IERCU

Discussion paper No. 221

The management of common pool resources in tourism destinations: A simple model analysis of marine resource management

Masahiro Yabuta (yabuta@tamacc.chuo-u.ac.jp)

Faculty of Economics, Chuo University, Japan

Noel Scott (noel.scott@uq.edu.au)

School of Tourism, the University of Queensland, Australia

Takashi Ozawa(ozawa@ns.nijinet.or.jp)

Centre for Research and Promotion of Japanese Islands

March, 2014

IERCU Discussion Paper

Institute of Economic Research

Chuo University

Tokyo, Japan

The management of common pool resources in tourism destinations: A simple model analysis of marine resource management

Masahiro Yabuta (yabuta@tamacc.chuo-u.ac.jp)

Faculty of Economics, Chuo University, Japan.

Noel Scott (noel.scott@uq.edu.au)

School of Tourism, the University of Queensland, Australia

Takashi Ozawa (ozawa@ns.nijinet.or.jp)

Centre for Research and Promotion of Japanese Islands

Abstract

This paper examines the management of marine resources such as coral reefs used as the tourism attractions. From an economic perspective, these marine resources exhibit the characteristics of 'free-access use (non-excludability)' and 'competitive use (rivalry)' and may be considered common pool resources (CPRs). CPRs tend to be overused in the absence of careful management (Ostrom 1990), and indeed in many tourism destinations, tourism operators and/or tourists have been found to overuse and damage the natural tourism resources such as coral reefs. Measures to control their usage include regulations (zoning, seasonal utilization, number of users, and tourist activity), and economic incentives (tax or subsidies). Among these measures, controls on tourism operators, such as restrictions on the number of tourism operators and the boundaries of their activities, are particularly effective in avoiding overuse of CPRs. This paper provides a theoretical analysis of these measures in managing the competitive use of such CPRs sustainable, and examines the implications of entry- and usage-related regulations in tourism destinations where the major tourism resources are coral reefs.

Keywords

Sustainable tourism, marine resource management, coral reefs, common pool resources, entry regulations

JEL Classification-Q22,Q26

1. Introduction

This paper examines, from a primarily theoretical perspective, the management of marine resources such as coral reefs in destinations, where the major industry is tourism. An island or coastal coral reefs, marine activities, such as diving, snorkelling, kayaking and whale watching are major tourist attractions. Hence, marine resources are resources which tourists and tourism businesses utilize, and in such destinations, residents often wholly or mainly rely on tourists for their livelihood. Marine resources, like other common pool resources (CPR) such as rivers, forests and fish, have two basic attributes; non-excludability in use, and high-rivalry in appropriation. A lack of regulation of usage of CPRs has been found to lead to their overuse or destruction (Ostrom 1990; 1994; 2002). Unless some restrictions on investment are imposed, the number of tourism businesses increases, leading to overuse of the tourism resources and environmental deterioration of the marine resources such as coral reefs (Yabuta et al. 2014).

For example, while the major cause of the deterioration of coral reefs is global warming, tourist activities also have destructive effects on many coral reefs and their surroundings (ICRI, 2010). Therefore, to prevent reefs from deteriorating, the use of coral reefs as tourist attractions must be limited within their carrying capacity. This is the same as other tourism attractions which affect the marine life. To do so, policy measures or governance systems (including self-regulation) must be implemented. The core issues of CPR management revolve around the design of policies to coordinate economic incentive measures and the governance system to enforce cooperative resource management in the community. From a supply-side management perspective, controls on tourism operators, such as restrictions on the number of tourism operators and the boundaries of their activities, are particularly effective in order to avoid overuse of CPRs (ICRI, 2010). This paper provides a theoretical analysis of the competitive use of CPRs in order to assess the effectiveness of these measures in managing CPRs for their sustainability. In particular, it examines the situation of entry- and usage-related regulations in tourism destinations where the major tourism resources are marine-related resources.

The composition of the paper is as follows: after this introduction, Chapter 2 gives a brief overview of the present condition of coral reefs as an example of marine resources and their use in tourism destinations. Chapter 3 gives a theoretical analysis of marine resources as CPRs, where tourism businesses enter and use them to the extent they have an incentive to enter the tourism market. Chapter 3 also assesses the effectiveness of procedures to regulate their use, in particular, controls on the number of entries using a game-theoretic framework. Following the theoretical analysis of governance systems of CPRs, Chapter 4 provides an example of how management systems to control the entry and operation of tourism operators in and around the marine resources actually operate. In this relation, as a typical example of the coral reef area in

Japan, the paper mentions the Kerama Islands and overviews the situation of the marine tourism resource management, while its socio-economic aspects will be examined by Yabuta et al. (2014) which focuses the severe restrictions on the number of diving businesses and their related activities. The theoretical analysis and actual CPR management systems are compared and some effective policy measures to make CPR use sustainable are identified. Lastly, Chapter 5 provides conclusions and remarks on the findings of the paper.

2. Tourism development and marine resources as CPRs

Before giving a theoretical analysis of the management of CPR, we shall investigate the attributes of marine resources such as coral reefs and whales as the tourism resources. Tourism resources such as wildlife in natural areas and coral reefs in marine zones need to be well managed by related stakeholders to maintain the sustainability of tourism development. The reason why the tourism development has tended to fail to preserve the natural environment is that some stakeholders have been concerned only with the economic benefits, not concerned with the marine's environmental value and its benefit for future generations.

