

Overview of fisheries traceability infrastructure in Turkey

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ABSTRACT: Monitoring fisheries and ensuring the traceability of seafood by computer infrastructure has become increasingly important in developing countries over the last decade. Many countries implemented new traceability systems in their fisheries and aquaculture production. However, many of them are having problems due to the small-scale fishing structure, numerous uncontrolled landing locations, non-standart fishing tools and foreign fishermen in their own territorial zones. Predominance of traditional fisheries and traditional structure of artisanal fishermen away from technological developments are also the important factors preventing development and application of tracing efforts. Turkey is one of these countries that has implemented computer-based monitoring systems on fisheries and aquaculture production since 2007. In this paper, the infrastructure and the application of computer-based traceability system in terms of system design, related legislation, applications and their effects on Turkish fisheries industry have been researched and analyzed.

Keywords : Aquaculture, BAGIS, fisheries engineering, fisheries traceability, SUBIS

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I. INTRODUCTION

Traceability is defined as the ability to track a product from its origin to the consumer through all stages of the supply chain. Today, the vast majority of developed countries require the traceability of food products they import and the certification of food safety. In addition, as a result of increased public awareness of food safety, consumers want to have more knowledge about the foods they buy. Such trend enforces governments to take initiatives to monitor sensitive foodstuff like meats, dairy products, fruits, vegetables, crops and seafood by traceability systems.

Traceability in fisheries is a valuable tool for stock management, reliable statistics, preventing illegal fishing, seafood safety, sustainability and efficient control on production. Whole information on the catch, production and processing of fish throughout the supply chain should be recorded and communicated to the related institutions and consumer to ensure the safety of seafood [1]. However, such huge amount of information requires a well established infrastructure to collect, organize and disseminate the data. Traceability systems with sophisticated technological infrastructure have been put into practice by many developed and developing countries in recent years. Turkey is one of these countries that implemented computer-based tracing through traceability systems since 2007.

General structure of fisheries industry in Turkey is based on coastal and artisanal fisheries which are the major source of seafood production. Nearly 90% of 15680 commercial marine fishing vessels that registered in 2015 were under 12m length [2]. However, purse seiners and trawlers over 12m length are the active hunters in the fishing fleet that supply 90% of the total marine production [3]. In 2015, nearly 64% of the total 672 241 tons seafood production have been supplied by commercial fishing activities. Totally 312 554 tons of this capture were consisted of pelagic fish such as anchovy (*Engraulis encrasicolus*), sardine (*Sardina pilchardus*), European sprat (*Sprattus sprattus*), horse mackerel (*Trachurus trachurus*), bonito (*Sardine sardine*) and bluefish (*Pomatomus saltatrix*). Total 193 492 tons of anchovy constitute 56% of total marine fish capture production that approximately 162.18 thousand tons caught from Black Sea by over 12m purse seine vessels and medium water trawlers. Nearly 53% of total anchovy catch are processing in fish meal and fish oil factories. The capture amount of other valuable seafood like carpet shell (*Tapes decussatus*), sea snail (*Rapana sp.*), black mussels (*Mytilus galloprovincialis*), horse mussel (*Modiolus barbatus*), shrimps (*Penaeus sp.*), spiny lobster (*Palinurus elephas*), octopus (*Octopus vulgaris*), European squid (*Loligo vulgaris*) and cuttlefish (*Sepia officinalis*) was 51 781 tons, with a share of 15% in total marine capture of the year 2015 [4].

