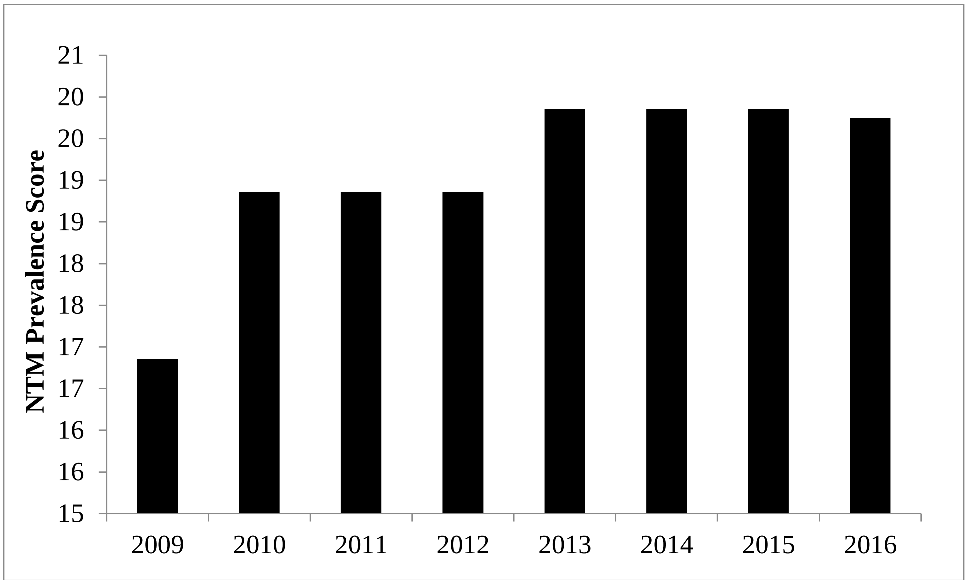
Figure 7: Change in the market concentration for Sri Lankan fish exports

Source: Calculated by authors based on Comtrade database

Turning to NTMs, prevalence score (*PS*) measures the average number of NTMs applied on a product, on a sector, or on overall imports. The focus of this study is the European Union market; hence, prevalence score in the European Union market was calculated at HS six-digit fish exports by Sri Lanka from 2009 to 2017. This score provides some indication of the level of regulatory obligations that trade flows face with the time. For illustrative purposes, figure 8 compares the PS across time. According to the graph, NTMs have increased with the time. When types of NTMs are considered, SPSs and TBTs dominate in the fish product sector and among them; SPSs are the highest at 63%. The frequency indexes for SPSs are 100% because fish is highly perishable subject to quality loss easily. At least 3 SPS measures were enforced for every product. From all the NTMs, there were 32% of NTMs directly or indirectly related to preventing IUU fishing and 16% of them directly related to IUU fishing.

As noted previously, TBTs enforced to prevent IUU fishing were categorized in to two types such as catch certificates (B8) and labelling (B3). The first type includes B83 which was enforced since 2010: “Seafood consignments exported by third (the non-European Union) countries to the European Union must be accompanied by a CC attesting the legal origin of the products through validation by the flag State of the vessel that caught the seafood” (European Commission, 2007). This certification process protects the right of consumers to know the origin of product they brought and the opportunity to refuse environmentally harmful products (Gutierrez and Agnew 2013). It is a good example of how forces of demand and trade regulation push production process towards more sustainable production.

Figure 8: NTM prevalence score (at HS 6 level) for Sri Lankan imports to the EU



Source: Calculated by authors based on Comtrade database

The second type of TBT is B3 labelling, which included the information of originated place offish, flag and other details of the boat. In addition to TBT, one pre-shipment inspection (NTM classification denoted as C4) was implemented to strengthen the battle against IUU fishing product entering the European Union market. Under this, pre-shipment inspection was mandated to check the catch certificate of fishing products. With regard to individual products, the tuna related products were highly affected by the European Union TBT measures. Twenty-one per cent of NTMs specially mention Yellow-fin, Bluefin and Big-eye tuna. As such, Sri Lanka was highly affected by the TBTs of the European Union because 69% of Sri Lankan export products for the European Union consisted of chilled, fresh or frozen tuna.

4.2 The impact on the local fish market and behavioural responses of fishermen to the European Union fish import ban

The fish export reduction positively affected the supply of fish to the local markets. Following Timmons, Wang and Lass (2008), we assumed that availability of fish for local consumer depended on local production, imports and exports. As the focal interest was about the offshore fishery, we only studied the supply of fish for local market by offshore fishery sector. According to figure 9, the fish production of offshore fishery has increased by 2% during 2014 and the ban period. The imports and exports of fishery products related to offshore fish products were calculated for both 2014 and 2015. Exports decreased by 36% and this excess production have been diverted to the local market. As a result, imports decreased by 16%.

