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# Adaptive maritime domain planning model: Transferable fishing concessions in Croatia

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## ABSTRACT

The Croatian long-lasting fisheries problem still vivid one year after the Croatian admission to the EU is overfishing in a “common pool resource”. After the questionable success of previous policies, the new EU Integrated Maritime Policy devolves some of the mechanisms of the Common Fisheries Policy to the member states. This gives Croatia the opportunity to set policies that reflect its own interests: to rebuild its fish stocks, its fishing fleet and the supporting fish processing, services, and shipbuilding industries. This may be achieved without direct command and control governmental intervention used in the past. The institutionalisation of fishing rights in the general form of Transferable Fishing Concessions and in particular as it is known in the EU: Individual Transferable Quotas, creates a new asset, with benefits to entrepreneurs and entire industries. They may be used as a collateral for fishers during the investment cycle, a source of information, an incentive for monitoring of competitors, and a source of windfall profits. Therefore, we argue that Transferable Fishing Concessions could enable the internalisation of negative externalities across Croatian Adriatic fisheries.

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## 1. Introduction

The European Union Common Fisheries Policy (CFP) is an example of policies with questionable success at EU level with the goal to control the allocation of a maritime domain commons by command and control mechanisms intervening directly into the production process with heterodox policies. As a consequence of this failure, and possibly having learned something from the immense scientific contributions to the field of common pool resources’ management, the European Union decided to repeal and

amend all major directives and decisions concerning the CFP and combining it with the Common Maritime Policy (CMP) consisting of the so called “Blue Growth” (maritime and coastal tourism, ocean renewable energy, marine mineral resources, aquaculture, and blue biotechnology), maritime transport, and shipbuilding, into an Integrated Maritime Policy (IMP) [3][4]. EU proposes the use of market allocation mechanisms to conserve fish stocks within sustainable levels. In a system of Transferable Fishing Concessions (TFCs) the fisher has an obligation to hand out the amount of Individual Transferable Quotas (ITQs)

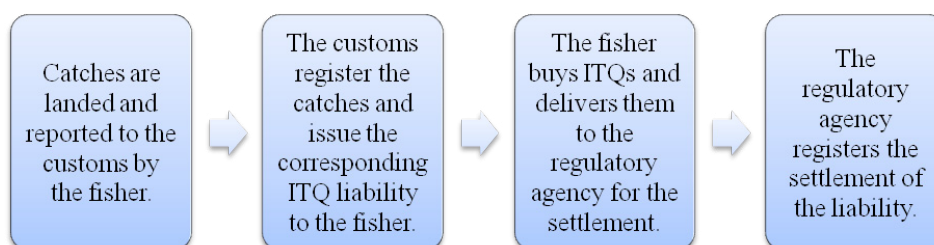


Figure 1 Individual transferable quotas within the system of transferable fishing concessions

Source: own representation.

corresponding to the quantity of landed species. The total amount of ITQs for the respective species is called Total Allowable Catch (TAC) and represents an estimate of an undisclosed sustainable yield measure setting the upper limit to the quantity of species that can be landed from a particular catchment area.

## 2. The institutinal setting at EU level

Since the EU has not explicitly defined TACs, or for that purpose, what measure of sustainability it is pursuing, it is impossible to *a priori* assess the success of the proposed policy tools. Some known measures of sustainability are: 1. Maximum Sustainable Yield (MSY) is the highest catch from a stock under existing environmental conditions without affecting significantly the reproduction process [13], Carrying Capacity (C) is the population level to which a logistic population growth model converges [1], Maximum Economic Yield (MEY) [13], Maximum Economic Performance (MEP) [10], Optimum Yield (OY) – the amount of fish harvested that: (a) provides the greatest present value of benefits to the national economy, (b) maximises the sustainable yield from the fishery and (c) in the case of overfishing, provides for the rebuilding of stocks to MSY levels [10].

The MSY has been scientifically discredited since it ignores the dependence of catches on fish stocks, and their maximum carrying capacity, and leads to a lower sustainable equilibria [1].

One of the sustainability definitions in fisheries refers to its capacity to meet the needs of the present generation, without hindering future generations from being able to meet their needs or causing trophic cascades or in any other way endangering the food web of the ecosystem. This highly enlightened definition is actually a platitude since no single person in its right mind can be against sustainability (however it may be defined) without discrediting itself. So, the concept of sustainability leaves us without a clear goal function.

