

RESOURCES MANAGEMENT THROUGH INDIVIDUAL TRANSFERABLE QUOTA SYSTEM AND ITS INFLUENCE ON THE TRADING VOLUME: A CASE STUDY OF NEW ZEALAND

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ABSTRACT

Resource management under Individual Transferable Quota System (ITQ's) is similar to that of Total Allowable Catch system. It, however, is said that the former is more difficult than the latter. In this paper, by analysing the case of the New Zealand's ITQ's during Fiscal Year 1991 and 2001, the current situation of resources management through ITQ's and its influence on the trading quota are examined. The main results are as follows. First, actual fishery situation become sharply cleared by concerning about characteristic of the area for fishing from 'the rate of fishing' is the ratio which catches occupied per quantity of quota. Second, it is cleared that there is group which has been continuously making the Over-Fishing and the number of these groups are increasing year after year. the cause of continuous the Over-Fishing is fisherman tend to catch not only quantity of quota but also catches that they can pay a penalty. Third, it is possible to catch before securing enough quota in New Zealand's ITQs system. Because of this precedent of fishing, Quota Leased have been utilized as an adjustment for the excess of catches.

Keywords: Resources Management, Individual Transferrable Quota, Quota Leased

INTRODUCTION

Now, many fisheries have faced over-fishing and look for designing for resource management. Around Europe and United States, the introduction of Individual Transferable Quota (ITQ) System has proceeded to obtain economic efficiency. Resource management under ITQ system is similar to that of Total Allowable Catch (TAC) system. It, however, is said that the former is more difficult than the latter. As one the primary factor, this paper picked up that a interrelationship between Transferability and resource management under ITQ system has effected.

In this paper, by analyzing the case of the New Zealand's ITQs system during Fishing Year 1991 and 2001, the current situation of resource management through ITQs system and its influence on the trading quota are examined.

As Concretely assignment, there was 3 points. First, it was concerning about characteristic of the Fishing Management Areas and declaring 'the rate of fishing'. Second, it showed status and continuity of the Over-Fishing by unit. Third, it provided relation between 'the rate of fishing' and 'rate of quota leased'.

In this paper, view of this analysis is status of catch-limited under the ITQ system, compare catches with quota by species and the Fishery Management Area. So, this paper is not concerned with reliability of quota volume and impact to fishery resources by the over-fishing.

The component of this paper is below. Firstly, It was distilled rule of New Zealand's ITQ System with fishing. Second, it was described results of this analysis. Thirdly, it was analytical description. Finally, conclusion was check outcomes and next outlooks.

NEW ZEALAND'S ITQs SYSTEM RELATED CATCH

ITQ system consist of TAC, Individual Quota and Transferability¹. So, resource management of ITQ is based TAC. New Zealand's Exclusive Economic Zone (EEZ) is divided into 10 of the Fishing Management Area². Each the Fishing Management Areas are set TAC by Species under New Zealand's ITQ System. TAC is shared between the commercial fishery and the non-commercial fishery³. New Zealand's ITQ system manages the former, and Total Allowable Commercial Catch (TACC) is given

within TAC. 'Kermadec' named the Fishing Management Area 10 have little Quantities of quota, catches and trading quota⁴. New Zealand's ITQs system introduced at 1987 Fishing Year change over Quota form fixed-quota to shared-quota. So, permitted quantities of catch is change by fluctuation of TACC, if quantities of quota shared⁵. There are three reports. These reports are Catch Effort Landing Return (CLR) filled in by fisherman, Licensed Fish Receiver's Return (LFRR) written by licensed fish receiver and Quota Management Report (QMR) entered by quota owner. They are checked mutually⁶. Moreover, action of discarding is punished strictly. If dumping were happened, fishing vessel, quota, another asset relate to discarding were confiscated. But flexible rules against the Over-Fishing have be established. These rules are 4 point. Firstly, excess of quota and carrying forward unused quota had be permitted until 10 % of quantity of quota⁷. Secondly, trading quota is consisted of quota traded in perpetuity and quota leased are permitted, after fisherman catches. Thirdly, it pays penalty for quantities of over-catches to Crown⁸. Finally, it offset unusing quota of another species in compensation for quantities of over-catches.