As shown in figure 10, the average fish price in the local wholesale market dropped during the ban period but the fishermen did not reduce the offshore fish catch (figure 9). This incident can be explained by economic theories. First, the opportunity cost of fishing is very low in developing countries (Panayotou, 1982). Second, the fishers tend to work under minimum revenue; hence, the supply of fish is inelastic for a price reduction. Figure 11 illustrated that the number of boats dropped in 2004 due to the tsunami disaster. From 2005 onward, boat registration increased again, partly due to a concessionary loan scheme given by local and international institutes for fishermen. Since 2013, the rate of increase in the number of boats slowed down, since the Government stopped issuing new boat licenses in response to the recommendation of international environmental protection authorities. Further, the compulsory condition to have vessel monitoring system (VMS) transponders caused a reduction in the number of boats during the ban. Although, the number of boats has decreased after 2014 (as shown in figure 11), the average annual fish production per IMUL boat has increased despite a slump in 2013-2014 (as shown in figure 12). Changes in the number of active fishing boats impacts the catch per fishing boat as well as employment opportunities in the offshore sector. With a reduction in the number of boats fishing at one time, the competition among boats decreases, and productivity per boat increases.

Figure 9: Annual offshore fish catch of Sri Lanka

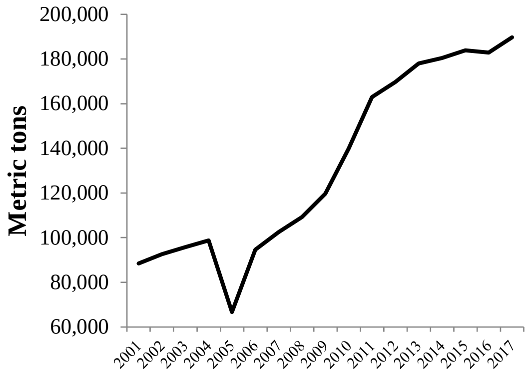


Figure 10: Average fish prices in the wholesale market of Sri Lanka

Figure 11: Number of IMUL fishing boats in Sri Lanka

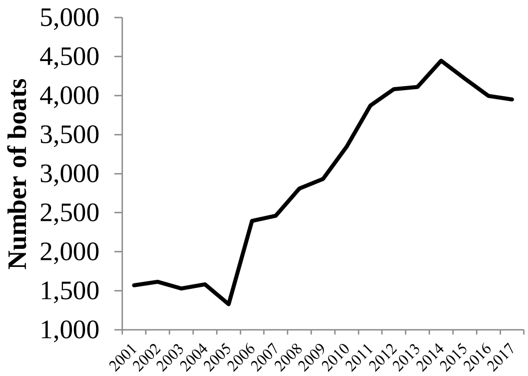
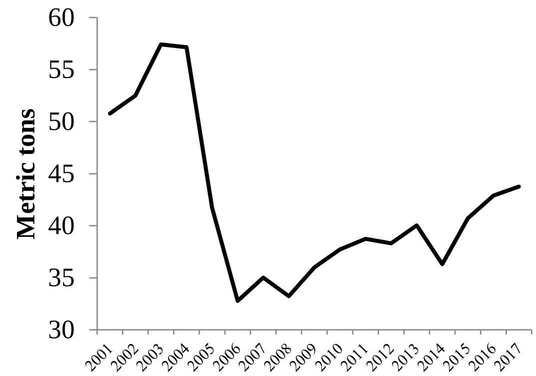


Figure 12: Annual fish supply to the local markets in Sri Lanka per IMUL fishing boat



Source: Calculated by authors based on Comtrade database

Our questionnaire provides insight to behavioural changes of the fishermen. Table 7 presents the result of paired "t-tests" used to compare different characteristic of fishing trips during ban period and after the ban related to ratio-scale data and table 8 presents chi-square results for categorical variables. The cross-sectional summary of the aforementioned categorical variables is presented in table 9. As shown in table 7, the European Union ban directly influenced changes in prices, decline in the number of active fishermen, and the reduction of the income of fishermen. Under lower prices, fishermen had to bear a higher risk of less income from long fishing trips which usually incur large operational costs. To minimize these risks, fishermen organised shorter trips during the ban period. Due to this shortness of fishing trips, travelling distance for the fishing trips, logically, were also reduced. As a cost cutting technique, fishing boats reduced the number of crewmembers per fishing trip. It is clear that labour cost and fuel cost were minimised in fishing operations during the ban period and total operation cost per trip was significantly lower during the ban period. Interestingly, fishermen have significantly increased the number of fishing trips per year during ban period. Due to the increase in the number of fishing trips and shorten the trip duration, there was no significant difference between the total numbers of fishing days per year between two periods. As depicted in table 8, there is a statistically significant difference across the use of type of gear and type of species caught with and without the ban. Further according to table 9, fishermen have reduced the usage of long-line nets and have started using small gillnets with small mesh sizes.[2] In addition, small fish instead of large fish dominate their fish composition of total harvest. Fishermen have reduced travelling long distance catching grounds to cut the operational cost and they have targeted small fish available close to the fisheries harbour. The intention to catch large fish by thus incurring large operational costs were lower during ban period due to lower prices received for the large pelagic fish species.