A twinning project that based on Food and Agriculture Organization's (FAO) International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing and 2009 FAO Post State

Measures, carried out by the Turkish Ministry of Food, Agriculture and Livestock (MoFAL) to ensure compliance and harmonize Turkish Fisheries Monitoring, Control and Surveillance (MCS) system with the EU legislation and FAO. In the project, Renewed Fisheries Law, Automatic Identification System, Vessel Monitoring System, Fisheries Monitoring System, designated ports, prior notification procedure for entering ports, audit in the ports, enforcement for landing declarations, weighing catch at the landing port, control procedures and sanctions are the major measures of the action plan related to the traceability of seafood [3]. In line with this vision; completion of infrastructure to get more information about the sources, creation and application of national data collection programs to monitor activities related with seafood, conducting research activities, increasing human and physical capacity to activate control services, activating marketing system and control mechanism by strengthening fishing organizations are the main policy objectives of the MoFAL. The port offices, wholesale market directorates, fishermen, auditors, cooperative associations, fisheries faculties and research institutions are planned to work together for the operation of the traceability system. Unfortunately, the delay in approval of revised Fisheries Law which constitutes the basis of tracing system, has preventing the concurrent and simultaneous collaboration of all these institutions.

The objective of this paper is to provide guidance to other countries by analyzing the infrastructure and the application of computer-based traceability system in terms of system design, related legislation, applications and their effects on Turkish fisheries industry.

1.1. Legislations on fisheries management and traceability

The objectives of Turkish Fisheries Management Policy are set by the State Planning Organization. MoFAL and General Directorate of Fisheries and Aquaculture (GDFA) are the National Fisheries Management body in Turkey. General Directorate of Food and Control (GDFC), Turkish Coast Guard Command and Turkish Statistics Institute (TUIK) have an active role in development and implementation of traceability practices within Fisheries Information System.

Controls and audits are essential tools for efficiency of traceability systems on prevention of Illegal, Unreported and Unregulated (IUU) fisheries. Moreover, the fines, which are updated every year by the MoFAL, are also important in terms of deterrence. In this context, Turkish Fisheries Law (No. 1380) enforces a fine of 2122 TL (730 USD¹) for those who do not have registry books. Fishermen who do not keeping records or not presenting them to the concerned bodies are fined 1055 TL (363 USD). Disembarking catch other than the designated landing point is fined 4249 TL (1461 USD) and the concerned catch is confiscated by the GDFA Officers. The transporters who do not have the certain documents to be taken from port offices or transportation with incorrect or missing information on the documents are fined 2122 TL (730 USD) and the concerned load is confiscated by the GDFA Officers.

In 2015, GDFA, GDFC and Turkish Coast Guard Command have doubled audits and controls, compared to the previous years. GDFA performed 91 094 audits in marine and inland waters, fishing vessels, landing points, transportation routes, wholesale and retail fish markets. It has been reported by GDFA that, about 887 tons of illegal catch and 7 772 fishing gears were confiscated, 4867 person were fined total 6.6 million TL (2 269 913 USD) and fishing licenses of 12 vessels were cancelled. [5]. Turkish Coast Guard Command is an other efficient control and audit body in implementing traceability and prevention of IUU fisheries at the sea. The Coast Guard Command reported that in 2015 a total of 2633 IUU fishing efforts were seized and fined 4 603 630 TL (1 583 309 US \$) [6].

TUIK is the other important body that is collecting, interpreting and publishing national fisheries data for fisheries management, traceability and prevention of IUU fisheries. TUIK and GDFA is compiling the fisheries production data from the fishing logbooks, surveys, landing declarations and sales reports.

1.2 Regional bodies in improvement and implementation of traceability system

Turkey has been a member of International Commission for the Conservation of Atlantic Tuna (ICCAT), EUROFISH-International Organization, General Fisheries Commission for Mediterranean (GFCM) and FAO since 2003, 2002, 1954 and 1948, respectively. [7]. In addition, Turkey has assumed an active role in "Black Sea Fisheries Agreement" with six countries of the Black Sea. Turkey has also expressed full support and readiness to contribute Black Sea Commission member countries in MCS and IUU prevention actions as a member of the Black Sea Commission. Turkey has fulfilled all decisions of ICCAT under the 2003 Recommendation Concerning Minimum Standards for the Establishment of a Vessel Monitoring System (VMS) in the ICCAT Convention Area on Bluefin tuna (*Thunnus thynnus*) and venus clam (*Venus gallina*) quote [8].