Ostrom (1990) and Ostrom et al. (1994) studied approaches to governing CPR and found that the stakeholders in the community need a management system with rules that enables it to manage the use of CPRs. The special attributes of a CPR are their low ‘excludability’ and high ‘rivalry’. CPR can be used by all but a particular person's use of the CPR can also conflict with that of another. In tourism destinations, where the major tourism resources are nature-related, the resources tend to be overused because they are CPRs. This has happened in many marine areas of coral reefs when tourism businesses are set up in an unrestricted fashion. The same situations occur in a case of whale watching where too many vessels tend to entry the business. Congestion in usage leads to ‘over-exploitation’ and increase the risk of destroying the natural environment. Recreational diving, for example, has been reported to have the serious impacts on coral reefs (Hawkins and Roberts 1994; Harriot et al. 1997). Harriot et al. (1997) found that divers contributed intensively to environmental damage in the Marine Protected Areas of Eastern Australia. Hawkins and Roberts (1994) discussed the development of coastal tourism in the Red Sea and highlighted the damage to coral reefs caused by tourism attractions and by tourist activities.

The common pool approach is useful to investigate what may happen to natural resources such as coral reefs unless they are managed properly. Inadequate use or over-exploitation of resources in this way is a type of market failure and is called an externality of the CPR. Examples include the phenomena that Hardin (1968) named ‘the Tragedy of the Commons’.

Without a proper management of CPR, it is impossible for a community to keep tourism development sustainable. The close relationship between CPR management and tourism development has been investigated by Healy (1994; 2006), Steins and Edwards (1999), Bosselman et al. (1999), Briassoulis (2002) and Blanco et al. (2009). These authors have emphasized the need of the common pool approach and investigated the principles of the policy design and the management system.

A number of traditional policies such as command-control and economic incentives along with voluntary governance mechanisms have been discussed to keep CPR sustainable. In empirical studies, factors which determine the effectiveness of CPR management system used by stakeholders include group size, frequency and durability of interactions, heterogeneity of the group, design of the institutional framework, and characteristics of CPR (Ostrom 1990; Berks 2006; Huybers and Bennett 2000; 2003). Huybers and Bennett investigated the case of Tropical North Queensland and showed that small scale, close proximity, locality and homogeneity of the tourism businesses operating in the limited tourism areas contributed to establishing a durable management system with various cooperative activities. Moreover, the nature-based tourism relies on the natural environment as its attraction so that its sustainability must be a key concern of stakeholders.

Prior researchers have primarily focused on regulatory measures used by government institutions for environmental preservation, whereas many kinds of CPR are self-governed and where the stakeholders are self-organized. In this regard, a sufficient condition for stakeholders to organize and operate these self-governing organizations effectively is their use of design principles underlying robust and long-living self-governed institutions (Ostrom 2002, 2009). Effectively designed management system, including institutions, incentive systems and set of rules should lead to the sustainability of the natural tourism destination. As far as the marine resources are concerned, institutions such as fishery cooperatives have played a primary role in preserving the marine resources. On the other hand, co-management of fisheries with other resource stakeholders has been expanded to the management of marine resources (Pomeroy 1995; Jentoft et al. 1998; Makino et al. 2009). Makino et al. (2009) found that Shiretoko, one of three World Natural Heritage Sites in Japan, provided an example of good practices whereby a wide range of stakeholders from many sectors established an integrated management system through an initiative by fishery cooperatives. Although they did not focus on the tourism sector, their analytical method can be interpreted from the viewpoint of common pool approach.

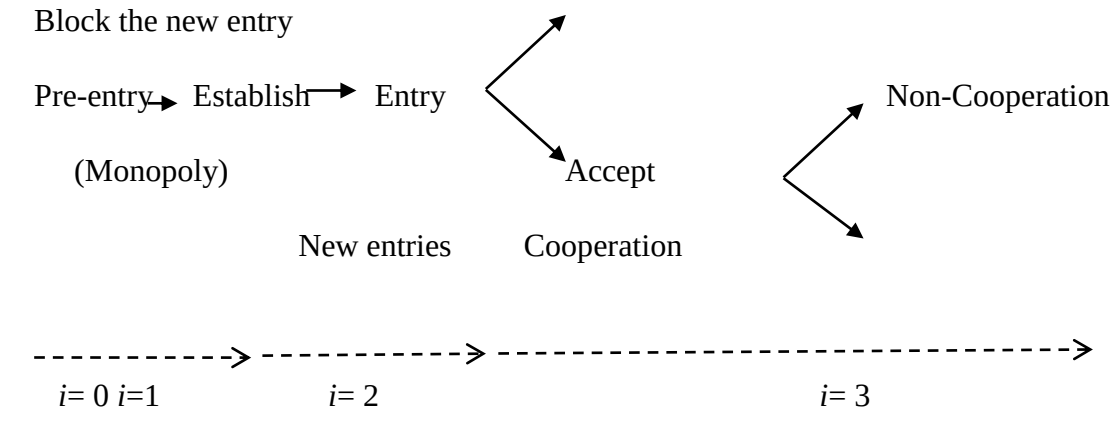
3. Cooperative management among stakeholders - A model framework

3.1. Assumptions

In this paper, the standard Gordon-Schafer model is employed (Burton 2003; McCarthy et al. 2001). In this model framework, an equilibrium that keeps the stock of CPR constant always exists whatever the individual resource use is. Therefore, incentives among stakeholders to cooperate come only from whether their profit from CPR use will increase or not. Unlike this model, cooperation motives among people should also be derived from the insecurity of unsustainable resource use. A negative externality of CPR has explicitly occurred from the inappropriate use of marine resources through tourism activities. The relationship between the resource use and its negative externality should be considered in a theoretical setting. It is very likely that the more CPR is used, the more the negative externality increases.