[2] Long-line is a commercial fishing technique that uses a long line of hooks and baits.

Table 7: The comparison of offshore fishing during ban and no ban periods

Characteristics	Period	Mean	Std. Error Mean	t-value	df	Sig. (2-tailed)
Number of days per trip	2015-2016	20.05	0.94	-2.29	129	0.02*
	2017-2018	22.18	0.77			
Number of trips per year	2015-2016	13.82	1.16	2.67	90	0.01*
	2017-2018	11.02	0.41			
Number of fishing days per year	2015-2016	223.2	9.41	-1.28	87	0.20
	2017-2018	237.0	8.75			
Total distance (Km)	2015-2016	1,085	91.1	-7.59	110	0.00*
	2017-2018	1,373	118.9			
Number of crewmembers	2015-2016	5	0.09	-7.05	129	0.00*
	2017-2018	6	0.11			
Operational cost per trip ($)	2015-2016	3,625	58,929	-4.78	129	0.00*
	2017-2018	4,027	69,002			

Source: Calculated by authors

Table 8: Chi-Square Tests to compare fishing gear types and species categories during ban and no ban periods

	Fishing gears			Species categories		
	Value	df	. Sig	Value	df	Sig.
Pearson Chi-Square	11.90[a]	3	0.00	39.53[b]	4	0.00
Likelihood Ratio	12.15	3	0.00	41.42	4	0.00
Linear-by-Linear Association	8.13	1	0.00	25.69	1	0.00
Number of Valid Cases	258			260		

Source: Calculated by authors
[a]0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.40
[b]0 cells (0.0%) have expected count less than 5. The minimum expected count is 16.50

Table 9: Descriptive statistics for gear type and catch species

		Gear				
		Long-line	Gill net with large size	Gill net with small mesh size	Purse seining	
Ban	Count	64	21	27	16	
	%	50%	16%	21%	13%	
After	Count	82	28	11	9	
	%	63%	22%	9%	7%	
		Species categories				
		Yellow fin tuna	Other tuna species	Billfish	Minor export fish species	Small fish species
Ban	Count	25	24	20	22	39
	%	19%	19%	15%	17%	30%
After	Count	66	15	13	26	10
	%	51%	12%	10%	20%	8%

Source: Calculated by authors

4.3 What we have found about the linkages between the European Union's import ban and its effect on the implementation of SDGs by Sri Lanka

Non-tariff measures are powerful policy tools that can directly influence Sustainable Development. The banning of certain products for importing to large markets through NTM regulations can serve as effective tools to influence noncompliance. This section attempts to acknowledge the direct and indirect impacts of the European Union's import ban on the SDGs.

1. *Poverty (SDG1)*

The European Union recommended an increase in the compliance rate set by the Indian Ocean tuna commission (IOTC) to remove the import ban. In support of reaching that condition, the Sri Lankan Government reduced the number of boats licensed to the high seas. During the ban period, fish income per trip declined and boat owners have reduced crewmember opportunities. Numbers of employment opportunities provide by offshore fishery have decreased 10% during the ban period. In response to the reduction in income, fishermen household expenditure was reduced by 31%. As a remedial measure to income reduction, 90% of fishermen took loans from money lenders by mortgaging their properties and 25% were unable to settle their loans after two years. As noted, this is significant since it is estimated that 560,000 individuals make their living out of seafood industry (Ministry of Fisheries and Aquatic Resources Development, 2018).

2. *Economic growth (SDG8)*

Trade is an engine for economic growth. Hence, trade performance and barriers for free trade is a useful indicator for measuring the development of a country. We used RCA, compound growth and market concentration of Sri Lankan fish exports to measure the trade performance (see table 4 for details). As a critical shaping factor of trade, the ban also had a direct influence on the economic growth of a country. We used export growth rate, export concentration index, RCA and NTM prevalence score as sub indicators to measure the impacts of export ban on SDG8. The RCA and market concentration rates declined from 0.16 to 0.11 and 3.95 to 2.49, respectively from 2014 to 2016 (before and at the last year of the ban). The growth rate declined from 9 per cent in 2014, to a 32 per cent decline in 2015 and 1 per cent growth in 2016 (see Annexure 3 for details).

3. Life below water (SDG14)

Prevention of IUU fishing and the application of sustainable fishing gear are critical factors in the sustainable use of marine resources. The number of fishers arrested in foreign sea territories and IOTC compliance rates are good indicators to observe the level of IUU fishing in a particular country. IOTC compliance assessment covers all the factors included for IUU fishing. According to the action taken by the Government and progress achieved to mitigate IUU fishing, compliance rate is calculated by IOTC. Even though Sri Lanka was warned, the compliance rate did not significantly change up to 2014. Because of the ban, all the relevant authorities in the fisheries sector of Sri Lanka worked effectively and achieved 82% of compliance rate in 2017. Due to the vessel monitoring system, awareness programmes for fishermen, boat inspection in the harbour and in the sea, movement of fishermen to the foreign sea territories and the rate of fishermen arrested by foreign countries have declined by as much as 85% after the ban.