THE SCOPE OF ANALYSIS AND CALCULATING DATA

It was said that resource management of ITQ system tend to increase high-grading, discarding and illegal landing or report in compare with TAC⁹.

New Zealand's ITQs system introduced at 1987 Fishing Year change over Quota form fixed-quota to shared-quota. In this paper, the period of analysis is during Fishing Year 1991 and 2001.

In this paper, species, units, Calculation Total Quota, Catches, quantity of quota leased under New Zealand's ITQs system depended on 'Quota Monitoring System: Report for September (The Blue Book)' Commercial Fisheries Serves Ltd. Published. New Zealand's 'Fishing Year' is a period of 12 months on commencing on each 1st day of October. But ROCK LOBSTER, PACKHORSE ROCK LOBSTER, SOUTHERN BLUE WHITING, SCALLOP are different period. So, these 4 species were removed from analysis of this paper. Therefore, the number of species analysed in this were 42¹⁰ in 46 species under New Zealand's ITQs system. Unit was focused on the units which are belongs 42 fish species and steted up quota or TACC. The number of analytical units is 254¹¹. But it was not linked to make species and units numbers clear because of a merge or division of the Fishery Management Area¹². All units classified by species and the Fishery Management Area, and it was named 'Quota Code'. Numbers following species name are show the Fishery Management Area. Quota Code and the end number express a name of unit.

In catches, here are 'Domestic Catches' and 'Domestic-combine Catches'. This paper had chosen the former¹³. Non-ITQ's species catch inside New Zealand's EEZ, fishing under the New Zealand's ITQs system out side New Zealand's EEZ and catch by Special permit non-based quota were removed from this analysis. the catches which treated in this analysis are means neither total catches in New Zealand nor total catches inside of New Zealand's EEZ.

In Quota, missed data with quota are revised by estimation of in front and behind sources¹⁴. These data was caused by 'The Blue Book'. So, total quota of this paper is 'calculation total quota'.

Trading Quota is consisted of quota traded in perpetuity and quota leased. This analysis especially focused on quota leased.

In Fishing Year 1991, All of the results of catches, quota and quantity of quota leased are reached by estimation¹⁵.

OCCRING OVER-FISHING AND IMPACT TO QUOTA LEASED

Total trend

Moreover, Rate of Fishing in all unit are classified at this Area is under 25%, and many of Low- Fishing Group is unit at "kermadec".

This Table 1 shows change in calculation total quota, catches, the number of species and the number of unit from Fishing Year 1991 to 2001. In these years, calculation total quota had increased, and catches had flattened.

Table 1: Total Trend of Quota, Catching, Species and Unit

	Calculation Total Quota (Tonnes)	Catches (Tonnes)	The Number of Species	The Nnumber of Unit
1991Fishing Year	558533	391686	29	174
1992Fishing Year	567195	422647	29	174
1993Fishing Year	573304	386761	29	174
1994Fishing Year	573810	374552	29	168
1995Fishing Year	592879	463671	29	168
1996Fishing Year	607877	319735	29	170
1997Fishing Year	645261	579786	30	173
1998Fishing Year	656045	469368	31	173
1999Fishing Year	666743	444799	40	243
2000Fishing Year	706040	412664	41	247
2001Fishing Year	708876	408667	42	253

Source

Quota Monitoring System: Report for September, Ministry of Agriculture and Fisheries, 1990, 1992• 1994. Quota Monitoring System: Report for September, Ministry of Fisheries, 1995• 1998. Quota Monitoring System: Report for September, Commercial Fisheries Serves Ltd, 1999• 2001

Note

1. Aouther calculate and clear some date based Source.
2. "Fishing Year" means a period of 12 months commencing on each 1st day of October

This Table 2 shows comparison the amount of quota with 3 species (HOKI, JACK MACKEREL and ARROW SQUID) and 'calculation total quota'¹⁶. In 1991 Fishing Year, the amount of quota with 3 species (HOKI, JACK MACKEREL and ARROW SQUID) was around 60% of 'calculation total quota'. In 2001 Fishing Year, it was around 80% of 'calculation total quota'. It shows that impact of few species vis-a-vis 'calculation total quota' is large. Therefore, analysis with arithmetic average obtain the result reflected individual status in New Zealand's ITQs system.

