Chapter 3

Methodology of the Research

3.1 Theoretical Framework for Analysis

(1) Theories of common pool resources and tropical timbers

Environmental quality is essentially a public good. It is therefore imperative to know the characteristics of public goods in order to understand environmental issues. Public goods can be classified into a few more specific categories such as pure public goods, congestive goods and common pool resources (CPRs). CPRs are also sometimes called open access goods or common property resources. General definition of public goods is that they are the goods that can be consumed by other people even if they are already consumed by one person. This is distinctively different from private goods that can not be consumed by another person if once consumed by one person. Examples of pure public goods are defense and radio broadcasting services. If these services are once provided, everyone can enjoy the benefit. For these services, quality of the services is not affected by the number of people who receive the cervices. Examples of congestive goods are public roads and bridges. These public goods are open to everyone but the number of people who can use the goods is not infinite. The more people use the facilities, the more they become congested. Efficiency of the services will decrease as they become congested; however, the amount of the goods is not affected. Examples of CPRs are clean air, water, ocean fisheries and the environmental values of tropical forests. Under the present legal system, they are not generally considered as private goods. Therefore, access and exploitation of these goods are free to everyone. They can be consumed as first comes first serves basis. For these goods, as the number of people who consume these goods increase, the amount of the goods themselves decrease and the service quality may deteriorate. CPRs can be further classified into renewable and non-renewable resources. If the rate of consumption is faster than the rate of

renewal, the goods will be all consumed up in the end.

As obvious from the above categorization, tropical timbers and environmental services obtained from tropical forests are considered to be classified as Common Pool Resources. Although these CPRs can to some extent behave like private goods in accordance with economic theories, theory analysis of public goods fits more in understanding the characteristics of CPRs. Therefore, it is required to introduce hereby the theory of public goods.

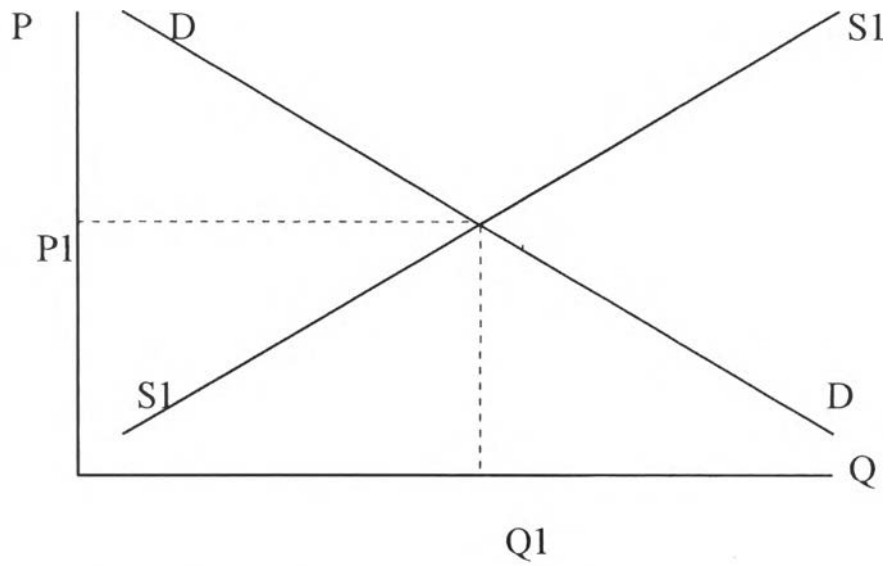
Common Pool Resources (CPRs) are those that are not exclusively controlled by a single agent [Tietenberg, p38]. The term "common-pool resource" also refers to a natural or man-made resource system that is sufficiently large as to make it costly to exclude potential beneficiaries from obtaining benefits from its use [Ostrom, p30]. Access to a CPR can be limited to a single individual or firm or to multiple individuals or teams of individuals who use the resource system at the same time.

It is necessary to understand how CPRs are treated in the market because this is the starting point why tropical forests can not be left to the market forces for its own conservation. Otherwise, no efforts would be needed by ITTO or any organizations for tropical forests conservation.

For normal private goods, the demand and supply function can be illustrated as shown in the Figure 1. Here, the amount of supply is expected to grow as the price of goods increases. This is considered as a common characteristic of normal private goods. However, for public goods, especially for pure public goods, the amount of supply is not affected by price changes. As illustrated in the Figure 2, the amount of supply in the case of public goods tends to be greater than normal private goods. Public goods are by definition free to be exploited by anyone. Tropical timbers are not pure public goods like defense or radio broadcasting services because their supply is not unlimited. However, total potential timber supply is considered so large in some developing countries that the resource value is felt almost unlimited in their market. Just like air, water or fisheries, tropical timbers are in some cases considered free to be exploited by those who require them. Therefore, apart from operating cost to harvest timbers, almost

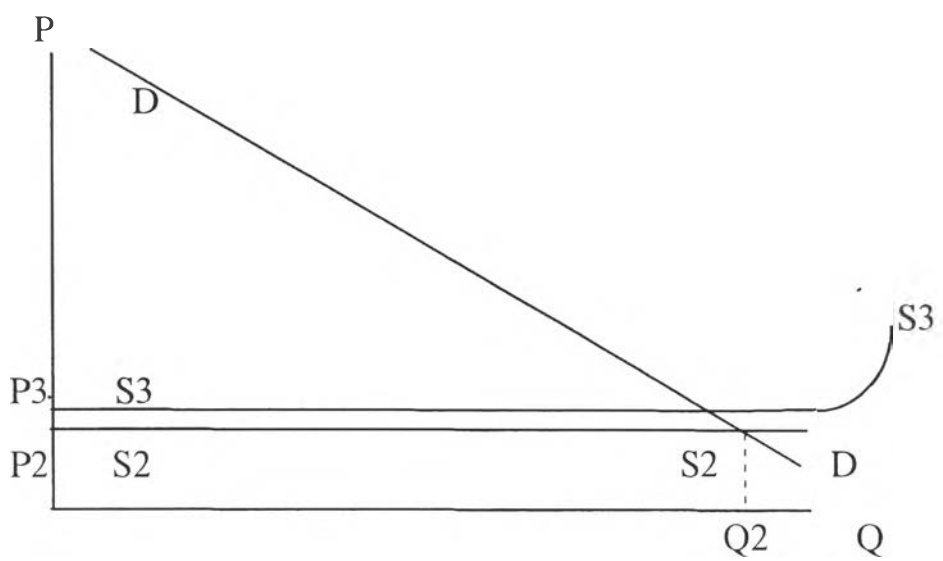
no cost is required to obtain timbers. This makes the price of tropical timbers lower than the case they were private goods. In the case of the environmental values deriving form tropical forests, they are more clear to be classified into CPRs, or in some cases into pure public goods.

Figure 1: Supply=Demand Relation for Normal Private Goods



S1 is the supply curve for a normal private good.

Figure 2: Supply=Demand Relation for Public Goods



S2 is the supply curve for pure public goods.

S3 is the supply curve for CPRs.

Figure 1. and 2. show that P1> P2, P3 and Q1 <Q2; therefore, CPRs are likely to be priced lower and exploited more than private goods.

These supply and demand relations can also be illustrated as shown in Figures 3, 4, 5 and 6, using Total and Marginal Cost functions. A total cost curve is normally considered to rise steeply first, then increase slowly and then again rise steeply. The maximum profit is achieved where AR=MC; therefore, the quantity supplied to the market would be Q1 in the case of normal private goods as shown in the Figure 3. In the case of public goods, the amount supplied into the market is larger than that of private goods. In the Figure 4, Q2 is the amount of supply. The cost of purchasing goods (tropical timbers here) is small or almost nothing as they are CPRs; therefore, the total cost curve reflects only the cost of harvesting operation. Thus, the public goods or CPRs are proved to be over-exploited than private goods, by MC and MR approach as well.

Figure 3: Total Cost and Total Revenue Relation (Private goods)

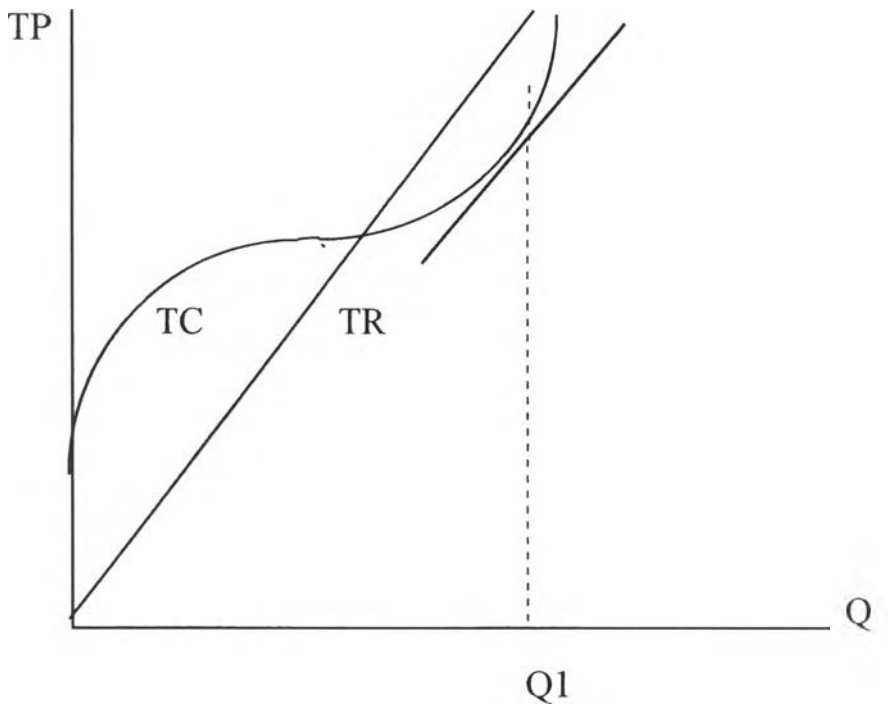


Figure 4: Marginal Cost and Average Revenue Relation (Private Goods)

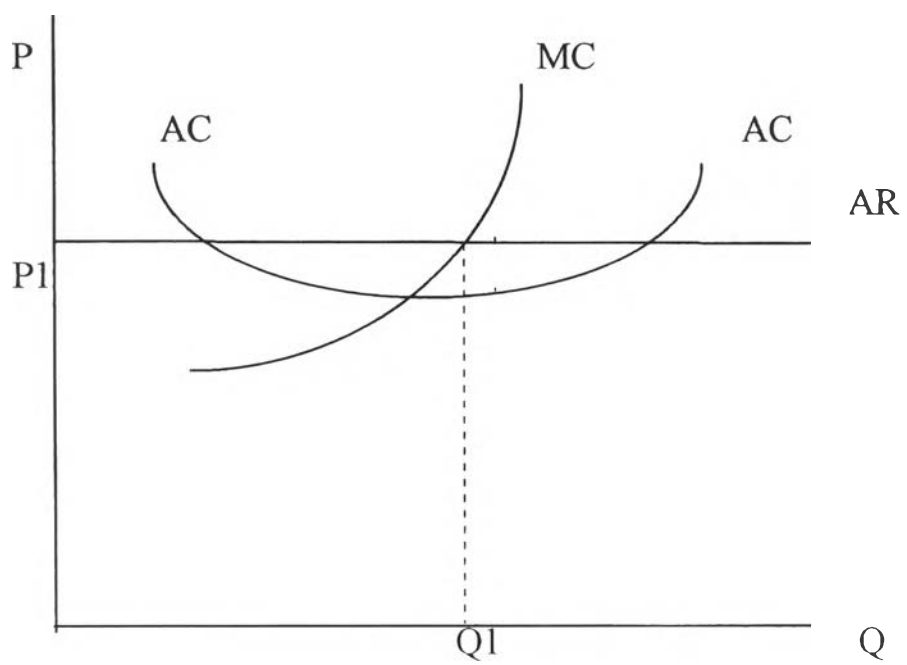


Figure 5: Total Cost and Total Revenue Relation (Public Goods)

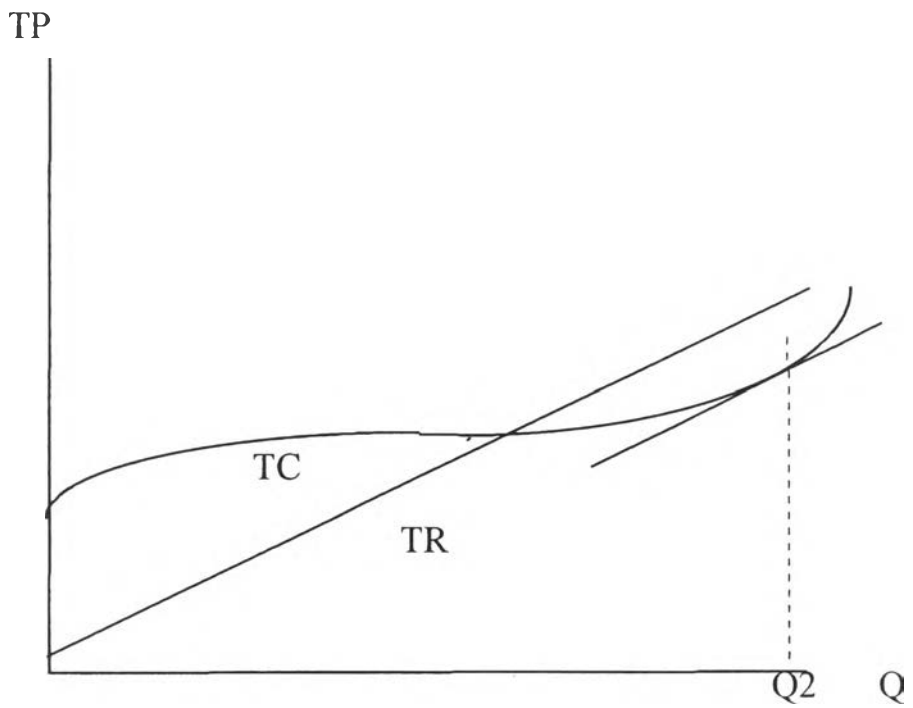
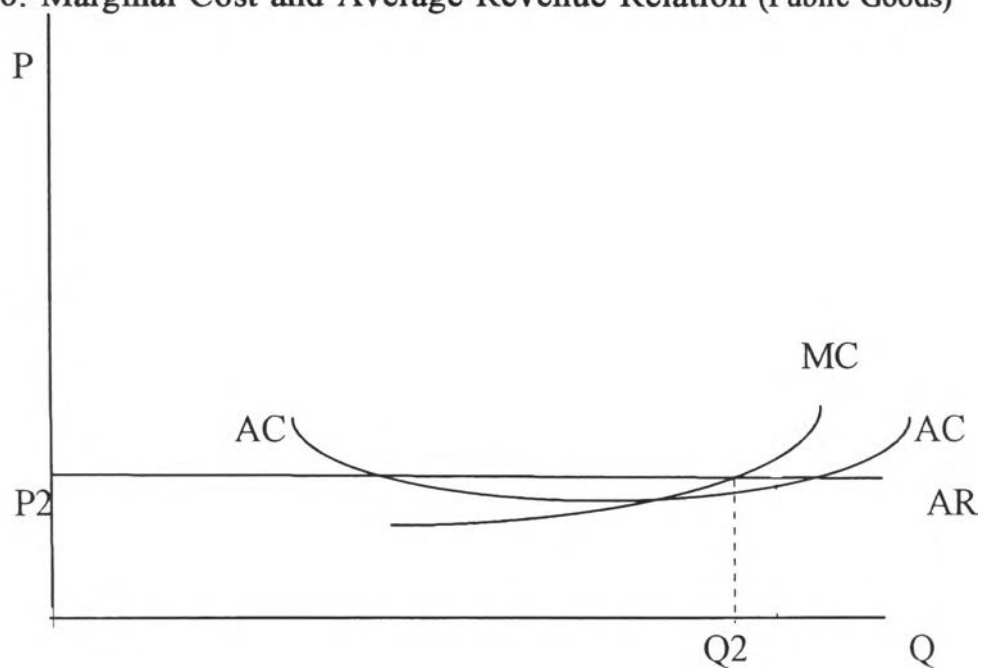


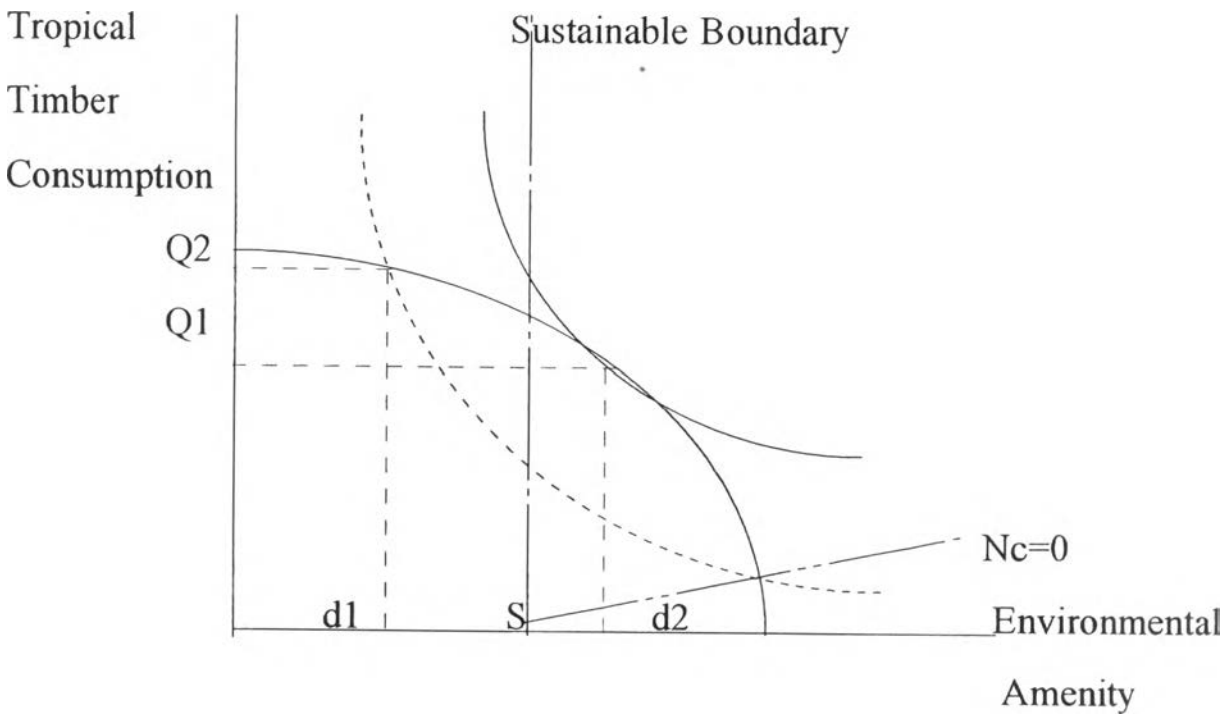
Figure 6: Marginal Cost and Average Revenue Relation (Public Goods)



The implication of above tendencies of over-exploitation of public goods (CPRs) for the sustainable management of the resources can be illustrated as shown in the Figure 7. In this Figure, the vertical line S represents where the resource can be managed to maintain the sustainable growth level. If consumption level leaves the environmental amenity level to the right of S, the resource can be sustainably managed, and if consumption brings the amenity level down to the left of S, the resource size is not capable to support sustainable management of tropical forests. It should be noted that the word "sustainable" has not been clearly defined in the case of tropical forests, particularly by ITTO member countries. Here, in order to understand easier the environmental concerns relating to tropical forests, S is considered to be the level where tropical forests can satisfy all environmental economic values such as biodiversity, sink capacity of CO2, bequest value and existence value. Therefore, below this point the tropical forests capacity to maintain global environmental values is not sufficient.

Nc=0 line in the Figure is the boundary within which the net consumption of tropical timbers is negative. In other words, timber consumption is being offset by plantation below this line. Tropical forests will keep decreasing in its amount above this level, leading to possible depletion of all forests in the end.

Figure 7: Tropical Timber Budget Line and Sustainable Level



(2) Theories of collective actions and International Agreements

It is generally understood that the negotiations at international organizations are explained by the economic theories of collective actions. [Field, p448-470] According to game theories, when there are gains to be made by defecting, rationale behavior by participants will result in the most undesirable outcome for all the participants. This indeed seems to be true in the negotiation process of distribution of contribution among ITTO members. Each member country always tries its best to make its own contribution as low as possible at the expenses of other members' contributions. If so, no arrangements taken by international organizations can succeed. Obviously, ITTO has its own workable system to allocate contribution among members.

The question here is how ITTO is coping with the collective action problems.

In addition to the problem of public goods as stated in (2) above, it is necessary to understand the collective action problem in order to fully realize the economic problems that tropical forests are facing. The collective action problem was first addressed by Olson (1965) in relation with the provision of public goods by organizations. The essence of collective action problem lies in inconsistency between individual and collective interests. It is usually explained by using game theory models as shown in Figure 8.

As it has been explained in the previous section, public goods are free to be exploited by anyone once they are provided. Environmental qualities that tropical forests provide to the global community, such as sink capacity of CO2, emission of O2 and existence value, are also public goods and are free for any country to enjoy once they are provided. Therefore, it would be beneficial, or economically profitable, not to contribute to the provision of these public goods but to free-ride on other countries. In the Figure 8, upper columns indicate economic values for a country A when it contributes and lower columns indicate the value when A free-rides. Similarly, the left columns indicate the value for a country B when it contributes and the right columns

indicate the values when B free-rides. There are several game patterns but the game illustrated in the figure 8 is most commonly used. In this game, the worst outcome is unavoidable if both countries adopt individually the best option that is to defect (free-ride).

Hence, collective action theory tells us that the desirable result will not be reached when individual participants try to maximize its own economic benefit. This is considered particularly true for international community because there is no authority in the international community that can force its individual members to choose an option that can maximize the benefit for the overall community. As Coase theorem indicates, market economy will work properly if the property rights are properly defined, but under international laws it is often not possible.

