Framework on Estimating Expected Benefits through Facilitating the Nagoya Protocol on Access and Benefit-Sharing:

With Emphases on the Multiple Benefits of Sustainable Utilisation of Resources, Non-Monetary Benefits, and Cost-Effectiveness of New Institutions

Mikihiko WATANABE
Faculty of Life and Environmental Sciences, University of Yamanashi

Kiyoshi FUJIKAWA
Graduate School of International Development, Nagoya University

Xi LU
Graduate School of International Development, Nagoya University

Inception Report of the Research
Distributed at the Eleventh Meeting of the Conference of the Parties to the Convention on Biological Diversity
8 - 19 October 2012, Hyderabad, India

About the Contributors

Mikihiko WATANABE

Professor, Faculty of Life and Environmental Sciences, University of Yamanashi, JAPAN

Professor Mikihiko WATANABE, who specialises in environmental economics and development economics, has been being involved in CBD and ABS for years. He is a former expert of the Meeting of the Group of Technical Experts on an Internationally Recognized Certificate of Origin/Source/Legal Provenance held in 2007 in Lima, Peru. One critical contribution in the context of economic values of biodiversity is his economic evaluation of microbial genetic resources. While many research outcomes on values of ecosystems and biological resources are available, economic evaluations of the genetic level are very rare. At the University of Yamanashi, Professor Watanabe tries to integrate life science, environment conservation, and economics towards the three goals of CBD.

Kiyoshi FUJIKAWA

Dean, Graduate School of International Development, Nagoya University, JAPAN

Professor Kiyoshi FUJIKAWA, who specialises in econometrics and statistics, has been playing an important role in the field of international development. He previously worked at the Statistical Office of the UN. He is at present working as Dean of the School, fostering graduate students from around the world and cooperating with international organisations such as the Asian Development Bank, JICA and so on. Amongst the analytical methods available, he is expected to contribute to this research through input-output analysis that can evaluate non-monetary benefits and that can be a breakthrough in the field of ABS.

Xi LU (Assistant Co-Author)

PhD Course Student, Graduate School of International Development, Nagoya University, JAPAN

Ms Xi LU, who specialises in environmental economics, conducts research on environmental problems caused by the trans-boundary movements of renewable resources and their related policies. She has obtained a masters degree in environmental sciences at the University of Shiga Prefecture in Japan and has completed a dissertation titled, “Pollution control policies on the cross-border circulation of renewable resources between China and Japan”. The dissertation investigated a case of waste plastics through comparative analysis on the effects of related environmental policies on the reduction of the waste. Ms Lu is now seeking a doctoral degree at the Graduate School of International Development, Nagoya University in Japan, and is developing a waste input-output table to analyse how to promote the cross-border circulation of waste plastics between China and Japan.

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Xi LU
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1. Objectives

The objective of this study is to provide the stakeholders of the Nagoya Protocol on Access and Benefit-sharing with a framework on estimating expected benefits. When the framework is provided, option values, non-monetary benefits, and comparison between expected benefits and costs will be emphasised.

An underlying objective of the study is to contribute to positive and constructive discussions and/or the designing of laws and/or institutions so that the Aichi Biodiversity Targets and the Nagoya Protocol can be realised in constructive ways maximising benefits of all parties of the Convention on Biological Diversity.

While the sixth mass extinction is caused by human activities, especially economic activities and while ABS is never free from benefits that fall within the category of economy, setting up a framework and estimating values and benefits do deserve to be carried out to reach the goal of the objectives above.

2. Significance

It is justified for parties of the CBD to wish to maximise expected benefits through the establishment or revision of ABS related laws or institutions, when the parties are about to ratify the Nagoya Protocol and are required to take the necessary legislative, administrative or policy measures, in response to certain articles in the protocol. In other words, the introduction or revision may not be justified from the viewpoint of social benefits, unless expected benefits can be maximised. Expected benefits are required to exceed administrative costs needed, when the new necessary legislative, administrative or policy measures are introduced. Furthermore, stakeholders of the new laws/institutions/ measures may not receive approval on introduction/revision of them in the decision making processes, unless expected benefits exceed sufficiently administrative costs of the new laws/institutions/ measures.