To confirm how many tourism businesses enter the market, a series of entries of the businesses is assumed (see the following figure). In this regard, we assume heterogeneity among tourism businesses which have different cost structures (Burton 2003), due to differences in location and/or skills of each business manager. The marginal cost of operation is assumed to increase gradually.

Figure 1 Access to CPR



* *i* is a number of entrants

3.2. A basic model

We shall incorporate a Gordon-Schafer type of appropriation of CPR, which gives marine biological aspects of the resource use. The amount of CPR use, R_i, by an individual business i, depends not only its efficiency but also the effort in providing tourism services, E_i. In a well-preserved eco-system, a marine resource such as coral reefs can provide high densities of flora and fauna, leading to easier access to them by tourists. An increase in the number of visitors may result in large scale structural damage to the coral reef and surroundings. This situation can be given by:

(1) $R_i = q E_i X, \quad q > 0,$

and the total appropriation will be:

(2) $R = \sum R_i = \sum qE_i X = qEX$.

X in equation 2 shows the amount of marine resources available. It is hard to estimate the recovery process of marine resources because of the complexity of ecosystem resilience, depending on its disturbances of changes. In this regard, by analogy with fishery resources, we shall assume a logistic growth function for a marine resource:

(3) $G(X) = rX(1 - X/K), \ r > 0,$

With no extinction by tourism activities, their amount must be K. Once tourism has developed there, it will decline to X_t.

(4) $R = G(X) \ \Rightarrow \ X_t = K(1 - q(\sum E_i)/r)$.

If degradation of the coral reef is severe, then X would approach zero and no tourism activities would be undertaken. In this formula, we shall assume $0 < \theta = X_t / K = (1 - q(\sum E_i)/r) \le 1$, where θ is a degradation rate of the marine resource. Whether the coral reefs, for example, can recover, or whether their healthy condition can be kept in dynamic equilibriums, clearly depends on not only how many tourism businesses access it, but also how much effort required in producing the tourism services. With a complex and dynamic ecosystem with resilience it is difficult to predict how much tourism activity should be accepted in the area. The risk factors include not only the high fragility of coral reefs and their environment, but also a tendency to their over-

exploitation as CPR. Then, the community should take measures to avoid these risks and establish an effective management system.

Let us examine what will happen if there is no restriction to access the CPR. At the beginning, assume only one tourism business (i=1) enters the market. This business may be the most cost-efficient as it can adopt the most favourable geographic and technical conditions to provide tourism services. A cost function assumed by Burton (2003) is employed here in order to allow heterogeneity among businesses:

(5) $C_i = c + \gamma\, i,\ c, \gamma > 0,$

Then, the profit to be maximized becomes:

(6) $\pi_i = PR_i - C_i E_i - tPR_i$

where P is the price of the resource use and t is a tax on the resource use. The result will be

(7) $E_1 = \dfrac{pqK - c - \gamma}{2pq^2 K / r},\ \ p \equiv (1-t)P$

(8) $\pi_1 = \dfrac{[pqK - c - \gamma]^2}{4pq^2 K / r}$

In this case, the degradation rate of coral reefs becomes:

(9) $\theta_1 = \dfrac{1}{2} + \dfrac{c + \gamma}{2pqK} < 1 \ \Leftrightarrow\ E_1 > 0$

Next, assume another business intends to enter the market. It will operate to the extent it obtains profit. If both two businesses are assumed to behave as the Cournot-Nash competitors, the outcomes will become:

(10) $E_1{}^2 = \dfrac{pqK - c}{3pq^2 K / r},\ E_2{}^2 = \dfrac{pqK - c - 3\gamma}{3pq^2 K / r}\ ,\ E^2 = E_1{}^2 + E_2{}^2 = \dfrac{2[pqK - c - 3\gamma/2]}{3pq^2 K / r}$

(11) $\pi_1{}^2 = \dfrac{[pqK - c]^2}{9pq^2 K / r},\ \pi_2{}^2 = \dfrac{[pqK - c - 3\gamma]^2}{9pq^2 K / r}.$

A sufficient condition for a possible new entry is $pqK - c - 3\gamma \geq 0$. The degradation rate of coral reefs becomes:

(12) $\theta_2 = \dfrac{1}{3} + \dfrac{2c + 3\gamma}{3pqK}$.

From (9) and (12), we may see that whenever a new entry is possible, the degradation rate of coral reefs will decrease because $\theta_1 > \theta_2$. After the entry, each business shares the benefits from the CPR use as follows:

(13) $\pi_1{}^2 < \pi_1$ and $\pi^2 = \pi_1{}^2 + \pi_2{}^2 < \pi_1$.

In this regard, we can determine the following results; (i) after an entry of the business, total profits will decrease although the total efforts increase, (ii) the first comer will lose its profit because its effort will decrease due to a second one's entry, and (iii) a degradation of coral reefs occurs because of the large appropriation by tourism activities. Therefore, both environmental situation and economic outcomes will deteriorate due to a new entry and an increase in the number of businesses.

Now assume that further entry into the market has continued. It is difficult to fix the behavior in the case with three entrants or more because they could compose various patterns of cooperation among them, such as coalitions and alliances. For example, there are six patterns of competition for the three entrants. One possible case can be given by:

(14) $$E_1^{\,3} = \frac{pqK - c + 2\gamma}{4pq^2K/r},\ E_2^{\,3} = \frac{pqK - c - 2\gamma}{4pq^2K/r},\ E_3^{\,3} = \frac{pqK - c - 6\gamma}{4pq^2K/r},\ E^3 = \sum E_i^{\,3} = \frac{3[pqK - c - 2\gamma]}{4pq^2K/r}$$

(15) $$\pi_1^{\,3} = \frac{[pqK - c + 2\gamma]^2}{16pq^2K/r},\ \pi_2^{\,3} = \frac{[pqK - c - 2\gamma]^2}{16pq^2K/r},\ \pi_3^{\,3} = \frac{[pqK - c - 6\gamma]^2}{16pq^2K/r}$$

A sufficient condition of the third business to enter the market is.The degradation rate of coral reefs becomes:

(16) $$\theta_3 = \frac{1}{4} + \frac{3c + 6\gamma}{4pqK}$$

These conditions indicate that:

(17) $$E_1 < E^2 < E^3,\ \pi_1 > \pi^2 > \pi^3 \ and\ \ \theta_1 > \theta_2 > \theta_3 .$$

As shown in equation (17), a new entry will lead to increased effort, but to reduced profits, and cause the environmental situation of coral reefs to deteriorate.