Turkey as an European Union candidate member, is still adopting its relevant fisheries legislation to the EU Common Fisheries Policy and data collection framework of the European Commission. Turkey also considers the FAO's Code of Conduct of Responsible Fishing as an important tool for the sustainable use and

¹1 Turkish Lira (TL)= 0.34 USD in 31.12.2015

conservation of marine living resources under national jurisdiction and plans to develop national policies in harmony with this Code. Turkey has also adopted the Data Collection Reference Framework of GFCM which is the only responsible Regional Fisheries Management Organization in Mediterranean and Black Sea. Some intensive studies have been conducted to eliminate the differences between EU obligations and GFCM Task 1 requirements [9]. In 2005, the MedFisis Project was asked to draw up a plan for implementing a monitoring system with particular emphasis on developing the “Fishing Vessel Register and Information System” for the GDFA and the European Union Twinning Project management [10]. The recommendations, based on the MedStat Fishing Vessel Register (since its structure is open and closest to the EC requirements) were accepted. Specific requirements from the Government of Turkey and European Commission were to be accommodated in the data model according to the approaches stated in the MedStat program. GFCM has provided initial support in addressing gaps relating to the lack of legislation and the incidence of fragmentation at national level. By the year 2014, recommendations of GFCM on the submission of combined data on fishing vessels [11], Logbook [12], Task 1 [9], VMS [13], List of vessels IUU fishing [14], Port State Measures [15] has been fully implemented and transposed into national legislation [16]. Logbook and landing/transport declarations were prepared under the minimum requirements of GFCM. Turkey has submitted information on fleet data and partially catch data to GFCM Secretariat since 2011 but this data must be updated since the information is older than 2 years.

1.3 Fisheries and aquaculture traceability infrastructure

Fisheries Administrative Offices, called as “Port Offices” are the most crucial structures of fisheries monitoring that collect reliable catch data from logbooks and monitor fishing efforts. Since 2006, 44 port offices were established at many important fisheries ports of Turkey (Fig 1). GDFA projecting to increase the number of port offices to 150 within 5 years. Nevertheless, the most important problem that prevents port offices from operating effectively is the delay in hiring trained personnel.