Despite the logical understanding of necessary factors for facilitating the protocol's ratification and diffusion, concrete figures of benefits are rarely found. More concretely, monetary benefits tend to be highlighted too often, although non-monetary benefits are important in the context of benefit-sharing. Therefore, recognising non-monetary benefits more strictly can improve the recognition of benefits.

In addition, the importance of the fact that the Nagoya Protocol is not isolated from the two objectives of CBD cannot be overstated. If ABS is carried out by two entities between a provider and a user, some habitats will be conserved at least during the period in which biological or genetic resources are being extracted for ABS such as research. This process generates option values (See below for details on option values). It is unreasonable to

expect that a number of habitats or huge areas can be conserved solely by ABS. It can be said, however, that ABS is able to add one scheme by which the habitats are to be conserved instead of destroyed.

The discussions above can be clarified into three crucial points as significance in this study.

i. With regard to an option value, if the option value(s) is clearly explained and is strictly recognised, decision makers are able to understand option values as benefits available when ABS is facilitated.

ii. With regard to non-monetary benefits, recognising non-monetary benefits in quantitative ways is expected to provide appropriate understanding, while understanding non-monetary benefits in qualitative ways always bears the risk of underestimation. If non-monetary benefits are estimated in quantitative ways, the values of the benefits can be input into comprehensive decision making criterion (a).

iii. With regards to the comparison (*i.e.* the comparison between expected benefits and necessary costs), decision makers can make appropriate decisions through comparison between expected benefits and costs, especially when expected monetary benefits and non-monetary benefits are taken into consideration. Non-monetary benefits are a source of social benefits that deserve careful consideration when making decisions.

3. Background

A) Introduction of the Nagoya Protocol

The Nagoya Protocol was adopted in 2010. In this regard, what this research intends to contribute to this matter is not explaining the legal significance of each article in the protocol but to point out necessary economic factors so that the protocol can be diffused to reach objectives of CBD and the protocol. The keys are some of the obligations[1] stipulated in the articles. Prominent articles that mention new laws, institutions, regulations, and legislative, administrative or policy measures are pointed out below[2].

> **Article 6. Access to Genetic Resources**
>
> 1. In the exercise of sovereign rights over natural resources, and subject to domestic access and benefit-sharing legislation or regulatory requirements, access to genetic resources for their utilization shall be subject to the prior informed consent of the Party providing such resources that is the country of origin of such resources or a Party that has acquired the genetic resources in accordance with the Convention, unless otherwise determined by that

[1] This research and paper are not legal interpretations. Hence, the authors use general terms when mentioning expressions in articles even if they lack accuracy from the viewpoint of interpretation of law.

[2] Some parts are omitted to save space. For the full text, kindly refer to the original text. In addition, underlining has been added by the authors.

Party.

2. In accordance with domestic law, each Party shall take measures, as appropriate, with the aim of ensuring that the prior informed consent or approval and involvement of indigenous and local communities is obtained for access to genetic resources where they have the established right to grant access to such resources.

3. Pursuant to paragraph 1 above, each Party requiring prior informed consent shall take the necessary legislative, administrative or policy measures, as appropriate.

Article 13. National Focal Points and Competent National Authorities

1. Each Party shall designate a national focal point on access and benefit-sharing. The national focal point shall make information available as follows:

(a) For applicants seeking access to genetic resources, information on procedures for obtaining prior informed consent and establishing mutually agreed terms, including benefit-sharing;

(b) For applicants seeking access to traditional knowledge associated with genetic resources, where possible, information on procedures for obtaining prior informed consent or approval and involvement, as appropriate, of indigenous and local communities and establishing mutually agreed terms including benefit-sharing; and

(c) Information on competent national authorities, relevant indigenous and local communities and relevant stakeholders.

Article 15. Compliance with Domestic Legislation or Regulatory Requirements on Access and Benefit-sharing

1. Each Party shall take appropriate, effective and proportionate legislative, administrative or policy measures to provide that genetic resources utilized within its jurisdiction have been accessed in accordance with prior informed consent and that mutually agreed terms have been established, as required by the domestic access and benefit-sharing legislation or regulatory requirements of the other Party.

2. Parties shall take appropriate, effective and proportionate measures to address situations of non-compliance with measures adopted in accordance with paragraph 1 above.

3. Parties shall, as far as possible and as appropriate, cooperate in cases of alleged violation of domestic access and benefit-sharing legislation or regulatory requirements referred to in paragraph 1 above.