The environment friendliness of a fishing gear is measures by-catch, postharvest loss, and harvest quality and disturbance level of the gear to marine ecosystem. When comparing fishing gears base on environment friendly qualities, the long-line is more efficient than gillnet (Santos et al., 2002). Sri Lanka IOTC country reports from 2013-2017 highlighted gillnet and ring-nets have a higher by-catch rate than long-line. During the ban period, fishermen have increased gillnets and ring-nets usage more compared to the usage of long-line to reduce operational costs. That can be considered as a threat to sustainable usage of fishery resources.

4. Zero hunger (SDG2)

The fishing boats in Sri Lanka customarily provide free of charge fish to crewmembers. When fish prices increase, a larger percentage of the fish harvest is sold to the exporters and in low price period, a comparatively larger amount of fish is distributed among fishermen. Fish is one of the main suppliers of animal proteins among poor fishing communities in Sri Lanka (Bogahawatte, 1986). During the ban period, we observed a 37% increment of free of charge fish distributed among crewmembers. Even though prices reduced, fishermen kept a relatively constant production level. In a macro perspective, availability of fish for local consumer has increased due to reduction of exports. Furthermore, affordability of consumer fish has improved due to a lower price. Due to high availability and lower price of fish, the poor communities of Sri Lanka had higher access to fish protein and there was a positive impact in terms of hunger alleviation.

5. *Industry, innovation and infrastructure (SDG9)*

The Fisheries Department of Sri Lanka has installed 1,615 vessel monitoring system (VMS) transponders for multiday fishing boats. The VMS enables boat location to be monitored from the VMS monitoring centre. This system is not only used to control IUU fishing, but also reduces the risk to fishermen. When a fishing boat has an accident at sea, this system helps locate the boat. The department further tried to develop this system to provide weather information and fishing ground forecasting. At the same time, the Government has increased the size of grants offered for fishermen to upgrade boatyards and purchasing of multiday vessels longer than 55 feet – large scale vessels with improved technologies.

6. *Responsible consumption and production (SDG12)*

SPS measures directly links to the enhancement of the physical quality of the final product, but some TBTs that are less directly related can also increase the physical quality of the product. The catch certificate and the information given in the label provide an opportunity for the consumer to backtrack the product details and ensure that the product, which they bought, was produced through sustainable production processes. Furthermore, it gives an opportunity for the consumer to participate in sustainable goals through responsible consumption. According to unpublished data from the Fisheries Ministry of Sri Lanka, the export of fish products with catch certificates has increased by 85% and the boat inspection at the arrival, departure and sea has increased by 83% after the ban.

4.4 Composite indicator of SDG

At the indicator collection step, we have collected 20 indicators. Not all the indicators may contribute significantly for the total variance of the composite indicator. To remove the skewness of the dataset, all data was transformed into log values. Some variables with missing data were replaced with mean of natural logarithm value for each variable. The correlation tests revealed take away catch and expenditure data were highly correlated and their correlation coefficient exceed the cut-off coefficient of 0.8. The results of the correlation test are given under Annexure 4. To maintain the parsimoniousness in the variable system, the components that were highly correlated with many variables were thinned-out.

In principal component analysis, there is a high risk of eliminating theoretically important variables due to lack of data and correlation with other variables. The scree-plot, which was constructed, illustrated more than eight variables, which can be selected to compute the indicator system. The cumulative Eigen values showed the selected eight variables covered 90% of the variance (Annexure 4). The Verimax rotation was performed to finalize the selection of sub-indicators. The scree-plot results of the principal component analysis are given under Annexure 5. The summaries of major results are displayed in table 10 and that shows two tests results that indicate the suitability of the data for structure detection. Kaiser-Meyer-Olkin (KMO) test result was 0.5, which implied that the sample size was just adequate to run a reliable principal component analysis. At the end of principal component analysis, eight sub-indicators were selected to represent five sustainable goals and those SDGs are given in the first column of table 11.

All the sub-indicators were considered equally important hence absolute value of the weight was set to 1. To decide the plus or minus signed of weighting factor, information in table 11 was used. The second column of table 11 represents SDGs' catalysing or inhibiting nature of the sub-indicator. The fifth column of Table 11 represents increased or decreased change of the sub-indicator and last column represent final weighting factor of the sub indicator.

