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Strong User Rights in Fisheries: Delineating the Impacts

Ragnar Arnason & Birgir Th. Runolfsson

Address:

Faculty of Economics
University of Iceland
Sæmundargata 2
101 Reykjavik, Iceland
Email: bthru@hi.is

Ragnar Arnason & Birgir Th. Runolfsson[1]

Strong User Rights in Fisheries: Delineating the Impacts[2]

Abstract

User rights in fisheries refer to the rights of fishers to harvest from fish resources. In terms of security, exclusivity, duration, and transferability these rights can be strong or weak. In recent years there has been a substantial movement toward stronger user rights in many fisheries around the globe and further shifts of the same kind are recommended by many fisheries advisors.

The transition from weak to strong user rights in fisheries has a wide range of impact. Here we attempt to identify and describe some of the more prominent of these impacts. It is convenient to divide these impacts into economic, environmental, and social impacts. Though this classification is by no means perfect or even exhaustive, it can serve as a framework for further research in the field. We then provide some discussion of the social desirability and undesirability of the various impacts. This discussion, however, is in broad terms and very preliminary.

Keywords: User rights in fisheries, property rights in fisheries, property rights, strong user rights, impacts of strong user rights, SURFs

JEL classification: B10, B25, P14, P48, Q22, Q28

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1. Introduction

User rights in fisheries are a part of the much wider and general topic of the economics of property rights. Theorizing about ownership and property in the western world spans more than two millennia. An early contributor was Aristotle who in his *Politics* (around 330 B.C) argued that private property promoted prudence and other social virtues, a topic taken up and extensively examined by Thomas Aquinas (1273 AD) and the scholastics (see Waldron 2004). Early modern political and economic theorists including Locke (1689), Hume (1739), Smith (1776) and Mill (1848) had similarly much to say about ownership and property using various and often different arguments. More recent authors, writing more strictly within the field of economic theory, include Coase (1960), Alchian (1965), Demsetz (1967), Pejovich (2001) and Scott (2008). A fundamental finding of modern property rights theory is that strong or high quality private or individual property rights are necessary for a high degree of economic efficiency and economic growth (Arnason 2000). In this paper we take the existing theory of property rights for granted and draw on some of its practical results.

By strong user rights in fisheries, we mean fishing rights that score reasonably highly[3] on a property rights quality index (Arnason 2007, 2009) with respect to the fishing activity (as distinct from the fish stocks). Examples of such rights are (i) sole owner rights, (ii) IQs/ITQs and (iii) TURFs. Note that to score highly on a property rights quality index, the fishing rights in question must be held by individual decision-making entities or users. Thus, fishing rights held in common by groups or communities are generally not strong user rights. However, they may give rise to such rights if they are sub-assigned to individual users.

An assessment of the advantages and disadvantages of strong user rights in fisheries Is necessarily relative to some alternative, such as represented by an index. There is of course a very high number of possible alternatives. One alternative that is frequently employed in assessing the benefits of fisheries management regimes (and other natural resource use regimes) is the common property or common pool arrangement. In what follows, the user rights implied by these arrangements will often be our point of reference. However, to be more general and at the same time more rigorous we would like to compare the class of strong user rights in fisheries with the class of weak user rights. For this we obviously need a definition of and, preferably, a measure of the strength of user rights. This kind of a measure is suggested by Scott (2008) and his earlier writings (e.g., 1989 and 1996) and rigorously defined by Arnason (2007). This aspect of the matter will be clarified in the first section of this paper.[4]

The transition from previous fisheries management regimes such as a common property arrangement or, more generally, weak property rights to strong user rights has a myriad of consequences some of which may be socially significant. These consequences tend to be more dramatic the larger the shift in the strength of the user rights. A minor shift in rights-regimes or a gradual, stepwise transition over a period tends to cause less noticeable ripples in the social fabric.

It is important to realize that a shift in user rights regimes sets into motion a dynamic process of adjustments and readjustments. This suggests that the long-term effects of a transition to

[3] At this stage it is not necessary to be precise as to what constitutes a reasonably high score in this context.

[4] For a more detailed discussion see the paper by Runolfsson (2022)

strong property rights or the reverse, may be different from the short run effects. It immediately follows that the advantages and disadvantages of (strong) any form of property rights may be different in the short and long run. Obviously, this substantially complicates the assessment of these advantages and disadvantages.

We expect that in most cases following the various impacts and social disturbances of a transition to strong user rights, there will be a convergence to a new socio-economic equilibrium where the various changes and their repercussions have worked themselves out and the system settled down. In other cases, there may not be a convergence to a new equilibrium and either a prolonged period of disequilibrium or a dramatic shift (bifurcation) in the social structure. So, in the case of a convergence to a new equilibrium the changes are a bit like the impact of a stone thrown into a pond with ripples spreading out and gradually dying down. The other dramatic case is rather like a stone thrown into a pane of glass and breaking it.

The long run impact of a transition to stronger user rights in fisheries also depends on the size and nature of the surrounding socio-economic system. The impact can be quite drastic in small fish dependent communities but tends to be nullified by normal socio-economic adjustments in larger and less fisheries dependent communities and, therefore, less noticeable.

Key consequences from a transition to strong user rights may be conveniently divided into three broad classes:[5]

(i) Economic
(ii) Environmental
(iii) Social

These classes of consequences generally contain both advantages (gains) and disadvantages (losses). To determine the overall desirability of adopting strong user rights, these advantages and disadvantages need to be evaluated. To do this, it is obviously necessary to begin by cataloguing the main consequences of strong user rights.

In section 3 and 4 below, we will list several impacts of strong user rights that fall into these classes and indicate on the basis of theoretical and empirical knowledge the likelihood and evidence for each. Before coming to that, we will, in the next section, examine the concept of strong user rights and relate it to the theory of property rights quality.

[5] It is of course possible to talk about other type of consequences such as political (a subset of social), psychological, technical, and so on. These, however, seem the most crucial from a broad utilitarian point of view.