Article 17. Monitoring the Utilization of Genetic Resources

1. To support compliance, each Party shall take measures, as appropriate, to monitor and to enhance transparency about the utilization of genetic resources. Such measures shall include:

(a) The designation of one or more checkpoints.

(b) Encouraging users and providers of genetic resources to include provisions in mutually agreed terms to share information on the implementation of such terms, including through reporting requirements; and

(c) Encouraging the use of cost-effective communication tools and systems.

2. A permit or its equivalent issued in accordance with Article 6, paragraph 3 (e) and made available to the Access and Benefit-sharing Clearing-House, shall constitute an internationally recognized certificate of compliance.

3. An internationally recognized certificate of compliance shall serve as evidence that the genetic resource which it covers has been accessed in accordance with prior informed consent and that mutually agreed terms have been established, as required by the domestic access and benefit-sharing legislation or regulatory requirements of the Party providing prior informed consent.

4. The internationally recognized certificate of compliance shall contain the following minimum information when it is not confidential.

As stipulated in some articles above, each party is required to take appropriate, effective and proportionate legislative, administrative or policy measures to facilitate the Nagoya Protocol. . Important things are that the party must bear the costs when it tries to take the measures and that the costs are not justified unless the social benefits exceed the costs of undertaking the measures. Even if the measures are requirements in the protocol and are obligations as a party, a comparison between the costs and benefits are needed. In particular, for developing countries where the establishment of new institutions is a heavy burden, this is a critical matter.

B) Lack of Domestic Laws to Manage ABS

There is a lack of domestic laws to manage ABS. Two decades have passed since the CBD entered into force. Despite this fact, only 41 parties have stipulated information on national focal points and only 26 parties have done it on competent national authority in their environment or ABS related laws, regulations, or institutions as of 2010 (Watanabe and Kitano, 2012). If you remember the fact that approximately 190 are parties to the CBD, the numbers above cannot help but be recognised as a lack of policy measures.

This is a serious problem for facilitation of ABS. Even if an entity with good will tries to have PIC under a provider country's regulations on ABS, the entity has difficulties knowing who to contact or what are the regulations. In other words, this situation leaves uncertainty and risks for users. As a result, ABS is not facilitated.

This lack must have been one of the reasons why the Nagoya Protocol has been adopted. This entails a need for establishing new laws, regulations, or institutions and for establishing policy measures to manage ABS and justifies the necessity of estimating expected benefits of the establishment.

C) Underestimation of Non-Monetary Benefits Arising from ABS

The importance of non-monetary benefits is widely recognised. Despite this fact, quantitative measures to estimate non-monetary benefits can hardly be found, while the Bonn Guidelines and Annex of the Protocol specify examples of non-monetary benefits in qualitative ways.

The absence of measures to estimate non-monetary benefits in quantitative ways may have caused an underestimation of the non-monetary benefits and an overestimation of monetary benefits. As a result, the underestimation and overestimation may cause

inappropriate designing of ABS related regulations, missing an appropriate balance between the two kinds of benefits.

Inclusion of monetary benefits into new ABS-related regulations does not necessarily exclude inclusion of non-monetary benefits into the regulations. Some laws, however, that overestimate monetary benefits in the short term tend to be adopted, unless the balance between monetary benefits and non-monetary benefits are objectively compared.

Hence, ways/measures/techniques/frameworks for estimating non-monetary benefits are desirable. This is one crucial background.

D) A Lack of Consideration on the Relationship between Conservation, Sustainable Utilisation, and ABS

The relationship can be explained by two views. The first view can be provided in the context of conservation, sustainable use of biodiversity and ABS. ABS is not designed for conservation in a narrow sense. Having said so, ABS is able to provide an incentive for conservation. In other words, ABS has a function to conserve biodiversity and improve the sustainable use of it.

At least, as long as some habitats are conserved instead of "developed (*e.g.* land clearance for agricultural production)", the habitats are conserved for a period of time. This process is an additional option of conservation made possible by the ABS scheme. In addition, if monetary benefits and non-monetary benefits obtained by this scheme are used for the conservation of biodiversity, this also can facilitate conservation.

