

# **A CASE STUDY ON THE FUNCTION AND ATTRIBUTE OF ARTIFICIAL REEFS AS AN IDEAL TYPE OF SOCIAL OVERHEAD CAPITAL**

**BY**

**AKIO CHII<sup>1</sup>**

## **1. INTRODUCTION**

In this paper I have put together data obtained from several investigations undertaken in Japan as to the socio-economic role of artificial reefs (ARs). My basic viewpoint is that although ARs have been thought of as only productive capital, by expanding their category to include not only productive capital but social capital as well, a framework can be provided in which their influence and effect can be observed more extensively. The views expressed in this report are my own, and not those of the Japanese Government, fishing industry, or any other organization.

## **2. THE FUNCTION, EFFICIENCY, AND ATTRIBUTES OF SOCIAL CAPITAL**

I will first explain briefly the concept of social capital. In general, it is said that social capital is a socially demanded indirect capital which does not promote direct profit-oriented production activity, but rather the productivity of private capital, or capital that promotes improvement of national welfare and maintenance of the living environment. Special examples include:

- industrial base maintenance (including conservation of national land) such as roads, ports, fishing ports, irrigation systems, reforestation and flood control, electric power, communications, etc.,
- maintenance of the living environment, including housing, water supply and drainage, schools, hospitals and parks.

The theory of social capital however, is difficult and not yet sufficiently developed. Moreover, almost all theory concerns a metropolitan or national scale, whereas no theory concerning traditional societies such as farming or fishing villages or micro social capital such as fishing ports.

Based on the premise that ARs are a form of social capital, I will discuss here the function, efficiency, and attributes of ARs. In Japan, there is a debate not only about ARs, but also about fishing ports and the like, as to whether investment in such facilities is not excessive, and as to the kind of effects that can be expected. Although this kind of debate is reasonable, it will be unproductive, unless the function (or purpose) of ARs is first well defined. This is because whether or not there are effects is a problem of efficiency rather than a problem of function.

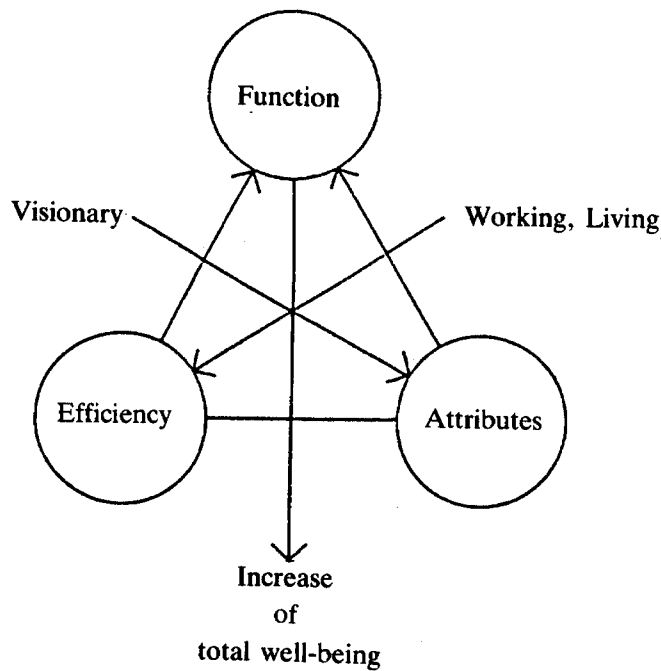
For example, if the function of an automobile is considered to be a means of transport that goes fast and far, it can be said of a jeep being driven on an expressway that its efficiency is poor and its effects few, whereas if a sedan is driven on a muddy road, it can be said that its effects are non-existent. In addition, these effects are greatly affected by factors such as crowded roads and the technique of the driver. In the same way, the effects of ARs are thought of as the sum of this function, fishing ground conditions, fishermen's technique, and their life-style.

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<sup>1</sup> Professor, Faculty of Education Kanazawa University, 1-1 Marunouchi, Kanazawa, Ishikawa-kin, Japan.