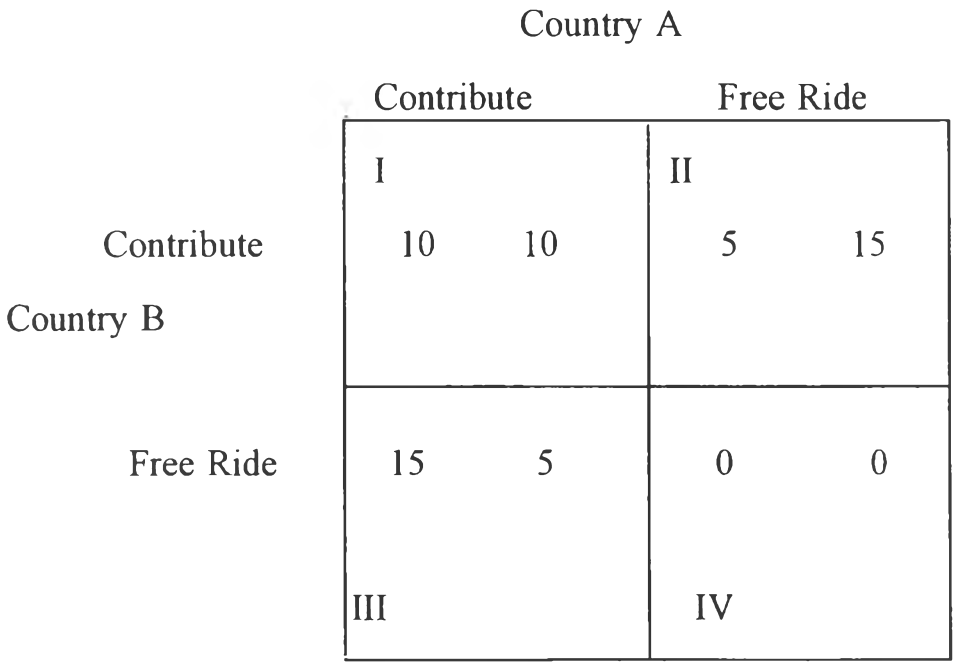
This is why international agreements are required. International agreements can overcome this collective action problem by providing necessary legal framework to which all member countries are requested to abide by. Economic sanctions or other types of punishments can also be introduced to let the agreements work properly.

The Figure 9. indicates the case when the country A damages the environmental quality of its domestic tropical forests at the point d1 and international community wishes to regulate the damage to be reduced to the level of d2. If property rights are properly defined to the global community, the damage level can decrease from d1 to d2 automatically but in the international society A is free to choose d1 as its best economically beneficial level because A has absolute sovereign power to decide the level of its economic activities. In the case of tropical forests, a topical timber producing country can determine by itself the level of timber production. However, if A is a member of an international agrement that regulates the level of damage to the environmental quality, A has to abide by the rules set by the agreement. As already stated above, international community can even punish A if it does not observe the conditions set by the agreement.

In other words, as Ostrom indicated in his 1990 article, collective action problem can be solved if proper negotiation or information exchange can be made before each participant to the game decides its own individual action. In the case of Figure 8,

the right bottom is the outcome reached in the absence of international agreement, and the top left can be the outcome obtained under an international agreement.

Figure 8: International Agreement and Game Theory

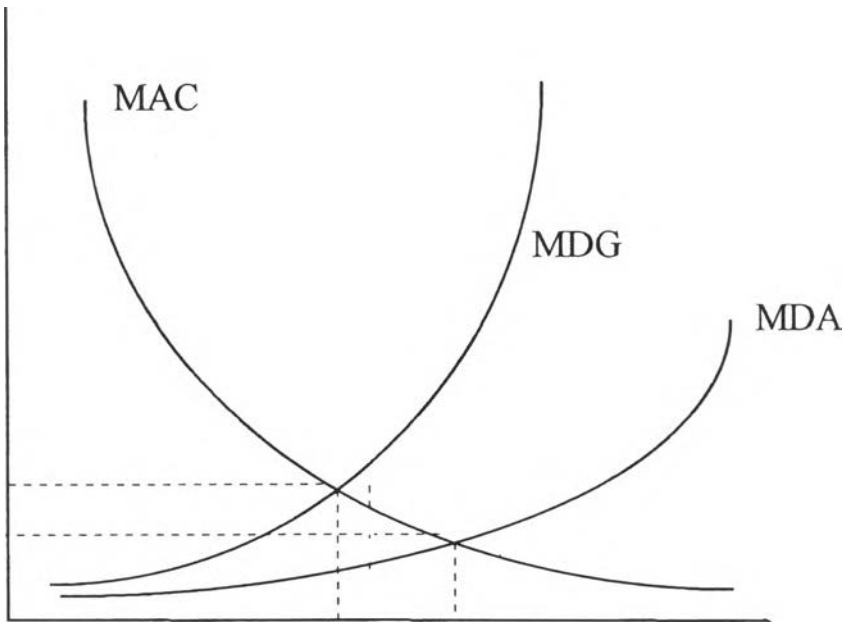


IV is the result without an international agreement

I is the result with an international agreement

Figure 9. Contribution and Forest Depletion Relation

Contribution $



MDA is the Marginal Damage Curve for Country A.

MDG is the Marginal Damage Curve for the Global Community.

(3) Other economic theories relevant to tropical forests

There are several other economic theories that can be utilized to analyze the arrangements to be taken by the ITTO for protection of tropical forests. Examples of such theories are theory of opportunity cost, theory of monopolistic market and theory of elasticity of substitution, to name only a few. Apparently, it is necessary to take into account the opportunity cost of timber production in order to determine true value of tropical forests. Also, it is important to know the mechanism of OPEC type production cartel because commodity agreements basically supports the idea of production cartel to maintain a profitable international price for producing countries. If the tropical timber price is to be controlled by ITTO, it would be imperative to know the price elasticity of substitution to measure the impact of price changes of substitute products onto the tropical timber products. Here, the theory of monopolistic market and its implication to ITTO mechanisms are briefly explained.

What would happen in the tropical timber market if the ITTO introduces price intervention measures such as quota allocation? The following general theory of monopolistic market can provide an answer to this question.

The Figure A illustrates the market equilibrium level (E) and the level monopolistically set by producers (M). The monopolistic production level is lower than the market-oriented production level; therefore, the resource can be conserved by the introduction of monopolistic measures. The monopolistic price level is higher than the market price level; therefore, the producers can receive sufficient revenue despite reduction in production.

The most serious problem to be caused by such production restrictive measures is the possibility of chiseling. Individual producing member countries find attractive to increase their quota allocation because the producers' preferred production amount at the price level P2 is at Q3. If many producing countries try to increase their production above their allocation quota, the effect could be devastating for their forest assets. If all countries try to gain extra revenue by selling timbers at the price P2, production level

will be Q3 which is much higher than the level produced under free market.

Hence, for such production restrictive measures to be successful, strict control over the producing member countries is imperative.

In connection, it would be beneficial to touch briefly upon the theory of elasticity of substitution because the elasticity can affect the outcome of production restriction measures under monopolistic market control.

In the case of tropical timbers, temperate timbers are the substitution products. The effect of ITTO trade intervention measures depend heavily on demand change of topical timbers against temperate timbers.

Figure B1 shows the case the elasticity of substitution is high between tropical timbers and temperate timbers. When the price ratio between topical timbers and temperate timbers is P1:p, quantity of tropical timbers traded in the market is Q1 and temperate timbers at q1. Now let us suppose that the price of tropical timbers increased because of the price intervention arrangement by ITTO and the price ratio between the two timber products became P2:p. If the elasticity of substitution is high between the two timber products, the indifference curve touches the new budget curve (p-P2) at the point highly in favor of the temperate timbers. Therefore, the quantity of tropical timbers traded in the market now greatly decreased from Q1 to Q2 while the quantity of temperate timbers trade increased from p1 to p2.

Figure B2 shows the case the elasticity of substitution is low between tropical timbers and temperate timbers. In this case, both topical timbers and temperate timbers decrease their respective quantity trade in the market in accordance with the price change of tropical timbers Although the quantity of tropical timbers traded in the market decreased, the amount reduced is much smaller than the case stated in the Figure B1. In the Figure B2, new quantity traded in the market is Q2 for tropical timbers and q2 for temperate timbers.

Thus, trade intervention measures do not always create desirable outcome for tropical timbers. If the elasticity of substitution is high against temperate timbers, price increase caused by the ITTO mechanisms significantly shifts the demand of tropical

timbers to temperate timbers. If this is the case, ITTO's trade intervention mechanisms would not achieve desirable outcome. It should be noted that temperate timbers may not be the only products that can substitute tropical timbers. Non-timber products such as metal or plastic can also act as substitution products in the market. It is necessary to know the elasticity of substitution with all these products if the ITTO's market intervention mechanisms are to succeed.

Figure A: Tropical Timber Export Quota Allocation and Market

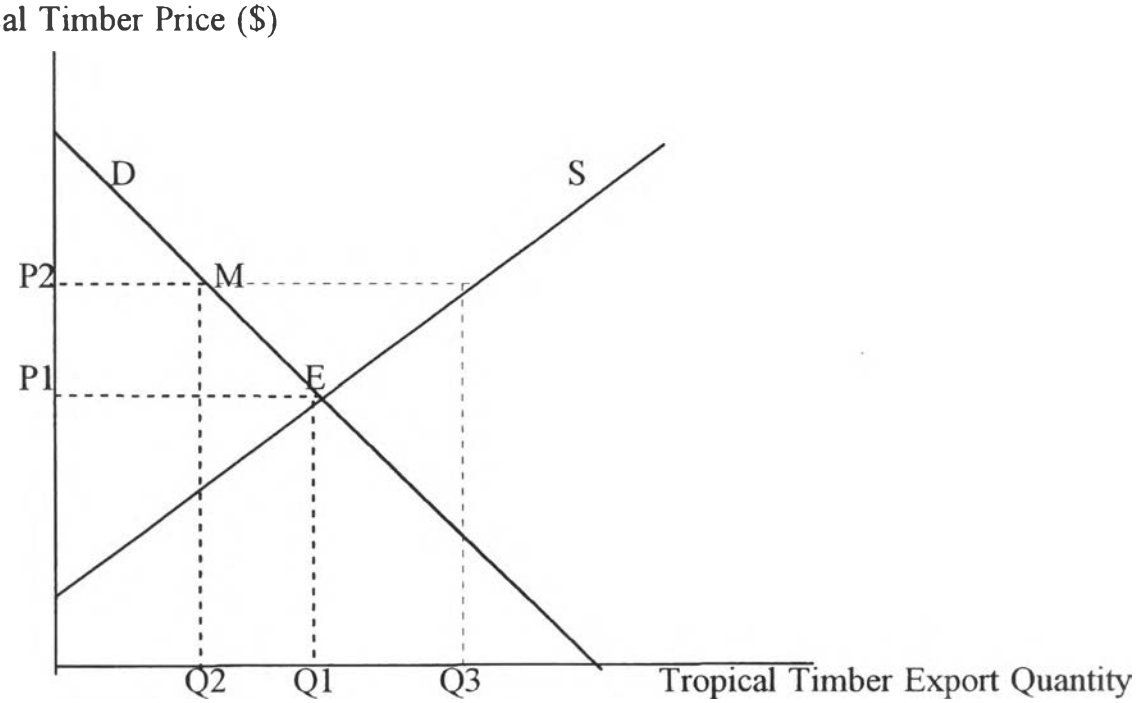


Figure B1: Elasticity of Substitution (High Elasticity)

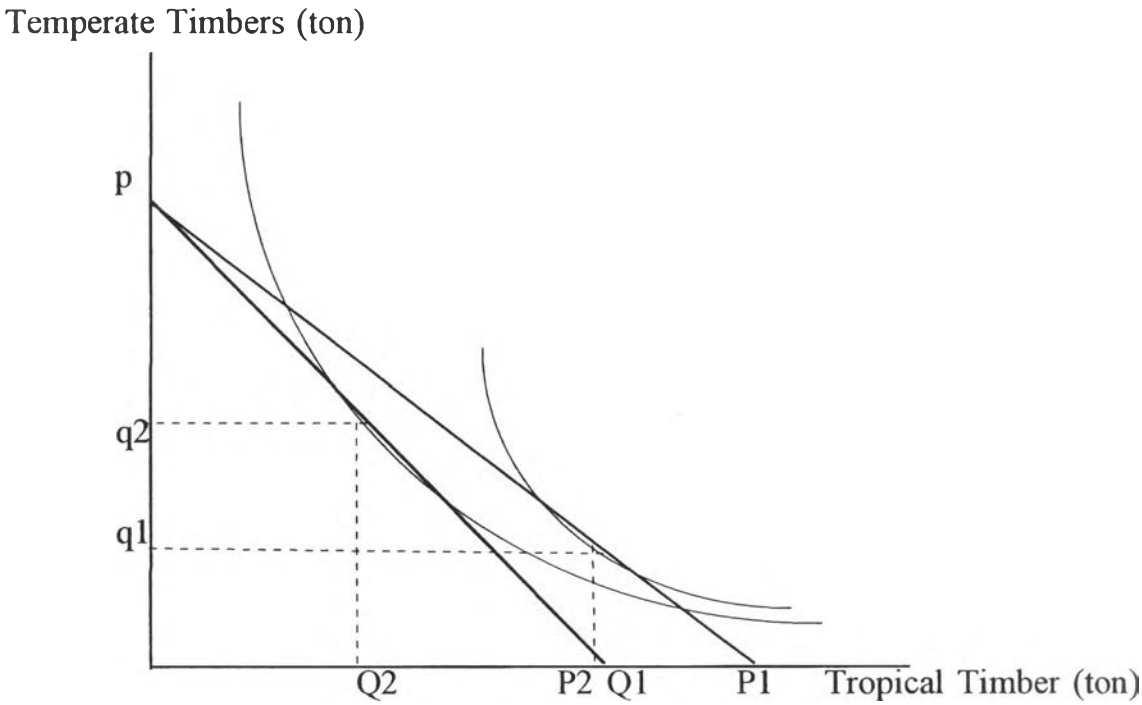
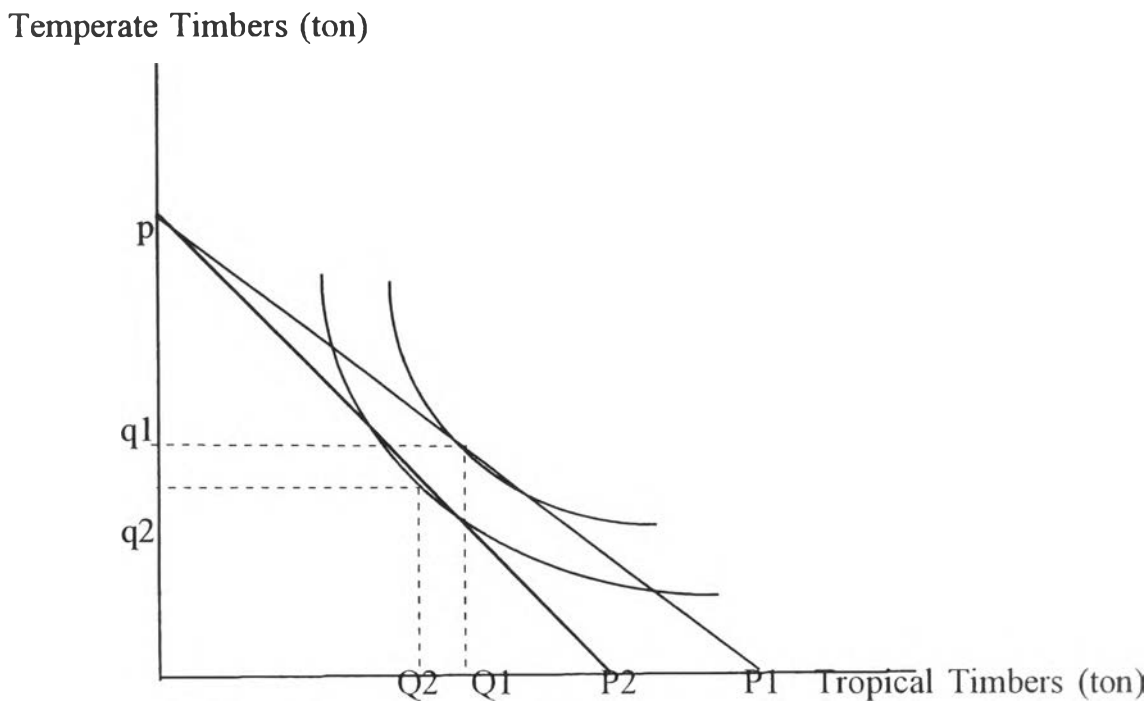


Figure B2: Elasticity of Substitution (Low Elasticity)



3.2 Data to Go into Models

-- General perspective of tropical forests and ITTO mechanisms --

In this chapter, application of the above theories to ITTO mechanisms and its surrounding economic situation would be examined. As explained in Chapter 2, ITTA of 1994 proclaimed to establish the Bali Partnership Fund to finance sustainable management of tropical timber trade by the year 2000. There have been heated discussions since the adoption of ITTA of 1994 with regard to the amount needed to realize this target, but no consensus has been reached until today. No figures have been officially recognized by the ITTO's various fora. Producing countries tend to assert that a large amount of compensation is needed from Consuming countries if the latter request the former to forgo a part of economic values being accrued from exploiting tropical forests, while Consuming countries tend to request that Producing countries also take responsibility to protect global environment. However, there are two unofficial estimates provided by private researchers. One research conducted in 1992 estimated the amount to be needed to achieve the target would be around 400 million US dollars per year. According to this research, the net required amount is 300 million dollars because 100 million dollars are already being provided. The other research estimated that 1.5 billion US dollars per year is needed. [Barbier et al, p140-142] In this thesis, these two figures are assumed to be the amount needed to implement ITTO's 2000 year objective.

Before actually applying the above data with economic theories to ITTO mechanisms, it would be necessary to introduce some other background figures related to tropical forests depletion and the general direction of ITTO negotiations. Tables 3. and 6. tell us that overall tropical forests annual depletion rate is 0.8%, while its increase rate by plantation is approximately 0.2%. Therefore, annual net depletion rate is considered to be approximately 0.6%. Figure 10 illustrates current and future maximum production curves (budget lines) between tropical timber net consumption and forest exploitation. Naturally, as long as net depletion rate is a positive figure, this budget line will eventually shrink to the left of the sustainable boundary of S. If the global tropical

forests plight becomes this stage, they can no longer provide sufficient environmental services, such as sink capacity of CO2, to the global community even though the rate of net depletion then becomes zero.

Figure 10: Current and Possible Future Budget Lines

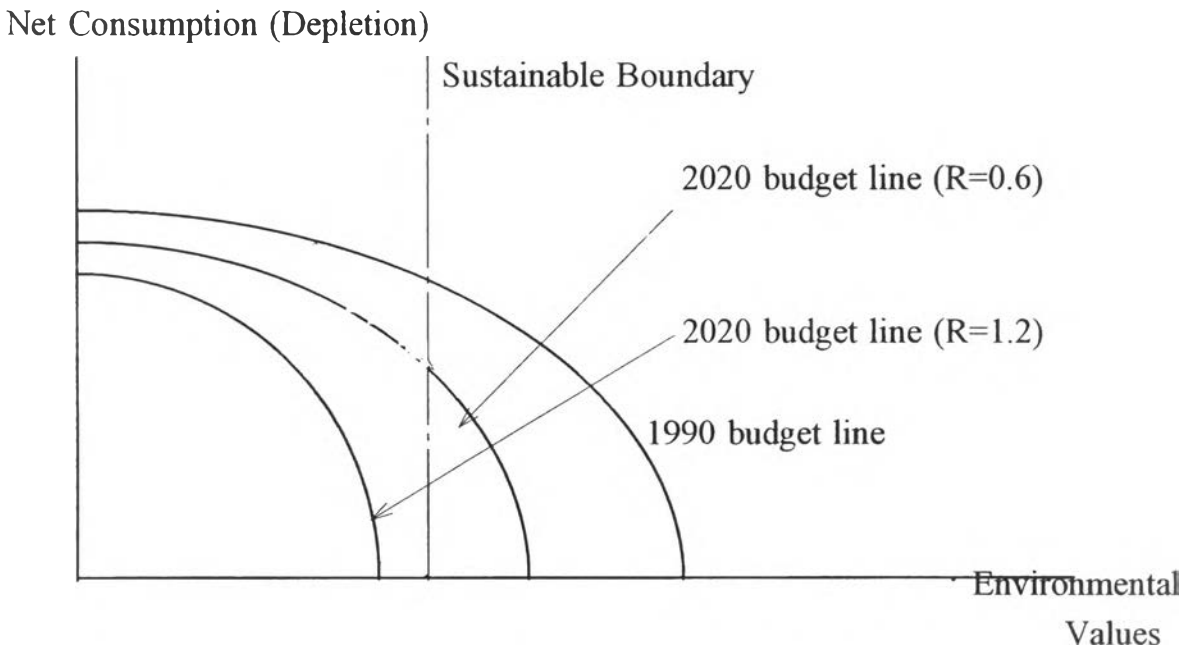
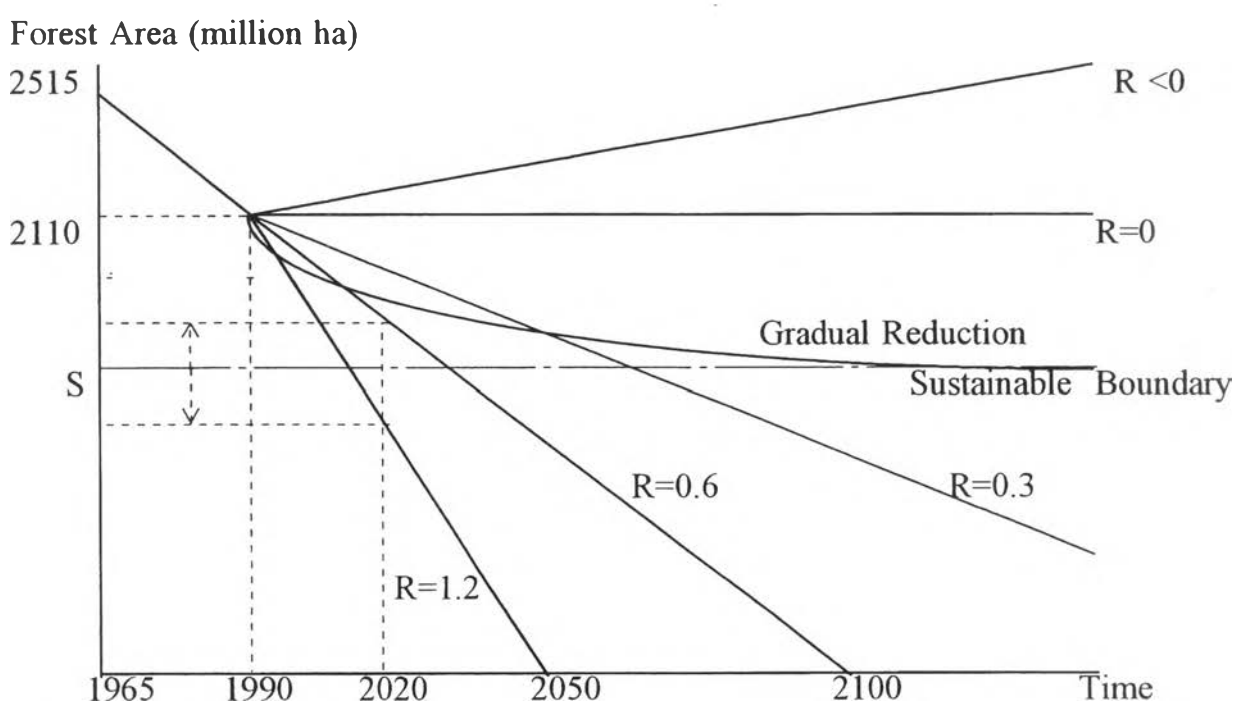


Figure 11: Long-tern Tropical Forests Depletion Perspectives



In this connection, the number of years required for complete depletion under this current net depletion rate is calculated as follows:

Case 1. 0.6% per year (current rate)

(Years)	(Depletion)
10 years	6.2%
30 years	19.7%
50 years	34.9%
68 years	50.0%
116 years	100%

If the rate changes to 0.3 and 1.2, the following time spun for complete depletion is expected.