The new European Common Fishery Policy (CFP) is integrated into the new European Integrated Maritime Policy (IMP) [6]. A new maritime domain management model is devolved to member states according to the principle of subsidiarity, but its basic principles, nevertheless, remain common to all member states. The new CFP moves towards markets that are deemed to be successful in achieving the set goals of the preservation of scarce resources by simultaneously successfully equalising the marginal costs of the preservation of the resource and transmitting that information through the price system. After the success of the much criticised greenhouse gas emission abatement programme called European Union Emissions Trading Scheme (EU ETS), the EU is moving towards markets in other areas of environmental regulation. Aside from sustainability goals, the new CFP should also increase the productivity of the fisheries sector, stabilise markets, and ensure the availability of

food supplies at reasonable prices. To achieve these goals the member states shall, in their respective Exclusive Economic Zones (EEZ), introduce a system of Individual Transferable Quotas (ITQs) that would achieve sustainability and efficiency by equalising marginal costs of environmental protection for an assessed sustainable fish stock at least cost. The new CFP permits member states to set differential policies for territorial waters and the EEZ [4]. A rational policy could maximise the benefits for Croatian fisheries, its supporting industries, local communities, taxpayers, other stakeholders, and the environment.

To be able to implement the full set of economic incentives proposed by the new CFP, Croatia needs to assert its sovereignty over the natural resources it claims. Firstly, this means the proclamation of its *contiguous zone* to be able to effectively prosecute illegal fishers escaping territorial waters. Without the proclamation of the contiguous zone, Croatia loses its right to prosecute illegal fishing in its territorial waters if the trespasser has already left the territorial waters [15]. Without legal power to effectively implement its economic legislation, Croatia cannot achieve the goals stated by the new CFP. The rule of law firstly starts with the national sovereignty and the inclusive application of the written legislation. Only the legislation that is effectively applied has the power of law and may induce compliance. Secondly, it includes the proclamation of the exclusive economic zone, where the introduction of the Individual Transferable Quotas (ITQs), as a cornerstone of the new CFP, may be fully implemented [4]. Croatia, as a member of the EU needs to pay special attention not to discriminate against other member countries' and their citizens' rights (especially Italy and Slovenia). The new CFP, nevertheless, enables member states to discriminate against other member states' fishers on the grounds of boat origin, but only in territorial waters [4]. In order to be able to fish in Croatian territorial waters, the boat has to be registered as a Croatian fishing vessel. The Exclusive Economic Zone (EEZ) remains an area of competitive fishing between EU vessels and prone to devastation. The enforcement of rules in the new, according to the principle of subsidiarity, devolved CFP stays with the member states, with community level oversight. The system is a complicated multilevel regulation with heterodox rules and goals. Although one of the goals of the new CFP is to increase fishing efficiency, the technical measures to preserve fish stocks increase the fishing effort and unavoidably reduce fishing efficiency. The previous CFP's centralised, top-down approach to maritime domain management is in the new CFP replaced by the member states' flexibility to adopt one or many of the other available tools. The new CFP sets overall goals, but the implementation is left to EU member states. The primary goals are to reduce catches within maximum sustainable yield levels, to implement an "ecosystem-based approach" to fishing, to reduce fleet overcapacity through market measures, and to develop alternative management models. It is up to

the ability of individual member states to rationally adopt policies that would maximise the benefits from resource use at least cost having in mind the environmental target as a given one. This is basically a cost effectiveness analysis. Croatian institutions and organisations are well suited to assess fish stocks, sustainable yields, reproductive areas and reproduction times. Beside the governmental organisations that are manned to do the administrative work, Croatia has three scientific institutions specialised in oceanography and marine biology: Institute of Oceanography and Fisheries in Split, Institute Ruđer Bošković – Centre for Marine Research in Rovinj, and the Institute for Marine and Coastal Research of the University of Dubrovnik. They are more than capable of assessing and forecasting Croatian fish stocks. It is their assessment that is ultimately going to be presented to the EU Commission for approval since it is the only scientifically backed data.