2. The Economic Theory of Property Rights

Rights to phenomena be they physical (things) or nonphysical (e.g., intellectual property) may be regarded as property rights. A reasonably well-developed economic theory of property rights exists (Alchian 1965, Demsetz 1967 and Scott 1989, 1996 and 2008). User rights in fisheries are a subset of the wider category of property rights. More precisely, they are rights to harvest from the fish stocks. Other user rights may be defined in a similar way.

Any property right is specified by three key features:

(i) The holder of the property right – who holds the property?
(ii) The content of the property right – what exactly are the rights involved?
(iii) The subject of the property right – to what phenomenon do the rights apply?

The second feature, the content of the property right, defines the quality of the property right in the sense of Arnason (2000).

2.1 Attributes of property rights

As pointed out by Alchian (1965), Demsetz (1967) and Scott (1989, 1996) any property right consists of a collection of different attributes or characteristics. According to Scott (1996, 2008) the most crucial property rights attributes are:

- Security
- Exclusivity
- Durability
- Transferability

These attributes form the basis for developing a measure of property rights quality.

Security refers to the ability of the holder of the property right to withstand challenges to his property right. It is perhaps best thought of as the probability that the owner will be able to hold on to his property rights. Probabilities range from zero to one. A security measure of unity means that the owner will hold his property with complete certainty. A security measure of zero means that the owner will certainly lose his property.

Exclusivity refers to the ability of the property rights holder to utilize and manage the property in question without outside interference. An individual's personal things such as his clothes generally have a very high degree of exclusivity. A right to the enjoyment of a public park has very low exclusivity. The right of a fisherman to harvest from a fish stock has exclusivity roughly reciprocal to the number of other fishermen with the same right. Obviously, the degree of exclusivity can range from zero corresponding to no exclusivity to perfect exclusivity.

Durabilit*y* refers to the time span of the property right. This can range from zero to infinite duration. Leases are examples of property rights of a finite duration. Many rights colloquially referred to as "ownership", usually represents a property right in perpetuity or for as long as the owner wants. The duration of a property right may seem related to security –if a property right is lost then, in a sense, it has been terminated. Conceptually, however, the two characteristics are quite distinct. Thus, for instance, a rental agreement may provide a perfectly secure property right for a limited duration.

Transferability refers to the ability to transfer the property right to someone else. For any scarce (valuable) resource, this characteristic is economically important because it facilitates the optimal allocation of the resource to competing users as well as uses. An important feature of transferability is *divisibility*, the ability to subdivide the property right into smaller parts for the purpose of transfer. Perfect transferability implies both no restrictions on transfers and perfect divisibility.

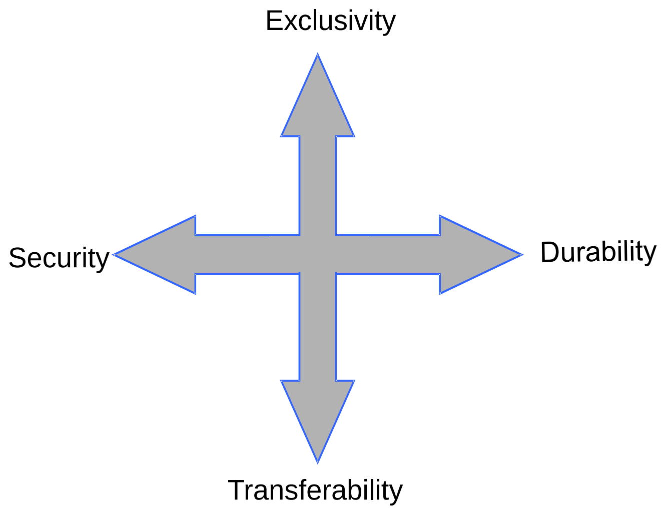
2.2 Quality of property rights

A given property right may exhibit the different property rights attributes to a greater or lesser extent. The more it has of any given attribute the higher is its quality and vice versa. A high-quality property right has much of each attribute. A low-quality property right has little of the property rights attributes. Indeed, a property right that has nothing of each property rights attribute would in normal parlance not be called property at all. Note, however, that the different attributes may not be equally important. Some might be essential in the sense that without any of that attribute the property right would be worthless. Duration is obviously one such attribute. Other attributes, such as transferability, while useful would not be essential for the property right to have value.

2.3 The characteristic footprint of a property right

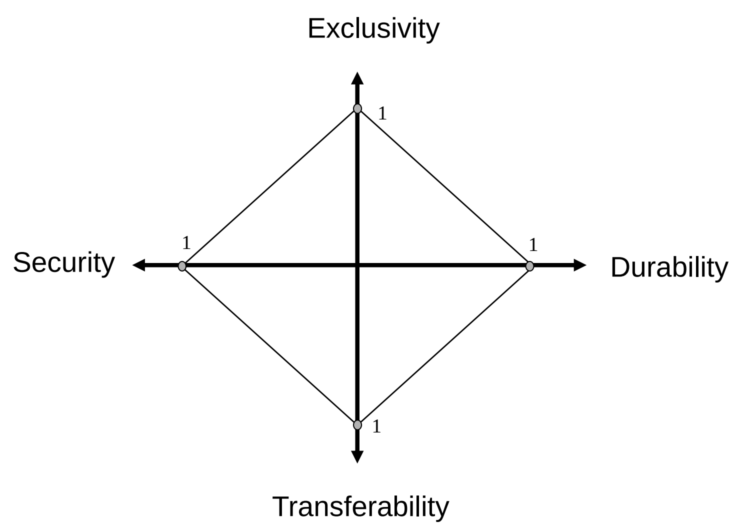
As suggested by Scott (1989), it is helpful to visualize these attributes of property rights as measured along the axes in four-dimensional space referred to as the attribute space. This is illustrated in Figure 1. Obviously, if more than four attributes are needed to describe a property right, the number of axes in the diagram would simply be increased correspondingly as in Scott (1989).