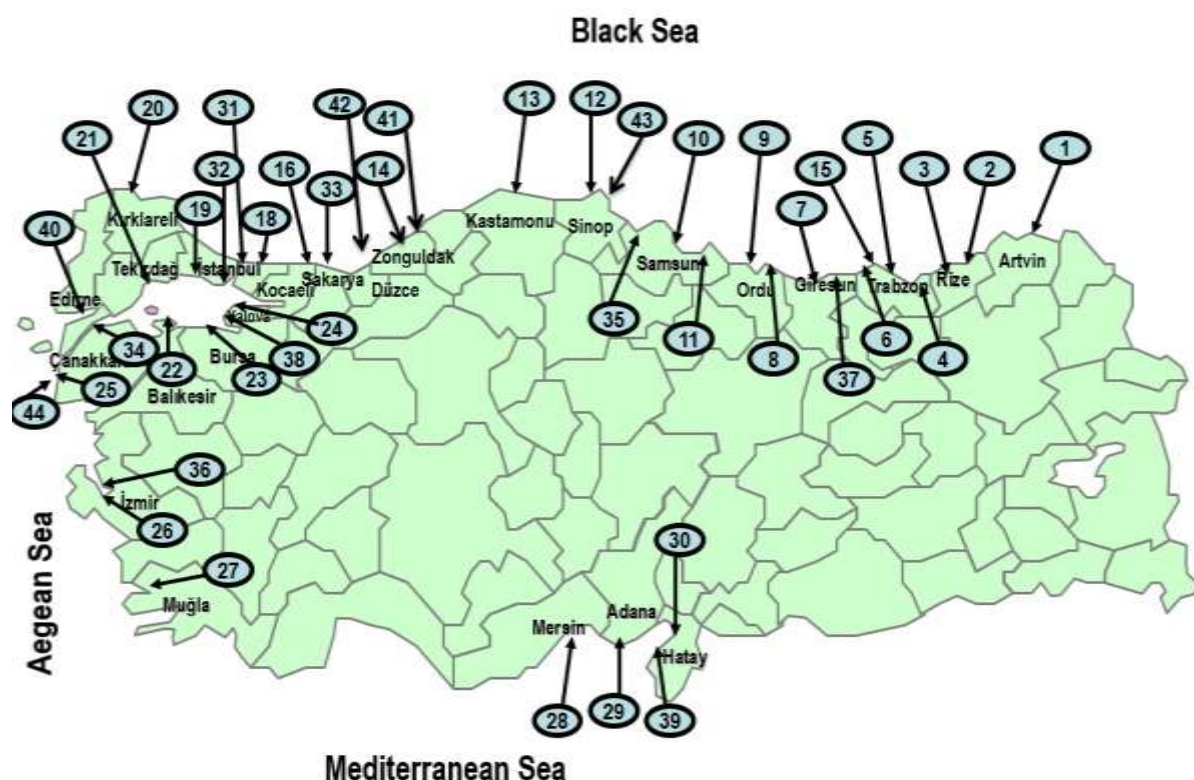


Figure 1. Operational port offices along the Turkish coasts at the end of 2015 (Circles indicate the location and number of port offices) [2]

Turkey is relying on two computer-based systems for tracing its fisheries and aquaculture production: Fisheries Information System (SUBIS) and Fishing Vessel Tracking System (BAGIS). VMS and Automatic Identification System (AIS) are the vital components of SUBIS. Satellite based VMS for tracking coordinate, route and speed of any fishing vessel over 15m has been developed by GDFA and Ministry of Transport,

Maritime Affairs and Communication according to GFCM and ICCAT agreements since the adoption of recommendation GFCM/33/2009/7 [13]. AIS has been mandatory for the fishing vessels over 15 m since 21 January 2010 in Turkey (Fig2). G DFA is monitoring and tracing the fishing efforts of all ICCAT tuna fish vessels in Turkish seas through VMS and AIS according to ICCAT agreements.



Figure 2. Automatic Identification System (AIS)

1.4 Fisheries Information System (SUBIS)

Fisheries Information System is a computer-based network system implemented by G DFA for monitoring fisheries and aquaculture efforts and collecting data more easily, effectively and reliably by fishing logbooks, landing, transport and storage declarations and sales reports data in the system. Also, seafood being exported to European Union is within the scope of SUBIS and data related with catch and sales of export seafood is being tracked by the system. SUBIS is integrated with Fleet Register System (GKS) and VMS for tracking fishing vessels. There are 15 sections inside the system for data entry [17]. Some additional data sections were added into the system in 2013 within the framework of EU conformity. Also, the system has been improved for tracking quota allocation of Bluefin tuna (*Thunnus thynnus*) and striped venus (*Venus gallina*) and monitoring anchovy catch [18]. SUBIS is an effective traceability system to deliver the timely and accurate product information to track tainted products back to their source and to verify sustainability [19].

1.5 Fishing Vessel Tracking System (BAGIS)

G DFA has started to improve the fisheries tracing system to cover whole fishing vessels over 12m length while the fishing efforts and disembarked catches of the vessels under 12m length have being monitored through the questionnaires, sub-sampling and sales notes. A new tracking system called Fishing Vessel Tracking System (BAGIS) will be effective for monitor all fishing vessels over 12m from the year 2016. BAGIS consists of AIS and electronic fishing logbook which are integrated into a single device that will be mounted to the fishing vessels (Fig3a). That device will track and record the identity, location, speed and route of fishing vessels and the data about captured seafood by satellite and will send these data to the BAGIS Center through GSM networks. BAGIS aims to monitor the fishing activities of the fishing vessels, increase the efficiency of the inspections and record the data of the captured products through the electronic fishing logbooks more rapidly [20] (Fig3b). Moreover this new monitoring system will be improved to trace the whole marketing chain of captured fish from catch to plate.