Case 2. 0.3% per year (improved rate)

(Years)	(Depletion)
10 years	3.0%
30 years	9.4%
50 years	16.2%
136 years	50.0%
232 years	100%

Case 3. 1.2% per year (deteriorated rate)

(Years)	(Depletion)
10 years	12.7%
30 years	43.0%
34 years	50.0%
50 years	81.6%
59 years	100%

The above three cases are illustrated in the Figure 11. In any case, as long as the annual net depletion rate is positive, tropical forests are doomed to be wiped out completely soon or later, most likely within a hundred years. As the figure 11 shows, net depletion rate has to become zero at a point in the near future if the tropical forests are to be sustainably managed. What is generally envisaged under the ITTO's 2000 year objective is to realize this Gradual Reduction curve in the Figure 11. It is a simple fact that either or both reduction in depletion rate and improvement in plantation rate need to be achieved for realization of this goal.

The level of efforts needed by the ITTO member countries depends heavily on where the sustainable boundary level is. If the level S is much lower than the one in the Figure 11, the ITTO members can spend much longer years to realize this goal. It may not have to be the year 2000. If the level is already higher than current stock level, it is imminent for them to avert the direction of depletion to increase the total amount of tropical forests. Unfortunately, although there have been heated discussion among ITTO member countries, this level of sustainable management has not been identified.

Some of the variations of the Figure 11 are illustrated in the Figure 11a and 11b. The Figure 11a is the case ITTO decides the sustainable level of tropical forests for its 2000 year target is the level of 1990 when this target was being formulated. In this case, the tropical forest depletion has to be reduced back to the level of S90 curve in the Figure 11a by the year 2000. This scenario has become more and more unlikely as the forest depletion has not stopped until today.

Figure 11b illustrates the case ITTO decides the sustainable level be much higher than the S90 level. This may be possible because most of the consuming countries consider that tropical forests in 1990 were already over-exploited. In this case, tropical forests depletion rate has to become negative to push the depletion curve up to the level of Sh in the Figure 11b. This scenario has become virtually impossible to be achieved by the year 2000. Based on this reality, some ITTO member countries started to demand that the target year be postponed from 2000 to a later year.

Figure 11a: The case sustainable level is set at 1990

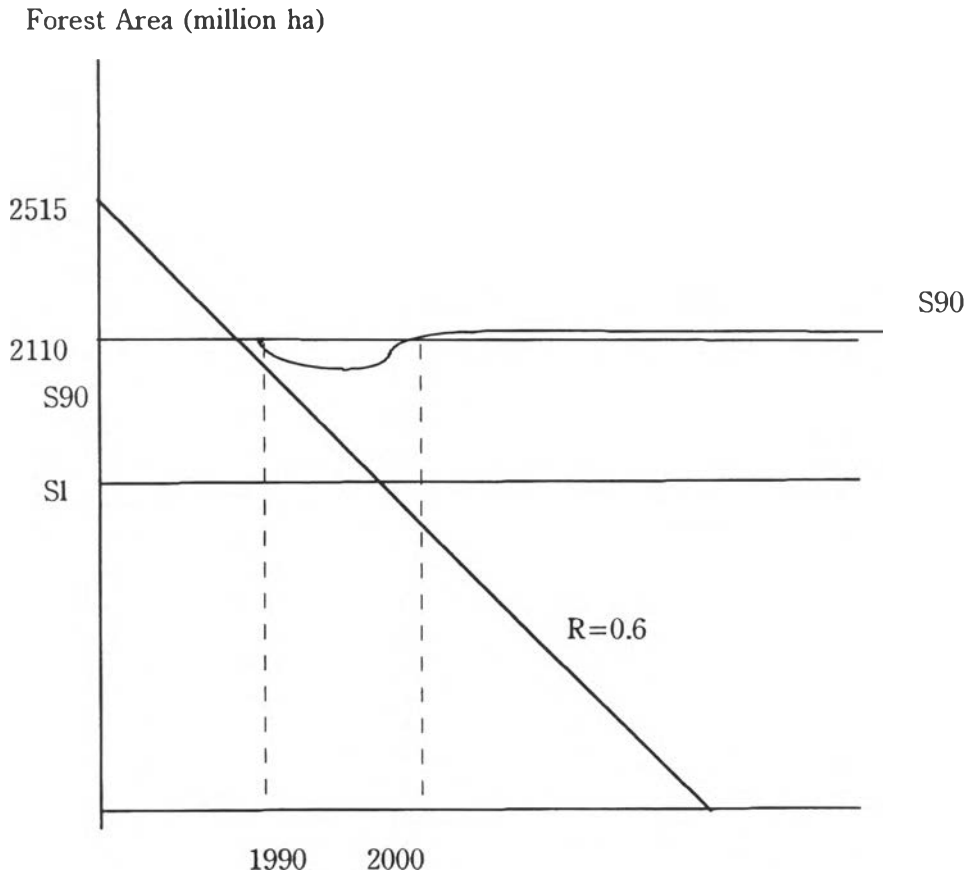


Figure 11b: The case sustainable level is much higher than present level

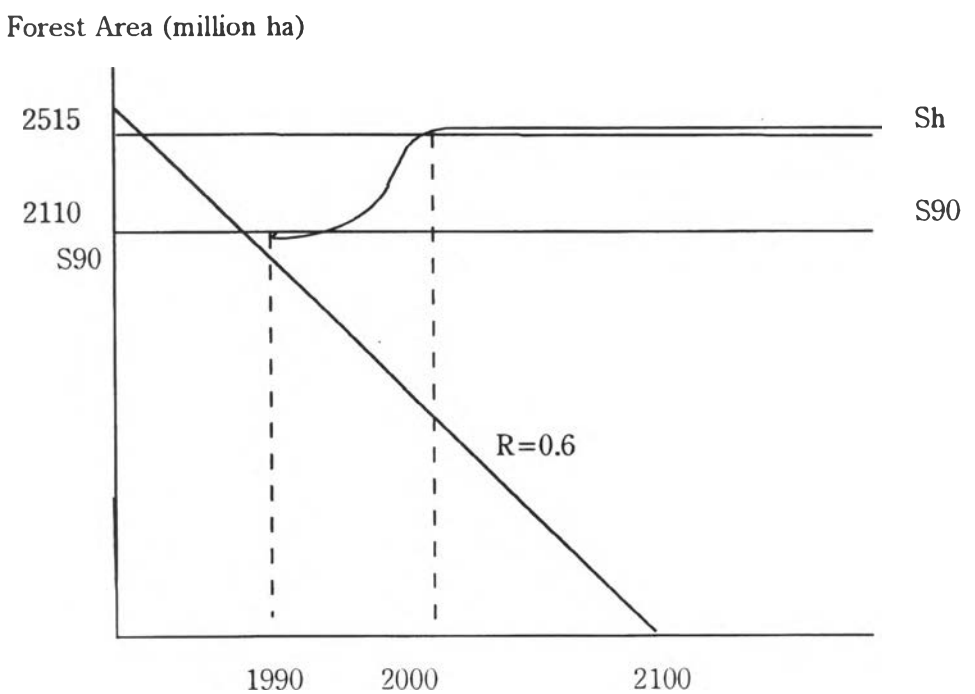


Figure 12 indicates MAC (marginal abatement cost) presently recognized by ITTO's consuming countries, MDp (marginal damage of producers) perceived by the ITTO's producing countries, and MDg (marginal damage of global community). All of these are hypothetical curves. The current level of forest depletion is considered to be occurring at the level d1 where these two lines intersect. The amount being paid to keep this level of forest depletion is set at 100 million US dollars (see p62). Now, let us suppose that the global community, though most likely represented by ITTO's consuming countries alone*, decides that the sustainable level of forest exploitation should be at the point S and the corresponding amount of contribution annually required is 400 million US dollars. In order for this to happen, MDp must shift upwards from MDp to MDg in the Figure 12, which implies that ITTO's consuming countries are expected to contribute extra 300 million US dollars to keep this level.

Figure 13 shows the case that 1.5 billion US dollars are required to achieve year 2000 target (see p62). It simply indicates that the MDg curve must make a large shift for achieving level S of forest depletion. The corresponding amount, i.e., 1.5 billion US dollars, needs to be contributed from consuming countries under this case.

Figure 14 is the case that MDp remains the same level and MAC shifts downward to achieve the level S. For this to happen, ITTO producing countries need to provide measures or fund to alleviate the burden of consuming countries. As Coase theorem indicates, if the property rights of changing the level of environmental quality are properly given to consuming countries, then this becomes a realistic case. However, in reality, it is the producing countries that have perfect sovereign over their internal tropical forest resources. Thus, Figure 14 is not considered plausible in the case of ITTO arrangements. Likewise, the Figure 12 is the case property rights are properly given to producing countries, and this is suited to explain the case of ITTO. Here, in accordance with Coase theorem, MAC curve remains the same and MDp curve shifts to MDg as responsibility of consuming countries.

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* It is assumed in this paper that, when consumers and producers perceive different value in environmental quality of tropical forests, the larger one is presumed to be equivalent to the global value.

Figure 12: ITTO Contribution and Sustainable Level of Forest Depletion (Case 1)

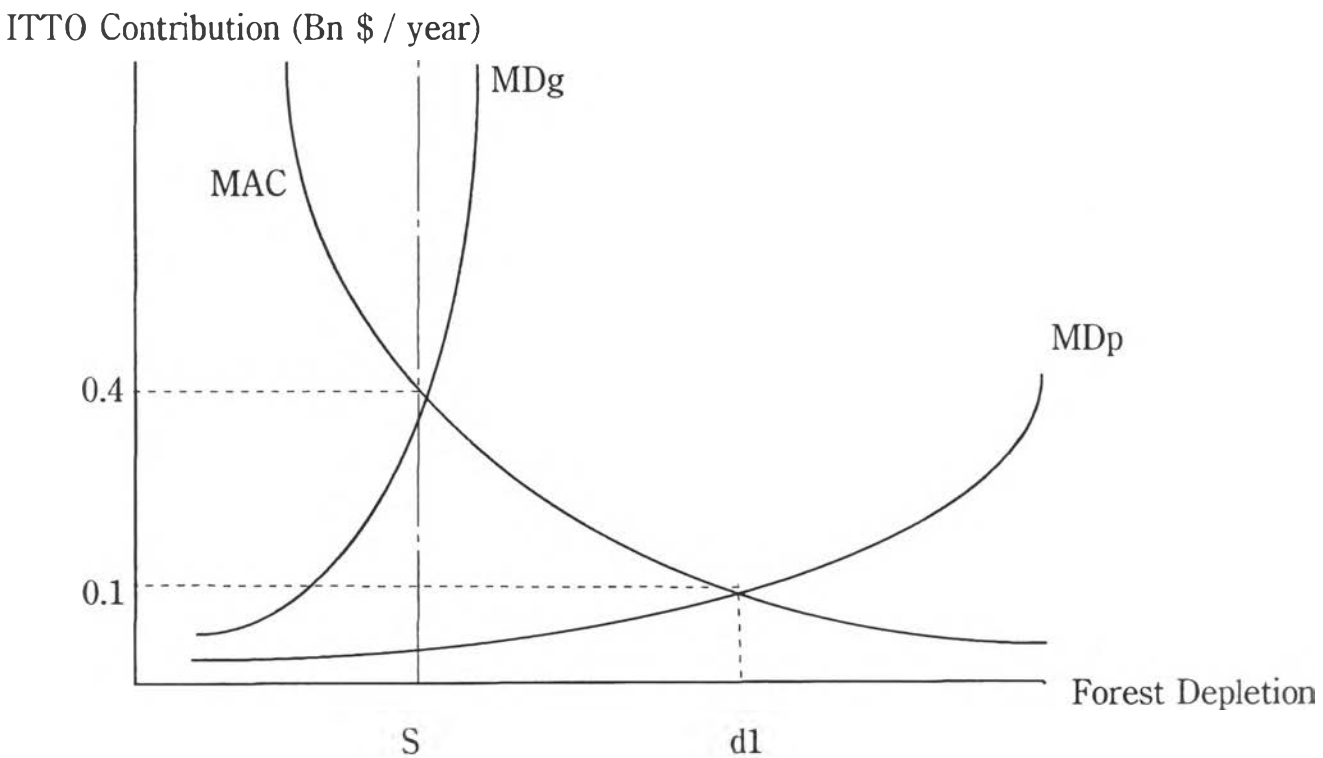


Figure 13: ITTO Contribution and Sustainable Level of Forest Depletion (Case 2)

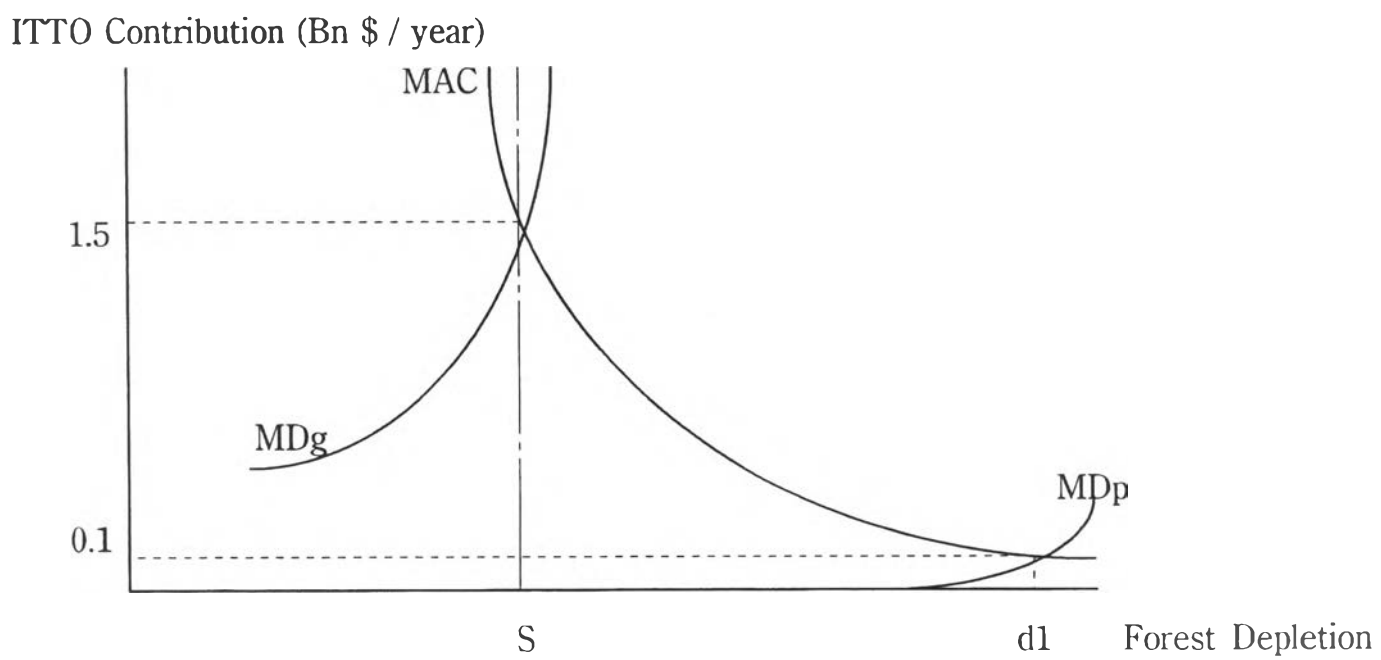
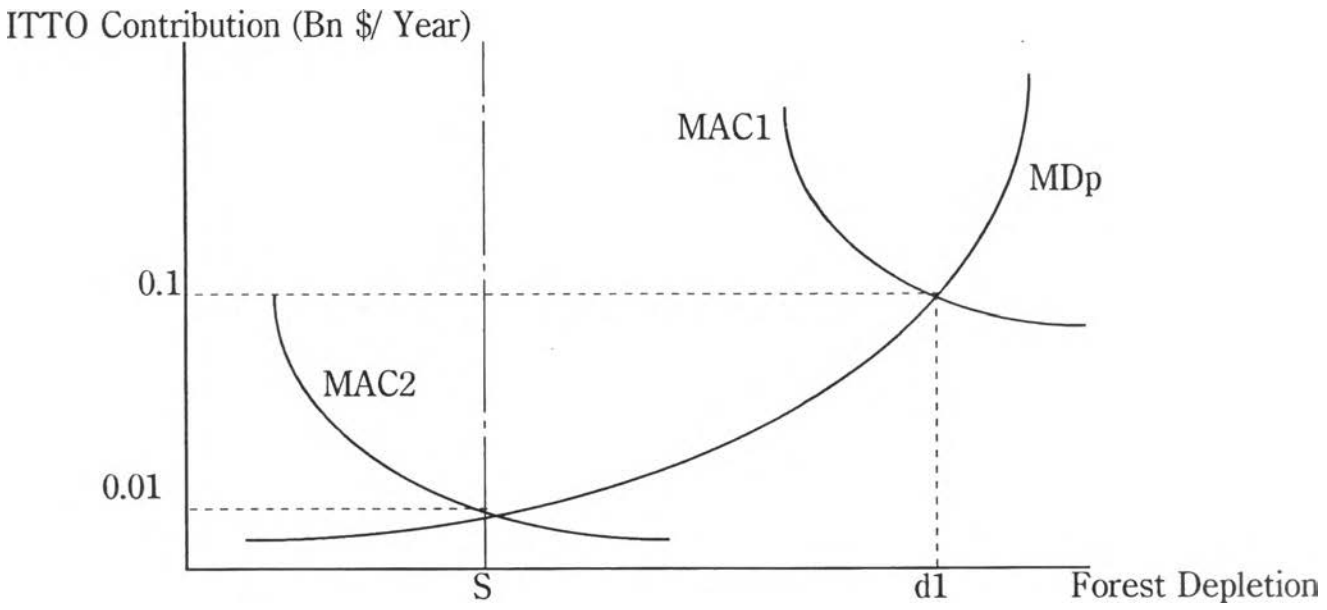


Figure 14: ITTO Contribution and Sustainable Level of Forest Depletion (Case 3)



3.3 Analytical Method to be Used

(1) Game theory scenarios and possible ITTO contribution arrangements to the Bali Partnership Fund

In this thesis, six basic scenarios are introduced. For five basic scenarios for producers, an extra scenario is introduced for each of them that examines the effect of fund transfer from consumers to consumers as a means of compensation. The last scenario is for consumers, and Japan is introduced as a model consuming country. Thailand and Malaysia are introduced as models for producers. In addition, a supplementary game that includes a penalty factor is played for all the scenarios. All tables for these penalty games are put in the Attachment to this thesis. Further, three cases are examined under all five scenarios for producers. The case 1 is the game under which producers and consumers are assumed to recognize the same environmental value in the tropical forests. Under the case 2, producers are assumed to identify no value in the tropical forests as the environmental assets. Producers are assumed to identify half as much environmental value as consumers do under the case 3.

(a) Scenario 1

As already stated previously, 1500 million US dollars are estimated as an annually needed amount for global conservation of tropical forests. This possibly implies that sustainable environmental value of tropical forests is recognized to be US$ 1500 million and that the magnitude of damage to the environment is also US$ 1500 if there is no contribution made to protect tropical forests. This relation between contribution and environmental value under the above assumptions can be put in an equation as shown in the Figure 15 (Scenario 1).

Based on this equation, a game illustrated in the Figure 16 would be employed to examine possible distribution of contribution to the Bali Partnership Fund between

ITTO's consuming countries and producing countries. The global environmental value in columns I, II and III in the Figure 16 is 1500 million dollars because this is the assumed amount to achieve sustainable level of tropical forests management. Any amount under this amount is assumed hereby unsatisfactory.

In order to simplify the games, the following two conditions are assumed for all games to be played in this paper hereafter.