What then is the function of ARs? From the socio-economic point of view, the function of ARs is not to gather fish, but to gather fishermen, as can be said of fishing ports as well. In this way, ARs, like fishing ports, are an excellent example of social capital. Therefore, the efficiency of ARs is thought to be determined by the number of fishermen gathered and method by which this is done. Thus, even if many fish are not caught, but a few fish at a time are caught at the AR every day, the efficiency of the AR is good to the fishermen.

**Figure 1. Structure of social capital.**



A more important matter, is that by commuting to nearby ARs “the structure of living time” is greatly altered. Not only is the time needed to search for schools of fish reduced and labor time and fuel expenses saved, but more likely daily life becomes more regular. Just as in many countries, in addition to production investment, enormous educational and social investment is being undertaken for the purpose of rationalization of living time, it is thought that this “hidden effect” is present in the case of ARs as well.

In Japan, from about 30 years ago, the division of paddy fields has been enlarged to facilitate the use of farm machinery. This so-called land readjustment project has been undertaken throughout the country. However, its result, namely labour saving, has led to the migration of farmers away from agricultural society to metropolitan areas, with a resulting decrease in the farming population, and has become a major concern. In other words, the efficiency of the land readjustment of paddy fields has been good and has succeeded as productive capital, whereas as social capital in gathering people, its efficiency has been poor and failed.

In short, the utilitarian Japanese agriculture modernization policy has been a failure. I believe it is imperative that developing countries should avoid a similar mistake.

There is an additional important problem concerning capital, viz. the problem of “attributes”. For example, automobiles have the attribute of being a status symbol, but also have the direct negative attribute of being noisy. In the case of ARs, this kind of problem also exists, and discussed below.

### 3. AR UTILIZATION AND CHANGES IN FISHING HOUSEHOLD LIVING

The example that I will take up here is that of small coastal fishing strata which, making use of ARs off the Japanese coast, engage in pole-and-line fishing, gill net fishing, and longline fishing. By taking up and examining cases among these, in which effects of ARs are commonly seen, my purpose is to make a paradigm of investigations into the effects of ARs.

#### 3.1 Example of changes in fishing household living time due to AR utilization

Fig. 2 shows an example from fishing village T, situated close to Tokyo. It was prepared based on the results of detailed oral questioning of housewives of fishing households. One housewife stated: "30 years ago my husband often went out fishing twice a day, going out early in the morning, returning to port in the evening, again going out, and returning to port late at night. I didn't have enough time to sleep. While waiting for my husband to return to port, I was busy with housework and child rearing, in addition to fishing preparations, and when the boat returned to port, I helped land it. Compared to that time, my husband now leaves around 6 am, works mainly around the AR, and returns home at 5 or 6 pm. His work is now easier than that of a salaried worker, while we housewives of this village work less than half the amount we worked previously, and instead use out time to work part-time and devote ourselves to our household chores."

This example is representative of the approximately 50 households in T fishing village engaged in longline fishing, using 3–5 ton fishing boats.

Another housewife, speaking about ARs and the community stated: "Since using ARs, the trouble of fishermen has been reduced. The fishery cooperative prepared a schedule of operational order to regulate the use of the AR, with the result that the use of ARs has become equal and competition about leaving and returning to port times has disappeared. "(Competition about leaving port revolves around arriving at the fishing ground faster than other fishermen, while competition about returning to port revolves around landing fish faster than others, so as to sell fish at a good price, and in addition, securing a good anchorage, This kind of competition is even now widely seen)".

It is thought that these effects are brought about by the combination of the AR hardware, fishing ground conditions in which the fish gather, and the principle of equality adopted by the fishery cooperative and fishermen. These produce the same effects as those of school and social education.

Seen from the viewpoint of fishing management and fishing household living, the effects of stability and accessibility of fishing grounds, maintenance of a fixed catch (and income), and regulation of living time are more important than the increase in the amount of fish caught.

