

**ECONOMICS OF THE RECOVERY OF FISH STOCKS: COMPARISON OF A NPV CALCULATION  
OF A RECOVERY STRATEGY WITH THE REAL DEVELOPMENT OF THE BALTIC COD  
FISHERY**

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**ABSTRACT**

The recovery of fish stocks is in principle an investment decision weighing up short term losses against future gains. In the Common Fisheries Policy (CFP) of the EU long term management or recovery plans are a main instrument. One of the basic aims is to move from a short term to a longer term perspective in the management process by having automatic rules about how to set quotas in the following years. This gives fishermen more security on catch possibilities in the future. However, it is not clear whether measures in recovery plans are economically feasible or not. Fishermen may lose more than they gain from such a recovery plan. In the first part of the paper we describe the economics behind long term management plans and the rationale of such plans from an economic viewpoint. Secondly, we use the Baltic cod fishery as an example to compare the present value of recovery scenarios and a status quo scenario. As a simplification only one cod stock is assumed in that calculation (in the Baltic Sea a western and eastern stock are distinguished). In the meantime a long term management plan for Baltic cod is in place since 2008. Especially the Eastern stock shows strong signs of recovery because of reduced fishing effort and good recruitment. In a third part we analyze to which extent the general calculations are comparable to the experiences in the real fishery.

Keywords: Long-term fisheries management, Baltic Sea cod fishery, Common Fisheries Policy

**Introduction**

The basic regulation of the EU Common Fisheries Policy (CFP) (Council Regulation (EC) 2371/2002: Art 2) includes one overall objective: the CFP “shall ensure exploitation of living aquatic resources that provides sustainable economic, environmental and social conditions.” In the same article this objective is further qualified: the CFP “shall aim to contribute to efficient fishing activities within an economically viable and competitive fisheries and aquaculture industry, providing a fair standard of living for those who depend on fishing activities and taking into account the interests of consumers.”

The CFP is currently going through a reform process that will lead to the adoption of a new regulation in 2012. From the current regulation one instrument is receiving quite positive responses in the reform debate: recovery or long term management plans (LTMP).<sup>1</sup> The process of implementation of LTMPs started slowly but in the meantime around 10 plans are adopted or in the process of adoption. From an economic viewpoint a stock recovery can be seen as an investment decision. Now forgone catch possibilities can lead to longer term gains from increasing stock size. However, the plans do not include economic objectives besides the overall objectives of the CFP (see above). Still only Harvest Control Rules (HCR) are set and objectives following the precautionary approach (biomass or fishing mortality targets) are included in the plans. The LTMP are for sure a first step to move from a short to a medium/long term perspective in fisheries management. Especially from the business perspective of the fishing enterprises more security on catch possibilities in the following years helps in decision making processes (e.g. on investments). However, this longer term perspective does not guarantee that the plans are economically feasible.

In this paper we start with a description of the economic background of LTMPs and then use the Baltic Sea cod as an example for a stock managed now by such a plan. Döring & Egelkraut ([1]) described the fisheries on these stocks before the implementation of the LTMP and compared two recovery strategies with a status quo (ongoing overuse) and a sustainable exploitation scenario. Finally, we compare these scenarios with the actual situation nearly three years after the introduction of the management plan.

## Economic background of long term management plans

A stock recovery phase can be seen as an investment decision in order to reach higher catch possibilities in the future. Many plans include catch and effort restrictions over several years and fishermen are forced to catch less for a while.

The influence of such a plan on the fishermen's perception on their long term security for catches is often overlooked in the discussion on the effects of the management plans. Such security may influence the fishermen's behavior in such way that they keep the rules instead of trying to get around them (like underreporting of landings). Thus, a key issue of LTMP is that they are multiannual ([2]: 151). In most fisheries the management is basically still for a single year and this is under criticism by both the industry and conservation organizations for not giving a longer term perspective for fishermen.