To make the analysis simple, we shall assume that the third business doesn't enter the market because the condition $pqK - c - 6\gamma \geq 0$ is not satisfied. Accordingly, a high cost could block its effort to produce tourism service. Then, only two businesses remain in the market, whose outcomes are shown by equations (10) - (13). Competition between the first and the second user of the CPR, (or non-cooperative use of the CPR), can lead to a deterioration of both the environment and the economic profit. Therefore, the problems to be assessed here are as follows; firstly, what makes it possible for the first appropriator to block the new entry? Secondly, can a behavioural change of businesses from the non-cooperative to cooperative improve not only the environmental situation but also the economic condition as well? Thirdly, if it is so, what conditions encourage them to cooperate with each other to share the use of

CPR? The first and the third questions are issues about the management or governance of CPR and will be investigated in the next Chapter.

Figure 2 illustrates the outcomes after the entry of the second business. Figure 2 indicates both the cooperative and the non-cooperative situations. A monopolistic equilibrium before the entry is also depicted at point ***M*** in Figure 2, where the profit which the first appropriator gains is maximized. A non-cooperative equilibrium is examined when two businesses behave as the Cournot-Nash competitors. In this regard, we shall investigate what will happen if they change their behaviour towards the cooperative actions. The reaction function for each business is given by:

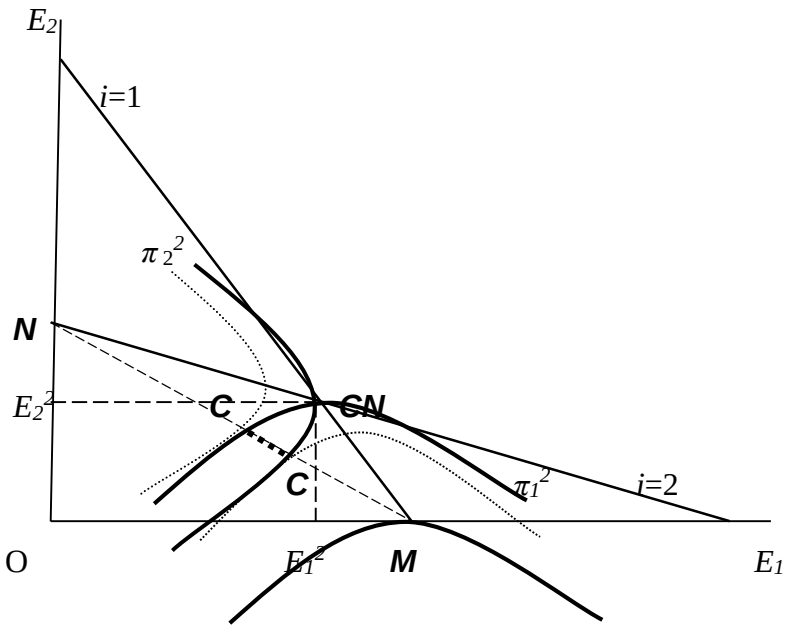
$$(18) \quad E_2^{\,2} = -2E_1^{\,2} + \frac{pqK - c - \gamma}{pq^2K/r}, \ \textit{for } i = 1 \ \textit{ and } \ E_2^{\,2} = -\frac{1}{2}E_1^{\,2} + \frac{pqK - c - 2\gamma}{2pq^2K/r}, \ \textit{for } i = 2 .$$

Then, the intersection point ***CN***(=(E_1^2,E_2^2)) gives the Cournot-Nash equilibrium, where each business gains the profit of π_i^2 (i=1,2).The iso-profit curve for each business can be depicted as in Figure 2. An iso-profit curve for i=1 is given as an upward hump-shaped curve, whereas an iso-profit curve for i=2 can be drawn by the one with rightward hump-shape. In this regard, it should be notable that the iso-profit curves of $\pi_1 = \pi_1^2$ and $\pi_2 = \pi_2^2$, together pass through ***CN*** and that an upward shift of π_1, or a rightward shift of π_2, leads to a profit reduction. Therefore, as shown in Figure 2, cooperative behaviour to reduce their efforts from ***CN*** to the south-west could easily increase their profit. In particular, any change from ***CN*** to a point on the contract curve (***C-C*** line), can produce an economic betterment for both businesses (see the Appendix for a mathematical proof). Intuition suggests that this conclusion is unacceptable because a reduction in the effort for appropriating CPR by each business would have a negative effect on profit. However, this is not practically possible because a decrease in the effort reduces the cost and increases the stock of CPR, possibly leading to an increase of profit.