Table 10: Major results of the principal component analysis

Indicators	1	2	3	4
IOTC compliance rate	0.911			
Reduce labor opportunities	0.847			
Fish availability for local consumption	-0.811			
Reduce annual income per boat ($)	0.792	-0.46		
Number of boats using VMS	0.523	-0.328		
Market competition		0.930		
Number of fishers arrested in foreign seas		0.714	-0.411	
Provide subsistence to improve facilities of IMUL boats			0.870	
Market concentration index	-0.500		0.782	
Usage of destructive fishing gears (%)	-0.554	0.348	-0.579	
Product quantity export with catch certificate				0.703
Export growth rate		0.533	0.318	0.697
NTM temporally adjusted prevalence score	0.354			0.673
Percentage of boat inspection			-0.464	0.659

Extraction Method: Principal Component Analysis. Four components extracted
Rotation Method: Varimax with Kaiser Normalization. The rotation converged in eight iterations.
Sources: Calculated by authors

As depicted in table 12, selected data were subjected to min-max normalisation and each sub-indicator was converted in to a common scale between 0 and 1. The minimum-maximum values and average value of each sub-indicator during the ban period are given in columns 2-5 of table 12. The final column of table 12 contains additive aggregation result of the sub-indicators representing each SDG. This column depicts the relative size of the impact of the European Union ban on each SDG.

Table 11: Weighting factors of the sub-indicators

Indicator	Weighting factor for the nature of sub-indicator (Catalyst +1, Inhibitor -1) (A)	Average value before the ban (2013-2014)	Average value in the ban period (2015-2016)	Weighting the change of sub-indicator (Increased +1, Decrease -1) (B)	Overall weighing factor (A*B)
Labor opportunities (number of employees)	1	21,395	20,535	-1	-1
Annual income of a boat($)	1	574	470	-1	-1
Fish available for local consumption (Mt)	1	38	42	1	1
Market concentration rate	-1	0.17	0.14	-1	1
NTM prevalence rate	-1	17	20	1	-1
Number of boats with VMS	1	50	1,163	1	1
IOTC compliance rate	1	55	75.5	1	1
Usage of destructive fishing gears (%)	1	31	25	-1	-1

Sources: Calculated by authors

Table 12: Composite index

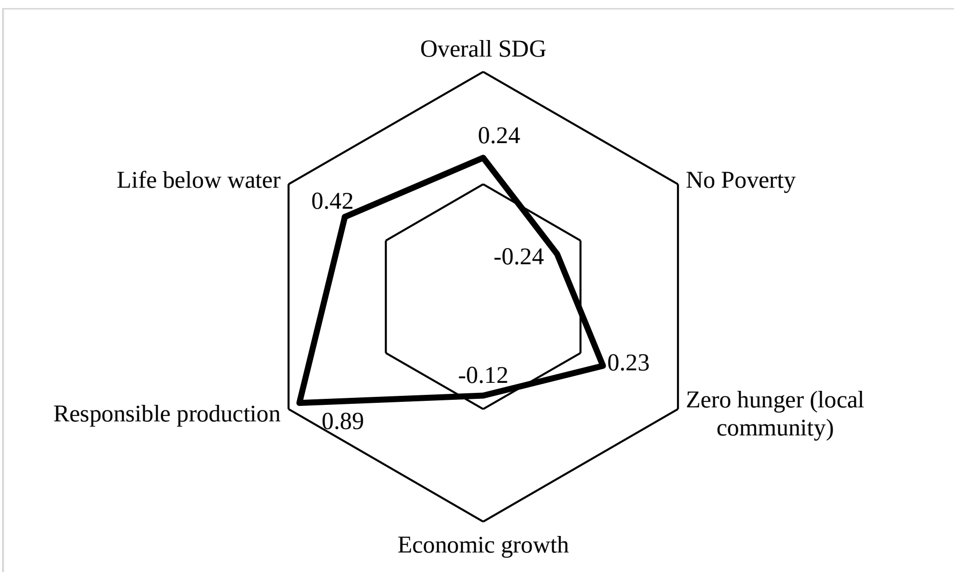
SDG	Indicator	Max	Min	Value in ban period	Normalized value	Weighting indicators	Sub index	Aggregation
1	Labor opportunities	23,712	19,360	20,535	0.27	-1	-0.27	-0.24
	Annual income of a boat($)	582	440	470	0.21	-1	-0.21	
2	Fish available for local consumption (Mt)	57	28	42	0.45	1	0.45	0.45
8	Market concentration rate	0.26	0.09	0.11	0.10	1	0.10	-0.29
	NTM prevalence rate	17	11	15	0.67	-1	-0.67	
12	Number of boats have VMS	1,500	0	1,163	0.86	1	0.86	0.86
14	IOTC compliance rate	82	5	75	0.92	1	0.92	0.42
	Usage of Destructive fishing gears (%)	36	24	25	0.08	-1	-0.08	
				Overall				0.24

Sources: Calculated by authors

The summarised results of the indicators are presented in figure 13. According to the results, the European Union's fish import sanction had a positive influence on SDG concerning zero hunger of local communities. As the sanction blocked the entry for international market, it enhanced the availability of fish under affordable price for all consumers of Sri Lanka. It should be noted that only Sri Lankan producers and consumers were considered because at this stage we cannot surmise the situation of the European Union consumers. It could be surmised that because of catch certificate and labelling, the consumers of the European Union have access to the information of purchased fish and opportunity to contribute towards responsible consumption. Due to the ban, SDG 12