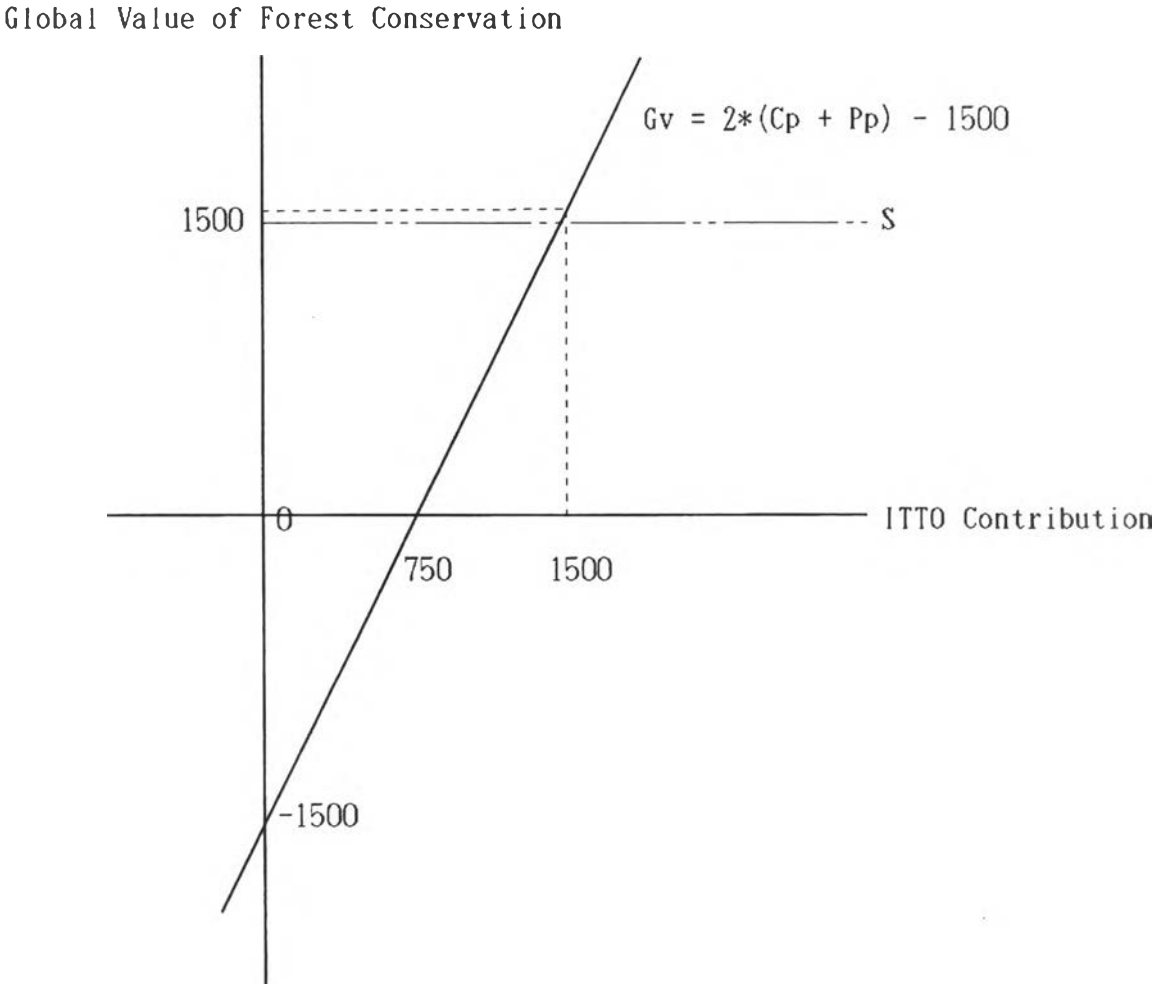
(i) When Consumers and Producers perceive different value in environmental quality of tropical forests, the larger value is presumed to be equivalent to the global value attached to tropical forests.

(ii) When either Consumers or Producers have intention to make contribution to the Bali Partnership Fund, the Fund will be fully supplied even though the other party does not make any contribution at all.

(iii) Factor "e" adopted in the model v of the 1990 Ostrom's thesis is assumed to exist within ITTO. Therefore, the games played in this paper do not fall into prisoner's dilemma. The Ostrom's factor "e" is represented as 'a' for all the games except supplementary games with a penalty parameter represented as 'e'.

The left figure in each column indicates the total value for consuming countries and the right figure indicates the total value for producing countries. Based on the above-mentioned assumptions, either consumers or producers are expected to provide entire contribution in the columns II and III. Both groups would contribute the same amount in the column I, while both provide no contribution in the column IV.

Figure 15: Relation between ITTO contribution and Global Environmental Value of Tropical Forests / Scenario 1 (Gv = 2*(Cp + Pp) - 1500)



Gv = Global Value of Tropical Forests Conservation
Pp = Contribution paid by ITTO Producing Countries
Cp = Contribution paid by ITTO Consuming Countries

Figure 16: Contribution to the Bali Partnership Fund and Game Theory
Scenario 1 (Gv = 2(Cp + Pp) - 1500)

ITTO Consuming Countries	ITTO Producing Countries: Contribute	ITTO Producing Countries: Not contribute
Contribute	I (Gv) Cv Pv	II (Gv) Cv Pv
Not contribute	III (Gv) Cv Pv	IV (Gv) Cv Pv

(million $)

Gv = Global Value Gained from Tropical Forest Conservation
Cv = Total Value for Consumers
Pv = Total Value for Producers
Cp = Contribution by Consumers
Pp = Contribution by Producers
Gvc = Global Value Perceived by Consumers
Gvp = Global Value Perceived by Producers
Cpr = Consumers Payment Ratio / Ppr = Producers Payment Ratio
e = Cost of enforcement by penalty (e is applied for non-contributors)
a = Cost of enforcement by self arranged arbitrator
(When a>0, the game is under the control of the arbitrator)

Gv = 2(Cp + Pp) - 1500
Cv = Gv - Cp
Pv = Gv - Pp
It is assumed that either Consumers or Producers provide entire contribution when either Cp or Pp is zero.
Namely, Cpr:Ppr = 5:5 (Column I), Cpr:Ppr = 10:0 (Column II)
Cpr:Ppr = 0:10(Column III), Cpr:Ppr = 0:0 (Column IV)

The Figure 17 -19 illustrate how the budget allocation to the Bali Partnership Fund can be made between ITTO producing countries and ITTO consuming countries in accordance with theory of collective actions by using the game described in the Figure 16. The Figure 17 illustrates the case that both producers and consumers value the environmental assets of tropical forests equally. Fifteen hundred million US dollars is assumed to be the amount required to the Bali Partnership Fund. In this Figure, it is presumed that both producers and consumers are requested by the ITTO Council to contribute 750 million US dollars each to acquire 1500 million US dollars equivalent of environmental services from tropical forests. It is also presumed that the value of the environmental services are recognized by the both sides equally beneficial. In this game, as a traditional game theory indicates, the logical result will be the column IV in which both do not contribute. If the both sides behave individually to obtain the maximum benefit for themselves, this is the inevitable result. In other words, if the contribution is left to the market principles, the Bali Partnership Fund will inevitably fail. Nevertheless, it is clear that the column I is a better result than the column IV for both players of the game. This better result can be obtained if they cooperate through communication and information exchange. Ostrom (Governing the global commons, 1990) introduced a very detailed analysis of the game theory and concluded that a built-in enforcement mechanism (factor "e") and proper communication can prevent games from reaching less desirable results. ITTO is indeed an organization where member countries abide by the binding rules and exchange information to seek the best arrangements for them to induce maximum benefit without relying on market forces. It should be reminded that commodity agreements are accepted as an exception of free trade under GATT XX (h). GATT allows ITTO to come up with anti-market measures. ITTO, as an international commodity agreement organization, therefore can overcome the defect of market mechanisms predicted by the game theory.

Hence, it would be possible for the Bali Partnership Fund to receive sufficient contributions from member countries just like the game illustrated in the Figure 17.

Figure 18 illustrates the case ITTO producing countries do not identify any

values in the tropical forests environmental assets and do not have any incentive to contribute to the Fund. This is actually the case close to reality faced among ITTO members. In general, ITTO producing countries demand that the consuming countries bear all the expenses for the Bali Partnership Fund as compensation for their opportunity costs of tropical forests utilization. In the game illustrated in the Figure 18, it will not be possible for producing countries to make contribution to the Fund even though both players hold proper communication each other. Under this game, the only desirable result for environment protection is the column II where consumers bear entire contribution. Unfortunately, when consuming countries believe the environmental quality is a universal property, this is not likely to happen. Then, according to game theory, the only possible result is the bottom right. This would be catastrophic for the world tropical forests.

Figure 19 illustrates the case ITTO producing countries identify only half of the environmental value of tropical forests recognized by consuming countries. In this game, the best result for environment conservation is either column I or column II, but for this to happen, members of ITTO must overcome the logical result of the column IV as predicted by the traditional game theory. If they overcome it, it is left for the both parties to negotiate and decide which one between I and II is to be chosen.

In realty, it would be very difficult to achieve the year 2000 objective if producing member countries do not recognize any value in environmental quality of the tropical forests. No matter how large the contribution from consuming countries is, forest depletion may not be reduced under such a case. Cost estimation also tend to become impractically high, exactly as the current discussions by ITTO members show. This should be true from the general understanding that an efficient outcome can not be obtained when there is no incentive to do so. Under the fact that the tropical forests are CPRs or public goods, this would be particularly true.

Therefore, it is necessary for ITTO to let its both producing and consuming member countries recognize that the efforts and cooperation by both sides are needed to

prevent forests depletion which is counter-beneficial for all countries in the world. In order to do this, further research and negotiations are required. Having noted this, it is indeed exactly what ITTO is trying to do now. It is hoped that these researches and negotiations at ITTO will lead to the creation of common goal and common value for all members of ITTO. The above case in the Figure 18 had better be avoided. If all ITTO member countries recognize the same environmental value of tropical forests, the games like in the figures 17 and 19 would become possible.

Figure 17: Same environmental value for both consumers and producers

Case 1: Gv = Gvc = Gvp, e = 0, a > 0

ITTO Consuming Countries	ITTO Producing Countries: Contribute	ITTO Producing Countries: Not Contribute
Contribute	I (1500) 750 750	II (1500) 0 1500
Not Contribute	III (1500) 1500 0	IV (-1500) -1500 -1500

(million $)

I: Gv = 2*{750(Cp) + 750(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 750(Cp) = 750
Pv = 1500(Gv) - 750(Pp) = 750

II: Gv = 2*{1500(Cp) + 0(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 1500(Cp) = 0
Pv = 1500(Gv) - 0(Pp) = 1500

III: Gv = 2*{1500(Cp) + 0(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 0(Cp) = 1500
Pv = 1500(Gv) - 1500(Pp) = 0

IV: Gv = 2*{0(Cp) + 0(Pp)} - 1500 = -1500
Cv = -1500(Gv) - 0(Cp) = -1500
Pv = -1500(Gv) - 0(Pp) = -1500

Game result: Success, because Column I Pv > Column IV Pv.
Column II and III are possible if either side agrees to pay the entire amount under political consideration.

Figure 18: No environmental value for producers

Case 2: Gv = Gvc, Gvp = 0, e = 0, a > 0

		ITTO Producing Countries: Contribute	ITTO Producing Countries: Not contribute
ITTO Consuming Countries	Contribute	I (1500) 750 -750	II (1500) 0 0
	Not contribute	III (1500) 1500 -1500	IV (-1500) -1500 0

(million $)

I: Gv = 2*{750(Cp) + 750(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 750(Cp) = 750
Pv = 0(Gv) - 750(Pp) = -750

II: Gv = 2*{1500(Cp) + 0(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 1500(Cp) = 0
Pv = 0(Gv) - 0(Pp)/2 = 0

III: Gv = 2*{1500(Cp) + 0(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 0(Cp) = 1500
Pv = 0(Gv) - 1500(Pp) = -1500

IV: Gv = 2*{0(Cp) + 0(Pp)} - 1500 = -1500
Cv = -1500(Gv) - 0(Cp) = -1500
Pv = 0(Gv) - 0(Pp) = 0

Game result: Failure, because the game falls into PD.
Column II is possible if Consumers agree to pay the entire amount under political consideration.
Column I is not possible because Column I Pv < Column IV Pv.

Figure 19: Half environmental value for producers

Case 3: Gv = Gvc, Gvp = Gv/2, a>0

ITTO Consuming Countries \ ITTO Producing Countries	Contribute	Not contribute
Contribute	(1500) 750 0	(1500) 0 750
Not contribute	(1500) 1500 -750	(-1500) -1500 -750

(million $)

I: Gv = 2*{750(Cp) + 750(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 750(Cp) = 750
Pv = 1500(Gv)/2 - 750(Pp) = 0

II: Gv = 2*{1500(Cp) + 0(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 1500(Cp) = 0
Pv = 1500(Gv)/2 - 0(Pp) = 750

III: Gv = 2*{1500(Cp) + 0(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 0(Cp) = 1500
Pv = 1500(Gv)/2 - 1500(Pp) = -750

IV: Gv = 2*{0(Cp) + 0(Pp)} - 1500 = -1500
Cv = -1500(Gv) - 0(Cp) = -1500
Pv = -1500(Gv)/2 - 0(Pp) = -750

Game result: Success, because Column I Pv > Column IV Pv.
Column II and III are possible if either side agrees to pay the entire amount under political consideration.

(b) Scenario 1b

Figure 16-2 indicates the case the contributions from ITTO consuming countries are to be given directly to ITTO producers. ITTO producing member countries may claim compensation for their opportunity cost if they have to give up their economic activities and development schemes in achieving Year 2000 Objective. In fact, as already discussed in the Chapter 2, economic development is the key factor that causes tropical forest depletion in the ITTO producing member countries. Here, it is assumed that the said 1500 million US dollars needed to achieve Year 2000 Objective include costs to compensate the foregone value of opportunity cost for ITTO producers. Therefore, the Bali Partnership Fund needs to supply cash to ITTO producing countries engaged in pursuing sustainable management of their tropical forest at the expense of their economic development. Under this scenario, the relation between ITTO contributions and conservation value can be illustrated as show in the Figure 16-2 (Scenario 1b).

Figure 16-2: Contribution to the Bali Partnership Fund and Game Theory

Scenario 1b (Gv = 2(Cp + Pp) - 1500)&(Pv = Gv - Pp + Cp)

ITTO Consuming Countries \ ITTO Producing Countries	Contribute	Not contribute
Contribute	I (Gv) Cv Pv	II (Gv) Cv Pv
Not contribute	III (Gv) Cv Pv	IV (Gv) Cv Pv

(million $)

Gv = Global Value Gained from Tropical Forest Conservation
Cv = Total Value for Consumers
Pv = Total Value for Producers
Cp = Contribution by Consumers
Pp = Contribution by Producers
Gvc = Global Value Perceived by Consumers
Gvp = Global Value Perceived by Producers
Cpr = Consumers Payment Ratio / Ppr = Producers Payment Ratio
e = Cost of enforcement by penalty (e is applied for non-contributors)
a = Cost of enforcement by self arranged arbitrator
(When a>0, the game is under the control of the arbitrator)

Gv = 2(Cp + Pp) - 1500
Cv = Gv - Cp
Pv = Gv - Pp + Cp
It is assumed that either Consumers or Producers provide entire contribution when either Cp or Pp is zero.
Namely, Cpr:Ppr = 5:5 (Column I), Cpr:Ppr = 10:0 (Column II)
Cpr:Ppr = 0:10(Column III), Cpr:Ppr = 0:0 (Column IV)

Figure 17-2, Figure 18-2 and Figure 19-2 respectively indicate the cases corresponding to their scenario figures 17, 18 and 19. Namely, Figure 17-2 show the case both consumers and producers perceive the same value in tropical forest as environmental assets. Figure 18-2 shows the case producers do not see any environmental values in tropical forests. Figure 19-2 shows the case producers recognize half of the environmental value perceived by consumers.

Under these games, total value for producers in the columns I and II is much higher than the value obtained in the games 17 to 19 where consumers contributions are not assumed to be disbursed to producers. Therefore, the possibility for producers to free-ride and try to gain high value in the column II is much higher under this scenario. In this sense, these games are considered to be more likely to fail in protecting tropical forests. However, it is also possible to consider that more motivated producers would negotiate hard with consumers and wold succeed persuading consumers into pay all the contributions. Then, the game will be settled in the column II.

Further, here again, relaxation of game conditions as stated in Ostrom's 1990 article may make it possible for producers to participate in the Bali Partnership Fund. Since the value for producers in the column I is higher than the games 17 to 19, the incentive for producers to avoid column IV and try to realize the column I is also high. In this sense, these games can be considered more likely to induce producers to contribute to the Fund. The most distinctive case is the game illustrated in Figure 18-2. In this game, the value in the column I is equal to that in the column IV for producers; therefore, the producers have less difficulty in contributing. In the game 18, the value for producers in the column I was much lower than that in the column IV; therefore, it is more difficult to expect producers to contribute under scenario 1a than 1b.

Figure 17-2: Same environmental value for both consumers and producers

Case 1: Gv = Gvc = Gvp, e=0, a>0

ITTO Consuming Countries \ ITTO Producing Countries	Contribute	Not Contribute
Contribute	I (1500) 750 1500	II (1500) 0 3000
Not Contribute	III (1500) 1500 0	IV (-1500) -1500 -1500

(million $)

I: Gv = 2*{750(Cp) + 750(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 750(Cp) = 750
Pv = 1500(Gv) - 750(Pp) + 750(Cp) = 1500

II: Gv = 2*{1500(Cp) + 0(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 1500(Cp) = 0
Pv = 1500(Gv) - 0(Pp) + 1500(Cp) = 3000

III: Gv = 2*{1500(Cp) + 0(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 0(Cp) = 1500
Pv = 1500(Gv) - 1500(Pp) + 0(Cp) = 0

IV: Gv = 2*{0(Cp) + 0(Pp)} - 1500 = -1500
Cv = -1500(Gv) - 0(Cp) = -1500
Pv = -1500(Gv) - 0(Pp) + 0(Cp) = -1500

Game result: Success, because Column I Pv > Column IV Pv.
Column II and III are possible if either side agrees to pay the entire amount under political consideration.

Figure 18-2: No environmental value for producers

Case 2: Gv = Gvc, Gvp = 0, e=0, a>0

ITTO Consuming Countries \ ITTO Producing Countries	Contribute	Not contribute
Contribute	I (1500) 750 0	II (1500) 0 1500
Not contribute	III (1500) 1500 -1500	IV (-1500) -1500 0

(million $)

I: Gv = 2*{750(Cp) + 750(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 750(Cp) = 750
Pv = 0(Gv) - 750(Pp) + 750(Cp) = 0

II: Gv = 2*{1500(Cp) + 0(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 1500(Cp) = 0
Pv = 0(Gv) - 0(Pp) + 1500(Cp) = 1500

III: Gv = 2*{1500(Cp) + 0(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 0(Cp) = 1500
Pv = 0(Gv) - 1500(Pp) + 0(Cp) = -1500

IV: Gv = 2*{0(Cp) + 0(Pp)} - 1500 = -1500
Cv = -1500(Gv) - 0(Cp) = -1500
Pv = 0(Gv) - 0(Pp) + 0(Cp) = 0

Game result: In-between, because Column I Pv = Column IV Pv.
Column II is possible if Consumers agree to pay the entire amount under political consideration.
Column III is not possible because Column III Pv < Column IV Pv.

Figure 19-2: Half environmental value for producers

Case 3: Gv = Gvc, Gvp = Gv/2, e=0, a>0

		ITTO Producing Countries	
		Contribute	Not contribute
ITTO Consuming Countries	Contribute	(1500) 750 750	(1500) 0 2250
	Not contribute	(1500) 1500 -750	(-1500) -1500 -750

(million $)

I: Gv = 2*{750(Cp) + 750(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 750(Cp) = 750
Pv = 1500(Gv)/2 - 750(Pp) + 750(Cp) = 750

II: Gv = 2*{1500(Cp) + 0(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 1500(Cp) = 0
Pv = 1500(Gv)/2 - 0(Pp) + 1500(Cp) = 2250

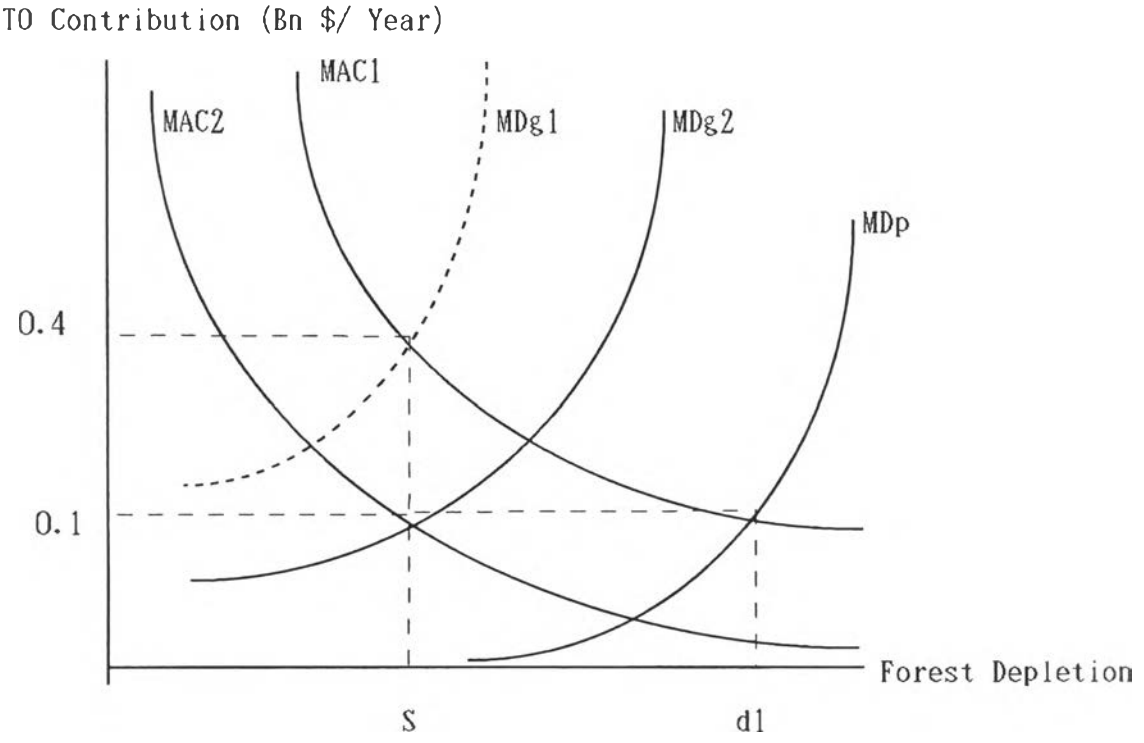
III: Gv = 2*{1500(Cp) + 0(Pp)} - 1500 = 1500
Cv = 1500(Gv) - 0(Cp) = 1500
Pv = 1500(Gv)/2 - 1500(Pp) + 0(Cp) = -750

IV: Gv = 2*{0(Cp) + 0(Pp)} - 1500 = -1500
Cv = -1500(Gv) - 0(Cp) = -1500
Pv = -1500(Gv)/2 - 0(Pp) + 0(Cp) = -750

Game result: Success, because Column I Pv > Column IV Pv.
Column II and III are possible if either side agrees to pay the entire amount under political consideration.