I will next examine not only the changes in time and fishing grounds, but also the details of the income and expenditure of the fishing households using the AR fishing grounds. Table 1 shows the changes in the working time of Mr. N aged 57 years, who is engaged in set gill net fishing around the islands of the Inland Sea. Thirty years ago, Mr. N employed 2 workers, but at present works together only with his wife. Of the 150 days a year that he engages in fishing, his dependency on ARs is approximately 50%. Since using ARs, his yearly working time has been reduced to 78%, while that of his wife has been cut in half. However, the length of Mr. N's working day has increased because the number of gill nets he uses has increased.

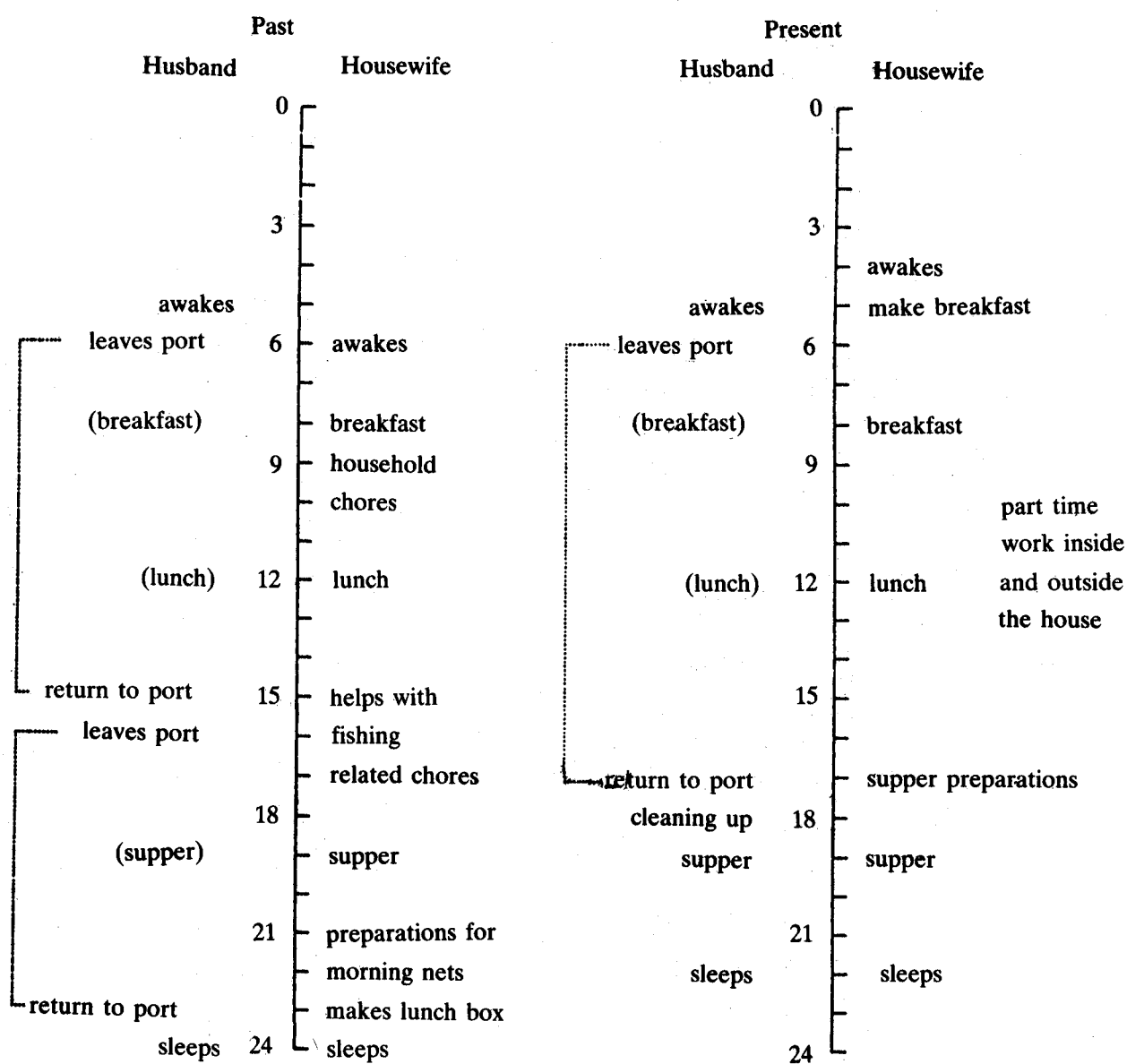
The combined working time of Mr. and Mrs. N is close to that of a national civil servant. (In response to criticism from abroad regarding the long working hours in Japan, it can be said that the working time of this couple represents an exemplary standard).