Figure 1
Attributes of property rights: The attribute space



A given property right may exhibit the different attributes to a greater or lesser extent. To represent this, it is convenient to measure this extent on a scale from 0 to 1. A measure of zero means that the property right holds none of the attribute. A measure of unity means that the property right holds the attribute completely. On this basis we may draw a map of a perfect property right as a rectangle in the space of the four property rights attributes as illustrated in Figure 2. We refer to this map as the characteristic footprint of a perfect property right. Other less perfect property rights will have other characteristic footprints.

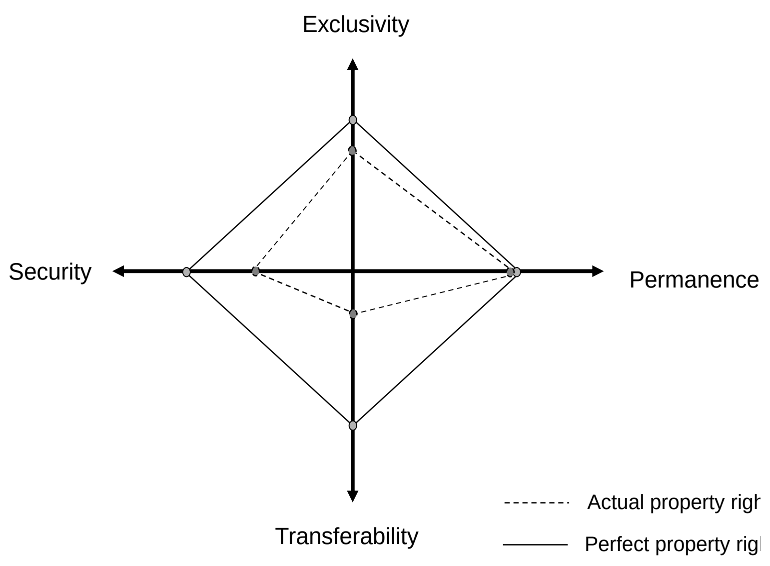
Figure 2
The characteristic footprint of a perfect property right



Obviously, the characteristic footprint of a perfect property right represents the outer boundary for characteristic footprint of all property rights. It follows that the corresponding characteristic footprint of any actual property right in the same space of attributes must be completely contained within this rectangle. An example of this is illustrated in Figure 3.

Figure 3 illustrates the characteristic footprint of some actual property right within the characteristic footprint of a perfect property right. It is easy to see that the ratio between the areas enclosed by the two characteristic footprints provides an idea of the relative quality of the actual property right. Obviously the closer the characteristic footprint of a property right is to that of a perfect property right, the higher is its quality. It is worth noting that this measure of property rights quality has the convenient property of being between zero and unity with the latter corresponding to a perfect property right.

Figure 3
The quality map of a property right



2.4 The Q-measure of property rights quality

Given the multi-dimensional nature of property rights, it is obviously useful to have a uni-dimensional numerical measure of the quality of a property right. The ratio of the area of the characteristic footprint of the property right to that of a perfect property right discussed above is one such measure. However, this measure treats all the attributes of the property right equally which seems an unreasonable restriction.

A more flexible numerical measure of property rights quality is the so-called *Q*-measure of property rights quality proposed by Arnason (2000). In the case of the above four property rights characteristics, the *Q*-measure is defined by the expression:

(1) $Q \equiv S^{\alpha} \cdot E^{\beta} \cdot D^{\gamma} \cdot (w_1 \cdot + w_2 \cdot T^{\delta})$, $\alpha, \beta, \gamma, \delta, w_1, w_2 > 0$ and $w_1 + w_2 = 1$

where S denotes security, E exclusivity, D duration and T transferability. $\alpha, \beta, \gamma, \delta, w_1$ and w_2 are parameters. It is worth noting that due to the last equation in (1), only one of w_2 and w_1 is independent.

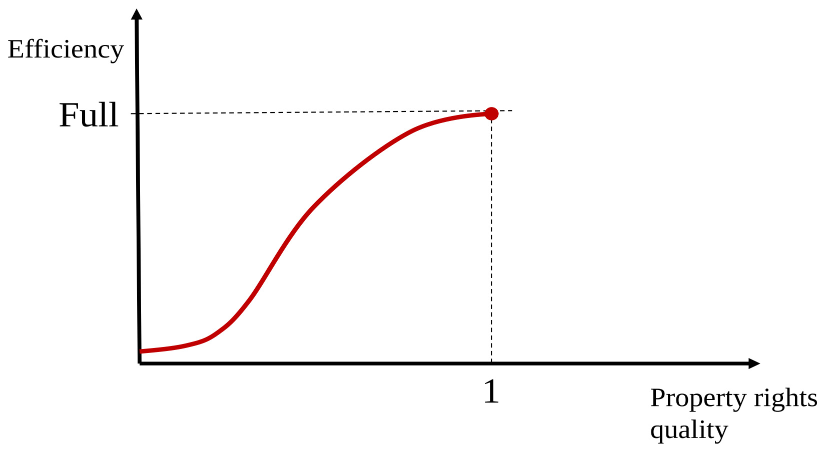
The *Q*-measure has some attractive properties. It is easy to verify that it is nonnegative and takes values in the interval [0,1]. A value of zero means that the property right has no quality; it is worthless. A value of unity means that the property right is perfect. Note that in the formula in (1), the first three property rights characteristics are considered essential. If any one of them is zero, the overall property right quality is also zero. The fourth characteristic, transferability, by contrast, is not essential. Even when there is no transferability, the property right will in most cases still be valuable and its quality measure therefore positive.

To apply the *Q*-measure, its five independent parameters need to be specified. The most appropriate specification should reflect the relative contribution of the different attributes to the property rights quality. This, clearly, both depends on the researcher's conception of property rights quality and empirical assessment.

2.5 Property rights quality and economic efficiency

Basic economic theory suggests a strong positive relationship between property rights quality and economic efficiency. Standard microeconomics has shown that perfect property rights generate full economic efficiency (see e.g., Debreu 1959). Simple economic logic indicates that zero quality property rights result in very low economic efficiency: if no-one will be able to hold onto anything durable he produces there will obviously be very little production (Arnason 2000). Employing this logic and assuming continuity it seems obvious that economic efficiency increases monotonically with the quality of property rights. In the absence of empirical research, it appears most likely that this increase will be best described by an S-shaped curve as in figure 4.