(Responsible production) was positively affected through motivating government to install VMS systems and encouraging the fishermen towards environment friendly production. SDG 14 (life below water) showed the largest positive change. The Sri Lankan Government and the fishing community organisations implemented a series of activities to establish a sustainable fishing industry. There was a clear difference of destructive fishing gear usage rates before, during and after the ban period. Before the ban, 31% of exported fishers used environment friendly fishing gears but during the ban period, it was reduced to 25% because the restriction in exports created a lower demand for high quality fish caught under environmentally friendly fishing gears. After removal of the ban, 36% of fishermen applied environment friendly fishing techniques as the demand for high quality fish was restored in the international market. Through the elimination of IUU fishing, some SDGs have been negatively impacted such as SDG 1 (no poverty) as the offshore fishery cut down 10% of the jobs because of deteriorating profits under sanctions. SDG 8 (economic growth) had mixed impacts because sanction reduced growth rate of fish exports but increased export diversification through penetrating new markets with new products.

Figure 13: Changes of SDGs as an impact of the European Union ban



Sources: Calculated by authors

5. Conclusion

All in all, NTMs are not all negative because each NTM can generate both positive and negative impacts on trade partners. Some NTMs, such as catch certificate can positively contribute to the environmental protection and negatively impact on fishermen because of increased production costs. Financial incentives, best practices, eliminating the disadvantages in production costs, and premium price paid for fish caught under environmentally sustainable conditions can be recommenced as some of the best practices for mitigating negative impacts of NTMs. When trade partners do not comply with the NTMs, sanction can be used as a final tool to enforce them to agree to the NTMs. The impact of NTMs and the impact of a ban might generate contradictory outcomes. For an example, because of the sanction, there was no attractive price for the fish caught under sustainable fishing techniques hence fishermen were inclined to use low-cost destructive fishing gears. On the other hand, after sanctions, fishermen were attracted towards sustainable fishing gears because the fish with catch certificate fetched significantly high prices. To harness NTMs to address the challenge of sustainable oceans and fisheries use, NTMs have to be part of coherent policy frameworks, which include improvements to the management and governance of fisheries resources at all levels. If not, both importers and exporters may face unavoidable negative consequences.

In the case of this study, fish exports of Sri Lanka were in a fragile situation because the export basket was highly concentrated to few products (such as frozen and chilled yellow-fin tuna) and few markets (as the European Union, Japan and the United States). Because of the low diversification, Sri Lankan seafood export industry was highly vulnerable to the changes in the European Union market such as the ban, which occurred during 2014-2015. After the tsunami, Sri Lankan seafood industry had a largest market shock with the European Union ban. Sri Lankan fish export industry experienced an 82% growth, which dropped between 2014 and 2015. When a country sells its products in a concentrated manner to only a few markets, changes in bilateral trade terms will severely affect market growth. The whole fish export market of Sri Lanka struggled to cope with the negative impacts of the ban. During this period, Sri Lankan fish export trade flow changed significantly. It was observed that Sri Lanka's export basket became more diversified and available to new markets, namely the Russian Federation, economies of East Asia and the Middle East, with low-value exports products like skipjack tuna and crustacean. The supreme status of the European Union being the largest Sri Lankan seafood market was largely eroded over the import ban period and leadership of market share was occupied by the United States. However, after ban, the European Union returned as a preferred destination for fish exports from Sri Lanka.

Among the range of TBTs implemented by the European Union, catch certification is the most effective TBT, which can combat with illegal unreported fishing. Ensuring participation of all relevant parties will result in trade measures that are fairer, more transparent and non-discriminatory, and that will not create unnecessary obstacles to trade in both their design and implementation. Indeed, current “unilateral” attempts to use trade-related measures to address IUU fishing, such as the European Union regulations on IUU fishing are distinctive in their efforts to work collaboratively with the affected stakeholders of the fish exporting countries. From an exporter perspective, compliance with some NTMs can be very costly, because that process requires resources, infrastructure, implementation capacity, technical knowledge and intensive monitoring systems. In addition, the production process and attitudes of stakeholders need time to change. Individual producers such as small-scale fishermen and poor farmers do not have the ability to take necessary action to fulfil some requirement stipulated under NTMs.

The ban or NTMs should not be a weapon used against trade competitors or geopolitical opponents. Such measures should be constructive tools used to motivate sustainable development. The decisions around implementing NTMs or imposing a ban should not be taken spontaneously because they have very sensitive and invisible linkages with the sustainable development goals of different stakeholders.

The SDG analysis of this research was done base on the composite indicator techniques. As the focal point of the research, we have explored the impact of the fish import ban of the European Union on fish trade performance and SDGs of Sri Lanka. Findings of this research revealed that the ban generated mixed effects on a selected set of SDGs. Due to the ban, SDG 12 (responsible production), SDG 14 (life below water) have positive impact while SDG 1 (no poverty) and SDG 8 (economic growth) showed negative impacts. This study recommends further research to determine the impacts of NTMs, and to adjust the nature of NTMs to generate holistic sustainable development across the world.