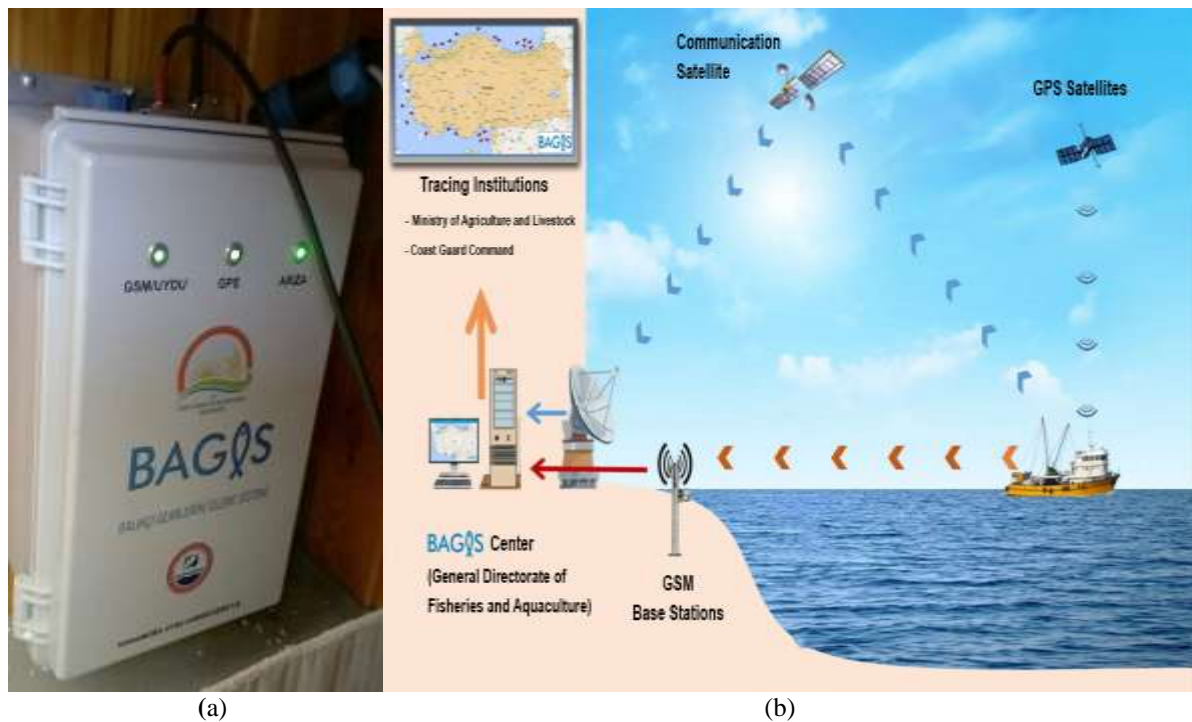


Figure 3.(a) BAGIS device mounted on fishing vessel,(b) Operation scheme of Fishing Vessel Tracking System [20]

1.6 Implementation status of traceability

Turkey has collected almost all fishing fleet data (except IUU) by Fleet Register System (GKS); licenses, fish processing and catch per unit data by questionnaires; more than half of the landing data by sales notes and nearly half of the biological and VMS data by sampling since 2014, within the fisheries data collection program of TUIK and FAO Eastmed Project [21]. However, there is no decent data on discards, fleet, landing, fishing gears, recreational fisheries and socio-economic variables yet.

Monitoring tools like logbooks for fishing vessels over 12m, sales reports (for the first sale), transportation documents and certificate of origin have been implementing for the fisheries and aquaculture since 2001 in accordance with EU conformity measures. Certificate of Origin is an important document that enables tracing legal seafood from the catch location to the table of consumer. Fisheries Law (No. 1380) enforces taking this certificate from province or district offices of MoFAL or cooperatives close to the disembarking locations prior to the transport or sale.