The long term security for fishermen on catches is, however, not regulated in a LTMP. Such security relies on the allocation of fishing rights. However, many fishermen have some kind of stability on how much quota (% of the overall quota) they receive because of the allocation system in their countries (IQ, ITQ etc.). Accordingly, the rules how to fix TAC in the coming years in the plans give fishermen a higher security than today. In today's management system for nearly all of the stocks in EU waters fishermen face a command and control system where decisions are being made at the level of the Council of Ministers. The TACs are fixed in December and many member states allocate the fishing rights to their fishermen via Individual Vessel Quotas (IQ – non transferable), Individual Transferable Quotas (ITQ) or leave an open quota (Open Access). Fisheries economists often recommend the allocation of ITQs because they end the race for fish as fishermen are sure that their quota share (a certain percentage of the TAC each year) will not be exploited by someone else ([3]: 6). However, in cases where IQs or ITQs are not well fixed over years fishermen have only short term security on their catch possibility in the next year.<sup>2</sup> In case of an open quota there are incentives to even invest in additional equipment or new techniques to be able to fish a higher percentage of the overall quota – which results in the well-known 'race to fish'.

The existing LTMPs also include many detailed regulations on the limitation of fishing effort. This is the first time in the Common Fisheries Policy that TACs and effort limitations are used at the same time ([2]: 152). This could only become effective after the Council of Ministers had agreed that TACs alone did not work. Effort limitations in combination with the TAC regulation may give a better chance for the recovery of overused stocks.<sup>3</sup> However, these regulations and technical measures (closed seasons, closed areas, gear limitations etc.) do not only add to the uncertainty of the fishermen on future catch possibilities in the longer run but also increase costs at the short term. These costs can be substantial and have to be added to the 'costs' of reduced catch possibilities following the TAC reductions in a recovery plan. However, so far only limited knowledge is available on the combined effects of reduced catch possibilities and cost increases from effort limitation.

Nevertheless, from an economic standpoint a long term management plan is an instrument for a transition from a short term management system to a longer term one and might give fishermen probably a higher security on longer term gains. Economists claim that because of the incentive structure in the current management system (unclear property rights, annual TACs, regularly changing technical measures etc.) fishermen clearly prefer short term gains. Therefore, fishermen discount future revenues at a very high rate.<sup>4</sup> Following the recovery program (reduced catches for some time) may not be a rational choice from their perspective – they still prefer the catches in the overuse situation over the gains from the long term recovery. The same applies for a long term management in case of a non-overfishing situation. If fishermen invest in such a fishery and they earn not enough they may prefer higher catches for some time over the fishing on a sustainable level.

What does this mean for the fishermen? They must have a higher security on long term gains and that they will receive that long term gains personally.<sup>5</sup> Stronger property rights are, therefore, one important issue in the debate on future fisheries management but beyond the scope of this paper.

### **Baltic Sea cod – scenarios for a LTMP before introduction**

The Baltic Sea cod fishery was in a situation of severe overfishing in 2006. Especially the eastern stock was in a dramatic state, fishing mortality well above  $F_{lim}$  ( $B_{pa}$  and  $B_{lim}$  not defined). High fishing pressure is not the only reason why the stocks were at that low level. Successful recruitment is very much dependent on favorable environmental conditions in the spawning grounds. The Baltic Sea is a brackish water semi-enclosed sea with only limited water exchange with the North Sea. Only an inflow of salt water with high oxygen content from the North Sea can improve spawning conditions in the deeper basins for mainly but not only the eastern Baltic cod stock. Over several years prior to 2006 the inflow of salt water was insufficient and the water volume where cod was able to spawn successfully decreased year by year. A second reason for low recruitment was high sprat and herring stocks. Especially sprat feed on cod eggs and if cod stocks are low the predation of cod on sprat is also low. Therefore, the Baltic Sea was a sprat dominated system instead of the second possible state - cod dominated.