The scope of the research was limited to offshore fishery, but in data collection process, it was difficult to distinguish coastal fishery products and deep-sea fishery products. Some important sub-indicates had no long-term time series data and those variables were rejected in the principal component analysis. Despite the challenges in data availability for all the possible indicators for the SDGs related to fisheries sector, the analysis in this paper presents a good baseline assessment and starting point to study impacts of NTMs on SDGs.

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Appendix

Annexure 1: Directly related TBT of the European Union for prevent IUU fishing

TBT main category	TBT sub category	Started date	Description	Relationship to prevent IUU fishing
INSP	C4	2009	Allowed if the fish cargo is accompanied by the relevant statistical importation document, properly validated and completed.	Direct
TBT	B83	2010	Imports of fishery products must be accompanied by a catch certificate in order prove the fish not originating from IUU fishing	Direct
TBT	B11	2013	Catch certificate should have all the information mention in relevant regulations	Direct
TBT	B11	2016	Catch certificate compulsory for Bluefin tuna	Direct
TBT	B31	2009	The label of the product must be included, information of products landed directly from the fishing grounds vessels flying the flag of a third country	Indirect
TBT	B33	2009	Packaging materials must include catch area: Caught at sea, fish species and maturity sizes of fish	Indirect

TBT	B31	2009	The following information must be provided on the labelling or packaging (caught at sea or in freshwater, or resulted from aquaculture)	Indirect

Source: Authors' preparation from UNCTAD –TRAINS database

Annexure 2: Secondary data sources for the research

Indicator	Data Source
Number employed	Fisheries statistic database from Fisheries Ministry
Income per fishing trip	Computed variable - Statistic database of Fisheries Ministry for production data and number of IMUL boat registered, COMTRADE export data, World bank exchange rate.
Compensate household expenditure	Through the primary survey of fishermen
Borrowing loan and mortgage properties	Through the primary survey of fishermen
Fish availability for local consumption	Local production data of the Fisheries Ministry and COMTRADE data
Usage of sustainable fishing gears	Annual reports of IOTS and primary survey of fishermen
Spending for family health	Through the primary survey of fishermen
Fish consumption take away catch	Through the primary survey of fishermen
Export growth rate	COMTRADE database
Market concentration and index	COMTRADE database
Market competition	COMTRADE database
Refusal rate	The European Union IUU fishing statistics
NTM temporally adjusted prevalence score	UNCTAD TRAINS data base
Spending for improve fisheries harbours	Annual performance reports of the Fisheries Ministry

Provide subsistence to improve facilities of IMUL boats and develop fisheries harbours	Unpublished data of the Fisheries Ministry
Number of boats use VMS and log book	Unpublished data of the Fisheries Ministry
Number of boat inspection	Unpublished data of the Fisheries Ministry
Number of fishers arrested in foreign sea territories	Performance reports of the Fisheries Ministry
Compliance rate	IOTC reports
Number of IUU fishing incidence	Unpublished data of the Fisheries Ministry
Product quantity export with catch certificate	The European Union fish export report

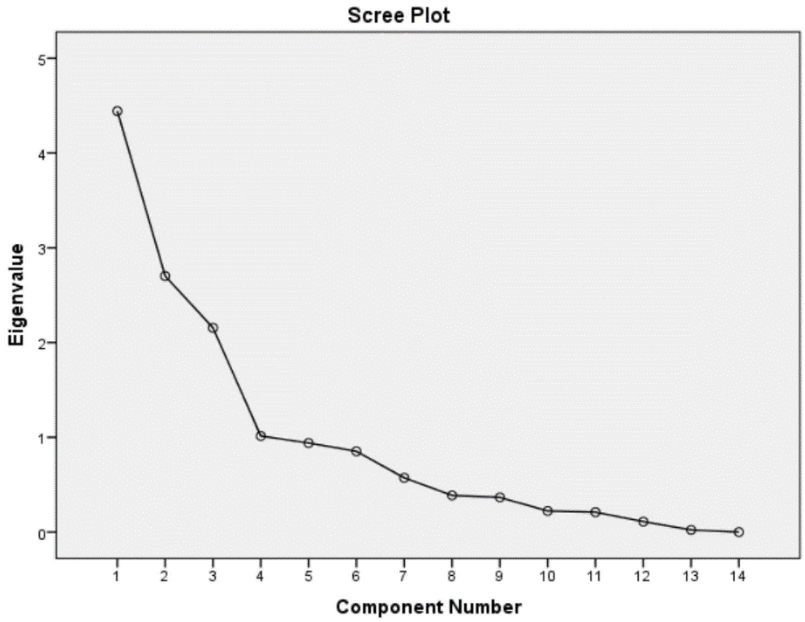
Annexure 3: Market performance

Year	Market concentration rate	RCA	Growth rate
2001	0.26	3.08	-
2002	0.20	2.62	-17.00
2003	0.19	3.19	19.00
2004	0.11	2.93	-6.00
2005	0.10	3.01	11.00
2006	0.09	3.88	34.00
2007	0.10	4.56	23.00
2008	0.11	4.69	2.00
2009	0.13	4.40	3.00
2010	0.15	3.81	-4.00
2011	0.16	3.66	14.00
2012	0.17	4.19	5.00
2013	0.14	4.40	19.00
2014	0.16	3.95	9.00
2015	0.10	2.81	-32.00
2016	0.11	2.49	1.00
2017	0.13	3.22	40.00