About the Fishing Management Area 10 "kermadec"

In this Area, the fish catches were very few. If the area units were removed, the average percentages of the rate of fishing rise 10% every year. In this period, 'average of rates of Fishing without "kermadec"' has shown mostly 70 - 80%

Table 3 has shown the comparison of 'total rate of fishing'¹⁷, 'average of rates of fishing'¹⁸ and 'average of rates of fishing without "kermadec"'¹⁹. Thus if the Fishery Management Area 10 were removed, rate of Fishing rise 10% every year. Date of the average of rate of fishing without "kermadec" shows that Catches is 60% to 70% of Calculation Total Quota, at least. In Fishing Year, the average of rate of

fishing without "kermadec" is over 100%.. 'The average of rates of fishing' include units of the Fishery Management Area 10 "kermadec". 'The average of rates of fishing without "kermadec"' do not include these.

Table 2: The Feature of Calculation Total Quota

	HOKI	JACK MACKEREL	ARROW SQUID	The Amount of 3 Species
1991Fishing Year	36.1%	5.2%	20.1%	61.4%
1992Fishing Year	36.1%	5.2%	20.1%	61.4%
1993Fishing Year	36.2%	5.2%	21.5%	62.9%
1994Fishing Year	36.2%	5.4%	21.5%	63.1%
1995Fishing Year	39.4%	5.8%	22.1%	67.4%
1996Fishing Year	43.0%	5.8%	22.1%	70.9%
1997Fishing Year	44.8%	10.8%	22.1%	77.7%
1998Fishing Year	44.8%	10.8%	22.1%	77.7%
1999Fishing Year	44.8%	10.8%	22.5%	78.1%
2000Fishing Year	44.8%	10.8%	22.8%	78.4%
2001Fishing Year	44.8%	10.8%	22.8%	78.4%

Source

Quota Monitoring System: Report for September, Ministry of Agriculture and Fisheries, 1990, 1992• 1994. Quota Monitoring System: Report for September, Ministry of Fisheries, 1995• 1998. Quota Monitoring System: Report for September, Commercial Fisheries Serves Ltd, 1999• 2001

Note

1. Aouther calculate and clear some date based Source.
2. "Fishing Year" means a period of 12 months commencing on each 1st day of October

Figure 1 show that 30% units are 'the lowest rate of fishing group (The group's Rate of Fishing is 0 to 25%, as follows 'Low-Fishing Group')', every fishing year²⁰. The number of Low-Fishing Group is about 40 to 80. 30 kermadec's units are belonging to this group every fishing year.

The over-fishing and impact to quota leased

About the Over-Fishing, it is assumed that fisherman catches not only quantity of quota but also catches that they can pay a penalty.

Figure 1 shows 'the highest rate of fishing group' (This group's Rate of Fishing is over 100%, as follows 'over-fishing group'). The rate that 'over-fishing group' occupied all unit is 10 to 20%. Therefore, the number of Over-Fishing Group fluctuates year-by-year.

Figure 2 shows that increasing the number of over-species depends on growing the number of 'over-Fishing Group'. In the beginning of analysis term, the number of over-species is about 10 species. However, in the latter term of that, it increased about 20 species. Almost all the species these are objected to this analysis are included 'over-fishing group'.

Table 3: Comparison of Rate of Fishing

	Total Rate of Fishing	The Average of Rates of Fishing	The Average of Rates of Fishing without "kermadec"
1991Fishing Year	70.1%	59.6%	72.0%
1992Fishing Year	74.5%	59.8%	72.2%
1993Fishing Year	67.5%	65.3%	78.9%
1994Fishing Year	65.3%	50.9%	62.0%
1995Fishing Year	78.2%	59.2%	72.0%
1996Fishing Year	52.6%	53.1%	64.5%
1997Fishing Year	89.9%	64.7%	78.2%
1998Fishing Year	71.5%	55.7%	67.3%
1999Fishing Year	66.7%	74.1%	84.5%
2000Fishing Year	58.4%	70.5%	80.2%
2001Fishing Year	57.7%	88.3%	100.1%

Source

Quota Monitoring System: Report for September, Ministry of Agriculture and Fisheries, 1990, 1992• 1994. Quota Monitoring System: Report for September, Ministry of Fisheries, 1995• 1998. Quota Monitoring System: Report for September, Commercial Fisheries Serves Ltd, 1999• 2001

Note

1. Another calculate and clear some date based Source.
2. "Fishing Year" means a period of 12 months commencing on each 1st day of October
3. The average of rates of fishing include all units were analyzed in this presentation
4. The average of rates of fishing without "kermadec" remove the Fishery Management Area 10 from The average of rates of fishing.