Even if the protocol's stipulation on this matter is limited, it clearly states this matter and that is:

> Article 9. Contribution to Conservation and Sustainable Use
> The Parties shall encourage users and providers to direct benefits arising from the utilization of genetic resources towards the conservation of biological diversity and the sustainable use of its components.

The second view can be expressed by the multiple economic values available in the conservation of biodiversity. When ABS contributes to biodiversity conservation, multiple economic values are obtained. Recently, it is widely known that biodiversity has many economic values such as direct use values, indirect use values, option values, and non-use values. These are multiple benefits.

An important thing here is some values are critically important for alleviating other environmental problems especially climate change and desertification. In reality, the UN proposes a notion called the Rio Conventions. The Rio Conventions are the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD), and the United Nations Convention to Combat Desertification (UNCCD). In this notion of the Rio Conventions, the three conventions and problems interact with

each other.

For instance, conserved biodiversity bears the function of carbon absorption. This absorption is regarded to be an economic value for mitigating climate change. Furthermore, conserved biodiversity is able to conserve watersheds. It can help ease desertification. It means that conserving biodiversity can result in mitigating desertification. As long as ABS is able to contribute to the conservation of biodiversity, through having these multiple values that are regarded to be benefits, ABS can contribute to alleviating other environmental problems.

E) Need for Information on Benefits and Costs Available for Domestic ABS laws and/or Designing Article 10 of the Protocol

While parties and stakeholders discuss very often desirable amounts of shares of monetary benefits, they rarely refer to costs. The importance of costs cannot be overstated in the context of ABS. Actually, for instance, the absence of clear domestic regulations increases transaction costs. Unclearness of conditions on PIC entails a longer negotiation time. It results in increases in transaction costs. In addition to all the transaction costs, having longer times always makes stakeholders bear opportunity costs that consist of foregone revenues (*i.e.* benefits) that could have been obtained by shorter negotiation times and foregone economic values of genetic resources that could have been conserved by shorter negotiation times as well[3].

Introduction of the Nagoya Protocol has two sides on this matter. It is, firstly, expected to reduce costs through clearer domestic compliance measures. Secondly, it has to bear administrative costs. Comparisons between expected benefits and expected costs are, therefore, the most important thing for especially decision makers, while costs are rarely discussed.

Before concluding this background, Article 10 of the protocol, the Global Multilateral Benefit-sharing Mechanism, should be mentioned in this context. It requires the parties to consider the need for and modalities of a global multilateral benefit-sharing mechanism. Modalities should consider this comparison, including non-monetary benefits that are rarely concretely taken into consideration in quantitative ways.

[3] EU pointed out this in this context. "A study to analyse legal and economic aspects of implementing the Nagoya Protocol on ABS in the European Union (Schally, 2012, p. 10)"

4. Advantages and Limitations of the Study

4.1. Advantages

A) Providing criterion for Decision Makers from the Viewpoint of Costs and Benefits of Designing New Domestic ABS-Related Legislative, Administrative or Policy Measures

This research intends to provide decision makers with criterion/platform for designing ABS-related laws, institutions, regulations, and legislative, administrative or policy measures through clarifying a framework on expected benefits and costs. This is an advantage of the research because these criterion and/or platform are rarely found even if these are necessary for designing new laws and institutions that need justification from the viewpoint of comparison between benefits and costs.

B) Recognition of an Option Value as Economic Value for Conserving Biodiversity for ABS

Recognising an option value is crucial for stakeholders of ABS and for conservation of biodiversity, because postponing habitat destruction so that some research (*e.g.* taxonomic research under ABS PIC and so forth) can be carried out as ABS is always able to generate value. The value can be generated, even if the research rarely finds biological and genetic resources with high market value.

The first reason why value can ALWAYS be generated is that some research for ABS can always bring new information, even if the research results in "no useful resources could be found". This result can exclude uncertainty of the habitat that can bring information for making a decision by which the habitat is destroyed or conserved. The second reason is that the loss of biodiversity, especially loss of genetic material, is an irreversible process. If the process is irreversible, an option value is always generated.

In these senses, introducing an option value for a framework is an advantage. (See 5.1 for details on option value.)