Figure 4
Likely relationship between property rights quality and economic efficiency



3. Quality of user rights in fisheries: An illustrative assessment

The *Q*-measure discussed above provides us with a straight-forward way to numerically assess the quality of common types of user rights in fisheries. We will refer to user rights with high property rights *Q*-value as strong and those with low *Q*-values as weak.

Let us for illustration purposes consider seven types of widely employed user rights in fisheries; (i) open access, common property, (ii) common pool rights, (iii) fishing licenses, (iv) TURFs, (v) IQs, (vi) ITQs and (vii) sole owner rights.[6] The first two are often referred to jointly as common property. The difference, however, is that under (i), open access, common property, there is no restriction on who can pursue the fishery, while under (ii), the common pool arrangement, access is restricted to a prespecified group.

It may seem a bit peculiar to refer to common property arrangements as a type of user rights. After all common property means that no user has exclusive rights, However, common property confers the right to use to anyone (in the case of perfectly open access) and to anyone belonging to prespecified group (in the common pool case). Surely, these are user rights although their quality may not be very high.

Under each of these categories of user rights there is a very wide range of possible variants, some of which can be found in real fisheries. However, for our purposes, it is more expedient to consider ideal types. Therefore, in all seven cases, we assume that the rights are perfectly enforced and held with full security and are of infinite duration. Thus, they only differ with respect to exclusivity (with respect to harvest from the resource) and transferability of the right.

[6] TURFS is an acronym for territorial user rights in fisheries. IQs is a acronym for individual catch quotas and ITQs for individual transferable catch quotas.

The first two user rights, the common property variants, have very low exclusivity and no transferability. The third, fishing licences, also has very low exclusivity – restrictive licencing (e.g., fixed number of licenses) has exclusivity like common pool, unrestricted licencing is more like open access. On the other hand, licences constitute a property that may be perfectly transferable. TURFs have exclusivity that depends on the extent to which the resource in question remains within the TURF. Obviously, this can range from virtually zero to virtually unity. As a result, it is not reasonable to possible to determine the exclusivity of TURFs in general. IQs and ITQs have high exclusivity with respect to harvest that is modified primarily be the extent of poaching and the empirical facts that IQs and ITQs are almost by necessity specified over a time interval giving rise to competition between holders for harvest during the most favourable fishing periods. Obviously, IQs have no transferability and ITQs perfect transferability. Sole ownership is here regarded as a complete ownership of the entire fishery with virtually full exclusivity and transferability.

The following table summarizes these assumptions about exclusivity and transferability and calculates the resulting *Q*-values for the seven types of user rights.

Table 1
***Q*-values for certain common user rights in fisheries: Indicative calculations**
(Calculations based on equation (1) with $\alpha=\beta=\gamma=1/3$, $\delta=1$ and $w_1=0.6$)

	Exclusivity*	Transferability*	*Q*-value
(i) Open access, common property	0.001	0	0.06
(ii) Common pool	0.01	0	0.13
(iii) Licenses	0.01	1.0	0.22
(iv) TURFs	0.2-1.0	1.0	0.58-1.0
(v) IQs	0.9	0.0	0.58
(vi) ITQs	0.9	1.0	0.97
(vii) Sole owner rights	0.99	1.0	1.0

* Security and duration assumed to have value unity

The pattern that emerges from table 1 is that the first three types of user rights have low *Q*-values (under 0.3) and can, therefore, be regarded as weak user rights. Referring to figure 1, this implies the economic efficiency of the fishery will be correspondingly low. Of the remaining user rights regimes, ITQs and sole-owner rights have fairly high *Q*-values (close to unity) and may be classified as strong user rights. The same applies to TURFs provided they are large enough to contain a good part of the fish stocks in question.[7] It follows that economic efficiency in the fisheries based on these user rights will be high. IQs, due to their non-transferability have substantially lower *Q*-values than ITQs, sole ownership and strong TURFs and the fishery will, therefore, be economically less efficient. The *Q*-value of close to 0.6, however, is sufficiently high for IQs to qualify as strong user rights.

[7] It may be noted that sufficiently large TURFs merge into sole ownership.

4. Impacts of strong user rights in fisheries

In the introduction, the impacts of strong user rights in fisheries (SURFs) were divided into three main categories:

1. Economic
2. Environmental
3. Social

In what follows, we will consider each category in turn.

It is important to realize that SURFs generally do not amount to the entire fisheries management framework. In virtually all actual situations, there is an outside authority that controls and sets certain fisheries management aspects (such as TACs, gear restrictions etc.) and enforces the rules. In assessing the impact of SURFs, we assume that these exogenous management parameters are set so as to maximize the economic return of the fishery.

4.1 Economic impacts

The economic impacts of SURFs are extensively studied both theoretically and empirically (see e.g., Arnason 1990, Anderson and Seijo 2010 and Bjorndal and Munro 2012 and many others). The more prominent among the impacts suggested by this research are the following:

- (i) Less fishing effort and use of fishing capital in fishing. (This holds at all levels of biomass and, therefore, for both fully developed and underdeveloped fisheries).
- (ii) Reduced cost of fishing per unit of landings. (Primarily due to larger stocks).
- (iii) Increased profitability in fishing.
- (iv) Alteration in the volume of fish supply.
- (v) More quality and higher unit value of landings.
- (vi) Increased stability of fish supply and, consequently, more operational stability in the fishing industry.
- (vii) Increase in the value of the user rights.
- (viii) Reduced employment in the harvesting activity.
- (ix) Costly implementation and enforcement of SURFs.
- (x) Altered structure of the fishing industry with respect to the number, size and operating focus of the fishing companies.
- (xi) Altered geographical location of the fishing industry.
- (xii) Shift to a higher economic growth path.
- (xiii) Unequal distribution of the costs and benefits following from SURFs.