The Figure 20 illustrates the case when producers compromise to take their own measures to conserve tropical forests; thereby making it possible for consumers to pay smaller amount of contribution. In the Figure, not only MD curve changes from MDp to MDg2 but also MAC curve shifts from MAC1 to MAC2. It is then observed that the Level S is achieved at around 100 million US dollars that is cheaper than the level recognized in the game in the Figure 12. This outcome should correspond to a few cases illustrated in the previous Figures such as column I in the Fugues 17 and 17-2, the column I and II of the Figures 19 and 19-2. On the other hand, the current situation and the most likely agreement to be made between producers and consumers is the case consumers bear all expenses which would be utilized by producers to compensate their opportunity costs of forgoing economic values of tropical forests utilization. This corresponds to the column II of the Figure 18 and 18-2.

Figure 20: ITTO Contribution and Sustainable Level of Forest Depletion
(Case 4: Both consumers and producers share responsibility)



The Figure 21 illustrates the budget line of contribution to the ITTO's Bali Partnership Fund. If US$ 1500 million is considered to be the minimum amount required for supporting sustainable management of tropical forests, contribution from member countries has to be made somewhere on this budget line.

The Column I of the Figure 17-19 corresponds to the point A in the Figure 21. This is the point where ITTO's producing countries and consuming countries contribute the same amount. B is the point where consuming countries bear all contribution to the Fund. This is the present general direction of the negotiations being held at the ITTO. Since the Bali Partnership Fund should basically be designed to provide necessary fund for producing countries to take measures in preventing over-exploitation of tropical forests, it may not be proper to consider that producing countries would make actual contribution by cash. Consuming countries are requested by producing countries to pay entire amount though it is not likely for consumers to bear all the responsibilities. Even a very small amount of actual monetary contribution from producing countries, such as the point C, does not seem to be agreed. However, if producing countries agree to bear a part of the burden, not a cash contribution, and share positive responsibility for the protection of tropical forests, the required amount for the Bali Partnership can be reduced. If producing countries contribute by such a way, the actual form of contribution could be as the introduction of internal legal or administrative measures on tropical forests conservation. Since such measures are expected for producing countries to sacrifice a large amount of economic values to be obtained from utilization of tropical timbers, producing countries can have the right to claim that these measures are contribution to the Fund even though no cash contribution is made. Such values should include not only income from timber trade but also income for local people by slash and burn agriculture and creation of residential and industrial area.

For example, if the internal measures taken by producing countries are considered equivalent to US dollars 500 million, this would correspond to the point D in the Figure 21. However, as stated above there is no cash contribution from producers in this case. Therefore, it is more proper to describe this scenario as illustrated in the Figure 22. Here, the original budget line shifts downward owing to the contribution by

producing countries. D' is the point where actual cash contribution is made to the Bali Partnership Fund. Thus, the level of cash contribution to the Fund depends the level of efforts made by producing countries. Hence, it is expected that ITTO's negotiation may focus on the internal legal and administrative measures to be taken by producing countries as well as the amount of cash contribution from consuming countries. In order for sustainable management of tropical forests is to be properly provided, either complete US$ 1500 million dollars cash contribution from consuming countries or burden sharing between producing and consuming countries are required.

As discussed previously, it would not be theoretically viable for the former solution to happen because consuming countries do not consider it is the best tactics for them to take. Likewise, the latter solution would also not possible as long as producing countries do not find necessary values in tropical forests conservation. Hence, as already discussed before, negotiations for legal binding framework under an international agreement become indispensable for sustainable management to be provided. Consensus reached by negotiations on legal binding agreement will make sustainable management possible just as Ostrom suggested in his 1990 article. By this way, the defect of the market system in regard to tropical forests protection could possibly be overcome.

Figure 21: Budget Line of Bali Partnership Fund

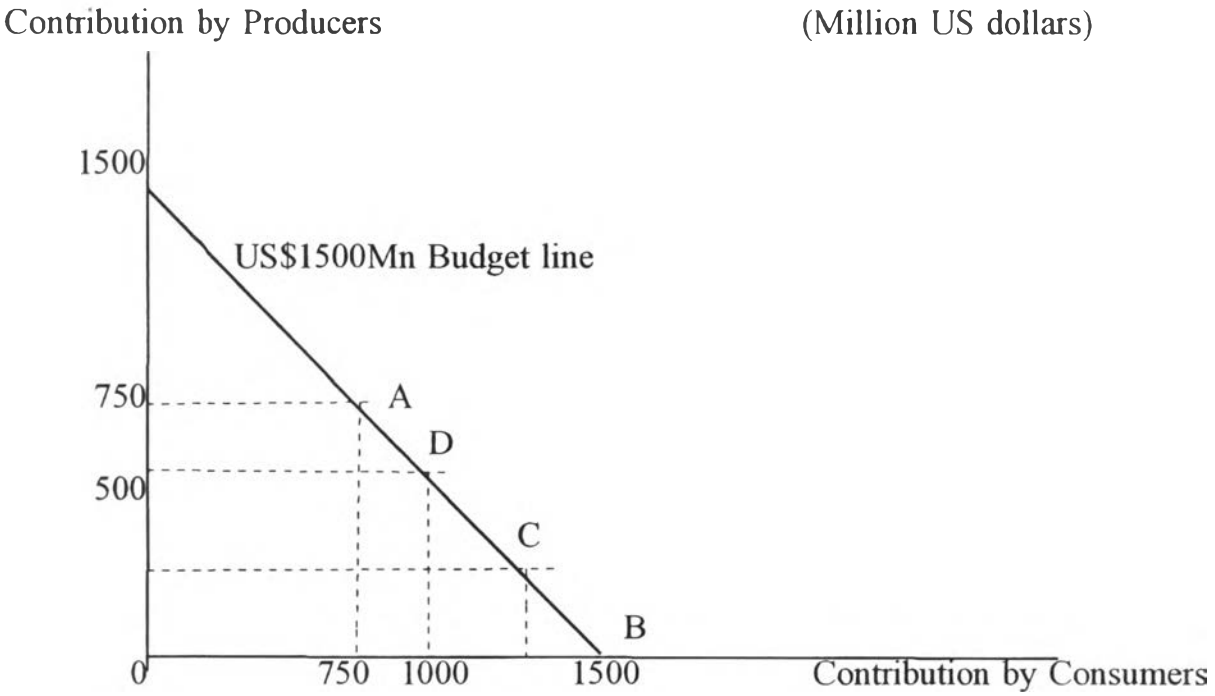
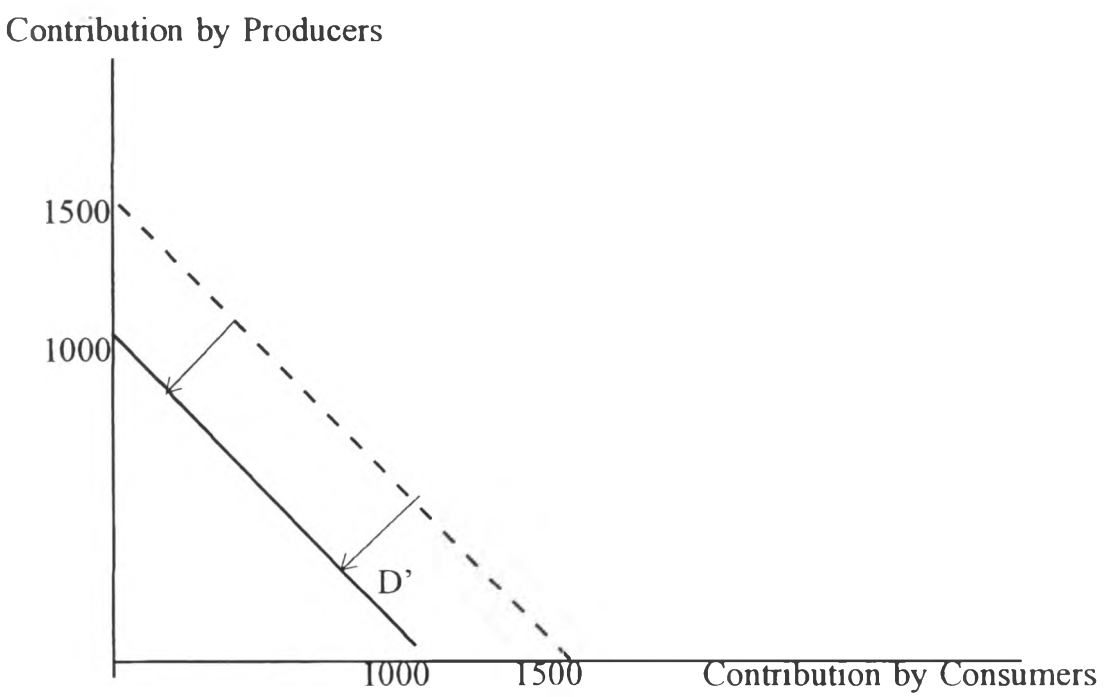


Figure 22: Budget Line Shift by Producers' Efforts



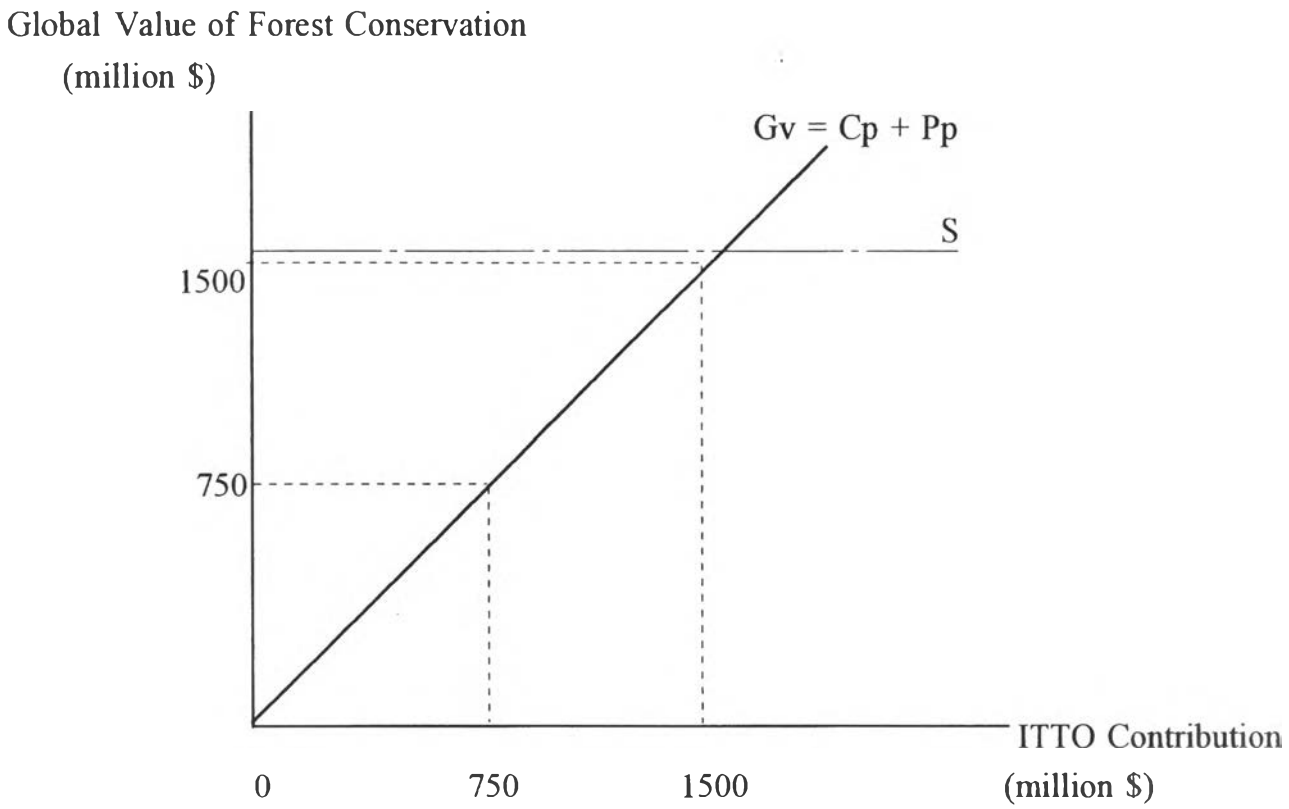
(c) Scenario 2 and 3

A few more general scenarios can be illustrated as follows.

The figure 23 indicates the relation between ITTO contributions and environmental value is represented by an equation Gv = Cp + Pp (Scenario 2). Under this formula, Global environmental value for tropical forest conservation is simply considered to be equal to total contributions from both consumers and producers. This scenario implies that sustainable level of tropical forest is lower than current stock. In other words, the Bali Partnership Fund will be utilized to achieve sustainable management level in the future by curving the rate of depletion.

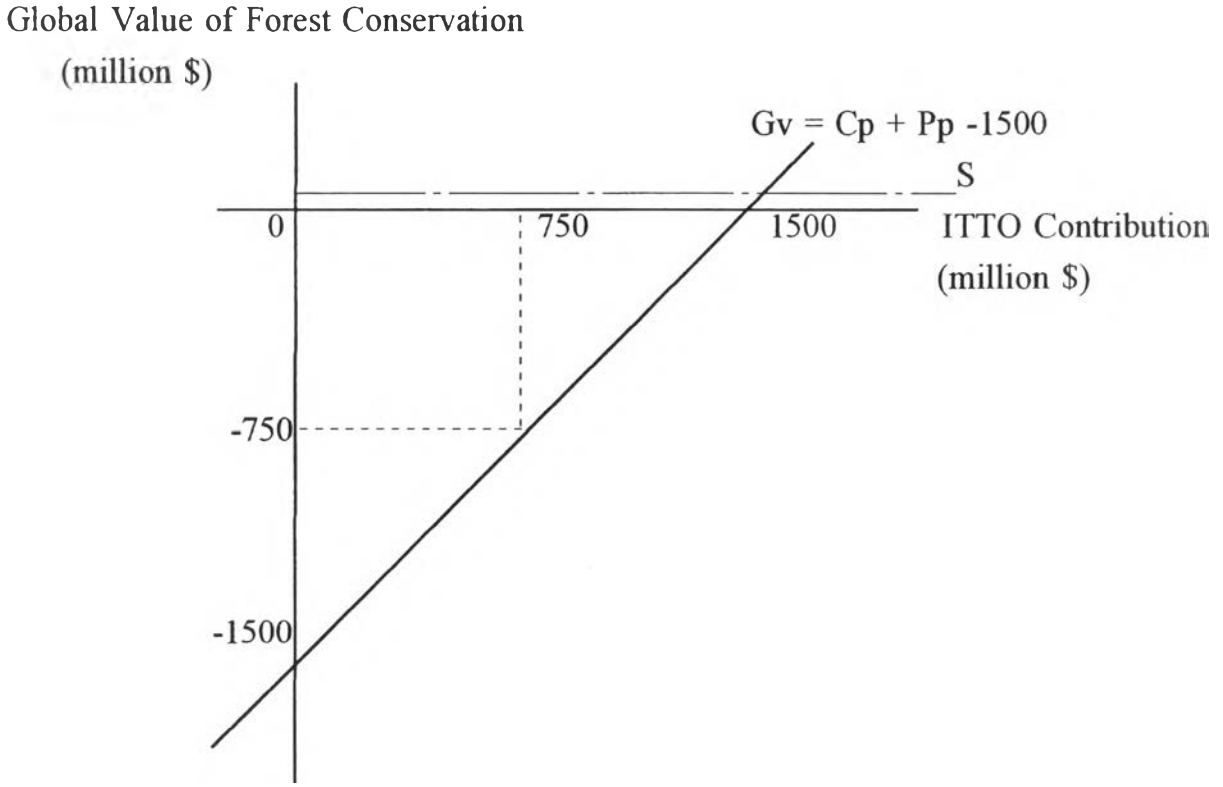
On the contrary to the concept contained in the Figure 23, the Figure 24 explains the case where current tropical forest stock level is already below the sustainable management level. The relation between contributions and environmental value in this case is illustrated by an equation Gv = Cp + Pp - 1500 (Scenario 3). Under this scenario, the Bali Partnership Fund will be utilized to increase the area of topical forests to the level of sustainable management.

Figure 23: Relation between ITTO contribution and Global Environmental Value of Tropical Forests / Scenario 2 (Gv = Cp + Pp)



Gv = Global Value of Tropical Forests Conservation
Pp = Contribution paid by ITTO Producing Countries
Cp = Contribution paid by ITTO Consuming Countries

Figure 24: Relation between ITTO contribution and Global Environmental Value of Tropical Forests / Scenario 3 (Gv = Cp + Pp -1500)



Gv = Global Value of Tropical Forests Conservation
Pp = Contribution paid by ITTO Producing Countries
Cp = Contribution paid by ITTO Consuming Countries

Figure 25 illustrates the game format for the scenario 2. Figures from 25a to 25c represent the cases with the same concept as illustrated in the previous figures from 17 to 19. Figure 26 illustrates the format for the scenario 3. Figures from 26a to 26c represent the cases with the same concept as illustrated in the previous figures form 17 to 19.

Figure 25: Contribution to the Bali Partnership Fund and Game Theory
Scenario 2 (Gv = Cp + Pp)

ITTO Consuming Countries \ ITTO Producing Countries	Contribute	Not contribute
Contribute	I (Gv) Cv Pv	II (Gv) Cv Pv
Not contribute	III (Gv) Cv Pv	IV (Gv) Cv Pv

(million $)

Gv = Global Value Gained from Tropical Forest Conservation
Cv = Total Value for Consumers
Pv = Total Value for Producers
Cp = Contribution by Consumers
Pp = Contribution by Producers
Gvc = Global Value Perceived by Consumers
Gvp = Global Value Perceived by Producers
Cpr = Consumers Payment Ratio / Ppr = Producers Payment Ratio
e = Cost of enforcement by penalty (e is applied for non-contributors)
a = Cost of enforcement by self arranged arbitrator
(When a>0, the game is under the control of the arbitrator)

Gv = Cp + Pp
Cv = Gv - Cp
Pv = Gv - Pp
It is assumed that either Consumers or Producers provide entire contribution when either Cp or Pp is zero.
Namely, Cpr:Ppr = 5:5 (Column I), Cpr:Ppr = 10:0 (Column II)
Cpr:Ppr = 0:10(Column III), Cpr:Ppr = 0:0 (Column IV)

Figure 25a: Same environmental value for both consumers and producers

Case 1: Gv = Gvc = Gvp, e =o, a>0

ITTO Consuming Countries	ITTO Producing Countries: Contribute	ITTO Producing Countries: Not Contribute
Contribute	I (1500) 750 750	II (1500) 0 1500
Not Contribute	III (1500) 1500 0	IV (0) 0 0

(million $)

I: Gv = 750(Cp) + 750(Pp) = 1500
Cv = 1500(Gv) - 750(Cp) = 750
Pv = 1500(Gv) - 750(Pp) = 750

II: Gv = 1500(Cp) + 0(Pp) = 1500
Cv = 1500(Gv) - 1500(Cp) = 0
Pv = 1500(Gv) - 0(Pp) = 1500

III: Gv = 1500(Cp) + 0(Pp) = 1500
Cv = 1500(Gv) - 0(Cp) = 1500
Pv = 1500(Gv) - 1500(Pp) = 0

IV: Gv = 0(Cp) + 0(Pp) = 0
Cv = 0(Gv) - 0(Cp) = 0
Pv = 0(Gv) - 0(Pp) = 0

Game result: Success, because Column I Pv > Column IV Pv.
Column II and III are possible if either side agrees to pay the entire amount under political consideration.

Figure 25b: No environmental value for producers

Case 2: Gv = Gvc, Gvp = 0, e =o, a>0

ITTO Consuming Countries \ ITTO Producing Countries	Contribute	Not contribute
Contribute	I (1500) 750 -750	II (1500) 0 0
Not contribute	III (1500) 1500 -1500	IV (0) 0 0

(million $)

I: Gv = 750(Cp) + 750(Pp) = 1500
Cv = 1500(Gv) - 750(Cp) = 750
Pv = 0(Gv) - 750(Pp) = 0

II: Gv = 1500(Cp) + 0(Pp) = 1500
Cv = 1500(Gv) - 1500(Cp) = 0
Pv = 0(Gv) - 0(Pp) = 0

III: Gv = 0(Cp) + 1500(Pp) = 1500
Cv = 1500(Gv) - 0(Cp) = 1500
Pv = 0(Gv) - 1500(Pp) = -1500

IV: Gv = 0(Cp) + 0(Pp) = 0
Cv = 0(Gv) - 0(Cp) = 0
Pv = 0(Gv) - 0(Pp) = 0

Game result: Failure, because Column I Pv < Column IV Pv.
Column II is possible if Consumers agree to pay the entire amount under political consideration.
Column III is not possible because Column III Pv < Column IV Pv.