The over-fishing and impact to quota leased

About the Over-Fishing, it is assumed that fisherman catches not only quantity of quota but also catches that they can pay a penalty.

Figure 1 shows 'the highest rate of fishing group' (This group's Rate of Fishing is over 100%, as follows 'over-fishing group'). The rate that 'over-fishing group' occupied all unit is 10 to 20%. Therefore, the number of Over-Fishing Group fluctuates year-by-year.

Figure 2 shows that increasing the number of over-species depends on growing the number of 'over-Fishing Group'. In the beginning of analysis term, the number of over-species is about 10 species. However, in the latter term of that, it increased about 20 species. Almost all the species these are objected to this analysis are included 'over-fishing group'.

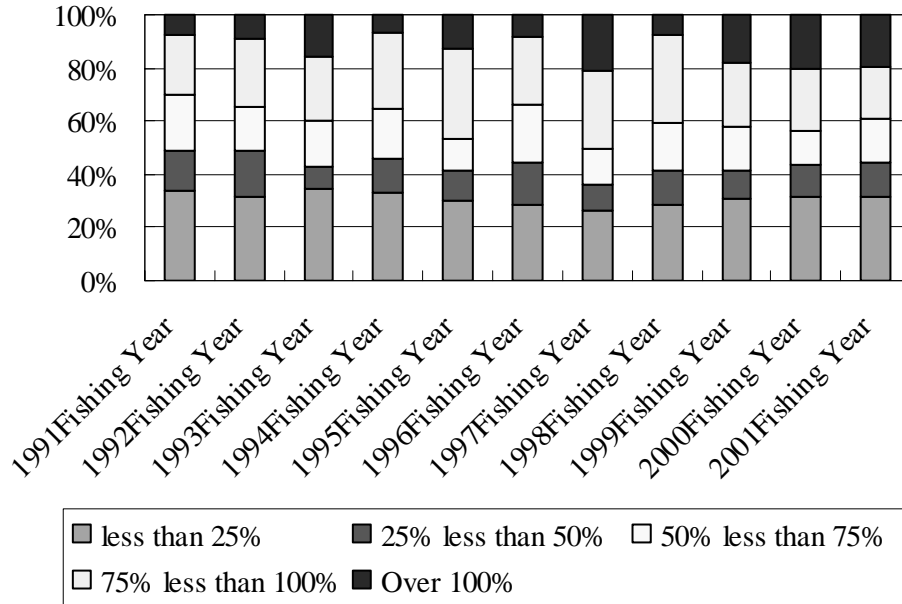


Figure 1. The Hierarchy of Rate of Fishing

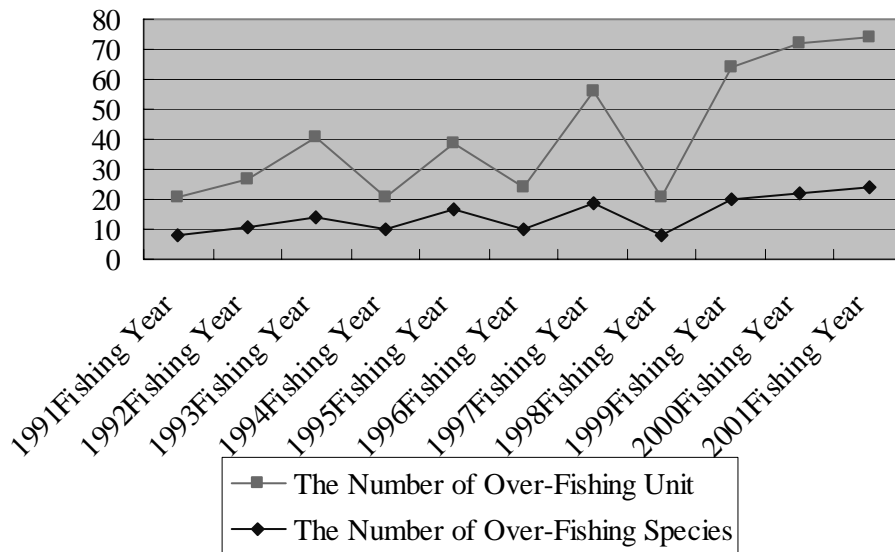


Figure 2. The Number of the Over- Fishing Sprecies and The Number of The Over-Fishing Unit