### 3. Croatian fisheries

Croatia has about 7,800 fishing vessels. Some 3,500 are registered for commercial purposes. More than 80% of all fishing vessels are not categorized as fishing ships since they measure less than 12 meters and are less than 15 tonnes of weight. The installed power of the fleet in the year 2011 was 327,000 KW and the total draught 45,000 gross tonnes. During the same year the commercial fishing fleet of 226 vessels reported a total catchment of 64,389 tonnes of pelagic fish. The Croatian fisheries market is organised into cooperatives, buy-off stations and registered first buyers. Captures may be marketed for the first time exclusively in accordance with the standards regulating presentation, preservation, freshness and size. Market organisation differentiates demersal and pelagic fisheries. High-quality demersal fish is mostly retail sold or exported after the first sale. Small pelagic species such as sardines and anchovy (over 80% of the total catchment) are mostly processed or sold as feed to tuna farms. Almost 90% of the catch is realized by purse seines. Towed gear accounts for some 8%, and gillnets and trammel nets for around 1% of the total catch. All other gear accounts for less than 1% of the total catch. Fish accounts for 96% of the total catch [16].

The latest EU regulation should improve the CFP by adapting exploitation rates so as to ensure that, within a reasonable time-frame, the exploitation of marine biological resources restores and maintains populations of harvested stocks above levels that can produce a maximum sustainable yield [3]. Since Croatia has more than 1,000 small-scale coastal fishing vessels, it shall adopt an action plan for the development, competitiveness and sustainability of small-scale coastal fishing. Together with the preservation of the exclusive fishing rights in the Croatian territorial waters for Croatian fishers (a ban for all other fishers from the EU and the third countries), the action plan should introduce a constant quantification of the biomass for the purpose of yearly assessments of variable

TACs. Croatia has a detailed system of fishery regulations based on years of negotiations between fishers, government, scientists, NGO's, and other stakeholders. Although Croatia has already introduced TACs and daily allowable catches for specific species (tuna), these quotas are not recognized as assets, and are not tradable. Without trading, banking, lending and borrowing ITQ's, sustainable fishing efficiency is greatly diminished. Without the possibility of time-space-scope ITQ arbitrage and speculation, fishers cannot optimize on catches, fishing effort, fishing costs and other parameters. The problem of discards and by-catches is then also harder to solve. Although discards are now fully banned, they cannot in reality be stopped. The lack of trading ITQ's makes the problem only greater. The present Croatian system of direct regulation includes the entire spectrum of measures: catchment period restrictions during recruitment months, catchment location restrictions with the protection of major assessed recruitment locations, regulation of catchment quotas (total weight), catchment size (minimal length) and catching fishing effort by regulating fishing tools' technical characteristics.

The consequence of Croatian long-lasting overfishing problem can be illustrated through a well known *sintagma* "tragedy of the commons" [8], that in a common pool of renewable resources, without an effective control over the catching, the fishers tend to overharvest the stock of fish to the point of its irreversible depletion. Marine biologists and economists have different perspectives of the underlying problem of the tragedy of the commons in fisheries. Marine biologists tend to view the problem from the exclusive perspective of protecting the fish and other endangered sea creatures from overharvesting by directly tackling fishing technologies. Economists are aware that it is an incentive problem and shun direct intervention into production technologies that make fishing harder, but ultimately do not eliminate overharvesting, since the fishers compensate it by increasing their fishing effort. The economists' perspective is to influence behaviour by creating a set of allocation and monitoring rules. By regulating fishing technologies, the regulator directly influences economic benefits from the fisheries, mostly having a negative impact on efficiency by simultaneously not promoting effectiveness. By allocating TAC (Total Allowable Catch) through ITQs (Individual Transferable Quotas), the regulator does not disrupt the economic process of competition between different production techniques, i.e. different production functions. This knowledge is specific in Hayekian sense and is unknown to the regulator [9]. A comprehensive management system of fisheries should acknowledge the specificities of different sciences and relate to them the important decisions from their respective fields of study. When the regulator makes decisions about minimal standards for the protection of marine species, allowed harvesting techniques or allowed fishing areas and times, it directly influences fishing effort [13].