Figure 25c: Half environmental value for producers

Case 3: Gv = Gvc, Gvp = Gv/2, e=0, a >0

		ITTO Producing Countries	
		Contribute	Not contribute
ITTO Consuming Countries	Contribute	(1500) 750 0	(1500) 0 750
	Not contribute	(1500) 1500 -750	(0) 0 0

(million $)

I: Gv = 750(Cp) + 750(Pp) = 1500
Cv = 1500(Gv) - 750(Cp) = 750
Pv = 1500(Gv)/2 - 750(Pp) = 0

II: Gv = 1500(Cp) + 0(Pp) = 1500
Cv = 1500(Gv) - 1500(Cp) = 0
Pv = 1500(Gv)/2 - 0(Pp) = 750

III: Gv = 1500(Cp) + 0(Pp) = 1500
Cv = 1500(Gv) - 0(Cp) = 1500
Pv = 1500(Gv)/2 - 1500(Pp) = -750

IV: Gv = 0(Cp) + 0(Pp) = 0
Cv = 0(Gv) - 0(Cp) = 0
Pv = 0(Gv)/2 - 0(Pp) = 0

Game result: In-between, because Column I Pv = Column IV Pv.
Column II is possible if Consumers agree to pay the entire amount under political consideration.
Column III is not possible because Column III Pv < Column IV Pv.

Figure 26: Contribution to the Bali Partnership Fund and Game Theory
Scenario 3 (Gv = Cp + Pp -1500)

ITTO Consuming Countries	ITTO Producing Countries: Contribute	ITTO Producing Countries: Not contribute
Contribute	I (Gv) Cv Pv	II (Gv) Cv Pv
Not contribute	III (Gv) Cv Pv	IV (Gv) Cv Pv

(million $)

Gv = Global Value Gained from Tropical Forest Conservation
Cv = Total Value for Consumers
Pv = Total Value for Producers
Cp = Contribution by Consumers
Pp = Contribution by Producers
Gvc = Global Value Perceived by Consumers
Gvp = Global Value Perceived by Producers
Cpr = Consumers Payment Ratio / Ppr = Producers Payment Ratio
e = Cost of enforcement by penalty (e is applied for non-contributors)
a = Cost of enforcement by self arranged arbitrator
(When a>0, the game is under the control of the arbitrator)

Gv = Cp + Pp -1500
Cv = Gv - Cp
Pv = Gv - Pp
It is assumed that either Consumers or Producers provide entire contribution when either Cp or Pp is zero.
Namely, Cpr:Ppr = 5:5 (Column I), Cpr:Ppr = 10:0 (Column II)
Cpr:Ppr = 0:10(Column III), Cpr:Ppr = 0:0 (Column IV)

Figure 26a: Same environmental value for both consumers and producers

Case 1: Gv = Gvc = Gvp, e=0, a>0

ITTO Consuming Countries	ITTO Producing Countries: Contribute	ITTO Producing Countries: Not Contribute
Contribute	I (0) -750 -750	II (0) -1500 0
Not Contribute	III (0) 0 -1500	IV (-1500) -1500 -1500

(million $)

I: Gv = 750(Cp) + 750(Pp) -1500 = 0
Cv = 0(Gv) - 750(Cp) = -750
Pv = 0(Gv) - 750(Pp) = -750

II: Gv = 1500(Cp) + 0(Pp)-1500 = 0
Cv = 0(Gv) - 1500(Cp) = -1500
Pv = 0(Gv) - 0(Pp) = 0

III: Gv = 1500(Cp) + 0(Pp) -1500 = 0
Cv = 0(Gv) - 0(Cp) = 0
Pv = 0(Gv) - 1500(Pp) = -1500

IV: Gv = 0(Cp) + 0(Pp) -1500 = -1500
Cv = -1500(Gv) - 0(Cp) = -1500
Pv = -1500(Gv) - 0(Pp) = -1500

Game result: Success, because Column I Pv > Column IV Pv.
Column II and III are possible if either side agrees to pay the entire amount under political consideration.

Figure 26b: No environmental value for producers

Case 2: Gv = Gvc, Gvp = 0, e=0, a>0

ITTO Consuming Countries	ITTO Producing Countries: Contribute	ITTO Producing Countries: Not contribute
Contribute	I (0) -750 -750	II (0) -1500 0
Not contribute	III (0) 0 -1500	IV (-1500) -1500 0

(million $)

I: Gv = 750(Cp) + 750(Pp) -1500 = 0
Cv = 0(Gv) - 750(Cp) = -750
Pv = 0(Gv) - 750(Pp) = -750

II: Gv = 1500(Cp) + 0(Pp) -1500 = 0
Cv = 0(Gv) - 1500(Cp) = -1500
Pv = 0(Gv) - 0(Pp) = 0

III: Gv = 0(Cp) + 1500(Pp) -1500 = 0
Cv = 0(Gv) - 0(Cp) = 0
Pv = 0(Gv) - 1500(Pp) = -1500

IV: Gv = 0(Cp) + 0(Pp) -1500 = -1500
Cv = -1500(Gv) - 0(Cp) = -1500
Pv = 0(Gv) - 0(Pp) = 0

Game result: Failure, because Column I Pv < Column IV Pv.
Column II is possible if Consumers pay the entire amount under political consideration.
Column III is not possible because Column IV Pv > Column III Pv

Figure 26c: Half environmental value for producers

Case 3: Gv = Gvc, Gvp = Gv/2, e=0, a>0

ITTO Consuming Countries	ITTO Producing Countries: Contribute	ITTO Producing Countries: Not contribute
Contribute	(0) -750 -750	(0) -1500 0
Not contribute	(0) 0 -1500	(-1500) -1500 -750

(million $)

I: Gv = 750(Cp) + 750(Pp) -1500 = 0
Cv = 0(Gv) - 750(Cp) = -750
Pv = 0(Gv)/2 - 750(Pp) = -750

II: Gv = 1500(Cp) + 0(Pp) -1500 = 0
Cv = 0(Gv) - 1500(Cp) = -1500
Pv = 0(Gv)/2 - 0(Pp) = 0

III: Gv = 1500(Cp) + 0(Pp) -1500 = 0
Cv = 0(Gv) - 0(Cp) = 0
Pv = 0(Gv)/2 - 1500(Pp) = -1500

IV: Gv = 0(Cp) + 0(Pp) -1500 = -1500
Cv = -1500(Gv) - 0(Cp) = -1500
Pv = -1500(Gv)/2 - 0(Pp) = -750

Game result: In-between, because Column I Pv = Column IV Pv.
Column II is possible if Consumers pay the entire amount under political consideration.
Column III is not possible because Column IV Pv > Column III Pv

(d) Scenario 2b and 3b

Similarly, Figure 27 shows the game format for scenario 2b that represents the idea contained in Figures 16-2 where consumers' contributions are directly disbursed to producers. Figures from 27a to 27c, here again, represent the cases with the same concepts as illustrated in the figures from 17 to 19.

Further, Figure 28 shows the game format for scenario 3b that represents the idea contained in Figures 16-2, and Figures from 28a to 28c represent the cases with the same concepts illustrated in the figures from 17 to 19.

Figure 27: Contribution to the Bali Partnership Fund and Game Theory
Scenario 2b (Gv = Cp + Pp)&(Pv = Gv -Pp + Cp)

ITTO Consuming Countries	ITTO Producing Countries: Contribute	ITTO Producing Countries: Not contribute
Contribute	I (Gv) Cv Pv	II (Gv) Cv Pv
Not contribute	III (Gv) Cv Pv	IV (Gv) Cv Pv

(million $)

Gv = Global Value Gained from Tropical Forest Conservation
Cv = Total Value for Consumers
Pv = Total Value for Producers
Cp = Contribution by Consumers
Pp = Contribution by Producers
Gvc = Global Value Perceived by Consumers
Gvp = Global Value Perceived by Producers
Cpr = Consumers Payment Ratio / Ppr = Producers Payment Ratio
e = Cost of enforcement by penalty (e is applied for non-contributors)
a = Cost of enforcement by self arranged arbitrator
(When a>0, the game is under the control of the arbitrator)

Gv = Cp + Pp
Cv = Gv - Cp
Pv = Gv - Pp + Cp
It is assumed that either Consumers or Producers provide entire contribution when either Cp or Pp is zero.
Namely, Cpr:Ppr = 5:5 (Column I), Cpr:Ppr = 10:0 (Column II)
Cpr:Ppr = 0:10(Column III), Cpr:Ppr = 0:0 (Column IV)

Figure 27a: Same environmental value for both consumers and producers

Case 1: Gv = Gvc = Gvp, e=0, a>0

ITTO Consuming Countries	ITTO Producing Countries: Contribute	ITTO Producing Countries: Not Contribute
Contribute	I (1500) 750 1500	II (1500) 0 3000
Not Contribute	III (1500) 1500 0	IV (0) 0 0

(million $)

I: Gv = 750(Cp) + 750(Pp) = 1500
Cv = 1500(Gv) - 750(Cp) = 750
Pv = 1500(Gv) - 750(Pp) + 750(Cp) = 1500

II: Gv = 1500(Cp) + 0(Pp) = 1500
Cv = 1500(Gv) - 1500(Cp) = 0
Pv = 1500(Gv) - 0(Pp) + 1500(Cp) = 3000

III: Gv = 1500(Cp) + 0(Pp) = 1500
Cv = 1500(Gv) - 0(Cp) = 1500
Pv = 1500(Gv) - 1500(Pp) + 0(Cp) = 0

IV: Gv = 0(Cp) + 0(Pp) = 0
Cv = 0(Gv) - 0(Cp) = 0
Pv = 0(Gv) - 0(Pp) + 0(Cp) = 0

Game result: Success, because Column I Pv > Column IV Pv.
Column II and III are possible if either side agrees to pay the entire amount under political consideration.

Figure 27b: No environmental value for producers

Case 2: Gv = Gvc, Gvp = 0, e=0, a>0

ITTO Consuming Countries \ ITTO Producing Countries	Contribute	Not contribute
Contribute	I (1500) 750 0	II (1500) 0 1500
Not contribute	III (1500) 1500 -1500	IV (0) 0 0

(million $)

I: Gv = 750(Cp) + 750(Pp) = 1500
Cv = 1500(Gv) - 750(Cp) = 750
Pv = 0(Gv) - 750(Pp) + 750(Cp) = 0

II: Gv = 1500(Cp) + 0(Pp) = 1500
Cv = 1500(Gv) - 1500(Cp) = 0
Pv = 0(Gv) - 0(Pp) + 1500(Cp) = 1500

III: Gv = 0(Cp) + 1500(Pp) = 1500
Cv = 1500(Gv) - 0(Cp) = 1500
Pv = 0(Gv) - 1500(Pp) + 0(Cp) = -1500

IV: Gv = 0(Cp) + 0(Pp) = 0
Cv = 0(Gv) - 0(Cp) = 0
Pv = 0(Gv) - 0(Pp) + 0(Cp) = 0

Game result: In-between, because Column I Pv = Column IV Pv.
Column II is possible if Consumers agree to pay the entire amount under political consideration.
Column III is not possible because Column III Pv < Column IV Pv.

Figure 27c: Half environmental value for producers

Case 3: Gv = Gvc, Gvp = Gv/2, e=0, a>0

		ITTO Producing Countries	
		Contribute	Not contribute
ITTO Consuming Countries	Contribute	(1500) 750 750	(1500) 0 2250
	Not contribute	(1500) 1500 -750	(0) 0 0

(million $)

I: Gv = 750(Cp) + 750(Pp) = 1500
Cv = 1500(Gv) - 750(Cp) = 750
Pv = 1500(Gv)/2 - 750(Pp) + 750(Cp) = 750

II: Gv = 1500(Cp) + 0(Pp) = 1500
Cv = 1500(Gv) - 1500(Cp) = 0
Pv = 1500(Gv)/2 - 0(Pp) + 1500(Cp) = 2250

III: Gv = 1500(Cp) + 0(Pp) = 1500
Cv = 1500(Gv) - 0(Cp) = 1500
Pv = 1500(Gv)/2 - 1500(Pp) + 0(Cp) = -750

IV: Gv = 0(Cp) + 0(Pp) = 0
Cv = 0(Gv) - 0(Cp) = 0
Pv = 0(Gv)/2 - 0(Pp) + 0(Cp) = 0

Game result: Success, because Column I Pv > Column IV Pv.
Column II is possible if Consumers pay the entire amount under political consideration.
Column III is not possible because Column IV Pv > Column III Pv.

Figure 28: Contribution to the Bali Partnership Fund and Game Theory
Scenario 3b (Gv = Cp + Pp -1500)&(Pv = Gv - Pp + Cp)

ITTO Consuming Countries \ ITTO Producing Countries	Contribute	Not contribute
Contribute	I (Gv) Cv Pv	II (Gv) Cv Pv
Not contribute	III (Gv) Cv Pv	IV (Gv) Cv Pv

(million $)

Gv = Global Value Gained from Tropical Forest Conservation
Cv = Total Value for Consumers
Pv = Total Value for Producers
Cp = Contribution by Consumers
Pp = Contribution by Producers
Gvc = Global Value Perceived by Consumers
Gvp = Global Value Perceived by Producers
Cpr = Consumers Payment Ratio / Ppr = Producers Payment Ratio
e = Cost of enforcement by penalty (e is applied for non-contributors)
a = Cost of enforcement by self arranged arbitrator
(When a>0, the game is under the control of the arbitrator)

Gv = Cp + Pp -1500
Cv = Gv - Cp
Pv = Gv - Pp + Cp
It is assumed that either Consumers or Producers provide entire contribution when either Cp or Pp is zero.
Namely, Cpr:Ppr = 5:5 (Column I), Cpr:Ppr = 10:0 (Column II)
Cpr:Ppr = 0:10(Column III), Cpr:Ppr = 0:0 (Column IV)

Figure 28a: Same environmental value for both consumers and producers

Case 1: Gv = Gvc = Gvp, e=0, a>0

ITTO Consuming Countries	ITTO Producing Countries: Contribute	ITTO Producing Countries: Not Contribute
Contribute	I (0) -750 0	II (0) -1500 1500
Not Contribute	III (0) 0 -1500	IV (-1500) -1500 -1500

(million $)

I: Gv = 750(Cp) + 750(Pp) -1500 = 0
Cv = 0(Gv) - 750(Cp) = -750
Pv = 0(Gv) - 750(Pp) +750(Cv) = 0

II: Gv = 1500(Cp) + 0(Pp)-1500 = 0
Cv = 0(Gv) - 1500(Cp) = -1500
Pv = 0(Gv) - 0(Pp) +1500(Cp) = 1500

III: Gv = 1500(Cp) + 0(Pp) -1500 = 0
Cv = 0(Gv) - 0(Cp) = 0
Pv = 0(Gv) - 1500(Pp) +0(cp) = -1500

IV: Gv = 0(Cp) + 0(Pp) -1500 = -1500
Cv = -1500(Gv) - 0(Cp) = -1500
Pv = -1500(Gv) - 0(Pp) +0(Cp)= -1500

Game result: Success, because Column I Pv > Column IV Pv.
Column II and III are possible if either side agrees to pay the entire amount under political consideration.

Figure 28b: No environmental value for producers

Case 2: Gv = Gvc, Gvp = 0, e=0, a>0

ITTO Consuming Countries \ ITTO Producing Countries	Contribute	Not contribute
Contribute	I (0) -750 0	II (0) -1500 1500
Not contribute	III (0) 0 -1500	IV (-1500) -1500 0

(million $)

I: Gv = 750(Cp) + 750(Pp) -1500 = 0
Cv = 0(Gv) - 750(Cp) = -750
Pv = 0(Gv) - 750(Pp) +750(Cp) = 0

II: Gv = 1500(Cp) + 0(Pp) -1500 = 0
Cv = 0(Gv) - 1500(Cp) = -1500
Pv = 0(Gv) - 0(Pp) +1500(Cp) = 1500

III: Gv = 0(Cp) + 1500(Pp) -1500 = 0
Cv = 0(Gv) - 0(Cp) = 0
Pv = 0(Gv) - 1500(Pp) +0(Cp) = -1500

IV: Gv = 0(Cp) + 0(Pp) -1500 = -1500
Cv = -1500(Gv) - 0(Cp) = -1500
Pv = 0(Gv) - 0(Pp) +0(Cp) = 0

Game result: In-between, because Column I Pv = Column IV Pv.
Column II is possible if Consumers agree to pay the entire amount under political consideration.
Column III is not possible because Column IV Pv > Column III Pv

Figure 28c: Half environmental value for producers

Case 3: Gv = Gvc, Gvp = Gv/2, e=o, a>0

ITTO Consuming Countries \ ITTO Producing Countries	Contribute	Not contribute
Contribute	(0) -750 0	(0) -1500 1500
Not contribute	(0) 0 -1500	(-1500) -1500 -750

(million $)

I: Gv = 750(Cp) + 750(Pp) -1500 = 0
Cv = 0(Gv) - 750(Cp) = -750
Pv = 0(Gv)/2 - 750(Pp) +750(Cp) = 0

II: Gv = 1500(Cp) + 0(Pp) -1500 = 0
Cv = 0(Gv) - 1500(Cp) = -1500
Pv = 0(Gv)/2 - 0(Pp) +1500(Cp) = 1500

III: Gv = 1500(Cp) + 0(Pp) -1500 = 0
Cv = 0(Gv) - 0(Cp) = 0
Pv = 0(Gv)/2 - 1500(Pp) +0(Cp) = -1500

IV: Gv = 0(Cp) + 0(Pp) -1500 = -1500
Cv = -1500(Gv) - 0(Cp) = -1500
Pv = -1500(Gv)/2 - 0(Pp) +0(Cp) = -750

Game result: Success, because Column I Pv = Column IV Pv.
Column II is possible if Consumers pay the entire amount under political consideration.
Column III is not possible because Column IV Pv > Column III Pv.

(2) Implication of ITTO Mechanisms on selected individual member countries

It would be interesting to examine how the above mentioned game scenarios may affect a member country of the ITTO. Malaysia and Thailand are herewith taken up for consideration.

(i) Malaysia and Thailand

Malaysia is the largest tropical log producer of the world. Malaysia's share in world topical log production in 1995 was 26.0%. Malaysia is also the largest tropical log exporter of the world. Its share of the world tropical log export in 1995 was 48.4%, nearly half of the world export (Table 9). Malaysia's forest area was 15,471,000 m3 in 1995 consisting 47.1% of its total land area. The forest area decreased by annual average rate of -2.4% from 17,472,000 m3 in 1990. Although Malaysia's total tropical forest area is only 0.93% of the global tropical forest area in 1995, its decrease is responsible for 3.5% of the tropical forest depletion of the world between 1990 and 1995 (Table 8). This rate may be said to be relatively small compared with its huge share in global tropical log production and export. (Table 7-9)

Malaysia is the world's top exporting country for tropical log, sawnwood and veneers but Indonesia takes the top place for exports of plywood. Most of the Malaysian exports are consumed in Asia. As for species, Malaysia produces logs and other export products from various kinds of species; however, nearly half of the log products are made from *Shrea spp* (Meranti) (Appendix 3). Malaysia is promoting secondary processed wood products over logs. Especially, Malaysian government put an high priority in furniture export for further strengthening its processing industries. This policy is clearly represented in its high import tariff of plywood (45%) and core veneer (25%), while import tariff is free for log and sawnwood. Malaysia is facing serious dilemma between environmental protection and development of forest land. In 1996, a large dam construction in Bakun, Sarawak, resumed after a court decision identifying the project against the environmental laws was overturned. The construction project will

clear as much as 69000 hectares of tropical forest lands. [ITTO 1996a, p13-50]

As already stated earlier, ITTO has not determined allocation plan of Bali Partnership Fund among member countries. Therefore, it is not possible to identify the amount that Malaysia receives from the Fund. Two of the most simple allocation arrangements that could be adopted by ITTO may be as follows:

1) The Fund may be allocated to producing member countries engaged in implementation of 2000 Year Objective by prorata basis according to each member country's share in global tropical timber production or export.

2) The Fund may be allocated by prorata basis in accordance with each member country's responsible rate in the global tropical forest depletion.

The method stated in the above 2) may be more suitable to deal with depletion problem because the fund allocation is directly related with the rate of depletion caused by each member country. However, this method may not be supported under the framework of ITTO because ITTO is a trade promotion organization and the arrangements for its 2000 Year Objective are more or less expected to use export as the main leverage to reduce tropical forest depletion. (It should be noted that ITTO allocates amount of each member country's contribution to its first account in accordance with their trade share). If the Bali Partnership Fund is to be allocated among ITTO producing countries by prorata basis according to trade share, as much as 48.4 % of the Fund is allocated to curve tropical forest depletion in Malaysia. Although this type of allocation method is familiar with ITTO member countries, it is highly unrealistic because Malaysia is responsible only for 3.5 % of the global tropical forest depletion. Therefore, it is assumed hereby that the Bali Partnership Fund is to be allocated according to each producing member country's responsible rate in global tropical forest depletion. Under this assumption, 3.5 % of the Fund is to be allocated to Malaysia. If the total amount needed to achieve 2000 Year Objective is assumed to be 1500 million US dollars per year again, Malaysia will require and receive 52.5 million US dollars to achieve sustainable management of its tropical forest.

Thailand's share of the tropical log production in 1995 was 0.016%, almost negligible. Thailand's share in the world tropical log export was nil in 1990 and was 0.11% in 1995. Thailand's forest area was 11,630,000 m3 in 1995 consisting 22.8 % of its total land area. The forest area decreased by annual average rate of -2.6 % from 13,277,000 m3 in 1990. It consisted 0.7 % of the global tropical forest area in 1995. Despite the fact Thailand contributes almost nothing in the global production and exports of tropical logs, its responsibility in the global tropical forest depletion is 2.9 % in 1995. (Table 7-9)

Just as in the case of Malaysia, the amount to be distributed to Thailand from the Bali Partnership Fund is not possible to be identified under the current state of negotiations at the ITTO. However, it can be calculated that only 0.11 % of the Fund is allocated to Thailand when ITTO adopts the method stated in the above (i) 1), and that 2.9 % would be allocated to Thailand when the above (i) 2) method is adopted. If the method stated in (i) 2) is assumed to be adopted here just like in the case of Malaysia, 43.5 million US dollars will be allocated to Thailand from the Fund.