C) Estimating Non-Monetary Benefits of ABS: Importance of Foreign Direct Investment (FDI)

ABS is nothing without some access from abroad. Foreign Direct Investment (FDI) is a typical format of access from abroad. FDI is the flow of capital from abroad that consists of various formats. FDI is expected to transfer technologies and know-how of business administration by a foreign entity to a domestic area. In addition, FDI is expected to fill in the gap between saving and investment. Analysing non-monetary benefits through adaptation of the notion of FDI brings many lessons for decisions. This can be regarded as one of the advantages of this research.

4.2. Limitations

Estimation of non-monetary benefits is done by simulation. It is not a result of actual data. This is because all the relationships between transferred technologies and final outcomes of products can hardly be perfectly revealed. Even if it was possible from the viewpoint of techniques, firms would never disclose all the necessary information. All that can be done at present is simulation under the careful setting of conditions. This is a limitation.

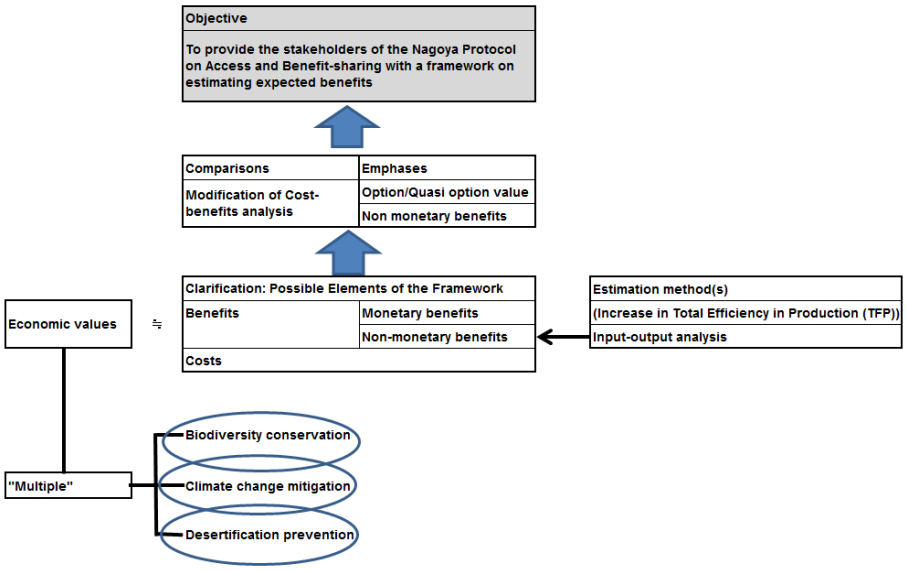
However, in contrast, this research is to provide a platform for future development of estimation methods. In addition, it must be emphasised that conditions for the simulation are to be carefully chosen through field interviews/data and data on which simulations are based are actual macroeconomic data. Furthermore, input-output analysis used for the simulation is an established standard method for understanding changes in the outputs of the country's economy and is reliable. Hence, being a simulation is not a crucial negative factor of this research even if it should be noted.

5. Methodology

5.0 Conceptual Framework

Bearing the background, significance, advantages, and limitations explained above, this research is to be carried out under the concept described in Figure 5.0-A.

Figure 5.0-A Conceptual Framework



Sources: Arranged by the Authors

Possible elements of the framework are, first of all, clarified. Most benefits and economic values of biodiversity coincide in the clarification. As emphases, attempts are made to estimate the non-monetary benefits of ABS. Under the assumption that ABS resembles foreign direct investment (FDI), non-monetary benefits, especially those by technology transfer, are estimated by input-output analysis that is one the standard methods in macro economics. In addition, some models of technology transfer on total efficiency in production may be added to the estimation of non-monetary benefits[4]. With regard to economic values that are almost similar to benefits, multiple benefits of conservation are considered. Costs with explicit recognition of transaction costs, administrative costs, and opportunity costs are added to this framework. Eventually, modified cost benefit analysis (CBA) is used for comparison of costs and benefits. This comparison is a framework for benefits that are expected to be obtained through establishment or revision of domestic laws, institutions, legislative, administrative or policy measures on the Nagoya Protocol.

5.1 Clarifying the Option Value in the Context of all the Economic Values available from Biodiversity including Genetic and Biological Resources

When economic values are recognised, benefits emerge. Benefits can be derived from the values that explicitly or implicitly exist. When an additional economic value is newly recognised, an additional benefit will emerge. Unless overall economic values of biodiversity including biological and genetic resources are understood or unless all the economic values are correctly clarified, benefits that are available amongst the values can barely be appropriately estimated.