#### 4. Alternative allocation mechanisms

There is an ongoing debate about economics acknowledgment of two broad groups of allocation mechanisms: allocation by compulsion, and allocation by free market cooperation. Environmental economic policy instruments may also be divided into three broad groups. Essentially, some authors argue for a dual division on prescriptive regulation consisting of various subtypes of command and control regulation versus market-based instruments manipulating economic incentives by controlling either prices or quantities. These perspectives are based on opposing dualities – public authority versus market based solutions. But there is also a third solution – self-governance mechanisms founded on stakeholders inclusion into the decision process. This approach has a prominent role in contemporary efforts to find better solutions to the problem of excessive and uncontrolled use of commons [12] and uncontrolled and irrational use of the maritime domain [2]. Both command and control, as well as market-based solutions, require rules and umpires. The first may consist of allocation rules of fishing times and fishing areas (lottery, regular rotation, homesteading rules, etc.) or command and control regulation prescribing fishing techniques such as gear regulations, minimum mesh sizes for nets, closed areas and seasons, minimum landing sizes, and by-catch limits as a percentage of the total catch. The most direct intervention into the production function includes limiting the fishing effort by controlling the fleet capacity measured in installed engine power and draught, and by limiting time spent at sea [7]. Market-based instruments manage economic incentives by controlling either prices or quantities and the decision on technology is left to the entrepreneur [10]. With command and control environmental policy instruments, control resides with the regulator who may not be up to date with the latest technologies, or who might favour certain types of technologies based on political circumstances. Prescriptive regulation is still an integral part of every regulation of fisheries, and will probably stay for a foreseeable future, at least as a standard of the best practice. With regard to the choice between market-based environmental policy instruments, there is a lot of debate between the proponents of price and the proponents of quantity regulation. Weitzman [18] shows that, in the case of fisheries, with recurrent ecological uncertainty, as in highly variable recruitments, and without regard to other uncertainties and risks, a price regulation in the form of an optimal landing fee is always superior to a quota system. The problem with the optimal landing fee is that, besides the need for a constant monitoring and calculation of TACs, it also necessitates a regulator that would constantly optimize the landing fee to the TAC. Without the ability of constant intervention into the landing fee, price regulation is unable to precisely control and prevent overfishing in a situation of already low recruitment [18]. The former problem of monitoring may easily be solved by using modern surveillance devices as in the case of the UK's Remote Electronic

Monitoring [14]. In the case of the latter problem of overfishing, only a constant trial and error management system may bring maximal sustainable yields. Harvest quotas in the form of TACs also have their own advantages and drawbacks. When TACs are defined, and if timespan between catchment and landing can efficiently be controlled against discards, the total quantity of fish being caught can be capped. The major problem with quotas, according to Weitzman, is their inability to control for fishing effort in times of low recruitment and opposing expectations from fishers [18]. Fishing effort is a measure of entrepreneurial activity. It is the problem for the individual fisher as an entrepreneur to solve his optimization problem, as he is the sole ultimate bearer of his own entrepreneurial decisions and risks. The proper role of the regulator is to give the fishery industry all possible information about estimated biomass, individual species' recruitments, growth rates, previous season's escapements, previous seasons' harvest quantities, estimated total sustainable yields, at the lowest possible cost. The landing fee and the ITQs unfortunately have a common problem: they exacerbate the problem of discards. The quantity of the catchment with the assessed value below the fee will be discarded in the case of landing fees, and the catchment for which no ITQs may be provided at lower cost than their assessed market value shall also be discarded. The difference between taxes and quotas is that input values for the discards in the case of taxes are a priori known, whereas, in the case of quotas, additional quotas must be bought. But, a fisherman only needs to call his broker and buy quotas depending on that day's catching. Experience has shown that market-based instruments are more environmentally effective, economically more efficient, and practically easier to administer than command-and-control regulation [3]. Command-and-control regulation in Croatia was unable to stop the halving of fish stocks during the period of some 50 years. Of the two proposed market-based instruments, uncertainty in the variables clearly favours quantity instruments [17].