For Baltic Sea fisheries management the International Baltic Sea Fisheries Commission (IBSFC) was established 1973 in Gdansk (Poland). This organization introduced management measures for all countries until Poland and the Baltic States joined the EU in 2004. After that the IBSFC was dissolved and now EU and Russia bilaterally agree on fishing opportunities in the Baltic Sea. Therefore, all countries around the Baltic Sea, except Russia, are now within the jurisdiction of the CFP. Poland and the Baltic States have been using structural funds to reduce fleet capacity. One consequence was that the unreported (illegal) landings of cod in Poland dropped dramatically. In the recent ICES advice for Baltic cod for 2011, the TAC and ICES landings (including also unreported catches) are similar for 2009-10 ([4]). Therefore, unreported catches apparently have become negligible. With only three dominant species (cod, herring, sprat), salmon and some flatfish species the Baltic Sea ecosystem is relatively easy to describe and influences of predation or competition on the cod stock is analyzed quite deeply. Therefore, it is easier to implement long term management tools than in areas like the North Sea with a lot of stocks and many mixed fisheries.

In the following part we use the example of the Baltic Sea cod fishery to show economic net present value (NPV) calculations for two stock recovery strategies before LTMP implementation. The main idea was at that time to answer the question whether a recovery of the stock(s) seems economically feasible.

With this starting point for the assessment Döring & Egelkraut ([1]) calculated two cod recovery strategies. For simplifying reasons only one stock was assumed in the NPV calculations. The long term sustainable exploitation rate of the stock was set at a level of 150.000 t if the stocks are in good condition (comparable to a situation in the mid 1980ies). To reach that level a 50% reduction of the actual TAC (appr. 50.000 t) was assumed and after five years an increase in TAC by 5.000 or 10.000 t per year until the 150.000 t are reached. Therefore, the recovery of the stock(s) would last 15 or 25 years. Another assumption was that the fishery also shall reduce its negative impacts on the ecosystem by changing fishing gear from bottom trawls to longlines.<sup>6</sup> Longlines are not feasible at the low stock level at the beginning of the management plan period because of high costs. For the NPV calculation catch costs per t for certain TAC levels were used from an earlier assessment of fishing costs of the Baltic Sea fleet (see table 1). It is clear that at a low stock level costs are much higher than on a higher level with higher concentrations of cod and as assumed here much higher catch possibilities to allow the use of longlines.

Table 1: Fishing costs estimates (see [1]: 639)7

Fishing gear	Annual landings (t)	Fishing costs (€ per t)
Bottom trawl	25,000	1,700
	50,000	1,200
	150,000	850
Longlines	150,000	1,000

The basic question was now whether the assessed recovery strategies are economically feasible or not. Seen as an investment decision the rate of return should be comparable to other investment possibilities. This was analyzed by using various discount rates to value future costs and benefits. Since fishing is a risky business interest rates are probably higher than in other sectors. Additionally, fishing enterprises have only short term security on catch possibilities. As Hillis and Wheelan ([5]) found out, discount rates can be quite as high as 30% and even higher. This reflects the fishermen’s perception of a very uncertain situation in upcoming years. To assess the efficiency of the recovery strategies four scenarios were compared:

Scenario 1: Status Quo: Baltic Sea fisheries continue to catch cod at a level of 50,000 t per year using trawl nets with mesh sizes remaining unchanged.

Scenario 2: Recovery program 1 – Reduction to 25,000 t per year during the first 5 years by using trawl nets with greater mesh sizes and escape window (to avoid catch of smaller cod). In year 6 catch of 50,000 t and then a 5,000 t increase up to 150,000 t. In year 25 fishermen have to switch to longlines.

Scenario 3: Recovery program 2 – same as 1 except of an increase in TAC from year 6 on of 10,000 t and switch to longlines in year 15.

Scenario 4: A catch of hypothetical 150,000 t every year.

The following table 2 shows the results of the assessment of Döring & Egelkraut ([1]) for the Baltic Sea cod recovery strategies.

Table 2: Assessment of different scenarios for the Baltic Sea cod fishery

Discount rate (%)	Net present value (million €)			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
0.0	750	2,768	3,077	3,750
2.0	469	1,503	1,737	2,347
4.0	318	857	1,036	1,589
13.4	105	105	155	679

At a discount rate of 13.4% the fishermen would prefer to go on with the overuse situation compared to the recovery of the stock. This discount rate seems high in absolute numbers, but realistic according to the assessment of Hillis & Wheelan.