Impacts (i) to (iii) are predicted by standard bioeconomic models and have also been verified in numerous empirical studies. Assuming exogenous fisheries management, measures are set to maximize the economic efficiency of the fishery (which the existence of SURFs will often encourage), they may be regarded as necessary consequences of SURFs compared to weak or no user rights (WURFs and NURFs). The magnitude of these consequences, however, depends on the exact SURFs and, of course, the potential value of the fish resource in question.[8] In most pre-existing commercial fisheries these magnitudes are large compared to the outcomes without SURFs.[9]

Impact (iv), alterations in the volume of fish supply, is also theoretically and empirically well established. The short run impact is usually, but not necessarily, a reduction in the supply of landings as fish stocks are rebuilt. Depending on overall management measures, the initial state of the resource and ecosystem interactions, the long-run equilibrium effect can be both in the direction of an increase and decrease. For highly valuable fish resources, which tend to suffer from the greatest overexploitation, the long-run equilibrium impact is most likely to be an increase in the volume of fish supply.

Impact (v), higher quality and unit value of landings, has been empirically found in many studies (see e.g. Geen and Nayar 1988, Arnason, 1993, Herrmann 1996 and many others) and, subsequently, theoretically explained by e.g. Homans and Wilen 2005. Important explanations for this outcome are (i) more landings of larger and, therefore, often more valuable fish due to increased stocks, (ii) greater ability to adjust supply of landings to market demand due to the SURFs, (iii) shifting of on-board resources, which are necessarily limited, from quantity to quality,[10] (iv) investments in quality improvements made possible by higher income and improved marketing due to more control over supply.[11] This increase in unit value of landings seems to be so empirically prevalent that it may be regarded as virtually inevitable consequence of SURFs.

Impact (vi), increased operational stability, follows from larger fish stocks and, consequently, the ability to maintain more stable levels of landings and other fishing activity.[12] It is also a consequence of the ability of the SURF-holders to adjust the supply of fish to the demand and avoid operationally detrimental fluctuations in landings.

Impact(vii), increase in the value of fishing rights, follows directly from (iii), increased profitability. The value of any right (including property rights) equals the present value of expected benefits obtainable from it. Note that this value gain does not rely on transferability of the user right (although transferability will result in a market value of the rights and greater transferability increase it). Importantly, note that the value of SURFs is a net addition to social wealth. The addition is the present value of expected increase in future benefits[13]. Note, moreover, that this added wealth becomes marketable capital if the SURFs are transferable. In that case, the added SURF value can assist in the raising of new financial capital and reduce the costs.

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[8] If the bio-economic parameters of the fishery, biomass growth rates, harvesting technology and prices are favourable, the degree of overexploitation under WURFs will be high and the shift to SURFs will have a large impact. In the case of unfavourable fishery parameters, overexploitation under URFs will be small and the shift to SURFs will have little impact. For more formal analysis of this see appendix A.

[9] This is because the fisheries with favourable parameters are most likely to be exploited.

[10] If on board-resources are limited and must be shared between catch volume and catch quality, it is straight forward to show that SURFs will move resources to catch quality.

[11] Increased return on investments in fish quality follows from the same analysis as alluded to in the previous footnote.

[12] The possibility that a profit maximizing fisheries management may, for technical or biological reasons, lead to greater fluctuations in supply should not be forgotten, however.

[13] In certain cases, these benefits are primarily profits.

Impact (viii). Since fishing effort and the number of fishing vessels are reduced, harvesting employment is generally reduced. The same would *ceteris paribus* apply to employment in industries producing inputs for fishing operations. Nevertheless, since, as explained above, there will be more emphasis on fish quality, product development and marketing, overall employment in the fishing industry will usually not be correspondingly reduced and may increase. Irrespective of whether that happens or not, a higher GDP and faster economic growth, a consequence of more efficiency in fishing (see impact (xii)), will generally provide more than sufficient new employment opportunities to absorb the employment made redundant in the harvesting activity.[14] There will be a need for labour to move between occupations, however, giving rise to economic costs that may, in certain circumstances, be substantial.

Impact (ix), costly implementation and enforcement of SURFs. Implementing SURFs requires designing the system, a great deal of socio-political discussion and consultation and very likely some new institutions and modification of others. This is inevitably costly. Also, SURFs, like other property rights, need enforcement. In the case of SURFs, the enforcement consists to a great extent of preventing SURF-holders and others from exceeding their rights by harvesting too much from the resource. This enforcement is also inevitably costly, often quite substantially so. It is important to realize, however, that whether the cost of enforcing SURFs is greater or smaller than that of enforcing the previous management regime depends on the previous management regime and its enforcement costs. It is a matter of fact that fisheries management costs under WURFs is often very extensive and correspondingly costly (Schrank et al. 2003). Since many of the previous management measures and, therefore, their enforcement become redundant under SURFs, overall fisheries management costs may actually be reduced.

Impact (x). Although this does not seem to have been systematically researched in the literature, SURFs may be expected to induce structural changes in the fishing industry. There are many reasons for this: Reduced fishing effort and capital implies a smaller number of companies (usually fewer vessels, less gear, etc.), *ceteris paribus*. More emphasis on quality and obtaining a higher value-added from unit of landings requires more advanced processing, product development and marketing. This implies a structural change in the fishing companies. Moreover, the returns to scale typically associated with the above value-added enhancing activities will generally create additional push toward fewer and larger companies. Technological innovations and more complicated operations will also require technologically more advanced operations. Higher profitability and larger companies will increase emphasis on professional operations and company profits as a measure of success.

Impact (xi). Altered geographical location of the fishing industry. Empirically it appears that a transition to SURFs is often followed by the fishing industry becoming more concentrated in fewer places than before. There are indeed theoretical reasons to expect this to be the case. As we have already seen, SURFs generally lead to fewer and larger companies than before. It stands to reason that fewer companies require fewer locations. Secondly, there are substantial economics associated with geographical concentration of the fishing activity, both as regards returns to scale and the rather wide range of supporting activities needed to efficiently operate advanced fishing vessels and fish processing factories not to mention product development and marketing.