Fishing logbooks that are the main data source of SUBIS and BAGIS were completely delivered to the fisheries vessels over 12m length at the end of 2013. Both electronic and published forms of these logbooks should be used. Captains of the related fishing vessels must enter the data about their fishing efforts and captured products into the electronic fishing logbooks until 12:00 the next day. Even if no fish are captured at the time of fishing, logbook information must be filled in and submitted. Besides the vessel related data on logbooks, extra information required for catch monitoring are: departure and return date, catch species and amount, fishing tools, coordinates of national fishing zones and name of the captain [22]. Logbooks are the primary source of data for fishing gear type, time of fishing, fishing area, number of fishing operations, effort, landing by species and total landing. Commercial fishing data as volume of landings and prices per species is being partly collected by monthly questionnaires. Data from the questionnaires on fleet monitoring is also being integrated with the logbooks. Misreporting and missing information are the main problems of fishing logbooks for reliable and efficient usage.

Quota implementation for anchovy has been started since 2009-2010 catch season with the realization of SUBIS. Collection of the biological sampling data via a new added module has been started in 2011 in experimental level. Turkey 2014 Progress Report published by European Union reported that new modules and software, monthly survey data on aquaculture and inland fisheries, collection of catch data, audit and control forms have developed SUBIS even further [18]. The access to SUBIS and integrated data flow among MoFAL, GDFA, TUIK, GDFA and Turkish Coast Guard Command (responsible bodies for the fisheries management, traceability and control) have been provided.

SUBIS integrated Fisheries Geographical Information System (SUBISCBS) was created and put into service since 2014 [23]. Also, SUBIS integrated Fleet Register System has been completed and put into service

with the entire vessel data at the end of 2013. The data of landing declarations has been entered the system by the activated port offices but the number of offices was still inadequate at the end of 2014. The absence of any expertise body and infrastructure on traceability practices prior to the development and implementation of SUBIS is delaying the activation of SUBIS.

In respect of food safety, traceability that would allow consumers to monitor seafood from catch to dish, could not be fully implemented yet. Current legislations, enforcing only one step forward and backward traceability. In other words, an enterprise is only responsible for the records of products or services it sells and buys [24]. The draft regulation called “Market Standards in Fishery and Consumer Information”, prepared in 2006 and still waiting to be adopted by Turkish Parliament [25]. In case of enacted regulation, information about the purchased seafood will be transferred to the final consumer with an etiquette, informative product package or a commercial document accompanying with the product which would provide the traceability. Consumer will be informed about the size, weight, freshness, catch zone and type (catch or aquaculture) of seafood through the labels of the products. The implementation of BAGIS will provide traceability of seafood to the consumers through integrated interfaces.

II. DISCUSSION AND CONCLUSION

Although the fisheries monitoring infrastructure, which has been developed since 2007, has improved more and more each passing day, there are some difficulties and problems in front of the seamless operation of the system. Tracking systems with a very comprehensive infrastructure can be significantly impacted by problems that arise in any of the institutions or components involved. Therefore, the correct diagnosis of the problems and the effective integration of the existing possibilities with the system will enable the monitoring systems’ comprehensive functionality in short-term. The SWOT analysis of the Turkish Fisheries Monitoring Systems showed that strengths and opportunities of the monitoring system and its infrastructure are quite promising compared to the weakness and threats (Table 1).