I will next look at Mr. N's finances, an outline of which is shown in Table 2. First, Mr. N's income is approximately 117% of that of a Japanese civil servant, which places him in the upper-middle earning

bracket of his fishing village. The hourly earnings of the N couple amount to about 2,350 yen per hour, compared to 2,500 yen per hour in the case of an average civil servant (1985).

Gill-net fishing households such as that of Mr. N together with pole-and-line fishing households, comprise approximately 60% of the families in this fishing village, with Mr. N's earnings and expenditures representative of his village. Although the size of Mr. N's family, with only 3 members, can be said to be small, his high rate of savings is indicative of the low level of old age social security in Japan, while the low levels of social security and taxation show the high level of political protection of Japanese primary industry. Mr. N's Engel's coefficient in 1985 was 17%, appreciably lower than the 28.9%, which was the average of Japanese salaried workers at that time.

**Figure 2. Changes of living time in T fishing village (Mr S-long line fishing)**



Note: (1) During the past, husband sometimes left port without waking wife and made lunch on boat.  
 (2) Meals on boat are shown within brackets.

### 3.2 The total picture of living changes due to AR utilization

I will next explain the way in which fishing household living has changed due to AR utilization, based on the results of a questionnaire consisting of 8 items. Table 3 shows the living changes in 204 fishing households, which were divided into 2 groups, AR. G, in which the rate of AR utilization was above 30%, and non. AR. G, in which it was under 20%.

Of these 8 items, the items showing the most clearly significant difference at the 1% level between the 2 groups was "fisheries income". In addition, significant differences at the 5% level were found in the cases of "juggling of family finances", dietary life and "community relations," which were also indicated by the example of T fishing village mentioned above. In this figure, no significant difference in working time was detected, because in the questionnaire, daily and yearly working times were not clearly differentiated. However, as shown in Fig. 2, the decrease in working time per year is a national trend.

**Table 1. Changes in the working time of Mr and Mrs N.**

	Past (1955)	Present (1985)
Number of fishing days	250–260 days/year	150–160 days/year
Husband	1,875 h/year, 7.4 h/day	1,469 h/year, 9.6 h/day
Housewife	2,250 h/year, 8.8 h/year	1,148 h/year, 7.5 h/year

Note: (1) In both past and present, housewife's household work is omitted.

(2) In both past and present, fishing preparations and net repairs on land and at home were counted as 1/3.

**Table 2. Mr N's family finance. (%)**

Production expenditure	Fishing management expenses	21.6	(15.2)
	Repayment of debts	0	(4.3)
Household expenditure	Savings	24.0	(18.8)
	Insurance due	3.2	(3.2)
	Repayment of debts	11.2	(0)
	Taxes, Social security	5.0	(5.3)
	Consumption	35.0	(53.2)

Note: (1) The figures within brackets are for a pole and line fishing household with the same level of income.

(2) Japanese national savings average is about 15% (1988).

**Table 3. Total picture of living changes due to AR utilization. (cases)**

Item	Group	AR.G	Non.AR.G.	Total	Significant difference
1. Husband's working time	A. reduced	28	26	54	(○)
	B. unchanged	45	27	72	
	C. increased	35	27	62	
2. Housewife's working time	A. reduced	31	17	48	(○)
	B. unchanged	37	29	66	
	C. increased	45	32	77	
3. Fisheries income	A. increased	51	14	65	●
	B. unchanged	37	15	52	
	C. reduced	37	45	82	
4. Juggling of family finances	A. improved	27	15	42	○
	B. unchanged	58	28	86	
	C. worsened	28	32	60	
5. Dietary life	A. improved	67	30	97	○
	B. unchanged	44	39	83	
	C. worsened	5	6	11	
6. Community relations	A. improved	23	11	34	○
	B. unchanged	82	54	136	
	C. worsened	5	12	17	
7. Health	A. improved	42	18	60	
	B. unchanged	50	34	84	
	C. worsened	20	14	34	
8. Feeling of security	A. feel easy	57	48	105	
	B. unchanged	18	12	30	
	C. feel uneasy	35	19	54	
Fishing household total		125	79	204	

Note ● - Difference at 1% level by test of significance.  
○ - Difference at 5% level by test of significance.