[14] The rather undemanding conditions for this to be the case can be rigorously derived.

Impact (xii), a shift to a higher economic growth path. Increased net income in the fishing industry and the jump in wealth due to the value of SURFs enhances the ability to invest. At the same time, new profitable investment opportunities in the fishing industry due to the SURFs offer improved return on investments. Subsequently, because of generally higher income levels, further new investment opportunities will emerge. In some respect these changes are like a technological shift in production possibilities. This may confidently be expected to shift the optimal economic growth path of the economy upward (see e.g., Acemoglu 2009).[15] The actual growth path of the economy is likely to follow suit.

Impact (xiii), unequal distribution of benefits and costs. The above-discussed impacts of SURFs strongly suggest that the associated economic costs and benefits will tend to be unequally shared. While there will almost surely be substantial total economic gains, the gains will be unequally enjoyed and there will most likely also be losers. The biggest initial gainers will probably be the receivers of SURFs, the fishers that man the remainder of the fishing fleet and those that participate in the revamped operations of the fishing industry. The initial losers will tend to be fishing labour and fishing input producers made redundant be reduced fishing. Subsequently, there will likely also be losers in fishing locations from which the fishing industry moves. In the longer run the gains from a more efficient fishing industry will become more widespread through the usual economic channels including increased overall demand for labour, more general spending power and higher government income, and losses will peter out via adjustments of labour and habitation.

The above economic impacts of SURFs materialize over a period. Some will appear very quickly (such as increase in the value of SURFs) while others will appear gradually over a considerable period (e.g., structural changes in the fishing industry). Moreover, many impacts will proceed in a non-monotonic fashion, i.e., cyclically. Most of the economic impacts appear to be positive, i.e., in the direction of higher net income. Some of them are an inevitable consequence of SURFs, Others depend on (i) initial state of fishery, (ii) the fisheries management measure (especially the TAC setting and similar stock enhancement measures). Some of the economic impacts may be modified by auxiliary measures. Measures to counteract perceived negative impacts are of particular interest.

4.2 Environmental impacts

Strong user rights have various environmental impacts many of which, albeit not all, seem socially desirable. The following lists some of the more obvious of these impacts.

(i) Larger commercial stocks

As discussed in the chapter on economic impacts, it is well established both theoretically and empirically that SURFs promote economically efficient fishing. Barring multiple equilibria and unfavorable strange dynamics, this necessarily implies relatively high stock levels, normally above the level corresponding to the MSY of the commercially important species (Clark and Munro 1975). Compared to the outcome under WURFs, this typically represents a great improvement in the stock levels of these species (Gordon 1954, Clark 1976, World Bank 2018). In this sense SURFs tend to move the ecosystem toward a more original state.

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[15] This is also easy to show within a simple Solow growth model.

(ii) Possible long-term tendency toward less biological diversity

However, to the extent that SURFs lead to multi-species and ecosystem management, some stocks detrimental to commercial fisheries may be reduced. This would for instance apply to marine predators of and competitors with commercially valuable species in a similar way to what has happened in land-based agriculture. From this perspective, SURFs in fisheries pave the way toward shifting marine ecosystems to states that are commercially more productive which may imply less biological diversity. It should be stated that few if any exiting SURFs have led to a noticeable movement in this direction so, most likely, this state of affairs is a long way off.

(iii) Less concomitant environmental impacts

SURFs promote less fishing capital and less fishing effort than WURFs. It follows that there will less concomitant environmental impact of the fishing activity in terms of polluting emissions (airborne and waterborne) and impacts on the ocean habitat (water masses and sea bottom and less by-catches and disturbance to marine life and environment in general.

The nature of the impact may well change also. It seems likely that SURFs will lead to improved technology of fishing primarily because this will become more beneficial but also because there will be more capital for technological development and investments.

(iv) More concern for marine health

SURFs imply more concern by the users than WURFs for the health of the marine ecosystem to the extent that this contributes to the value of their rights. This concern of SURF-holders is heightened for the simple reason that they have more to lose. Thus, they will be more inclined to oppose external impacts on marine health from pollution and other activities. This includes land-based effluents, ocean mining, ocean transportation, coastal zone development, airborne pollution, and of course certain types of climate change. How this will be translated into action depends on the ability of holders of SURFs to organize themselves into interest groups. It goes without saying that this ability will also be enhanced because they have more to gain from it.

(v) Platform for optimally harmonizing different marine resource uses

Marine resources can be used in a great number of ways. Many of these ways conflict with each other (Arnason 2008). Obvious examples are fish stock conservation and fisheries and recreational fisheries and commercial fisheries. Harmonizing these conflicting uses in an optimal manner is a major task for marine resource utilization. As explained in Arnason (2008, 2009), SURFs provide a certain platform for accomplishing this. This is because the existence of SURFs provides a basis, along the lines first suggested by Coase 1960, for bargaining and, in special case, trade with other users of marine resources conducting activities that conflict with the fisheries. A very interesting aspect of this is that this opens the door for conservation and other so-called non-market values to be compared with commercial benefits in a market-like situation.

4.3 Social impacts

SURFs seem to have numerous social impacts. Many of these are strongly related to the economic impacts discussed in section 4.1 which is not surprising because the economic activity is an integral part of social life. Among the more obvious of these social impacts are the following:

(i) Fewer, larger and economically stronger fishing companies.
(ii) Geographical rearrangement of the fishing industry (probably to fewer locations).
(iii) Reduced use of labour in the harvesting activity, albeit likely more labour use in processing and marketing.
(iv) More technically advanced fishing industry and, therefore, more demand for more skilled labour.
(v) Contraction in fishing inputs producing industries (due to reduced fishing effort)
(vi) Increased income in the fishing industry and fishing communities. This normally is enjoyed by individuals, companies, and local governments.
(vii) Altered distribution of income between individuals, companies, and communities (even with adherence to the Pareto improvement principle).
(viii) Altered power and social status relationships (follows from the above). Most obviously some fisheries management power will move from fisheries authorities to the holders of SURFs. Social and local distribution of power will also be altered because of altered levels and distribution of income.
(ix) Cultural shifts. The culture associated with previous methods of production and income generation will be replaced by a new culture in accordance with new methods of production, income generation and power relationships.
(x) A shift (local and possibly national) to a higher economic growth path because of more available investment capital and more investment opportunities. This will have additional social impacts.
(xi) A period of social disturbances as the adjustment from the previous arrangement to the new one takes place (assuming sufficient social stability).