In their paper Döring & Egelkraut added a further point. The costs for using longlines are still higher after the recovery of the stocks than for trawl nets. There seems to be no reason why fishermen shall use them. However, in a study on the willingness to pay for certified fish (comparable situation to using longlines with lower negative impacts on the ecosystem) Döring & Wichtmann ([6]) calculated a potential of 0.4-0.45 €/kg price premium on the current price. This can be translated to additional income of 200 € per ton for cod fished by longlines. If it were possible to guarantee the fishermen these additional payments, longlines would become economically feasible.

The overall conclusion of this study was that the investment in the recovery of the stock(s) is profitable. If the fishermen additionally will have a higher security on future catch possibilities than today they may decide to do it voluntarily. In this case their discount rate would be comparable to the market interest rates for long term governmental bonds (real 4-6%) and a risk premium but normally lower than the 13.4% which makes the recovery program 1 not economically viable.

### Baltic Sea cod – how different is the real development?

In 2008 the LTMP for Baltic cod was implemented. Instead of biomass limits, fishing mortality targets were set (see table 3). The TAC are allowed to fluctuate by 15% at the most (only in a case of a very high fishing mortality exemptions from that rule are possible). Furthermore, to reach the target a second instrument, the limitation of effort (days at sea), was included in the plan.

Table 3: Targets in the Baltic Sea cod management plan

Stock	Targets	Instruments	Comments
Baltic Cod		F-Reduction, TAC max. fluctuation (15%)	Before implementation problems with unreported catches and high discards in some areas
western	F (0.6)	Closed areas and seasons, max. fishing effort (days at sea)	
eastern	F(0.3)		

There is no target for a certain biomass level which corresponds to the Johannesburg agreement on harvesting the fish stocks at MSY level. Only just recently the EU-Commission asked ICES for advice thus following the Johannesburg agreement. However, for the cod fishery in the Baltic Sea a fishing mortality leading to MSY in the long run is now under consideration and might be included in a revised plan.

Since the implementation of the LTMP for the cod stocks, basically the eastern stock, are in a better situation than at the starting point. It is unclear yet which factor played the dominant role in this development. The following explanations are possible:

- a) A massive reduction in unreported landings together with the effort regulation in the LTMP reduced the fishing mortality substantially,
- b) Inflow of salt water from the North Sea improved the spawning conditions for cod.

This all led to a strong year class 2008 and a substantial biomass increase at least in the eastern stock. In table 4 we compare the actual situation (ICES advice for 2011) with the situation before the implementation of the plan (2007, advice 2008).

Table 4: Development of TAC/TAC advice since the implementation of the LTMP

Stock	Advice 2011 1000 tMSY/LTMP	TAC 2010 1000 t (following LTMP)	TAC 2009 1000 t (following LTMP)	TAC / Catch 1st year after implementation 1000 t (following LTMP)	Difference TAC 2008/ Advice 2011 1000 t
Baltic cod					
Western	18.2/18.8	17.7	16.3	19.2 / 20	- 1.0/0.4
Eastern	105/64	56.1	49.4	42.3 / 42	+ 62.7/21.7

There is now a difference in the advice between following MSY and the LTMP. For the western stock the TAC would be lower following MSY than the LTMP, whereas for the eastern stock the opposite is true. A TAC following the MSY approach would be much higher (41,000 t) than following the LTMP. In this case the limitation of TAC increases to 15% set the TAC at this comparably low level. In any case the TAC for the western stock is still below the TAC in 2008, for the eastern stock the TAC is substantially higher. So especially for the eastern stock this is a strong sign of recovery.

Following this table we will now compare the actual situation with the recovery scenarios by Döring & Egelkraut ([1], see table 5). Because of the different situation in which there was no real recovery phase with a substantial reduction in TAC following the LTMP, we assume only two years of reduced catches for the recovery scenarios. A second assumption is the fixing of the western quota in 2012 on the level of 2011 and a 15% increase every year for the eastern cod quota.