In the last few decades, many economic values of the environment have been recognised. In addition, there has been rapid development of evaluation methods in the field of environmental economics, even if they still have to bear many challenges. A number of evaluation results are available now. Appropriate decision making is impossible without information from the evaluation.

5.1.1. Multiple Values of Biodiversity

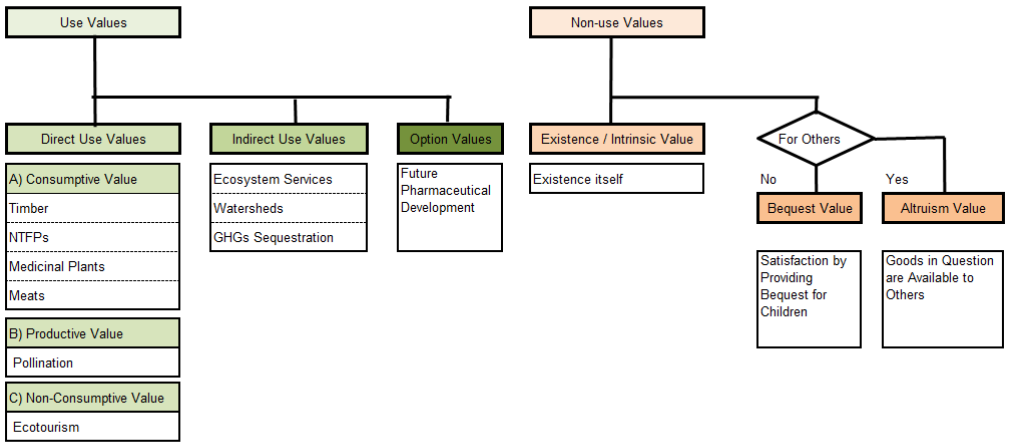
Here, the notion of economic values is re-classified and re-clarified in the context of ABS. The latest classification of economic values is shown in Chart 5.1-A. This classification has been proposed by Pearce *et al* (2006), previous classifications being improved.

An attempt by Pearce *et al* for improvement is that bequest value is classified into two; bequest value (*i.e.* "for myself") and altruism value (*i.e.* "for others"), while previous classifications have only one value, say, bequest value. Besides this, all the classifications are the same as the previous ones; use values and non-use values; direct, productive and

[4] Technology transfer models on total efficiency in production are not introduced in this report because it is an inception report. They are supposed to be explained in the final report.

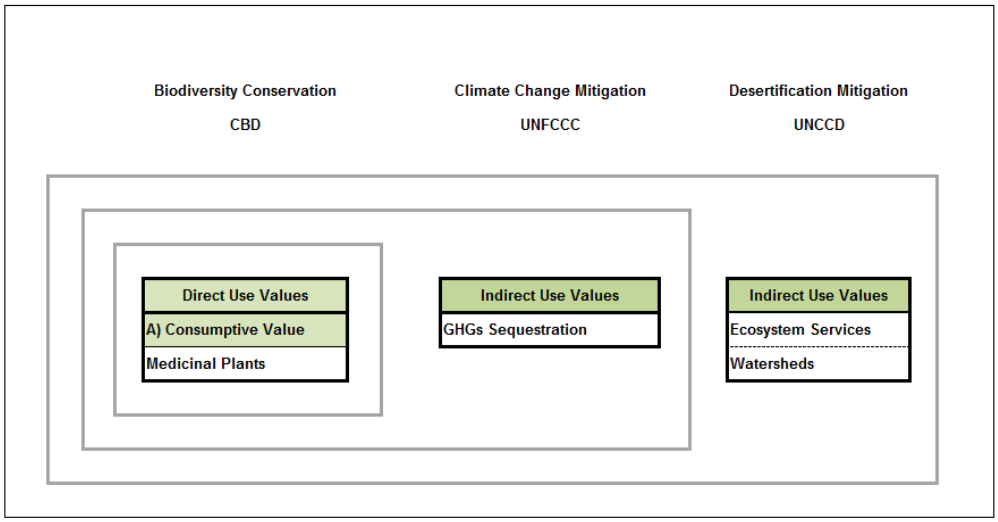
non-consumptive values; indirect values; option values (see below for details); and existence values.