The above discussion highlights some strategic issues in the design of a governance system through which all stakeholders in the community with marine resources cooperate in order to increase their welfare. Firstly, there is an issue about the scale or the scope of community participation. The stakeholders should not be limited to businesses, but include all community members involved in the CPR use. Government should play a key role as a planner or mediator, and residents also support or give their opinions to preserve their environment. Accordingly, their cooperative activities for improving the economic and social situation of the community should be considered. Secondly, there is an issue related to the excludability of CPR, namely the possibility of the community to reject or regulate a new entry of the tourism business. In this regard, we have to see what governance systems operate in the community. Fixing the

members who are entitled to use CPR and allocating the use of CPR among members are the central issues of the management system of CPR, which Ostrom (1990) classified as ‘boundary rules’ and ‘allocation rules’ respectively. In order to avoid an over-use of CPR, controlling the number of business members is important, whereas fixing the members is hard because CPR is basically non-excludable and any actions to prevent a new comer from using CPR violates the freedom of businesses. Thirdly, there is an issue about how to direct an individual's attention towards cooperative behaviour through a sense of public duty. As we have already shown, the competitive outcome with free entry might not be the best solution for the community. Besides, a cooperative adjustment by stakeholders can lead to a better situation from both the economic and environmental perspectives. However, even if this is true, each stakeholder may hesitate to reduce their effort as an individual contribution because it requires self-sacrifice. In the end, there is an inherent contradiction between self-interest and personal recognition of social benefits. Then, a governance system, in which people tend to think about their total outcomes from the social perspectives, should be established based on the human relationships among stakeholders, particularly businesses. Whereas it might be induced by a governmental organization, the rules and institutions implemented by the governance system will guarantee the community’s expected benefits are distributed among its members.

Figure 2 Cooperation and non-cooperation



3.3 The Management System

3.3.1. The first stage; Why at *M*?

A management system can be established by those who have a common recognition of the risk and a willingness to bear its cost. Each member of the community would follow the governance system composed of rules or other traditional customs about the use of CPR, by which an individual member could estimate how much he or she should pay for the risk burden. Accordingly, the management system includes the boundary rules and the allocation rules (Ostrom et al. 1994). Approved users of a CPR are limited within a geographic and a social scope, and their usage and process of using CPR is strictly limited. In this regard, the first issue of the management system is about an initial condition of the boundary rule. Even with a single or monopolistic-like business (see Figure 1), there must be some institutions in which the community operates together to accept businesses and to assure the scope and scale of their activities. Self-designed institutions or community-based institutions led by the government can maintain enduring CPR use. As far as the model analysis adopted here is concerned, the outcome would be well managed from a sustainability perspective because no issue of externality of CPR, such as an over-use of CPR, occurs.

Before the entry of the newcomers occurs, the governance system does not need to include regulations on business activities. Rules are conducted mainly on the other fields of the community activities, such as joint waste management, cleaning, festivals, and social welfare. Even in a small community, however, it may be impossible to eliminate intentions to break rules, mainly because of a sense of free-riding. A member tends to free-ride not only by skipping the community meetings or obligation-work, but also by cheating the community through the dishonest use of CPR. Then institutions must be designed to avoid such behaviour.

In general, a community has various mechanisms to avoid dishonest behaviour, such as penalties, rewards and social sanctions. However, these mechanisms only work if the community can implement a monitoring system to watch the behaviour of its members. Besides members, outsiders plundering of the CPR should be also monitored. This leads to a steep increase in the monitoring cost, although this depends on the social and geographical accessibility of the CPR. If the community pays for the monitoring cost alone, the overall cost of cooperative management may exceed its benefit, leading to a collapse of the management system. Then, some other measures, such as collaboration with other communities or sanctions by a higher government, must be also incorporated into the management system of the

community. Therefore, all these facts lead us to a conclusion that the governance system in the community would have various patterns depending on its historical and geographical situation.

3.3.2. The second stage with entry; From *M* to *CN* or staying at *M*?

The second-stage issue of the management system is about the additional boundary rules to be embedded in the governance system. The question is what makes it possible, or impossible, for the first appropriator to block the new entry. This problem relates to the procedures for how to manage a competitive market and its regulations. Most countries have an anti-monopoly policy, or equivalently a de-regulation policy, in order to eliminate inefficiency through market-failure. This basically prohibits any procedures to block a new entry into the market. In a real world, however, some restrictions on the new entry have been enforced in various markets or industries to protect the existing businesses or maintain environmental standards. Whereas our case is about the regulation of a small tourism site, which is carried out within a geographical area, it would not make any difference what the government-led regulations justified. The major motives to regulate businesses in a small area may include the same reasons as those for international trade or the domestic market, to protect interests. To enforce regulations to block the new entry effectively, a new institutional design should be incorporated to amend the boundary rules. In a case, a local government would adopt a new local ordinance, and in another case, a self-organized private institution or an institution based on a private-public partnership might be established. Moreover, their legal basis may be provided by the central government so as to attain an effective outcome.

3.3.3. The third stage; Cooperative behaviour; From *CN* to *C-C*?

Assume that a governance system permits the tourism businesses to entry the market, and it leads to a competitive equilibrium, ***CN***. On the other hand, the businesses know that if they take a cooperative action to reduce their effort towards ***C-C***, they can get more profit than at ***CN***. However, each business clearly has no incentive to reduce the effort, unless they are convinced that other businesses will also reduce their effort. This is because if business 1, as shown in Figure 2, reduces its effort downward from ***CN***, its profit will decrease whereas the profit of the other business will increase. Therefore, business 1cannot be certain that the other business would reduce their effort. Accordingly, a conjecture about the behaviour of the other businesses could never direct each business towards cooperation.