Table 5: Catch scenarios and real development for Baltic Sea cod (2006-2012)

	2006 (catch) 1000 t	2007 (catch) 1000 t	2008 (catch) 1000 t	2009 (catch) 1000 t	2010 (TAC) 1000 t	2011 (TAC advice) 1000 t	2012 (TAC) 1000 t
Baltic cod (real development)	89	75	62	61.3	73.8	82.2	92.4
Recovery scenario 1 (15 years)*	25	25	60	70	80	90	100
Recovery scenario 2 (25 years)*	25	25	55	60	65	70	75

\* Following Döring & Egelkraut [1], but only with two years of 50% reduction of the catch level in 2006 and 2007.

A closer look at the table shows that we cannot really compare the real development with the recovery scenarios. The recovery scenarios were very conservative regarding the recovery time. The real situation is much better than expectations before the implementation of the LTMP. Looking at an NPV calculation with a 2% discount rate it turns out that the real situation is better for nearly every year (table 6).

Table 6: Revenues for NPV calculation (2006-2012)

Discount rate 2%	2006	2007	2008	2009	2010	2011	2012
Real situation	146.85	130.5	102.3	74.9	122.93	145.25	172.05
Recovery plan 1	41.25	43.5	99	79.8	132	157.5	185
Recovery plan 2	41.25	43.5	90.75	68.4	107.25	122.5	138.75

Att.: Prices for cod: 2006 = 1.65 €/kg, 2007 = 1.74 €/kg, 2008 = 1.65, 2009 = 1.14, 2010 = 1.65, 2011= 1.75 und 2012 = 1.85 €/kg. Price in 2009 was very low and for the following years we assume prices on the level before the crisis with a slight increase.

The NPV for the real situation using 2, 4 and 13.4% discount rates is always the best choice (table 7).

Table 7: NPV (basis year 2010) for different discount rates (2,4 and 13.4%)

Discount rate	2%	4%	13.4%
	Mio. €	Mio. €	Mio. €
Real situation	910.97	928.79	1,034.44
Recovery plan 1	739.44	741.74	764.2
Recovery plan 2	615.71	619.8	649.1

It is possible though to extend the period to the 50 years in Döring & Egelkraut ([1]). However, it is obvious that this will not change very much because of the losses at the beginning of the period, which does not occur in the real situation where the recovery at least of the eastern stock was much faster than expected.

## Discussion

In the paper we aimed at presenting a comparison between the real situation of the Baltic cod fishery and a model calculation of recovery strategies. However, looking at table 7 some doubts might arise as to whether the comparison on the basis of a seven year time frame really makes sense. The recovery strategies by Döring & Egelkraut were calculated over a 50 year time frame with a distinct phase of low catches at the beginning (5 years)<sup>8</sup>. However, a calculation over 50 years requires many assumptions like future landing prices, also, uncertainties are quite substantial (like possible climate change effects on recruitment). Over the seven years period here the real development was much faster than predicted; we will have a closer look at the reasons below.

The basic question at the beginning was about the economic feasibility of recovery plans. It is obvious from the previous chapter that it is not possible in this case to give a clear answer to that question. Nevertheless, one aim of the management plan is to give fishermen a higher security on the circumstances how future TACs and effort limits will be set. Higher security may influence fishermen's behavior in

relation to obeying the rules. The following table 8 gives an overview how TAC and catches fit after introduction of LTMP.

Table 8: Comparison of TACs and landings in European fisheries under a LTMPs

Stock	Comment
Baltic Sea cod	Western stock ICES-landings below TAC 2006-8, above 2009 Eastern stock ICES-landings above TAC 2006-7, even 2008 and below 2009
Plaice North Sea	Before 2001 ICES-landings above TAC, afterwards even
Sole North Sea	ICES-landings above TAC nearly all years ([7]: 73)
Sole Bay of Biskay	After 2006 ICES-landings were under the TAC, discards decreased ([7]: 15)
Sole western channel	ICES-landings above TAC (catches reported for other areas)
North Sea cod	Official landings (no ICES-landings reported) under or near TAC in the North Sea and Skaggeiak, no information on the eastern channel
Herring west of Scotland	ICES-landings under TAC in many years
Northern hake	ICES-landings above TAC before 2006, afterwards until 2008 below

There seems to be no clear direction: in some fisheries the ICES-landings (including also unreported landings as far as there is data available) were already below the TAC or even before the introduction of the LTMP. However, in some fisheries the situation changes afterwards. For the Baltic Sea cod fishery the unreported landings were reduced substantially after 2006 ([8]). This is one reason why now the landings are below TAC. Further investigation is necessary to draw a clear conclusion as to whether the enforcement of the quota is better now or the fishermen are now more willing to keep to the rules.