Table 7.

Forest Cover in 1995

	Total Land (1,000 ha)	Total Forest in 1995			Natural Forest
		(1,000 ha)	% of land area	ha/cap	
Malaysia	32,855	15,471	47.1	0.8	15,371
Thailand	51,089	11,630	22.8	0.2	11,101

Source: FAO, State of the World Forest 1997

Table 8.

Change in Forest Cover, 1990-1995 (1,000 ha)

	Total Forest in 1990	Total Forest in 1995	Total Change 1990-1995	Annual Chang (1,000 ha)	Annual Change (%)
Malaysia	17,472	15,471	-2,001	-400	-2.4
Thailand	13,277	11,630	-1,647	-329	-2.6
Total Global Tropical Area	1,712,883	1,655,261	-57,622	-11,524	-0.8
Total Global Forest Area	3,510,728	3,454,382	-56,346	-11,269	-0.3

Source: FAO, State of the World Forest 1997

Table 9.

Production, Exports and Consumption of Tropical Logs 1992-1996

	Production		Export		Domestic Consumption	
	1992	1996	1992	1996	1992	1996
Malaysia	43,510	33,000	17,797	6,381	25,851	26,919
Thailand	119	20	0	15	2,151	718
Total ITTO Producers	139,309	126,784	24,271	13,185	118,437	115,754

Source: ITTO, Annual Review and Assessment of the World Tropical Timber Situation 1996

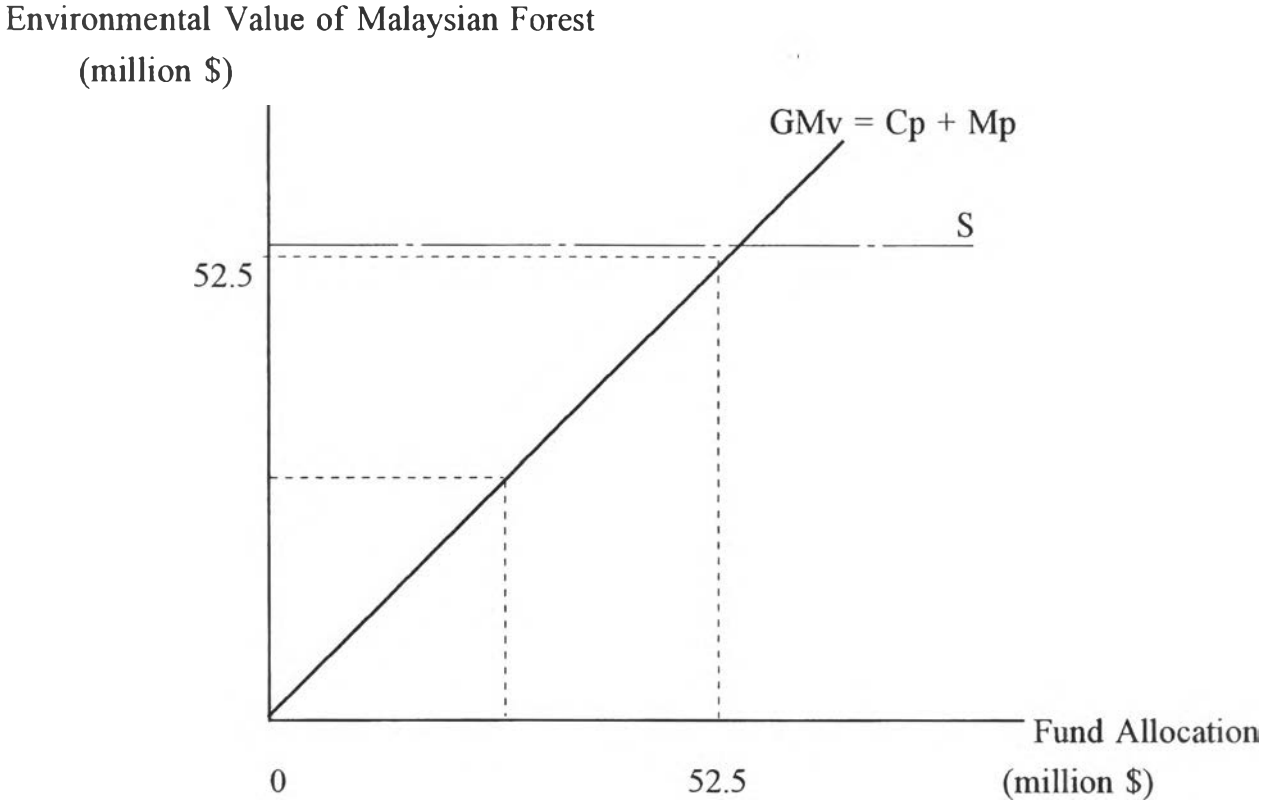
(e) Scenario 4 (Malaysia)

Malaysia's forest area is still 47.1% of its total land; therefore, its is considered that the amount of forest resource required for sustainable management under ITTO framework would be lower than current level. In other words, Malaysia might be able to further deplete its forest until the forest stocks be reduced to the minimum sustainable level. Hence, the most suitable game scenario for Malaysia should be Scenario 2a or 2b. It should be noted that this case corresponds to the case illustrated as the Gradual Reduction Curve in the Figure 11.

Figure 29 shows the relations between ITTO contribution for the conservation of Malaysian tropical forests and the Environmental values of Malaysian forests. The relation represented by an equation "GMv = Cp + Mp" (Scenario 4) is made up with the same concept explained in the case of the Figure 23 (Scenario 2). The only difference is the amount. Instead of 1500 million US dollars adopted in the case of the scenario 2, here the calculated portion of contribution to be allocated to Malaysia from the Bali Partnership Fund, i.e., 52.5 million US dollars, is indicated.

Just like the cases for the Figure 23, similar games can be implemented under the above equation of scenario 4. Figure 30 illustrates the game format for the scenario 4, under which consumers' contribution is not assumed to be used to compensate the foregone value of Malaysia in tropical forest exploitation. Figures from 30a to 30c represent the cases with the same concepts as illustrated in the previous figures from 25a to 25c.

Figure 29: Relation between the Bali Partnership Fund and Malaysia
Scenario 4 (GMv = Cp + Mp)



GMv = Global Environmental Value for Malaysian Forest
Cp = Contribution paid by ITTO Consuming Countries
Mp = Contribution paid by Malaysia

Figure 30: Contribution to the Bali Partnership Fund and Game Theory
Scenario 4: Malaysia (GMv = Cp + Mp)

ITTO Consuming Countries	Malaysia: Contribute	Malaysia: Not contribute
Contribute	I (GMv) Cv Mv	II (GMv) Cv Mv
Not contribute	III (GMv) Cv Mv	IV (GMv) Cv Mv

(million $)

GMv = Global Value Gained from Malaysian Tropical Forest Conservation
Cv = Value for Consumers
Mv = Total Value for Malysia
Cp = Contribution by Consumers
Mp = Contribution by Malaysia
Gvc = Global Value Perceived by Consumers
Gvm = Global Value Perceived by Malaysia
Cpr = Consumers Payment Ratio / Ppr = Malaysia's Payment Ratio
e = Cost of enforcement by penalty (e is applied for non-contributors)
a = Cost of enforcement by self arranged arbitrator
(When a>0, the game is under the control of the arbitrator)

GMv = Cp + Mp
Cv = GMv - Cp
Mv = Gvm - Mp
It is assumed that either Consumers or Malaysia provides entire contribution when either Cp or Mp is zero.
Namely, Cpr:Mpr = 5:5 (Column I), Cpr:Mpr = 10:0 (Column II)
Cpr:Mpr = 0:10(Column III), Cpr:Mpr = 0:0 (Column IV)

Figure 30a: Same environmental value for both consumers and Malaysia

Case 1: GMv = Gvc = Gvm, e=0, a>0

ITTO Consuming Countries	Malaysia: Contribute	Malaysia: Not Contribute
Contribute	I (52.5) 26.25 26.25	II (52.5) 0 52.5
Not Contribute	III (52.5) 52.5 0	IV (0) 0 0

(million $)

I: GMv = 26.25(Cp) + 26.25(Mp) = 52.5
Cv = 52.5(GMv) - 750(Cp) = 26.25
Mv = 52.5(Gvm) - 750(Mp) = 26.25

II: GMv = 52.5(Cp) + 0(Mp) = 52.5
Cv = 52.5(GMv) - 52.5(Cp) = 0
Mv = 52.5(Gvm) - 0(Mp) = 52.5

III: GM = 52.5(Cp) + 0(Mp) = 52.5
Cv = 52.5(GMv) - 0(Cp) = 52.5
Mv = 52.5(Gvm) - 52.5(Mp) = 0

IV: GMv = 0(Cp) + 0(Mp) = 0
Cv = 0(GMv) - 0(Cp) = 0
Mv = 0(Gvm) - 0(Mp) = 0

Game result: Success, because Column I Mv > Column IV Mv.
Column II and III are possible if either side agrees to pay the entire amount under political consideration.

Figure 30b: No environmental value for Malaysia

Case 2: GMv = Gvc, Gvm = 0, e=0, a>0

ITTO Consuming Countries	Malaysia: Contribute	Malaysia: Not contribute
Contribute	I (52.5) 26.25 -26.25	II (52.5) 0 0
Not contribute	III (52.5) 52.5 -52.5	IV (0) 0 0

(million $)

I: GMv = 26.25(Cp) + 26.25(Mp) = 52.5
Cv = 52.5(GMv) - 26.25(Cp) = 26.25
Mv = 0(Gvm) - 26.25(Mp) = -26.25

II: GMv = 52.5(Cp) + 0(Mp) = 52.5
Cv = 52.5(GMv) - 52.5(Cp) = 0
Mv = 0(Gvm) - 0(Mp) = 0

III: GMv = 0(Cp) + 52.5(Mp) = 52.5
Cv = 52.5(GMv) - 0(Cp) = 52.5
Mv = 0(Gvm) - 52.5(Mp) = -52.5

IV: GMv = 0(Cp) + 0(Mp) = 0
Cv = 0(GMv) - 0(Cp) = 0
Mv = 0(Gvm) - 0(Mp) = 0

Game result: Failure, because Column I Mv < Column IV Mv.
Column II is possible if Consumers pay the entire amount under political consideration.
Column III is not possible because Column IV Mv > Column III Mv

Figure 30c: Half environmental value for Malaysia

Case 3: GMv = Gvc, Gvm = GMv/2, e=0, a>0

		Malaysia: Contribute	Malaysia: Not contribute
ITTO Consuming Countries	Contribute	I (52.5) 26.25 0	II (52.5) 0 26.25
	Not contribute	III (52.5) 52.5 -26.25	IV (0) 0 0

(million $)

I: GMv = 26.25(Cp) + 26.25(Mp) = 52.5
Cv = 52.5(GMv) - 26.25(Cp) = 26.25
Mv = 52.5(GMv)/2 - 26.25(Mp) = 0

II: GMv = 52.5(Cp) + 0(Mp) = 52.5
Cv = 52.5(GMv) - 52.5(Cp) = 0
Mv = 52.5(GMv)/2 - 0(Mp) = 26.25

III: GMv = 52.5(Cp) + 0(Mp) = 52.5
Cv = 52.5(GMv) - 0(Cp) = 52.5
Mv = 52.5(GMv)/2 - 52.5(Mp) = -26.25

IV: GMv = 0(Cp) + 0(Mp) = 0
Cv = 0(GMv) - 0(Cp) = 0
Mv = 0(GMv)/2 - 0(Mp) = 0

Game result: In-between, because Column I Mv = Column IV Mv.
Column II is possible if Consumers pay the entire amount under political consideration.
Column III is not possible because Column III Mv < Column IV Mv.

(f) Scenario 4b (Malaysia)

Likewise, Figure 31 illustrates the format for the scenario 4b which is the case Consumers' contribution is directly paid to Malaysia for its government to utilize the fund to compensated the opportunity cost of forest exploitation. . Figures from 31a to 31c represent the cases with the same concepts as illustrated in the previous figures form 27a to 27c.

Figure 31: Contribution to the Bali Partnership Fund and Game Theory

Scenario 4b: Malaysia (GMv = Cp + Mp)&(Mv = GMv -Mp + Cp)

ITTO Consuming Countries	Malaysia: Contribute	Malaysia: Not contribute
Contribute	I (GM) Cv Mv	II (GM) Cv Mv
Not contribute	III (GM) Cv Mv	IV (GM) Cv Mv

(million $)

GMv = Global Value Gained from Malaysian Tropical Forest Conservation
Cv = Value for Consumers
Mv = Total Value for Malaysia
Cp = Contribution by Consumers
Mp = Contribution by Malaysia
Gvc = Global Value Perceived by Consumers
Gvm = Global Value Perceived by Malaysia
Cpr = Consumers Payment Ratio / Ppr = Malaysia's Payment Ratio
e = Cost of enforcement by penalty (e is applied for non-contributors)
a = Cost of enforcement by self arranged arbitrator
(When a>0, the game is under the control of the arbitrator)

GMv = Cp + Mp
Cv = GMv - Cp
Mv = Gvm - Mp + Cp
It is assumed that either Consumers or Malaysia provides entire contribution when either Cp or Mp is zero.
Namely, Cpr:Mpr = 5:5 (Column I), Cpr:Mpr = 10:0 (Column II)
Cpr:Mpr = 0:10(Column III), Cpr:Mpr = 0:0 (Column IV)

Figure 31a: Same environmental value for both Malaysia and consumers

Case 1: GM = Gvc = Gvm, e=0, a>0

ITTO Consuming Countries	Malaysia: Contribute	Malaysia: Not Contribute
Contribute	I (52.5) 26.25 52.5	II (52.5) 0 105
Not Contribute	III (52.5) 52.5 0	IV (0) 0 0

(million $)

I: GMv = 26.25(Cp) + 26.25(Mp) = 52.5
Cv = 52.5(GMv) - 26.25(Cp) = 26.25
Mv = 52.5(Gvm) - 26.25(Mp) + 26.25(Cp) = 52.5

II: GM = 52.5(Cp) + 0(Mp) = 52.5
Cv = 52.5(GM) - 52.5(Cp) = 0
Mv = 52.5(Gvm) - 0(Mp) + 52.5(Cp) = 105

III: GMv = 52.5(Cp) + 0(Mp) = 52.5
Cv = 52.5(GMv) - 0(Cp) = 52.5
Mv = 52.5(Gvm) - 52.5(Mp) + 0(Cp) = 0

IV: GMv = 0(Cp) + 0(Mp) = 0
Cv = 0(GMv) - 0(Cp) = 0
Mv = 0(Gvm) - 0(Mp) + 0(Cp) = 0

Game result: Success, because Column I Mv > Column IV Mv.
Column II and III are possible if either side agrees to pay the entire amount under political consideration.

Figure 31b: No environmental value for Malaysia

Case 2: GMv = Gvc, Gvm = 0, e=0, a>0

ITTO Consuming Countries	Malaysia: Contribute	Malaysia: Not contribute
Contribute	I (52.5) 26.25 0	II (52.5) 0 52.5
Not contribute	III (52.5) 52.5 -52.5	IV (0) 0 0

(million $)

I: GMv = 226.25(Cp) + 26.25(Mp) = 52.5
Cv = 552.5(GMv) - 26.25(Cp) = 26.25
Mv = 0(Gvm) - 26.25(Mp) + 26.25(Cp) = 0

II: GMv = 52.5(Cp) + 0(Mp) = 52.5
Cv = 52.5(GMv) - 52.5(Cp) = 0
Mv = 0(Gvm) - 0(Mp) + 52.5(Cp) = 52.5

III: GMv = 0(Cp) + 52.5(Mp) = 52.5
Cv = 52.5(GMv) - 0(Cp) = 52.5
Mv = 0(Gvm) - 52.5(Mp) + 0(Cp) = -52.5

IV: GMv = 0(Cp) + 0(Mp) = 0
Cv = 0(GMv) - 0(Cp) = 0
Mv = 0(Gvm) - 0(Mp) + 0(Cp) = 0

Game result: In-between, because Column I Mv = Column IV Mv.
Column II is possible if Consumers pay the entire amount under political consideration.
Column III is not possible because Column III Mv < Column IV Mv

Figure 31c: Half environmental value for Malaysia

Case 3: GMv = Gvc, Gvm = GMv/2, e=0, a>0

		Malaysia: Contribute	Malaysia: Not contribute
ITTO Consuming Countries	Contribute	I (52.5) 26.25 26.25	II (52.5) 0 78.75
	Not contribute	III (52.5) 52.5 -26.25	IV (0) 0 0

(million $)

I: GMv = 26.25(Cp) + 26.25(Mp) = 52.5
Cv = 52.5(GMv) - 26.25(Cp) = 26.25
Mv = 52.5(GMv)/2 - 26.25(Mp) + 26.25(Cp) = 26.25

II: GMv = 52.5(Cp) + 0(Mp) = 52.5
Cv = 52.5(GMv) - 52.5(Cp) = 0
Mv = 52.5(GMv)/2 - 0(Mp) + 52.5(Cp) = 78.75

III: GMv = 52.5(Cp) + 0(Mp) = 52.5
Cv = 52.5(GMv) - 0(Cp) = 52.5
Mv = 52.5(GMv)/2 - 52.5(Mp) + 0(Cp) = -26.25

IV: GMv = 0(Cp) + 0(Mp) = 0
Cv = 0(GMv) - 0(Cp) = 0
Mv = 0(GMv)/2 - 0(Mp) + 0(Cp) = 0

Game result: Success, because Column I Mv > Column IV Mv.
Column II is possible if Consumers pay the entire amount under political consideration.
Column III is not possible because Column III Mv < Column IV Mv.

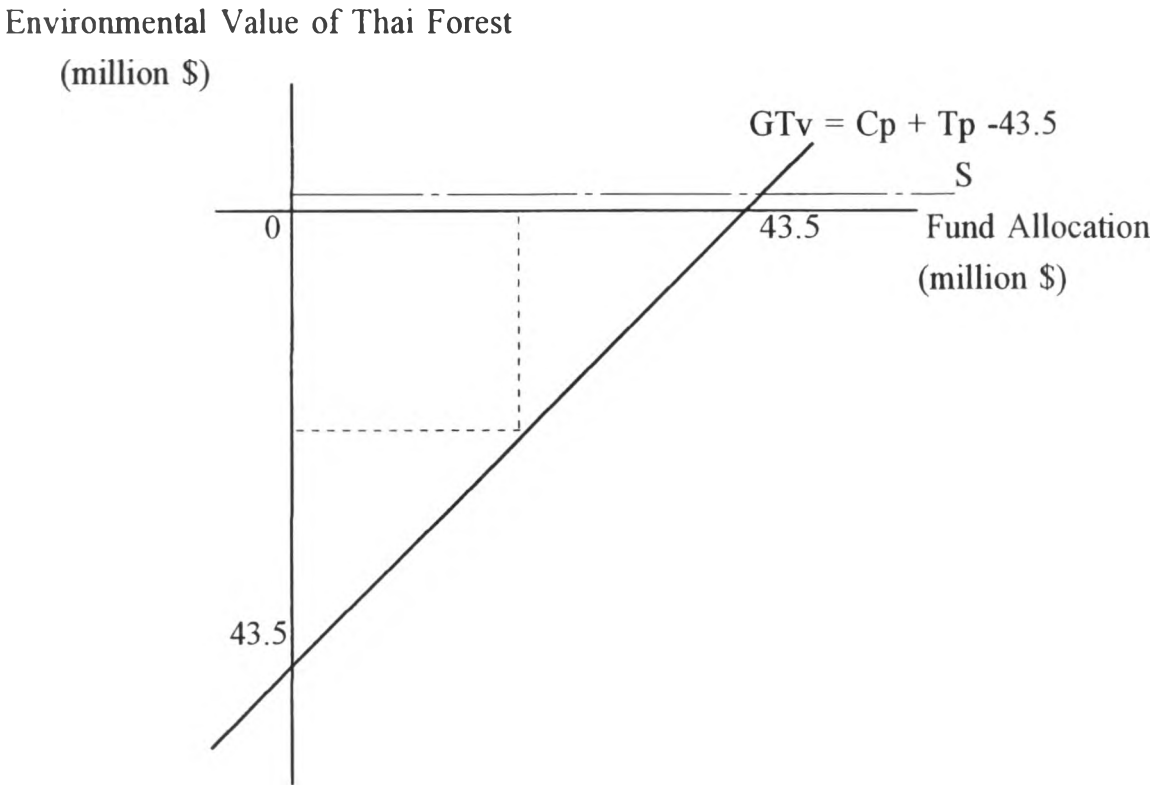
(g) Scenario 5 (Thailand)

Thailand's forest area is reduced to 22.8% of its total land in 1995 and Thailand has long turned to be a net import country of tropical timbers. Therefore, it is considered that the amount of forest resource required for sustainable management by Thailand under the ITTO framework would be higher than current stock level. In other words, Thailand could be requested to increase the area of forests until the forest stock be recovered to the minimum sustainable level. Hence, the most suitable game scenario for Thailand should be Scenario 3a or 3b. It should be noted that this case corresponds to the case illustrated as the forest depletion curve in the Figure 11b.

Figure 32 shows the relations between ITTO contribution for Thai tropical forests and their Environmental values. The relation represented by an equation "GTv = Cp + Tp -43.5" (Scenario 5) is made up with the same concept explained in the case of the Figure 24 (Scenario 3). Here again, the only difference is the amount. Instead of 1500 million US dollars adopted in the case of the scenario 3, here the calculated portion of contribution to be allocated to Thailand from the Bali Partnership Fund, i.e., 43.5 million US dollars, is indicated.

Just like the cases for the Figure 24, similar games can be implemented under the above equation of scenario 5. Here again, Figure 33 illustrates the game format for the scenario 5, under which consumers' contribution is not assumed to be used to compensate the foregone value of Malaysia in tropical forest exploitation. Figures from 33a to 33c represent the cases with the same concept as illustrated in the previous figures from 25a to 25c.