In this regard, a community needs a governance system to establish organizations or new rules, by which all businesses can establish a trustworthy relationship to control their effort. This

might include not only a self-governance institution organized by tourism businesses, but also a community-based institution with wide-ranged stakeholders including residents and other business groups. Hence, the scope of issues to be solved in the community will determine the range of participants in an organization. If it is a business matter, the organization must include only businesses. However, if it is a matter beyond the business, such as the environmental preservation, the institution should be designed to include all the stakeholders concerned. Degradation of coral reefs caused by tourism-related activities not only affects their business outcomes, but also damages the society due to an overall deterioration of the environmental situation. An approximation assumed in the Appendix shows us that after cooperation, the degradation rate of coral reefs will be improved by $[pqK-c]/6pqK$.On the other hand, an aggregate profit will increase by $[pqK-c]^2/36pq^2K$. Therefore, any policy measures exert a great influence upon all people in the community. Then, the institution should be planned and facilitated so as to involve all the residents and businesses in its establishment and enforcement. Thus, many stakeholders have to move in coordination with each other to use CPR more efficiently.

3.3.4. Policies by means of economic incentives

The model framework developed above includes a tax on resource use. In the tourism sector, there are many types of taxes levied on businesses or visitors. In natural tourism sites, taxes or charges on the resource use include admission taxes, reef taxes (the environment management charge (EMC) in GBR). Theoretically, the effect of a change of the tax rate or introduction of new taxation on the degradation rate and the effort level of each stage will be given by:

$$(19)\quad \frac{dE_1}{dt}=-\frac{c+\gamma}{2(1-t)^2Pq^2K/r}<0,\ \frac{dE^2}{dt}=-\frac{c+3\gamma/2}{3(1-t)^2Pq^2K/r}<0,$$

$$(20)\quad \frac{d\theta_1}{dt}=\frac{c+\gamma}{2(1-t)^2PqK}>0,\ \frac{d\theta_2}{dt}=\frac{2c+3\gamma}{3(1-t)^2PqK}>0.$$

Whereas the tax reduces the disposable income of businesses, some of the tax revenues are also expended in terms of preserving CPR or subsidies for the tourism sector. However, the mechanism of tax revenue and its expenditure is not clearly explicated. Even if a Pigouvian tax levied on the business activities to avoid the externality of the market, the efficient level of the tax rate on CPR use is hard to attain a required equilibrium. As far as the second stage is concerned when a non-cooperative outcome occurs, the tax rate can be adjusted properly to restore the efforts on *CN* to those on *C-C*. Theoretically, if the tax is imposed at the rate;

$$(21)\quad t^*=1-\frac{c+3\gamma}{PqK}\in(0,1),$$

the degradation rate will be improved to θ_1 in (9), the same level before the entry. However, (21) indicates that without knowing about both the cost structure of the new entrants and about the ecosystem of regeneration of coral reefs, it is impossible to estimate the adequate tax rate. Moreover, introducing a new tax generally tends to cause friction between the tax payers and its beneficiaries.

In the manner explained above, there are many deficiencies in taxation as a mechanism. However, taxation is a reliable policy measure to change the visitors' choice to access the tourism site. Obviously, introducing and adjusting the taxation would inflict a loss of the community due to a reduction of tourism demand. Therefore, it should be carried out by a governmental authority, leading to a governance system in which the community is involved. Even though the policy targets are the same each other, the governance system with taxation proposed by the community-based organization should be different from that proposed by the governmental initiative. Hence, the governance system should be investigated on a case-by case basis.

4. Implications of the model analysis – an application to the case of Coral Reefs management in Kerama

The theoretical perspectives developed above shows us an important implication that non-cooperative behaviour among stakeholders can lead to an inefficient outcome of the high environmental burden and low income. Investigate the case of the Kerama Islands where there is a conflict between the diving operators in the Kerama Islands and from Okinawa, both using the diving spots around the Kerama Islands. Because coral reefs as the tourism resources are characterized as a CPR, business people tends to overuse them and leads to degrading the coral reefs' environment. Hence, the stakeholders in and around the Kerama Islands together cooperatively establish the management system to attain the sustainable resource use (See Yabuta et al. (2014) for the details about the current environmental situation and the development process of the governance system of coral reefs.)

Here, we shall give a brief sketch of the recent development of the management system concerning regulations on diving operators and activities in the Kerama Islands. Many researchers have pointed out the conservation issues of coral reefs in the Kerama Islands (Fujisawa (2006), Takahashi (2007), Maruta (2011) and Taniguchi (2003)). They have argued about the effective measures to conserve the environment of the coral reefs and to avoid their degradation caused by the diving businesses, and mentioned the need of cooperative management of diving operators not only in the Kerama Islands but from Okinawa. The Kerama

Islands areas are certified by Ecotourism Promotion Law[1] in 2012, and announced the Collective Vision to Promote Ecotourism in the Kerama Islands in order to satisfy both the environmental protection and the development of tourism, focusing on the scuba diving activities. Although various efforts have been made to tackle the environmental issues, there are still environmental issues to overcome. One is the over-use of coral reefs caused by too many numbers of operators, about 60 in Kerama and 150 from Okinawa, and the other is a free-rider issue who use the coral reefs for diving activities but has no intention to take part in the activities to protect the coral reefs. They, manly from Okinawa, do not necessarily join the diving associations in Kerama Islands[2]. Zoning of marine areas and regulation of the diving activities, mainly restricting the number of visitors, are the major effective regulatory measures to protect the coral reefs. Hence, the Collective Vision to Promote Ecotourism in the Kerama Islands mentioned the allocation issue and shows that there is the coordination failure among diving operators.