In the debates on the performance of the cod management plan the basic argument for the increase in the eastern cod stock is the reduction of unreported landings and a much lower fishing effort today than a few years ago. Landings are now near TAC. The substantial reduction in fishing effort started after the Baltic States and Poland joined the EU and plans to decommission vessels started nearly immediately (see table 9).

Table 9: Baltic Sea fishing fleet 2004 and 2008 ([8]: 4)

Country	31.12.2004			31.12.2008			Change 2008/2004		
	No	GT	kW	No	GT	kW	No	GT	kW
DEU	2,163	66,301	161,987	1,826	69,131	161,216	-16%	4%	0%
DNK	3,403	96,051	335,614	2,894	73,024	263,833	-15%	-24%	-21%
FIN	3,393	18,160	179,379	3,240	16,046	169,707	-5%	-12%	-5%
SWE	1,603	44,893	219,595	1,486	41,807	208,913	-7%	-7%	-5%
<b>old MS</b>	<b>10,562</b>	<b>225,405</b>	<b>896,574</b>	<b>9,446</b>	<b>200,008</b>	<b>803,669</b>	<b>-11%</b>	<b>-11%</b>	<b>-10%</b>
EST	1,052	24,918	63,264	966	17,808	45,974	-8%	-29%	-27%
LTU	293	75,586	77,684	221	50,478	59,794	-25%	-33%	-23%
LVA	942	42,135	70,982	841	38,228	61,080	-11%	-9%	-14%
POL	1,248	45,567	147,086	833	40,971	98,958	-33%	-10%	-33%
<b>new MS</b>	<b>3,535</b>	<b>188,205</b>	<b>359,016</b>	<b>2,861</b>	<b>147,485</b>	<b>265,807</b>	<b>-19%</b>	<b>-22%</b>	<b>-26%</b>
<b>Total</b>	<b>14,097</b>	<b>413,610</b>	<b>1,255,590</b>	<b>12,307</b>	<b>347,493</b>	<b>1,069,475</b>	<b>-13%</b>	<b>-16%</b>	<b>-15%</b>

Source: calculations based on the EU fleet register data.

In a STECF report on fishing effort in the Baltic Sea ([9]) the authors state that between 2002-2008 the fishing effort (measured in kw\*days) decreased by about 16%. This is not an impressive number. However, missing data from Poland explains it. Following Motova & Kuzebksi ([8]: 11) the following table 10 shows the decrease of effort because of the removal of vessels from the Polish fleet.

Table 10: Fishing effort in the Polish fleet and withdrawal by decommissioning vessels

SEGMENT	A	B	B/A
	2004	2004-2008*	
00-12 m PG	84 907	25 225	30%
12-24 m DFN	13 130	4 773	36%
12-24 m DTS	16 105	7 286	45%
12-24 m HOK	1 405	88	6%
24-40 m DTS	11 988	8 429	70%
24-40 m PTS	12 536	4 778	38%
<b>Total</b>	<b>140 071</b>	<b>50 579</b>	<b>36%</b>

\*Fishing days (in 2004) of vessels withdrawn with public assistance in the 2004-2008 period

Source: own calculation based on administrative logbook data.

The quite moderate decrease came with some kind of shift from regulated to unregulated gear in the cod fishery. In the cod management plan a days at sea system is accompanied by closed seasons (west in April, east Mai and June). Before the plan was implemented the ‘closed days’ were already increased to reduce fishing effort (see table 11).