#### 5. Catchings or landings: the problem of discards

The problem of discards is one of the great problems of fishery that was observed in the North Sea fisheries after the introduction of Individual Transferable Quotas (ITQs). The problem appears when the portfolio of fisherman's ITQs does not correspond to the catchment, whereby the non corresponding catchment is discarded before landing. This problem will probably never be completely solved, as long as fishers have an economic incentive to discard. Even a complete prohibition of discards with penalties cannot stop the discards until the perceived benefits of discards are larger than the costs of the discards adjusted for the risks of being caught. So, it is an economic externality. Discards have never been an acute problem in Croatia as the fisheries in Croatia are more readily identified and almost all catchments have some economic value and are duly landed. The problem of discards might appear if ITQ's

are not implemented correctly, or if the market functionality and liquidity of the ITQ market is inhibited. One of the proposals to deal with the problem of by-catch discards are by-catch ITQs. If kept under permissible boundaries, by-catch ITQs might be an adequate solution to the problem of discards. Nevertheless, the problem of discards persists as long as the market value of the marginal by-catch is lower than the cost of the by-catch ITQ. Regarding the technical ways of solving the problem of discards, the discards of resistant species shall be allowed under the conditions of expedient processing. Fish that are discarded alive and survive, technically do not represent any discard. To solve this problem one must try to optimize the portfolio of ITQs ex-ante and equalize it ex-post with the catchment. One of the possible ways to do that is by permitting the ITQ market to function freely, including full forward and backward arbitrage and speculation by enabling it to form its own forward market including partial banking of at least several months, overlapping ITQ durations, constant ITQ supply, lending, and short selling. In doing so, the market would gain the necessary level of liquidity with additional benefit of more frequent market valuation. Another possibility to gain liquidity is by increasing the divisibility of ITQ's: by decreasing their standard unit of measure from 1 metric tonne to say 100 kg or less. The fisheries in the Adriatic Sea are, in comparison to the North Sea, relatively small. In some years the lack of sardines is compensated by the abundance of anchovies and vice versa. So, the third possible market incentive to deal with by-catch discards deals directly with interspecies recruitment risks and their correlation. But, if the recruitment correlation of sardines and anchovies is less than one, a number of interspecies pelagic (sardines and anchovies) ITQs may be issued, or alternatively, a conversion between the two may be permitted according to a predetermined ratio. The relative share of such ITQs would be small, not to endanger any particular species, or worse, to destabilise the exchange rate between different species' ITQ's. The fourth possible solution to the problem of total species and inter-

species recruitment variability are informational benefits from the forward ITQ markets for the regulator. The ITQ market constantly bets on the forecasts of future recruitments. The governmental fisheries institutes may play an important role in the reduction of informational asymmetries where possible. For this purpose, the results of monitoring activities such as MEDIAS, MEDITS, Deep Sea Survey, UWTV Survey, and other should be made public as soon as possible [16].

### 6. Total allowable catch allocation

The usual approach to harvesting strategies had long suggested the Maximum Sustainable Yield (MSY), i.e. the maximum value of the growth curve as an optimal strategy. This approach has been refuted since it ignores the dependence of harvest on the population size, it ignores the economic motivation of the harvesters as it may achieve an equilibrium MSY in an outright low population size diminishing the possible long run returns, and it ultimately leads to a fragile situation for fishery survival [1]. The Total Allowable Catch (TAC) shall thus take into consideration the achievable population sizes in form of maximum carrying capacities of species in an ecosystem. These are at least known from the historical data, and they show that in the case of the Adriatic Sea, the fish stocks have decreased over 50% and settled on a new much lower MSY stability point [16]. The fish stocks in the now Croatian Protected Ecological and Fishery Zone have been almost totally depleted [16]. This might be the principal reason for a lack of interest in the EEZ by the Croatian politics. As fish stocks in the EEZ are depleted, Croatian fishers abandon the EEZ as a common pool resource and the fish from the EEZ loses its greatest advocate: a political vicious cycle.