Annexure 4: Correlation coefficients of the principal component analysis

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
V1	1.0	0.3	0.0	0.0	-0.4	0.0	0.0	0.0	0.0	0.2
V2	0.3	1.0	0.5	-0.5	0.2	-0.5	0.5	0.5	0.5	0.3
V3	0.0	0.5	1.0	-1.0	0.0	-1.0	1.0	1.0	1.0	0.5
V4	0.0	-0.5	-1.0	1.0	0.0	1.0	-1.0	-1.0	-1.0	-0.5
V5	-0.4	0.2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	-0.4
V6	0.0	-0.5	-1.0	1.0	0.0	1.0	-1.0	-1.0	-1.0	-0.5
V7	0.0	0.5	1.0	-1.0	0.0	-1.0	1.0	1.0	1.0	0.5
V8	0.0	0.5	1.0	-1.0	0.0	-1.0	1.0	1.0	1.0	0.5
V9	0.0	0.5	1.0	-1.0	0.0	-1.0	1.0	1.0	1.0	0.5
V10	0.2	0.3	0.5	-0.5	-0.4	-0.5	0.5	0.5	0.5	1.0
V11	-0.2	0.3	0.1	-0.1	0.6	-0.1	0.1	0.1	0.1	-0.2
V12	0.3	-0.2	0.2	-0.2	-0.5	-0.2	0.2	0.2	0.2	0.4
V13	0.2	0.6	0.2	-0.2	0.1	-0.2	0.2	0.2	0.2	0.2
V14	0.0	-0.1	-0.3	0.3	0.1	0.3	-0.3	-0.3	-0.3	-0.4
V15	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	-0.1
V16	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1
V17	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	-0.1
V18	0.0	-0.4	-0.2	0.2	-0.1	0.2	-0.2	-0.2	-0.2	0.0
V19	0.2	0.4	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.2
V20	0.0	0.6	0.8	-0.8	-0.1	-0.8	0.8	0.8	0.8	0.6

	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20
V1	-0.2	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0
V2	0.3	-0.2	0.6	-0.1	0.0	0.1	0.3	-0.4	0.4	0.6
V3	0.1	0.2	0.2	-0.3	0.0	0.0	0.0	-0.2	0.0	0.8
V4	-0.1	-0.2	-0.2	0.3	0.0	0.0	0.0	0.2	0.0	-0.8
V5	0.6	-0.5	0.1	0.1	0.2	0.1	0.1	-0.1	0.1	-0.1
V6	-0.1	-0.2	-0.2	0.3	0.0	0.0	0.0	0.2	0.0	-0.8
V7	0.1	0.2	0.2	-0.3	0.0	0.0	0.0	-0.2	0.0	0.8
V8	0.1	0.2	0.2	-0.3	0.0	0.0	0.0	-0.2	0.0	0.8
V9	0.1	0.2	0.2	-0.3	0.0	0.0	0.0	-0.2	0.0	0.8
V10	-0.2	0.4	0.2	-0.4	-0.1	-0.1	-0.1	0.0	0.2	0.6
V11	1.0	-0.1	-0.1	-0.4	-0.3	-0.3	-0.4	0.2	-0.2	0.3
V12	-0.1	1.0	-0.4	-0.6	-0.4	-0.5	-0.4	0.4	-0.2	0.4
V13	-0.1	-0.4	1.0	0.2	0.1	0.3	0.4	-0.4	0.4	0.1
V14	-0.4	-0.6	0.2	1.0	0.3	0.9	0.7	-0.4	0.2	-0.6
V15	-0.3	-0.4	0.1	0.3	1.0	0.3	0.4	-0.5	0.1	-0.5
V16	-0.3	-0.5	0.3	0.9	0.3	1.0	0.8	-0.7	0.2	-0.2
V17	-0.4	-0.4	0.4	0.7	0.4	0.8	1.0	-0.6	0.3	-0.2
V18	0.2	0.4	-0.4	-0.4	-0.5	-0.7	-0.6	1.0	-0.3	0.0
V19	-0.2	-0.2	0.4	0.2	0.1	0.2	0.3	-0.3	1.0	0.0
V20	0.3	0.4	0.1	-0.6	-0.5	-0.2	-0.2	0.0	0.0	1.0



Annexure 5: Scree Plot