Figure 32: Relation between the Bali Partnership Fund and Thailand
Scenario 5 (GTv = Cp + Tp - 43.5)



GTv = Global Environmental Value of Thai Forests
Cp = Contribution paid by ITTO Consuming Countries
Tp = Contribution paid by Thailand

Figure 33: Contribution to the Bali Partnership Fund and Game Theory
Scenario 5: Thailand (GTv = Cp + Tp - 43.5)

		Thailand: Contribute	Thailand: Not contribute
ITTO Consuming Countries: Contribute		I (GTv) Cv Tv	II (GTv) Cv Tv
ITTO Consuming Countries: Not contribute		III (GTv) Cv Tv	IV (GTv) Cv Tv

(million $)

GTv = Global Value Gained from Thai Tropical Forest Conservation
Cv = Value for Consumers
Tv = Total Value for Thailand
Cp = Contribution by Consumers
Tp = Contribution by Thailand
Gvc = Global Value Perceived by Consumers
Gvt = Global Value Perceived by Thailand
Cpr = Consumers Payment Ratio / Tpr = Thai Payment Ratio
e = Cost of enforcement by penalty (e is applied for non-contributors)
a = Cost of enforcement by self arranged arbitrator
(When a>0, the game is under the control of the arbitrator)

GTv = Cp + Tp -43.5
Cv = GTv - Cp
Tv = Gvt - Tp
It is assumed that either Consumers or Thailand provides entire contribution when either Cp or Tp is zero.
Namely, Cpr:Tpr = 5:5 (Column I), Cpr:Tpr = 10:0 (Column II)
Cpr:Tpr = 0:10(Column III), Cpr:Tpr = 0:0 (Column IV)

Figure 33a: Same environmental value for both consumers and Thailand

Case 1: GTv = Gvc = Gvt, e=0, a>0

ITTO Consuming Countries	Thailand: Contribute	Thailand: Not Contribute
Contribute	I (0) -21..75 -21.75	II (0) -43.5 0
Not Contribute	III (0) 0 -43.5	IV (-43.5) -43.5 -43.5

(million $)

I: GTv = 21.75(Cp) + 21.75(Tp) - 43.5 = 0
Cv = 0(GTv) - 21.75(Cp) = -21.75
Tv = 0(Gvt) - 21.75(Tp) = -21.75

II: GTv = 43.5(Cp) + 0(Tp)-43.5 = 0
Cv = 0(GTv) - 43.5(Cp) = -43.5
Tv = 0(Gvt) - 0(Tp) = 0

III: GTv = 43.5(Cp) + 0(Tp) -43.5 = 0
Cv = 0(GTv) - 0(Cp) = 0
Tv = 0(Gvt) - 43.5(Tp) = -43.5

IV: GTv = 0(Cp) + 0(Tp) -43.5 = -43.5
Cv = -43.5(GTv) - 0(Cp) = -43.5
Tv = -43.5(Gvt) - 0(Tp) = -43.5

Game result: Success, because Column I Tv > Column IV Tv.
Column II and III are possible if either side agrees to pay the entire amount under political consideration

Figure 33b: No environmental value for Thailand

Case 2: GTv = Gvc, Gvt = 0, e=0, a>0

ITTO Consuming Countries	Thailand: Contribute	Thailand: Not contribute
Contribute	I (0) -21.75 -21.75	II (0) -43.5 0
Not contribute	III (0) 0 -43.5	IV (-43.5) -43.5 0

(million $)

I: GTv = 21.75(Cp) + 21.75(Tp) -43.5 = 0
Cv = 0(GTv) - 21.75(Cp) = -21.75
Tv = 0(Gvt) - 21.75(Tp) = -21.75

II: GTv = 43.5(Cp) + 0(Tp) -43.5 = 0
Cv = 0(GTv) - 43.5(Cp) = -43.5
Tv = 0(Gvt) - 0(Tp) = 0

III: GTv = 0(Cp) + 43.5(Tp) -43.5 = 0
Cv = 0(GTv) - 0(Cp) = 0
Tv = 0(Gvt) - 43.5(Tp) = -43.5

IV: GTv = 0(Cp) + 0(Tp) -43.5 = -43.5
Cv = -43.5(GTv) - 0(Cp) = -43.5
Tv = 0(Gvt) - 0(Tp) = 0

Game result: Failure, because Column I Tv < Column IV Tv.
Column II is possible if Consumers pay the entire amount under political consideration.
Column III is not possible because Column IV Tv > Column III Tv

Figure 33c: Half environmental value for Thailand

Case 3: GTv = Gvc, Gvt = GTv/2, e=0, a>0

		Thailand	
		Contribute	Not contribute
ITTO Consuming Countries	Contribute	(0) -21.75 -21.75	(0) -43.5 0
	Not contribute	(0) 0 -43.5	(-43.5) -43.5 -21.75

(million $)

I: GTv = 21.75(Cp) + 21.75(Tp) -43.5 = 0
Cv = 0(GTv) - 21.75(Cp) = -21.75
Tv = 0(GTv)/2 - 21.75(Tp) = -21.75

II: GTv = 43.5(Cp) + 0(Tp) -43.5 = 0
Cv = 0(GTv) - 43.5(Cp) = -43.5
Tv = 0(Gvt)/2 - 0(Tp) = 0

III: GTv = 43.5(Cp) + 0(Tp) -43.5 = 0
Cv = 0(GTv) - 0(Cp) = 0
Tv = 0(GTv)/2 - 43.5(Tp) = -43.5

IV: GTv = 0(Cp) + 0(Tp) -43.5 = -43.5
Cv = -43.5(GTv) - 0(Cp) = -43.5
Tv = -43.5(GTv)/2 - 0(Tp) = -21.75

Game result: In-between, because Column I Tv = Column IV Tv.
Column II is possible if Consumers pay the entire amount under political consideration.
Column III is not possible because Column III Tv < Column IV Tv.

(h) Scenario 5b (Thailand)

Likewise, Figure 34 illustrates the format for the scenario 5b which is the case Consumers' contribution is directly paid to Thailand for its government to utilize the fund to compensate the opportunity cost of forest exploitation. Figures from 34a to 34c represent the cases with the same concepts as illustrated in the previous figures form 27a to 27c.

Figure 34: Contribution to the Bali Partnership Fund and Game Theory

Scenario 5b: Thailand (GTv = Cp + Tp -43.5)&(Tv = Gvt - Tp + Cp)

ITTO Consuming Countries	Thailand: Contribute	Thailand: Not contribute
Contribute	I (GTv) Cv Tv	II (GTv) Cv Tv
Not contribute	III (GTv) Cv Tv	IV (GTv) Cv Tv

(million $)

GTv = Global Value Gained from Thai Tropical Forest Conservation
Cv = Value for Consumers
Tv = Total Value for Thailand
Cp = Contribution by Consumers
Tp = Contribution by Thailand
Gvc = Global Value Perceived by Consumers
Gvt = Global Value Perceived by Thailand
Cpr = Consumers Payment Ratio / Tpr = Thai Payment Ratio
e = Cost of enforcement by penalty (e is applied for non-contributors)
a = Cost of enforcement by self arranged arbitrator
(When a>0, the game is under the control of the arbitrator)

GTv = Cp + Tp - 43.5
Cv = GTv - Cp
Tv = Gvt - Tp + Cp
It is assumed that either Consumers or Thailand provides entire contribution when either Cp or Tp is zero.
Namely, Cpr:Tpr = 5:5 (Column I), Cpr:Tpr = 10:0 (Column II)
Cpr:Tpr = 0:10(Column III), Cpr:Tpr = 0:0 (Column IV)

Figure 34a: Same environmental value for both consumers and Thailand

Case 1: GTv = Gvc = Gvt, e=0, a>0

ITTO Consuming Countries	Thailand: Contribute	Thailand: Not Contribute
Contribute	I (0) -21.75 0	II (0) -43.5 43.5
Not Contribute	III (0) 0 -43.5	IV (-43.5) -43.5 -43.5

(million $)

I: GTv = 21.75(Cp) + 21.75(Tp) - 43.5 = 0
Cv = 0(GTv) - 21.75(Cp) = -21.75
Tv = 0(Gvt) - 21.75(Tp) + 21.75(Cv) = 0

II: GTv = 43.5(Cp) + 0(Tp) - 43.5 = 0
Cv = 0(GTv) - 43.5(Cp) = -43.5
Tv = 0(Gvt) - 0(Tp) + 43.5(Cp) = 43.5

III: GTv = 43.5(Cp) + 0(Tp) - 43.5 = 0
Cv = 0(GTv) - 0(Cp) = 0
Tv = 0(Gvt) - 43.5(Tp) + 0(Cp) = -43.5

IV: GTv = 0(Cp) + 0(Tp) - 43.5 = -43.5
Cv = -43.5(GTv) - 0(Cp) = -43.5
Tv = -43.5(Gvt) - 0(Tp) + 0(Cp)= -43.5

Game result: Success, because Column I Tv > Column IV Tv.
Column II and III are possible if either side agrees to pay the entire amount under political consideration.

Figure 34b: No environmental value for Thailand

Case 2: GTv = Gvc, Gvt = 0, e=0, a>0

		Thailand: Contribute	Thailand: Not contribute
ITTO Consuming Countries	Contribute	I (0) -21.75 0	II (0) -43.5 43.5
	Not contribute	III (0) 0 -43.5	IV (-43.5) -43.5 0

(million $)

I: GTv = 21.75(Cp) + 21.75(Tp) - 43.5 = 0
Cv = 0(GTv) - 21.75(Cp) = -21.75
Tv = 0(Gvt) - 21.75(Tp) + 21.75(Cp) = 0

II: GTv = 43.5(Cp) + 0(Tp) -43.5 = 0
Cv = 0(GTv) - 43.5(Cp) = -43.5
Tv = 0(Gvt) - 0(Tp) + 43.5(Cp) = 43.5

III: GTv = 0(Cp) + 43.5(Tp) -43.5 = 0
Cv = 0(GTv) - 0(Cp) = 0
Tv = 0(Gvt) - 43.5(Tp) +0(Cp) = -43.5

IV: GTv = 0(Cp) + 0(Tp) -43.5 = -43.5
Cv = -43.5(GTv) - 0(Cp) = -43.5
Tv = 0(Gvt) - 0(Tp) +0(Cp) = 0

Game result: In-between, because Column I Tv = Column IV Tv.
Column II is possible if Consumers pay the entire amount under political consideration.
Column III is not possible because Column III Tv < Column IV Tv

Figure 34c: Half environmental value for Thailand

Case 3: GTv = Gvc, Gvt = GTv/2, e=0, a>0

		Thailand: Contribute	Thailand: Not contribute
ITTO Consuming Countries	Contribute	I (0) -21.75 0	II (0) -43.5 43.5
	Not contribute	III (0) 0 -43.5	IV (-43.5) -43.5 -21.75

(million $)

I: GTv = 21.75(Cp) + 21.75(Tp) -43.5 = 0
Cv = 0(GTv) - 21.75(Cp) = -21.75
Tv = 0(GTv)/2 - 21.75(Tp) + 21.75(Cp) = 0

II: GTv = 43.5(Cp) + 0(Tp) - 43.5 = 0
Cv = 0(GTv) - 43.5(Cp) = -43.5
Tv = 0(GTv)/2 - 0(Tp) + 43.5(Cp) = 43.5

III: GTv = 43.5(Cp) + 0(Tp) -43.5 = 0
Cv = 0(GTv) - 0(Cp) = 0
Tv = 0(GTv)/2 - 43.5(Tp) + 0(Cp) = -43.5

IV: Gv = 0(Cp) + 0(Tp) - 43.5 = -43.5
Cv = -43.5(GTv) - 0(Cp) = -43.5
Tv = -43.5(GTv)/2 - 0(Tp) +0(Cp) = -21.75

Game result: Success, because Column I Tv = Column IV Tv.
Column II is possible if Consumers pay the entire amount under political consideration.
Column III is not possible because Column III Tv < Column IV Tv.

(ii) Japan

Japan is by far the largest tropical logs importing country (table 11). In 1996, Japan imported as much as 46.6% of the world import of tropical logs, though this rate is gradually decreasing over the past several years (table 10). Japan is also the largest consumer of tropical timbers among ITTO consuming member countries. Japan consumed 39.8 % of tropical logs among ITTO consuming member countries in 1996. (table 10). Japan's import reduction of tropical logs, therefore, is considered to have a significant impact on the world trade of tropical logs and thereby on the conservation of tropical forests. It should be noted, however, that percentage of logs traded in the international market is only a little over 10% of the world's consumption. Nearly 90% of tropical logs are therefore being consumed in producing countries. Then, Japan's portion in the global tropical log consumption comes down to mere 4.7% in 1996. Under such a condition, import restriction measures by tropical log importing countries may not create any constructive effects on the conservation of tropical forests. ITTO is also deeply concerned about this weakness of the ITTO mechanisms to achieve 2000 year objective. Hopefully, ITTO may formulate some new measures to put its influence using its trade restriction measures as a leverage onto the consumption of tropical logs in producing countries.

Figure 35 shows the relation between Japan's and other consuming countries' contribution to the Bali Partnership Fund (Scenario 6). Under this scenario, it is assumed that only consuming countries are responsible for providing contribution to the Bali Partnership Fund. (As stated earlier, it seems likely that ITTO will decide in the end that only the Consumers make constitution to the Fund; therefore, this can be a realistic scenario. As discussed before, the ITTO mechanisms will work more effectively if producing countries also share some values in the environmental quality of the tropical forests and then share some responsibility in their conservation. This is considered true by the results of game simulations conducted under scenarios from 1 to 3.) Since Japan's share of tropical log import is around 40%, 600 million US dollars

(40% of 1500 million US dollars) can be considered as the obligatory contribution of Japan to the Fund. The other 1200 million US dollars are to be supplied by other consuming countries.

Table 10: Japan's Imports and Domestic Consumption of Tropical Logs

(1,000 m3)

	1992	1993	1994	1995	1996
Imports					
World	22706	16721	15933	14574	13759
Japan	10990	8324	7949	6535	6407
% of Japan	48.4	49.8	49.9	44.8	46.6
Consumption					
Consumers of ITTO	23335	17275	17890	16602	15659
Japan	10990	8324	7949	6535	6232
% of Japan	47.1	48.2	44.4	39.4	39.8
World	141772	137395	139291	136327	131413
% of Japan	7.8	6.1	5.7	4.8	4.7

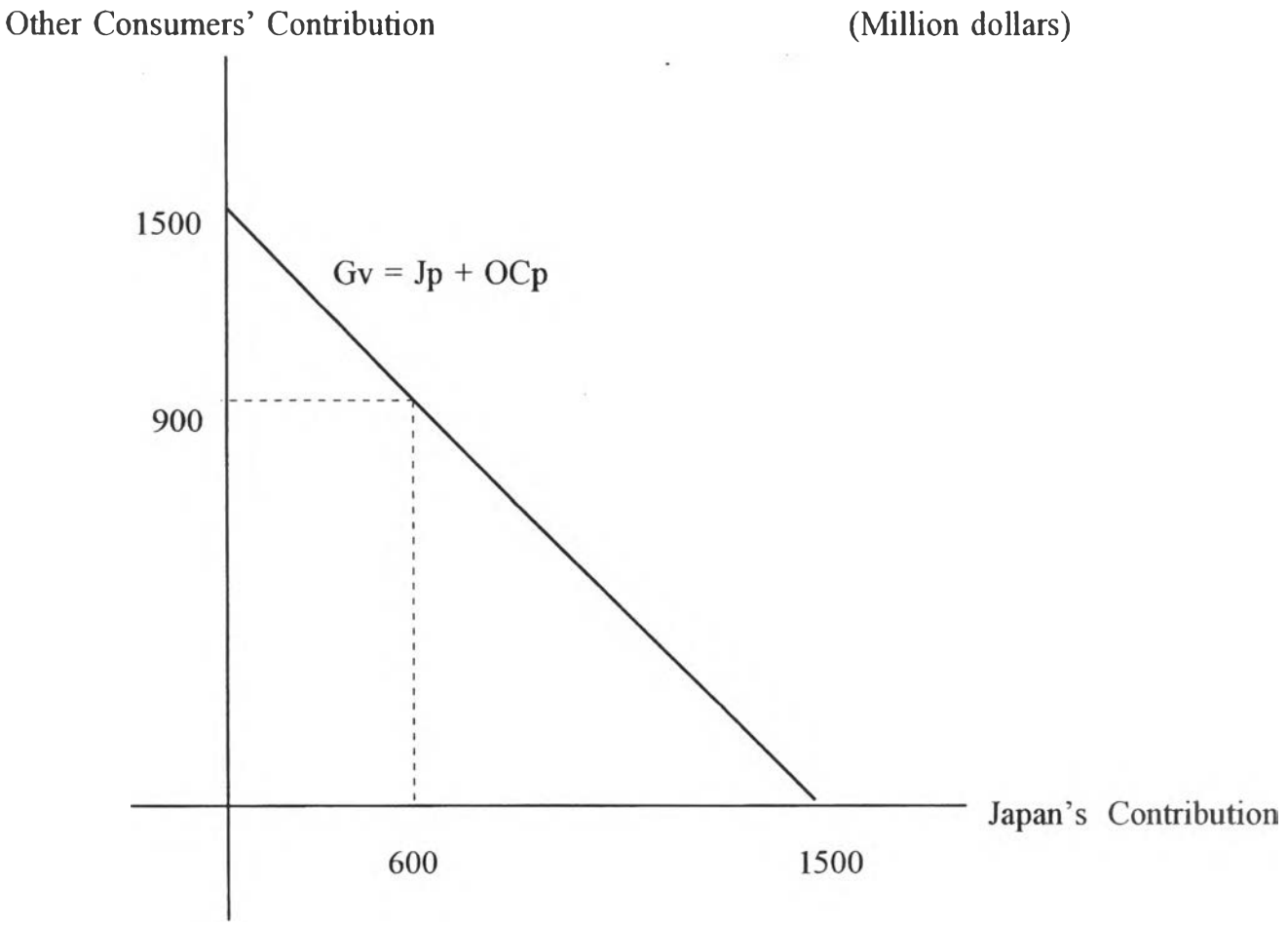
Source: 1996 ITTO Annual Review And Assessment of the World Tropical Timber Situation

Table 11: World Top 10 Importing and Consuming Countries of Tropical Logs

	Imports		Domestic Consumption	
	1992	1996	1992	1996
1	Japan	Japan	Indonesia	Indonesia
2	Taiwan	China	Malaysia	Malaysia
3	ROK	ROK	Brazil	Brazil
4	Thailand	Taiwan	India	India
5	China	Philippines	Japan	Japan
6	France	France	Taiwan	China
7	India	Thailand	ROK	Cote d'Ivoire
8	Philippines	Portugal	Thailand	Ecuador
9	Portugal	Italy	Ecuador	Cameroon
10	Italy	Malaysia	China	ROK

Source: 1996 ITTO Annual Review And Assessment of the World Tropical Timber Situation

Figure 35: Relation between Japan's and Other Consumers' Contribution to the Bali Partnership Fund (Scenario 6)



Gv = Global Environmental Value of Tropical Forests at Sustainable Level
Jp = Japan's Contribution to the Bali Partnership Fund
OCp = Contribution to the Bali Partnership Fund by Consumers other than Japan

(i) Scenario 6

Figure 36 shows the game format for scenario 6. Here again it is assumed that the total amount of 1500 million US dollars are to be filled if one of the parties has intention to provide contribution to the Bali Partnership Fund. Also, it is assumed that the total value for a game participant is the global value minus its amount of contribution. Figure 37 shows the result of a game based on the above assumptions.

Figure 36: Contribution to the Bali Partnership Fund and Game Theory
Format for Scenario 6: Japan (Gv = Jp + OCp)

Contribution by Other Consumers	Contribution by Japan: Contribute	Contribution by Japan: Not Contribute
Contribute	(Gv) OCv Jv I	(Gv) OCv Jv II
Not Contribute	(Gv) OCv Jv III	(Gv) OCv Jv IV

(million US dollars)

Gv = Global Value for Tropical Forest Conservation
Jv = Value for Japan
OCv = Value for Other Consumers
Pp = Contribution by Japan
OCp = Contribution by Other Consumers
Gvj = Global Value Perceived by Japan
Gvoc = Global Value Perceived by Other Consumers
Jpr = Japan's Payment Ratio / OCpr = Other Consumers Payment Ratio
e = Cost of enforcement by penalty (e is applied for non-contributors)
a = Cost of enforcement by self arranged arbitrator
(When a>0, the game is under the control of the arbitrator)

Gv = Jp + OCp
Jv = Gv - Jp
OCv = Gv - OCp
Gv = Gvj = Gvoc

It is assumed that either Japan or Other Consumers provides entire contribution when either Jp or OCp is zero.

Namely, Jpr:OCpr = 5:5 (Column I), Jpr:OCpr = 10:0 (Column II)
Jpr:OCpr = 0:10(Column III), Jpr:OCpr = 0:0 (Column IV)

Figure 37: Contribution to the Bali Partnership Fund and Game Theory

Scenario 6: Japan (Gv = Jp + OCp), e=0, a>0

		Contribution by Japan: Contribute	Contribution by Japan: Not Contribute
Contribution by Other Consumers	Contribute	(1500) 600 900 I	(1500) 0 1500 II
	Not Contribute	(1500) 1500 0 III	(0) 0 0 IV

(million US dollars)

I: Gv = 600(Jp) + 900(OCp) = 1500
Jv = 1500(Gvj) - 600(Jp) = 900
OCv = 1500(Gvoc) - 900(OCp) = 600

II: Gv = 0(Jp) + 1500(OCp) = 1500
Jv = 1500(Gvj) - 0(Jp) = 1500
OCv = 1500(Gvoc) - 1500(OCp) = 0

III: Gv = 1500(Jp) + 0(OCp) = 1500
Jv = 1500(Gvj) - 1500(Jp) = 0
OCv = 1500(Gvoc) - 0(OCp) = 1500

IV: Gv = 0(Jp) + 0(OCp) = 0
Jv = 0(Gvj) - 0(Jp) = 0
OCv = 0(Gvoc) - 0(OCp) = 0

Game result: Success, because Column I Jv & OCv > Column IV Jv & OCv.
Column II and III are possible if either side agrees to pay the entire amount under political consideration.