Table 1. SWOT analysis on Turkish Fisheries Monitoring System

STRENGTH	WEAKNESS
<ol style="list-style-type: none"> 1. Flexible and improved fisheries monitoring system infrastructure similar to EU and GFCM. 2. Compelling force of EU harmonization process. 3. EU funds for supporting traceability systems of candidate countries. 4. Effective work of the governmental institution specialized in Fisheries and Aquaculture Management such as GDFA. 5. Subsidization of the initial and operational costs of monitoring systems by the Ministry. 6. Renewed regulations that would provide active support to the traceability of fisheries. 7. Intensive control and audit policy on data flow and accuracy. 8. Fishing efforts limited to Turkish Territorial Zones. 9. Efficient and strong support of Turkish Coast Guard Command in controlling and monitoring of the fisheries. 10. Numerous experts and researchers studying on fisheries management and traceability. 11. Numerous training seminars and meetings for the fishermen about the fisheries traceability systems. 	<ol style="list-style-type: none"> 1. Inactive role of the cooperatives in traceability systems. 2. Absence of previous seafood related data in the systems. 3. Inability of consumers to track seafood for food safety and origin. 4. Lack of deterrence in sanctions for misrepresentation, obfuscation and not keeping data. 5. Unsecure working conditions for the auditors. 6. Inadequate number of port offices and technical staff. 7. Delay in approval of revised Fisheries Law.
OPPORTUNITIES	THREATS
<ol style="list-style-type: none"> 1. Providing fast reflex to the IUU fishing efforts and prevention. 2. Increasing awareness among consumers on food safety and traceability. 3. Supplying reliable catch data for fisheries management and sustainability. 4. Determining right and reliable quota for pelagic and demersal fish. 5. Providing control of seafood on each segment of value chain from origin to the consumer. 	<ol style="list-style-type: none"> 1. High demand from the restaurants and hotels for the high valued species caught by IUU fishing and uncontrolled marketing of them during fishing ban periods. 2. Increased resistance to the auditors by fishermen and vendors. 3. Lack of knowledge about the importance of fisheries traceability among consumers and fishermen.

The role of fisheries cooperatives on traceability system is quite negligible in Turkey. The involvement of fisheries cooperatives to the traceability practices through SUBIS would improve the quality and quantity of data on pelagic fish, shrimp, lobster and cephalopod provided by the recreational, sportive and artisanal fishermen with vessels below 12m length.

The absence of fisheries data for previous years in the SUBIS and BAGIS delays the usage of monitoring system for fisheries management and planning. Significant amount of fisheries data has been collected and studied by several institutes like TUIK, research institutes and fisheries faculties but such data was not shared enough for fisheries management. Project teams can be created among the researchers, academicians and experts for input of previous years' fisheries data into the traceability systems more quickly. Moreover, private sector that specialized in audit and data providing has a well-developed infrastructure that can be adapted to the traceability systems. However, private sector's contribution cannot be realized due to the lack of proper certification provided by MoFAL.

Major weakness caused by the inefficiency of traceability systems is the circulation of IUU products on the market and marketing of less valuable products as if they are precious and famous seafood. In uncontrolled markets, Mediterranean Sea sardine (*Sardina pilchardus*) can be marketed to the final consumer as Black Sea anchovy (*Engraulis encrasicolus*), shark (*Hexanchus griseus*) as sturgeon (*Acipenser stellatus*) and leerfish (*Lichia amia*) or pangasius (*Pangasius hypophthalmus*) fillets as sand sole (*Solea solea*). Traceability is a good tool to certificate the identity and quality of seafood on the market [26]. Traceability will become more common and demanded tool among consumers by letting them to get information about the seafood on the market through electronic labels, barcodes or other labeling agents on a consumer information portal integrated with traceability systems. Consumers who can trace the purchased seafood will naturally take part as a controller in the system which would prevent the inclusion of IUU products into the market chains [27]. Moreover, the fishermen should be informed and trained on the importance of fisheries traceability systems for preventing IUU fisheries that is the most important problem of the legal fishermen.

Although increased number of audits on keeping record, misrepresentation and obfuscation, the sanction levels for such offenses are still low. IUU fishermen consider the penalty-profit balance and continue illegal activities, ignoring low sanctions. The level of sanctions should be increased to deterrence levels. Moreover, the auditors' safety should be ensured by the law enforcement. It is essential for the police or security personnel to participate in the inspections for avoiding the resistance of fishermen and suppliers against the inspections.

IUU fishermen are rapidly developing new reactions and methods, despite the new revisions on Fisheries Laws and Regulations. Some useful MCS measures have been adopted in compliance with GFCM recommendations but more effective measures should be required to stop IUU fishing efforts. A good and acceptable traceability system must be able to provide the documents and information required by certain standards, open to new developments rather than solely based on financial documents [28]. Infrastructures like SUBIS, BAGIS, VMS, port offices, improvements in institutional capacity and awareness provided by FAO Agreements and EU twinning projects will be the essential tools that can support fast and efficient implementation of traceability practices.

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