As already noted, most of these social impacts are either different aspects of the economic impacts of SURFs or consequence of them. This appears reasonable, as social structures are generally closely linked to the methods of production.

Assessing the desirability or undesirability of the social impacts of SURFs is by no means straight-forward. Although there can be little doubt that people care about social structures, little seems to be known about their relative values and the cost associated with changing them.

It seems reasonable that changes in existing social structures are upsetting for many people and they would, *ceteris paribus*, like to avoid them. This appears to hold irrespective of whether they would prefer the new social structure or not. In this sense, changes in social structures can be regarded as akin to investment costs, i.e., a cost that must be incurred to enjoy the benefits (or suffer the costs) of a new social structure.

These transition costs seem to be largely independent of whether the new social structure is beneficial or not. Just as investments in any capital, investments in new social structures may or may not yield subsequent net benefits.

It appears obvious that while some people, e.g., those who enjoy more power and status in the new system, will prefer the new social structure to the old one, while others, e.g., those who lose power and status, will not do so. Thus, just as in the case of the purely economic impacts, there will generally both be losers and gainers. It may even be the case that many aspects of a social change, e.g., those having to do with social power and status, are generally a zero sum. i.e., the gainers only receive as much as the losers lose.

5. Discussion

In the above, we have attempted to identify and describe significant impacts of strong user rights in fisheries (SURFs). The process employed has not been very structured. Essentially, it has consisted of reviewing outcomes of SURFs that have been suggested fisheries economic models and/or observed in real fisheries. Therefore, we expect our list of impacts to contain omissions and even misclassifications that will hopefully be pointed out by later research.

In spite of these, undoubtedly significant weaknesses, we hope that this work will, nevertheless, prove helpful in systematic assessments of the advantages and disadvantages (or costs and benefits) of SURFs. Such assessments are, of course, crucial for the selection and design of the most beneficial management systems for fisheries as well as those for several other types of resource utilization.

Of course, merely producing a list, even a systematic one, of the impacts of SURFs is but a first step toward the assessment of their advantages and disadvantages. What needs to be done is to assess the values of the various impacts. These valuations, moreover, need to be internally consistent and comparable (measured in the same units) so that the overall advantages or disadvantages can be calculated. This is, to say the least, easier said than done. The economic methodology for this kind of task is benefit-cost analysis (see e.g., Layard and Glaister 1994). Careful application of this methodology is highly demanding. Those who have engaged in benefit-cost analyses know that to obtaining reliable benefit-cost ratios is both costly and difficult.

The relative magnitude of the advantages and disadvantages of SURFs is, of course, an empirical matter. This suggests that the net benefits of adopting SURFs will differ from case to case. More crucially, it is likely to be positive in some cases and negative in others.[16] Thus, it is unlikely that the advantages of SURFs will generally exceed the disadvantages or vice versa. Note, however, that while a general result of this nature is probably unavailable, it may still be the case that for certain classes of fisheries, e.g., large commercial ones in advanced economies, the advantages of SURFs generally outweigh the disadvantages by a significant

[16] To see this, it is sufficient to realize that the potential profitability of the various fisheries covers a range from the negative to the highly positive. Obviously, if the potential profitability of a fishery is sufficiently small, the cost of installing and operating SURFs, not to mention the social adjustment costs, may well exceed the benefits, while the opposite apparently holds true for potentially highly profitable fisheries.

margin. It seems that results of this kind can only be obtained based on empirical studies. With the accumulation of such studies, hopefully a pattern of this kind will emerge.

Even without valuations of their relative magnitudes, the list of impacts of SURFs may be of assistance to fisheries management decision makers. At minimum, it should help them to focus their thinking on the most important aspects and, hopefully, guide their own research.

References

Acemoglu, D. 2009. *Introduction to Modern Economic Growth*. Princeton University Press. US.

Alchian, A. 1965. Some Economics of Property Rights. *Il Politico* 30:816-29.

Anderson, L.G. and J.C. Seijo. 2010. *Bioeconomics of Fisheries Management*. John Wiley and Sons. NY.

Aristotle. c. 330 BC. *The Politics*, Stephen Everson (ed.), Cambridge: Cambridge University Press, 1988.

Arnason, R 2008. Harmonizing Recreational and Commercial Fisheries: An Integrated Rights-Based Approach. In D. Leal and W. Maharaj (editors) *Evolving Approaches to Managing Marine Recreational Fisheries*. Rowman and Littlefield Publishers New York.

Arnason, R. 2000. Property Rights as a Means of Economic Organization. In R. Shotton (ed.) Use of Property Rights in Fisheries Management. *FAO FisheriesTechnical Paper* 401/1. Food and Agriculture Organization of the United Nations. Rome.

Arnason, R. 2006. Property Rights in Fisheries: Iceland's experience with ITQs. *Reviews in Fish Biology and Fisheries* 15:243-264. 2005.

Arnason, R. 2007. Property Rights Quality and Economic Efficiency of Fisheries Management Regimes: Some Basic Results. In T. Bjorndal, D. Gordon R. Arnason and R. Sumaila (eds.). *Advances in Fisheries Economics*. Blackwell.

Arnason, R. 2009. Conflicting Uses of Marine Resources: Can ITQs Promote an Efficient Solution? Australian Journal of Agricultural and Resource Economics 53:145-74.

Arnason, R. 2013. Individual transferable quotas in fisheries. In: Shogren, J.F., (ed.) *Encyclopedia of Energy, Natural Resource, and Environmental Economics*, volume 2, pp. 183-191. Elsevier. Amsterdam.

Aquinas, T. [1272]. In Paul E. Sigmund (ed.) *St. Thomas Aquinas on Politics and Ethics*. W.W. Norton, 1988.