This is two tables(table 4 & 5) that shows units whose rate of catching exceeds 100% for more than 8 years in the 11 years of analysis term. But, for the recent joining for ITQ system, some species are under the administration of the system for less than 11 years. In that case, dividing the number of Fishing years that exceeds 100% by the number of Fishing years under the administration, units whose the result is more than 80% is shown. From two table, it clear the Over-Fishing occurred seriously²¹. Thus, there is high possibility of low-valuable species comparable to the species that were under the ITQ system for some time with the species of recent joining. That shows the difficulty of the administration of by-catch

species and the insufficiency of information about the stock size. It is considered that in case of by-catch species that are not under the ITQ system, concern for resource protection is lacking in the use of resource. Under such situation, though by-catch species are shifted to under the ITQ system, as the way of catching doesn't change, Catches of by-catch species doesn't go less than the quota. On the other hand, in the later case, the possibility of unreasonable quota set stock size or TACC is considered. In short, it is guessed that grasping the catches and stock size exactly is difficult. So, estimation of stock size and TACC that is figured out based on the stock size has a problem.

It is possible that each fisherman can fish based on the Quota under the ITQ system. In the New Zealand's ITQs system, fisherman is allowed to buy or lease quota, after he catches fish without enough Quota. So, This relationship between the Over-Fishing and quota leased shows that quota leased have been utilizing in order to adjust fisherman's Over-Fishing problems. Because of this precedence of fishing, the catches which cannot be appropriated with quota leased becomes the Over-Fishing.

Table 4: The List of keeping Over-Fishing units during 1991 and 1996

	1991Fishing Year	1992Fishing Year	1993Fishing Year	1994Fishing Year	1995Fishing Year	1996Fishing Year
BLUENOSE2	-----	-----	120.7%	139.4%	119.8%	102.4%
BLUENOSE3	-----	115.5%	-----	-----	109.3%	117.4%
CARDINAL FISH4	//////	//////	//////	//////	//////	//////
ELEPHANT FISH3	-----	102.6%	117.0%	105.9%	137.1%	124.4%
FROSTFISH2	//////	//////	//////	//////	//////	//////
FROSTFISH9	//////	//////	//////	//////	//////	//////
GHOST SHARK1	//////	//////	//////	//////	//////	//////
GHOST SHARK2	//////	//////	//////	//////	//////	//////
GHOST SHARK9	//////	//////	//////	//////	//////	//////
RIBALDO5	//////	//////	//////	//////	//////	//////
RIBALDO6	//////	//////	//////	//////	//////	//////
RIBALDO7	//////	//////	//////	//////	//////	//////
RIBALDO2	246.6%	223.5%	120.5%	105.8%	124.3%	-----
SEA PERCH1	//////	//////	//////	//////	//////	//////
SEA PERCH2	//////	//////	//////	//////	//////	//////
SEA PERCH4	//////	//////	//////	//////	//////	//////
SEA PERCH7	//////	//////	//////	//////	//////	//////
RIG2	-----	118.5%	101.7%	103.8%	104.4%	109.5%
GIANT STARGAZER7	-----	116.3%	107.0%	-----	104.1%	104.6%
WHITE WAREHOU7	//////	//////	//////	//////	//////	//////

Source

Quota Monitoring System: Report for September, Ministry of Agriculture and Fisheries, 1990, 1992• 1994. Quota Monitoring System: Report for September, Ministry of Fisheries, 1995• 1998. Quota Monitoring System: Report for September, Commercial Fisheries Serves Ltd, 1999• 2001

Note

1. Aouther calculates and clears some date based Source.
2. "Fishing Year" means a period of 12 months commencing on each 1st day of October
3. "-----" show that Rate of Fishing is under 100%.
4. "//////" show that theses units were non-ITQ Species
5. The Arabic numerals of end show the Fishery Management Area.