The Maritime Domain Management Model consists of optimizing the TAC quantity by stabilising the market clearing ITQ price at a level where social marginal benefits and costs of catchment would exactly be equal, with minimal costs of catchment and minimal costs of necessary fu-

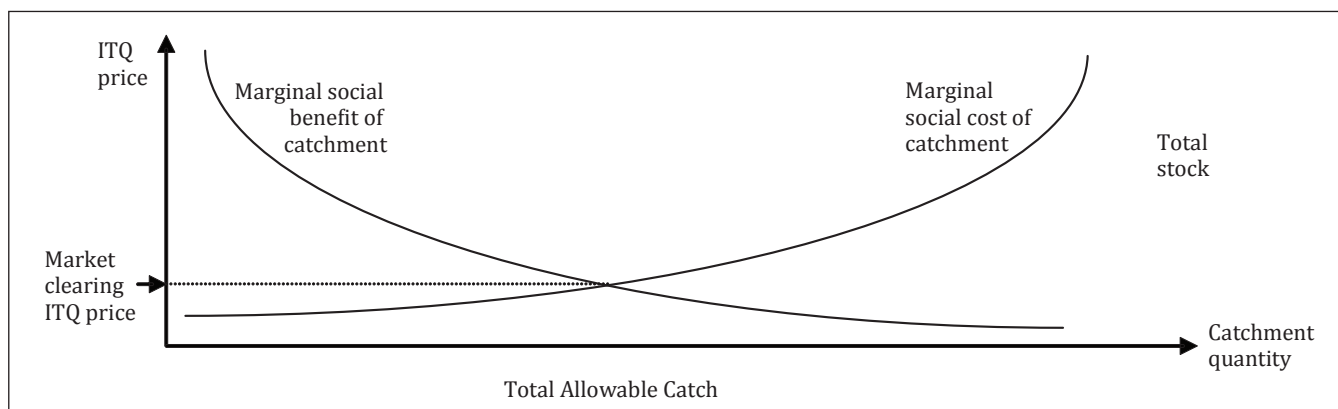


Figure 2 Equalisation of marginal costs and benefits under the transferable fishing concessions model