Table 1 is a summary of the policy measures to control the use of coral reefs indicated by the Collective Vision to Promote Ecotourism in the Kerama Islands. In order to protect the environment of coral reefs, it designated the specific area of the Kerama Islands, in accordance with the Ecotourism Promotion Law. It is named 'the Coral Reefs in Kerama Islands', the range shallower than 30 meters around each island. Then, it basically regulates any activities there except for the swimming area of the beach whereas fishery and other emergency activities, and the activities that will contribute to the improvement of the residents' welfare such as festivals and education are allowed. It is notable that the Collective Vision to Promote Ecotourism in the Kerama Islands also sets the maximum number of users of diving activities as the half of the current users. In this regards, it also notes that regulations on usage in the Coral Reefs in Kerama Islands can be reviewed from the fairness among users and from the other environmental aspects. Currently, the volunteers, membership fees and public funds support these policy measures to protect the environment, although these management expenses are not enough for making these actions effective.

Currently, though there still a lot of issues to be solved, the diving spots in Kerama seem to be well-shared between businesses in Kerama and those from Okinawa. This is because they must have reached an agreement about CPR use, whereas this agreement is set in an implicit way that there is no legal basis. From the theoretical perspectives, this means that they happen to be on a point towards Pareto superior point between C-C in Figure 2. As mentioned before, coral

[1] Ecotourism Promotion Law of Japan was enacted in 2008.
[2] This is one of the 'Common Pool' issue. Nobody has property right of the coral reefs, and nobody can exclude the use of someone else. Hence, this would lead to an overuse of the coral reefs as the tourism resources. Therefore, an effective management to reduce the usage of the resources should be implemented as the model analysis showed in Chapter 3.

reefs in the Kerama Islands are CPRs not only to Karama, but also to Okinawa. Therefore, this agreement implicitly attained is so fragile that some small changes in the policy concerning sharing the resource-use should alter the equilibrium, leading to an ineffective allocation of the resources.

Table 1 A summary of the policy measures to protect coral reefs in the Kerama Islands

Tourism management in Kerama Islands in accordance of EPL	Designation of specific tourism resources	user control	setting the criterion to set the restricted areas	Protection and development of the specific tourism resources	Effective Combination of Regional Community and Networking	Education of related Stakeholders	Properly Marketing	Monitoring and Study
Policy Measures	Zoning as the specific area of coral reefs.	Regulation of the maximum number of divers	Area protection by zoning	Organization for protective use of the Coral Reefs in Kerama Islands and members who join the Ecotourism Promotion Council	Consulting stakeholders and the public	Fostering awareness and knowledge of ecotourism	Codes of conduct for the stakeholders following ecotourism	Sustainability Indicators such as Monitoring site 1000 by Ministry of the Environment
Decision-makers/related subjects	head of villages	head of villages	head of villages	Cooperative Participation of all stakeholders	Cooperative Participation of all stakeholders	businesses, residents and children	businesses	Cooperative Participation of all stakeholders
Remarks	Fishery management/ Restriction of number of visitors/Carrying Capacity of visitors/Control of diving points		Capacity-building strategy among local residents/ Local planning for tourism development	Cooperative talks between operators in Kerama and from Okinawa(Resource allocation among conservation agencies/Effective management of the conservation agencies including fund raising		Integral Education reform/Pilot project for an environmental education program	Ecotourism/ Understanding on serious impacts/ Participation of local people on tourism/	Monitoring system and skill/Data base system of monitoring for ecosystem

5. Concluding remarks and further notes

The theoretical perspectives developed above shows us an important implication: A non-cooperative use of CPRs leads to an inefficient outcome including over-exploitation and

environmental destruction of CPRs. Non-cooperativeness may be originated by the heterogeneity itself among stakeholders who do businesses in different regions or in different styles because strangers are always different. However, even so, as far as they have to share the common resources such as tourism natural resources, it is efficient for them to go to a point on a contract curve through a cooperative manner, meaning that they should have reached an agreement that allows them to a Pareto superior situation.

In Kerama, stakeholders who use coral reefs as the tourism attraction both in Karama and from Okinawa seem to reach an implicit equilibrium (For the details, see Yabuta et al. (2014)). However, the fact is they further need to restrict the usage of the coral reefs together. Further regulations on the resource use will be towards the more difficult aspects.

Appendix

Total differentiation of (6) makes it possible to determine the shape of the iso-profit curve for each business rigorously.

(A-1) $\frac{dE_2}{dE_1}\Big|_{i=1} = \frac{1}{E_1}\left[\frac{pqK-c-\gamma}{pq^2K/r} - 2E_1 - E^2\right], \quad \frac{dE_2}{dE_1}\Big|_{i=2} = \frac{E_2}{2}\left[\frac{pqK-c-2\gamma}{2pq^2K/r} - \frac{E_1}{2} - E_2\right]^{-1}$

Then, as far as the first business is concerned, it is proven that a gradient of the iso-profit curve changes from positive to negative when it crosses the reaction function from left to right. Hence its iso-profit function will become convex upwards. On the other hand, as for the second business, its iso-profit curve will become convex rightwards. They are depicted by Figure 2.

Next, the contract curve between two business s will be investigated. Geometrically, it is defined as a set of the points where the iso-profit curves of each business come in contact with each other, being indicated by the curve *l*, or its subset ***C*-*C***, in Figure 2. The contract curve can be derived by the following procedure. By definition, it must satisfy

(A-2) $\frac{dE_2}{dE_1}\Big|_{i=1} = \frac{dE_2}{dE_1}\Big|_{i=2}$

Then, we have

(A-3) $\{(E_1, E_2) \in l \mid \ 2(E_1+E_2)^2 - 3a(E_1+E_2) + a^2 - a(\gamma)(a - a(\gamma) - 5(E_1 + 4E_2/5)) = 0\}$,

$$\textit{where} \quad a = \frac{pqK-c}{pq^2k/r},\ a(\gamma) = \frac{\gamma}{pq^2K/r}$$

The last term in (A-3) can cause a disturbance of the contract curve. However, if the difference in marginal cost between business s is so small that its effect could be neglected, then an approximate expression of the contract curve can be given as

(A-4) $\{(E_1, E_2) \in l \mid \ E_1 + E_2 = \frac{1}{2}a\}$

Therefore, the contract curve can be approximately expressed by a straight line to join ***N*** and ***M*** in Figure 2. To compare ***CN*** with the points in ***C-C***, for example, it is obvious that each business can get not less profit in ***C-C*** than in ***CN***. This means that any activities to reduce an effort from ***CN*** to ***C-C*** can improve their economic outcomes.