**Table 4. The reasons for and used of the increase in income. (multi-ans.,cases).**

			Reason		Used for	
Increase in fisheries income (65)	AR.G. (51)	1st place	AR	32	Reinvestment	21
		2nd place	Fishing boats and implements	27	Education expenses	16
		3rd place	Increase in working time	9	Housing, Furniture	16
	Non AR.G. (14)	1st place	Increase in working time	7	Housing, Furniture	6
		2nd place	Fishing boats and implements	5	Reinvestment	5
		3rd place	Rationalization of management	3	Savings	3
		4th place	Development of a new fishing ground	2		

Next, with regard to fisheries income, enquiries were made about the reasons for increase in income and the uses to which it was put with the results shown in Table 4. In the AR. G, use of AR was the reason most frequently given for the increase in income. In addition to increase in the actual amount of fish caught, it was thought that the increased freshness of the fish caught, (for which accordingly higher prices were obtained) and reduction of management costs accounted for the increase in earnings.

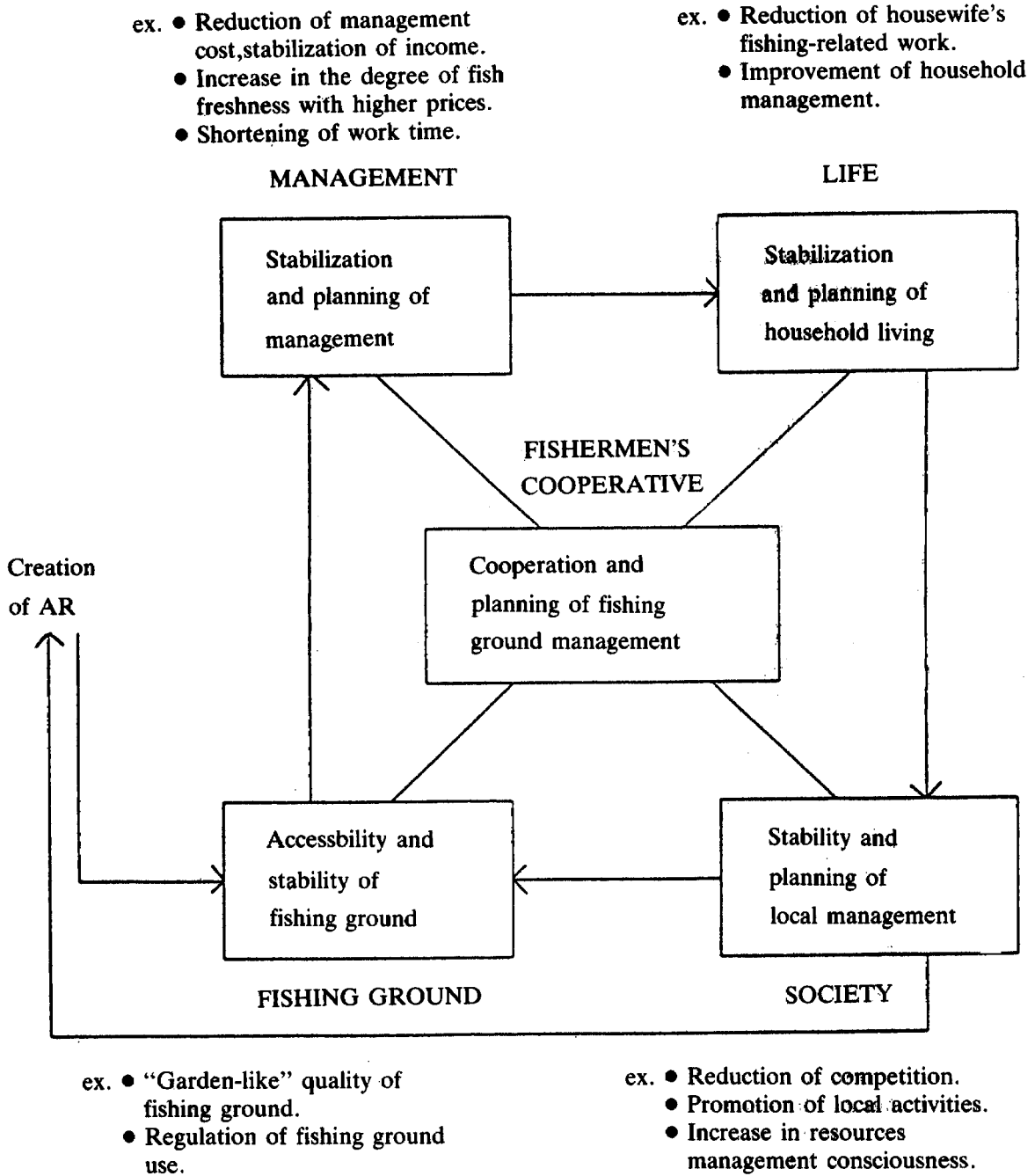
#### 4. FUTURE THEMES OF AR UTILIZATION INVESTIGATIONS