Source: Own representation

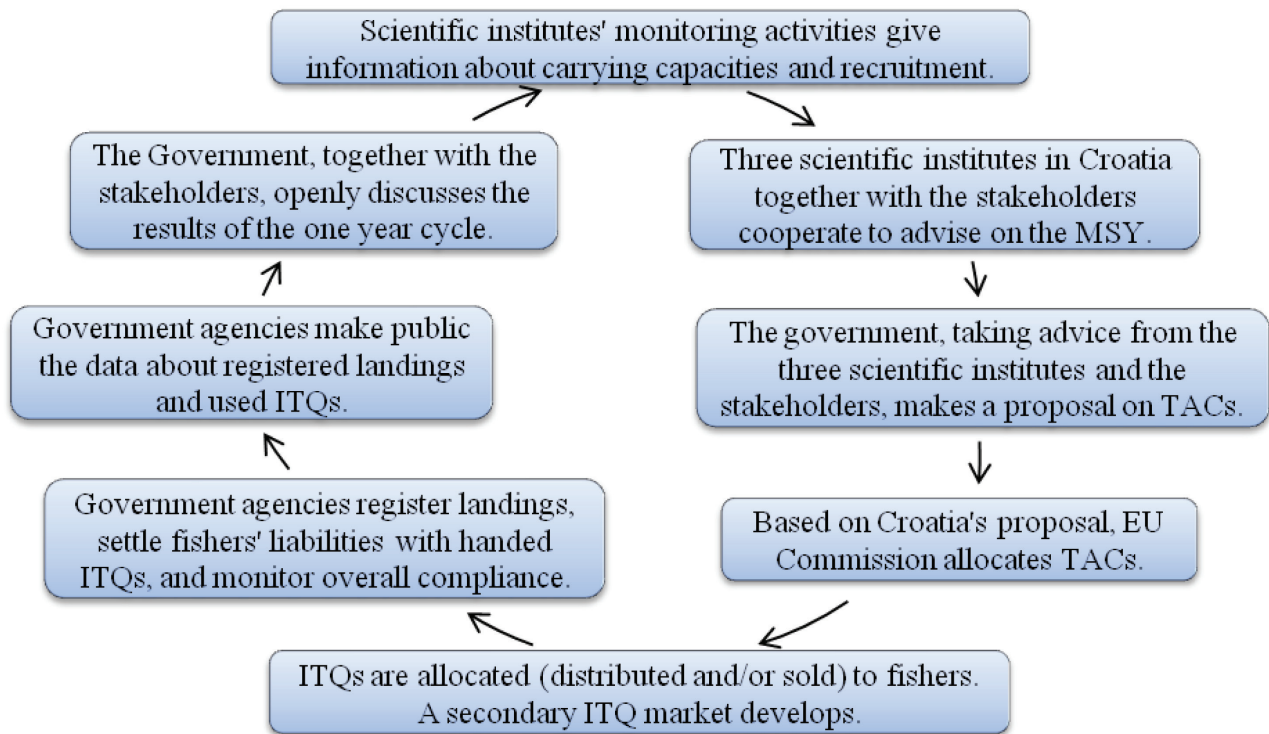


Figure 3 Maritime domain adaptive management model's one year cycle

Source: own representation

ture recruitment protection. Since the marginal costs and benefits as well as the measures of marginal fishing effort are unknown to the regulator, but some measures of sustainability may be decided upon, the regulation of quantity has informational advantages over the regulation of price. TACs need to be administratively set. The Adaptive Maritime Domain Management Model is based on the notion that social management models are evolutionary structures that need active participation from all stakeholders [3].

The success of the model is based on its ability to adapt to changing circumstances, and to deliver the expected results: full alignment of fisher's incentives with social and ecological goals together with full cost allocation (internalisation of externalities). Whether the TAC is set within the process of political log-rolling or administratively or scientifically set, is not without merit. As the example of the EU Emissions Trading Scheme certificate pricing has demonstrated, the political acceptability and economic success of common pool resource management by "privatisation" is determined by the possibility of the system to produce long-run stable prices as an informational basis for entrepreneurial decision making. The economic system is an information sharing system, where human action is bounded by encoded or embedded rules, and where effort and investment flows to the largest returns. An ITQ system may produce, as the EU ETS has shown, well in advance known quantities, stable prices, and enough incentives that would induce a new cycle of investment into

the new modern fishing equipment with multiplier consequences for the economy. ITQs are assets in the EU normally recognized by banks and investors as collateral ones for investments into fishing ships and fishing gear.

## 7. Conclusion

Marine biologists and economists have different perspectives of the underlying problem of the tragedy of the commons in fisheries. The Common Fisheries Policies failed to achieve any measure of "sustainability". Scarce maritime domain resources require management and allocation rules. Fisheries may achieve sustainable maximum carrying capacities, environmental effectiveness and economic efficiency provided that the incentives are transmitted as optimally priced, clearly defined, divisible and defensible property rights. Property rights are institutions that have been proven in the EU greenhouse gas mitigating programme. Transferable Fishing Concessions (TFCs) in the form of Individual Transferable Quotas (ITQs) is an allocation system of scarce resources based on market transfer of scarce and sparse information about marginal benefits of fishing, marginal costs of fishing, marginal costs of preservation of sustainable fishing stocks, and resulting marginal fishing effort. It is a system of incentives. The system has to be flexible enough to permit its own evolution by modifying its key financial (banking, lending, borrowing, shorting, etc.) and ecological (current biomass size and individual species' estimates, sustainable

carrying capacities, recruitment, growth rates, escapement, harvest, total allowable catch, etc.) parameters. In practice, market based instruments have sometimes been proven to be relatively environmentally effective, economically efficient, in some cases achieving an environmental objective at relatively low cost. On the other hand, in the field of common resources, management nowadays is particularly a remarkable approach that includes inclusion of stakeholders in decision-making process about the resource and is based on self-governance. Such approach to shared resources management is trying to overcome immanent market imperfections through giving allocation authority to the stakeholders – users. In this paper we are investigating only the market based solutions of the fishing concessions in Croatia to be in line with the actual EU policy in the sector. Since the markets are anonymous allocators, the ethical question of equity has also been better addressed than a command and control system prone to constant political log-rolling. One of the ITQ's other positive features is its ability to raise the incomes of the participants. ITQ's are assets that have previously not existed. With their introduction, ITQ owners are able to make long term investment plans in boats and fishing gear. The ITQ's are also a form of entry barrier, giving additional protection to incumbent fishers. The purpose of this paper is to present the benefits of the introduction of property rights based incentives and market-based instruments over prescriptive command and control regulation for Croatian fisheries. This policy has to include complete Croatian sovereignty over the internal and territorial waters as over the EEZ and its resources, the quantification and commodification of the resources, and allocation in form of Transferable Fishing Concessions, i.e. Individual Transferable Quotas.

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