References

Berkes, F. (2006), "From Community-Based Resource Management to Complex Systems: The Scale Issue and marine Commons," *Ecology and Society,* 11(1), 45.

Blanco E., Ray-Maquieira, J. and Lozano, J. (2009), "Economic incentives for tourism firms to undertake voluntary environmental management," *Tourism Management,* 30(1), 112-122.

Bosselman, F. Peterson, C. and McCarthy, C. (1999), *Managing Tourism Growth - Issues and Applications*, Island Press.

Briassoulis, H.(2002), "Sustainable Tourism and the Questions of the Commons," *Annals of Tourism Research,* 29(4), 1065-1085.

Burton, P.S. (2003), "Community enforcement of fisheries effort restrictions," *Journal of Environmental Economics and Management*, 43, 474-491.

Clark, C. (1976), *Mathematical Bioeconomics: The Optimal Management of RenewableResources*, Wiley, Toronto.

Fujisawa, N. (2006), "Negotiations on the Conservation of Coral Reefs in the Kerama Islands," Okinawa University, *Regional Research,* 2, pp.3-17. (in Japanese)

Gordon, H.S. (1954), "The economic theory of a common-property resource: the fishery," *Journal of Political Economy,* 62, 124-142.

Hardin, G. (1968), "The tragedy of the commons," *Science,* 162, 1243–1248.

Harriot, V.J., Davis, D. and Banks, S.A. (1997), "Recreational Diving and Its Impact in Marine Protected Areas in Eastern Australia, *Ambio*, 26(3), 173-179.

Hawkins, J.P. and Roberts, C.M. (1994), "The Growth of Coastal Tourism in the Red Sea: Present and Future Effects on Coral Reefs," *Ambio*, 23(8), 503-508.

Healy, R.G. (1994), "The "common pool" problems in tourism landscapes," *Annals of Tourism Research*, 21(3), 596-611.

Hearly, R.G. (2006), "The commons problem and Canada's Niagara Falls," *Annals ofTourism Research*, 33(2), 525-544.

Herath, G. (1996), "Ecotourism Development in Australia." *Annals of Tourism Research* 24(2): 442-446.

Huybers, T. and Bennett, J. (2000), "Cooperation in Tropical North Queensland's Nature-Based Tourism Industry," *Australian Agribusiness Review*, 8(7), 21-46.

Huybers, T. and Bennett, J. (2003), "Inter-firm cooperation at nature-based tourismdestinations," *Journal of Socio-Economics*, 32(5), 571-587.

ICRI (2011), *Status of and threat to Coral reefs*, (http://www.icriforum.org/about-coral-reefs/status-and-threat-coral-reefs, accessed 25/May/2011)

Jentoft, S. McCay, B.J. and Wilson, D.C. (1998), "Social theory and fisheries co-management," *Marine Policy*, 22/4-5, 423-436.

MaCarthy,N. (2001), "Common Pool Resource Appropriation under Costly Cooperation," *Journal of Environmental Economics and Management*, 42, 297-309.

Makino,M., Matsuda.M., and Sakurai,Y., (2009) "Expanding fisheries co-management to ecosystem-based management: A case in the Shiretoko World Natural Heritage area, Japan," *Marine Policy*, 33(2), 207-214.

Maruta, K. (2011), "Exclusion and symbiosis: The problem of a diving shop in Zamami - Village," Jinbungakubu Kiyo, Okinawa University, pp.29-39. (in Japanese)

Ostrom, E. (1990) *Governing the Commons, The evolution of institutions for collective action.* Cambridge University Press.

Ostrom, E. Gardner, R. and Walkers.J. (1994), *Rules, Games and Common-Pool Resources*, University of Michigan Press.

Ostrom, E. (2002), "Common-pool resources and institutions: Towards a revised theory," *Handbook of Agricultural Economics*, edited by Bruce,L.et al., l2(1), 1315-1339.

Ostrom, E. (2009), "A General Framework for Analyzing Sustainability of Social-Ecological Systems," *Science*, 325, pp.419-422.

Pomeroy, RS. (1995), "Community-based and co-management institutions for sustainable coastal fisheries management in Southeast Asia," *Ocean & Coastal Management*,27/3, 143-162.

Steins, N.A. and Edwards, V.M.(1999),"Collective Action in Common-Pool Management: the contribution of a social constructive perspective to existing theory," *Society and Natural Resources*, 12, 539-557.

Takahashi, M. (2007) "Establishing a diving business and coral reef conservation in Zamami Village: Conservation of resources conducted by a diving business," *Studies in Environmental Sociology*, (13), pp. 204-213. (in Japanese)

Taniguchi,H. (2003), " Effect of closing resort diving stations at Zamami-son and unexpected negative effect of closing -Result of the Reef Check Zamami-," Midoriishi, 14,16-19.

Wilkinson, C.(2004), *Status of Coral Reefs of the World*, Vol.I and Vol.II, Global Coral Reef Monitoring Network.

Yabuta, M., Scott, N. and Ozawa, T. (2014), "Sustainable Tourism Development: A recent experience of Coral Islands in Japan," mimeo.