Table 11: Closed days and days at sea since 2006 ([9])

Area	2006 (closed days)	2007 (closed days)	2008 (days at sea)
22-24	92	117	223
25-28	119*	183*	178**

\*There was no stop days in areas 28-32 during 2006-2007

\*\* during 2008, there were no stop days in areas 29-32

Another reason for the improvement in the cod stocks (especially the eastern) is the reduction of discards since 2003 ([9]).

Overall there seem to be other reasons for the recovery of the stock than the management plan. One is the reduction in illegal/unreported landings which means nothing different than a substantial reduction in catches. As a consequence, the assumption in the recovery scenarios by Döring & Egelkraut were not that different – except that the level of catches was much higher than the 50,000 t they assumed as the status quo/overuse scenario in the calculations. The reduction in fleet capacity was and still is costly but overall it seems that now with increasing catch possibilities and hopefully not further decreasing landing prices<sup>9</sup> the situation of the fishing fleets in the Baltic Sea may improve overall.

## Summary and Outlook

Long term or multiannual management plans are an important instrument in the Common Fisheries Policy. So far many of the plans were more recovery plans than management plans. A recovery of a stock is basically an investment in the stock to increase future catch possibilities. From an economic standpoint it is unclear whether such an investment pays off. Overall LTMP seem to be an important step from a short term to a longer term management system. We illustrate that with the Baltic Sea cod fishery as an example. In 2008 Döring and Egelkraut ([1]) published a paper with a comparison of different recovery strategies. The result was that a recovery is economically feasible. After the implementation of the plan

especially the eastern Baltic cod stocks shows strong signs of recovery. The TAC increases and the recovery is much faster than Döring and Egelkraut ([1]) predicted in their recovery scenarios.

It is, however, clear that not only the reduction of the TAC was the reason for such a recovery. A significant reduction in fishing effort in the eastern Baltic Sea was one other reason, good year classes because of favorable environmental condition another one. Nevertheless, the development shows that the recovery of a stock is possible if the fishing pressure will be reduced substantially.

The recovery of the stock(s) – there are two stocks in the Baltic Sea (western and eastern) – alone is not feasible to answer if this is economically viable. The economic crisis and more competition on the white fish market may lead to the decrease in landing prices. Besides an increase of quota over the last few years, the revenues of the fishermen are not increasing that substantially. There is still a problematic situation in the cod fleet and it is unclear if the improvement in the stock(s) will also lead to an improvement in the profits for the fishing vessels.

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ENDNOTES

<sup>1</sup> In the mean time all plans are only called multi annual plans without distinguishing between recovery and long term management plans.

<sup>2</sup> In an IQ or ITQ system this is the case if each year the government auctions the rights. Fishermen cannot be sure that they will be able to get the same amount of rights every year.

<sup>3</sup> There is another important aspect with effort limitations: the capital in the fishery is 'not used' many days and weeks over the year if the days at sea are very limiting. Having a very tight quota means a very inefficient use of the invested capital.

<sup>4</sup> Hillis and Wheelan calculated a discount rate above 30% after interviews with Irish fishermen ([5]).

<sup>5</sup> In case of longer term security the discount rate of fishermen will be at a comparable level with other sectors in the economy (see [10]). However, fishing is a risky business and, therefore, there will be a risk adjusted slightly higher rate than on capital markets.

<sup>6</sup> The idea was to have a sustainable fishery at the end of the recovery period not only by a sustainable exploitation rate but also by implementing elements of an ecosystem based approach.

<sup>7</sup> Fishing costs were calculated in a research project based on 2004 fleet data for the EU target fleet size.

<sup>8</sup> The basic idea to have a five year period of very low catches at the beginning and then a relatively slow increase in landings in the recovery strategies was to be very cautious. The main argument against such calculations is often that the future is very uncertain. Therefore, it was decided to have very cautious landings scenarios and relatively low prices.

<sup>9</sup> Prices for cod landings in Germany are in the first months of 2010 on a very low level (around 1 €, 114 € on average last year). This is lower than assumed in the Döring & Egelkraut calculations (they used the lowest level in the years prior to the calculations).