Table 5: The List of keeping Over-Fishing units during 1997 and 2001

	1997Fishing Year	1998Fishing Year	1999Fishing Year	2000Fishing Year	2001Fishing Year
BLUENOSE2	124.9%	100.7%	106.6%	121.2%	118.0%
BLUENOSE3	145.9%	106.0%	182.1%	140.2%	162.9%
CARDINAL FISH4	////	////	856.9%	702.3%	664.3%
ELEPHANT FISH3	145.6%	177.1%	160.8%	184.5%	113.4%
FROSTFISH2	////	////	677.6%	797.5%	962.0%
FROSTFISH9	////	////	109.9%	162.8%	145.2%
GHOST SHARK1	////	////	583.2%	157.6%	134.0%
GHOST SHARK2	////	////	184.2%	144.4%	141.1%
GHOST SHARK9	////	////	1287.1%	658.1%	852.6%
RIBALDO5	////	////	131.0%	148.5%	145.9%
RIBALDO6	////	////	177.5%	176.4%	147.4%
RIBALDO7	////	////	413.5%	484.5%	439.6%
RIBALDO2	138.8%	102.9%	103.2%	135.1%	126.6%
SEA PERCH1	////	////	118.4%	147.3%	130.4%
SEA PERCH2	////	////	258.5%	239.0%	237.1%
SEA PERCH4	////	////	247.5%	192.2%	135.4%
SEA PERCH7	////	////	181.8%	132.0%	127.6%
RIG2	114.2%	111.6%	111.0%	112.4%	105.1%
GIANT STARGAZER7	140.1%	-----	120.3%	152.3%	187.1%
WHITE WAREHOU7	////	////	113.7%	192.1%	109.6%

Source

Quota Monitoring System: Report for September, Ministry of Agriculture and Fisheries, 1990, 1992• 1994. Quota Monitoring System: Report for September, Ministry of Fisheries, 1995• 1998. Quota Monitoring System: Report for September, Commercial Fisheries Serves Ltd, 1999• 2001

Note

1. Aouther calculates and clears some date based Source.
2. "Fishing Year" means a period of 12 months commencing on each 1st day of October
3. "-----" show that Rate of Fishing is under 100%.
4. "/////" show that theses units were non-ITQ Species
5. The Arabic numerals of end show the Fishery Management Area.

Table 6 shows that 'the average of rates of quota leased in all unit', 'the average of rates of quota leased in the Over-Fishing group' and 'the average of rates of quota leased in non-Over-Fishing group'. 'The rates of quota leased' is arithmetic average of rate of quota leased against each quota. 'The average of rates of quota leased in all units' is arithmetic average of rate of quota leased in all units. 'The average of rates of quota leased in the Over-Fishing group' is a set of the unit that the rate of fishing is over 100 %. 'The average of rates of quota leased in the non-Over-Fishing group' is a set of the unit that the rate of fishing is under 100 %. A difference between 'the average of rates of quota leased in the Over-Fishing group' and 'the average of rates of quota leased in the non-Over-Fishing group' is 10 % to 30 % except Fishing Year 1992, 1996 and 1998. In addition, there is a tendency that a gap between each average becomes large by increasing of unit group which rate of fishing over 100 %.

Table 6 : The Difference of Average of Rates of Lease in Over-Fishing Group and Non-Over-Fishing Group

	Average of Rates of quota leased in All Unit	Average of Rates of Quota Leased in Over-Fishing Group	Average of Rates of Quota Leased in Non-Over-Fishing Group	The Difference Over-Fishing Group and Non-Over-Fishing Group
1991Fishing Year	38.8%	49.1%	35.1%	13.9%
1992Fishing Year	45.4%	45.7%	45.4%	0.3%
1993Fishing Year	56.1%	67.6%	45.6%	22.0%
1994Fishing Year	54.3%	70.7%	49.7%	21.0%
1995Fishing Year	59.5%	83.1%	30.2%	52.9%
1996Fishing Year	57.3%	61.1%	52.3%	8.8%
1997Fishing Year	63.6%	80.6%	46.3%	34.2%
1998Fishing Year	59.8%	68.0%	54.7%	13.3%
1999Fishing Year	67.4%	88.1%	51.5%	36.6%
2000Fishing Year	75.7%	95.6%	56.4%	39.2%
2001Fishing Year	82.4%	102.7%	82.4%	20.3%

Source

Quota Monitoring System: Report for September, Ministry of Agriculture and Fisheries, 1990, 1992• 1994. Quota Monitoring System: Report for September, Ministry of Fisheries, 1995• 1998. Quota Monitoring System: Report for September, Commercial Fisheries Serves Ltd, 1999• 2001

Note

1. Another calculate and clear some date based Source.
2. "Fishing Year" means a period of 12 months commencing on each 1st day of October
3. Over-Fishing Group show that Rate of Fishing in unit is over 100%.
4. Non-Over-Fishing Group show that Rate of Fishing in unit is under 100%.