The above changes in living structure due to AR utilization have been put in model form in Fig. 3. Rather than indicating the nation-wide reality, this model theoretically arranges the changes seen in fishing villages in which the effects of AR utilization appear in favourable form. This model is a tool to explore where the problems lie in fishing villages, in which the effects of ARs are not present or are few. Also, it is thought that the effects of AR utilization will not be sufficiently apparent if even one of the components of this model is lacking.

However, this is strictly a model, and since actual fishing villages exhibit many temporal and spatial differences, it should be understood that the manifestations of these effects are divided into a variety of types.

In addition, I must emphasize that not all of the changes seen in the living of these fishing households result from AR utilization itself. It goes without saying that, in addition to the creation of ARs, the release of hatchery fry, port maintenance, improvements in fishing boats use of marine radios, administrative guidance, activities to improve living, and general social policy all contribute to

**Figure 3. Diagrammatic total picture of effects of AR utilization.**



this phenomenon. Accordingly, future research and investigation of AR utilization must develop methods to clarify the exact contribution of AR utilization itself within the total framework of the living environment of the fishing household.

I list below some of the problems that merit attention in future investigations into the effects of AR utilization:



1) In future, investigations of this kind will require methods that are more varied and accurate. To this end, close cooperation between administrative and research institutions, fishermen's cooperatives, and among the fishermen themselves is indispensable.

2) One further point that must be emphasized is the necessity of management of the AR hardware and its fishing ground by a local autonomous organization. In this case as well, full realization of the effects of ARs depends on the management consciousness of the fishery cooperatives and leaders. At times, such autonomous management can play an even more essential role than that of the national system of management.

3) In conducting this investigation, one of the greatest difficulties was the lack of basic data. Henceforth, so as to better develop this kind of investigation, monitoring of AR fishing grounds and concrete data such as operational records, management books, and records of domestic finances from fishing households are necessary. In addition to the national undertaking of AR creation, a method to enforce the keeping of the operational records of AR fishing ground monitoring and sample vessels is needed.

Finally, if I may be permitted to stray for a moment from materialistic things, I wish to conclude by touching upon a historical fact about AR utilization in Japan. This is a story about the attributes of ARs. In Japan, the folk belief that Gods and the afterworld exist in the sea persists even today. Similar beliefs are probably entertained in India and other countries of the Pacific region. Furthermore, many Japanese fishermen have their own personal fishing ground, into which they themselves throw in stones and wood, thus creating their own AR. This practice has a long history. It is not so difficult to find elderly fishermen who believe that they will go to the Dragon Palace beneath the sea through their own AR or fishing ground when they die.

No matter in what way technology develops, it is of great importance that adequate attention is paid to national and local traditions and culture of fishing villages like these, so that these villages can be fostered as societies in which modernization and traditional culture can exist together.