Birgir Th. Runolfsson. 2022. Measuring Quality of Property Rights: Development of User Rights Quality in the Icelandic Fisheries, (Draft 2022)

Bjorndal, T and G. Munro. 2012. *The Economics and Management of World Fisheries*. Oxford University Press. UK

Clark, C.W. 1976. *Mathematical Bioeconomics: The Optimal Management of Renewable Resources*. John Wiley & Sons.

Clark, C.W., and G.R. Munro. 1975. The Economics of Fishing and Modern Capital Theory: A Simplified Approach. *Journal of Environmental Economics and Management* 2(2):92-106.

Coase, R.H. 1960. The Problem of Social Cost. *Journal of Law and Economics* 3:1-44.

Debreu, G. 1959. *Theory of Value*. Cowles Foundation. Monograph 17. Yale University Press, New Haven.

Demsetz, H. 1967. Toward a Theory of Property Rights. *American Economic Review* 57:347-59.

Geen, G. and M. Nayar. 1988. Individual transferable quotas in the Southern Bluefin Tuna fishery: An economic appraisal, *Marine Resource Economics* ***5:***365-87 (1988).

Gordon, H.S. 1954. Economic Theory of a Common Property Resource: The Fishery. *Journal of Political Economy* 62(2):124-42.

Herrmann, M. 1996. Estimating the induced price increase for Canadian Pacific Halibut with the introduction of the individual vessel quota system. *Canadian Journal of Agricultural Economics* 44:151-64.

Homans, F.R. and J.E. Wilen, 2005. Markets and rent dissipation in regulated open access fisheries. *Journal of Environmental Economics and Management* 49:381-404.

Hume, D. [1739] *A Treatise of Human Nature*. InL.A. Selby–Bigge and P. H. Nidditch (eds.), Oxford: Clarendon Press.

Layard, R. and S. Glaister. 1994. *Cost-Benefit Analysis* (2nd edition). Cambridge University Press, Cambridge.

Locke, John [1689] *Two Treatises of Government.* In Peter Laslett (ed.), Cambridge: Cambridge University Press.

Mill, J.S. [1848] *Principles of Political Economy.* In Jonathan Riley (ed.), Oxford: Oxford University Press.

Pejovich, S. 2001. *The Economics of Property Rights: Towards a Theory of Comparative Systems*. Edward Elgar Publishing.

Schrank, W.E., R. Arnason, and R. Hannesson. 2003. *The Cost of Fisheries Management*. Aldershot, UK:Ashgate.

Scott, A. 1989. Conceptual origins of rights based fishing. In P. Neher et al. (eds.) *Rights-based Fishing*. Kluwer Academic Publishers. Dordrecht.

Scott, A. 1996. The ITQ as a Property Right: Where it came from, how it works and where it is going. In B. Crowley (ed) *Taking Ownership: Property Rights and Fisheries Management on the Atlantic Coast*. Atlantic Institute for Market Studies. Halifax.

Scott, A. 2008. *The Evolution of Resource Property rights*. Oxford University Press. Oxford.

Shotton, R. (editor). 2000. Use of Property Rights in Fisheries Management. *FAO Fisheries Technical Paper* 401/1 and 401/2. Food and Agriculture Organization of the United Nations. Rome.

Solow, R. M. 1956. A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics* 70:65-94.

Smith, A. [1776]. *An Inquiry into the Nature and Causes of the Wealth of Nations*. Edition by E. Cannan 1977. University of Chicago Press, Chicago.

Waldron, J.2004. Property and Ownership. *Stanford Encyclopedia of Philosophy*.

Wilen, J.E. and F.R. Homans. 1997. Unraveling Rent Losses in Modern Fisheries: Production, market or Regulatory Inefficiencies. In E.K. Pikitch, D.D. Huppert and Michael P. Sissenwine (editors) *Global Trends: Fisheries Management*. American Fisheries Society. Pp. 256-263.

World Bank. 2017. *The Sunken Billions Revisited. Progress and Challenges in Gobal Marine Fisheries*. The World Bank. Washington DC.

Appendix A

The economic impact of SURFs under fisheries mismanagement

A detailed investigation of the economic loss resulting from fisheries mismanagement under SURFs is a substantial task. Here we merely show that in a simple fishery modelling context, there exists a degree of fisheries mismanagement that will not improve the economic outcome of SURFs compared to WURFs.

Let the profit function of a fishery be defined by the concave differentiable function:

$$\Pi(y,x),$$

where *y* represents the harvest level and *x* the volume of biomass.

Le the evolution of biomass be defined by:

(1) $$\dot{x} = G(x) - y,$$

where *G*(*x*) is the usual dome-shaped biomass growth function.

Under very weak user rights, the fishing activity may at all times be described by:

(2) $$\Pi_y(y,x) = 0\,.$$

Equations (1) and (2) define the evolution of the fishery under WURFs. The equilibrium may be written as:

$$G(x^\circ) - y^\circ,$$

(3) $$\Pi_y(y^\circ, x^\circ) = 0\,.$$

Note that (although this does not follow from this simple model) these equations apply under WURFs irrespective of the fisheries management.

Under SURFs and perfect exogenous fisheries management, the fishery evolves as the profit maximizing fishery defined by (1) and

(4) $$\Pi_y(y,x) = \lambda$$

(5) $$\dot{\lambda} - r \cdot \lambda = -\Pi_x(y,x) - \lambda \cdot G_x(x),$$

where *r* is the rate of discount and λ the shadow value of biomass. In equilibrium the fishery is defined by:

(6) $$G(x^*) - y^* = 0,$$

$$G_x(x^*) + \frac{\Pi_x(y^*, x^*)}{\Pi_y((y^*, x^*)} = r\,.$$

Let us now assume that the fisheries management authority sets the TAC at $y°$. Then (5) implies that $x^*=x°$. If immediately follows from (3) and (4) that $\lambda=0$ and the equilibrium fishery under SURFs is exactly the same as the equilibrium fishery under WURFs.