CONCLUSION

From the result of this analysis, three things are cleared.

First, the catches of around 30% units were less than 25% of the quota during these years, of which 30 units are classified at the Fishery Management Area 10. If the Area units were removed, the average percentages of the total catches rise 10% every year;

Second, the number of the units that catches exceeded the quota fluctuates year-by-year. Some units, however, kept the Over-Fishing during these years. the cause of continuous the Over-Fishing is fisherman tend to catch not only quantity of quota but also catches that they can pay a penalty; and,

Finally, 'the average of rates of quota leased in the Over-Fishing group' is nearly 10 % higher than 'the average of rates of quota leased in the non-Over-Fishing group'. It is cleared that a gap between 'the average of rates of quota leased in the Over-Fishing group' and 'the average of rates of quota leased in the non-Over-Fishing group' become large by increasing the number of the Over-Fishing unit. About a difference of two group, it is also can be said that the capture exceeds securing of Quota.

The next assignments are as follow. At first, it is important to make the Over-Fishing analysis which are divided fishery species into low-valuable species and high-valuable species, and design for management system based this analysis. It must be separately considered because fishery of low-valuable species are

caused by-catch and high-valuable species are caused by profit-making fishery. It is necessary to think about this difference and combine of result. Second, it might be possible to estimate the Over-Fishing amount by making a comparison between amount of payment to the government for the Over-Fishing and price in quota traded in perpetuity .

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ENDNOTES

1. Cf. Kusakawa(1994-a) and Kuronuma(1997).
2. Cf. C&A. ltd(1997) and OFCF(1997) without indicating another literatures.

3. Non-Commercial Fisheries consist of Maori Fisheries are traditional fisheries and the recreational fisheries.
4. Units are classified at “kermadec” are almost set these quotas at around 10 tonnes. Another units are classified at “kermadec” are set quotas at around 1 tonnes. The amount of Quota are belonged to “kermadec” is not full in 300 tonnes.
5. See explanation on FishsServe’s HP (<http://www.fishserve.co.nz/>, 30th, may, 2004) with relation among TACC, Quota share and ACE.
6. See Kusakawa(1994-b) and C&A. ltd(1997) at details.
7. Provisions for ”Over-Catches” and “Carry-Over” have be abolished.
8. Amount of the fine for the Over-Catches variable to quantity of the Over-Catches and species.
9. Cf. Anderson (1992), Rettig (1992), Kusakawa(1994-a), Kusakawa(1994-b).
10. See Table 1. with change in this period.
11. See Table 1. with change in this period.
12. Change of unit’s account in Fishing Year 1994 and 1996 come from modification on BLACK PAUA and YELLOWFOOT PAUA.
13. At this analysis, tow reasons made Domestic Catch adopt. One of the reason is criteria of eligibility in quota possession. In here, Oversea persons have not Quota, as a rule. Another reason is in ‘The Blue Book’. ‘The Blue Book’s had published the Domestic Catches as the comparison for Quota.
14. Order of calculation had be deleted for relation of space.
15. Cf. Annala et al. (2000) 。 Order of calculation had be deleted for relation of space, as mentioned above.
16. The number of calculation total quota without 4 species. Accordingly, a rate of 3 species account for calculation total quota becomes lower than it. But it is also true that limited number of species occupied large part of calculation total quota.
17. This is geometric average divide catches at calculation total quota.
18. This is a arithmetic average of ratio of fishing in each units.
19. It is pointed out that there are few quota and catches in ‘kermadec’. Therefore, ratio of fishing classified by the average of rates of fishing without ‘kermadec’.
20. The Hierarchy is divided into over 0 % under 25 %, over 25 % under 50 %, over 50 % under 75 %, over 75 % under 100 %.
21. This result is over degree of excess of quota and carrying forward unused quota.