Chart 5.1-A Economic Values of the Environment (Example: Forest Biodiversity)



Source: Pearce, Atkinson, and Mourato (2006)

Chart 5.1-B Horizontal Classification of Economic Values



Source: Arranged by the authors.

5.1.2 Multiple Values Available for Other Environmental Issues and Beneficiaries

One thing should be repeated here briefly. Conserving biodiversity creates multiple benefits that can be increased by the existence of an ABS scheme. Hence, this classification should be arranged so that these values can reflect correctly the characteristics of biodiversity and ABS.

The first classification intends to reflect the notion of the Rio Conventions that was mentioned in the background above. If you call this classification a "horizontal

classification" as a metaphor, the intention can be easily understood. (See Chart 5.1-B.)

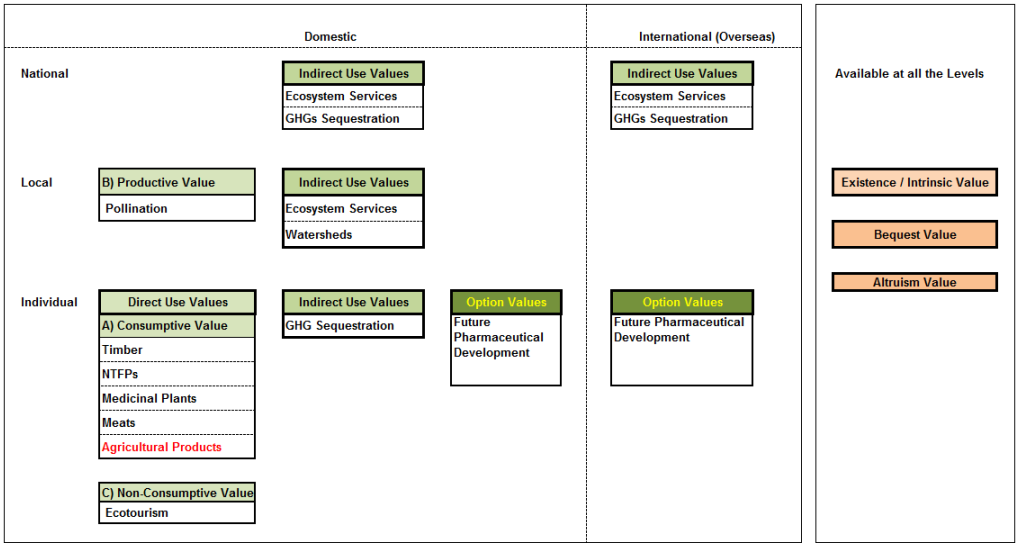
When, for instance, a habitat with rich biodiversity is conserved, the conservation can realise biodiversity conservation, stabilisation of climate change, and mitigation of desertification. More concretely, if a forest is conserved, economic values of, for instance, medicinal plants for biodiversity conservation, greenhouse gases sequestration for climate change mitigation, and watersheds protection for dissertation mitigation are simultaneously obtained. It means that implementation of policy measures for biodiversity conservation can generate multiple economic values for improvement of the three environmental problems and the three environmental treaties. These values are simultaneously regarded to be multiple benefits.

Focusing on ABS, conserving some forest areas, for instance, for collection of plants for screening as bio-prospecting, the conservation can generate multiple economic values that are benefits, even if the conservation for collection is guaranteed for a limited time.

This classification – or views – is very often mentioned in literature with an expression, "co-benefits" of conservation in the arena of climate change. Here, co-benefits are those for climate change mitigation and biodiversity conservation. However, if you consider the significance of the Rio Conventions and "multiple" - not just "co" – benefits, recognition of values by classification as multiple benefits should be more appropriate.

The second classification reflects characteristics of belongingness. Economic values do exist. However, the belongingness of each value differs. In other words, beneficiaries differ by each value respectively. (See Chart 5.1-C.)

Chart 5.1-C Layers of Economic Values of the Environment (Example: Forest)
Classification of the Values by Beneficiaries



Source: Arranged by the author from Pearce, D., Atkinson, G., and Mourato, S. (2006).

For instance, suppose that some forest areas that are privately owned are conserved and

that the conservation is for clean develop mechanism (CDM) under the Kyoto Mechanisms and resources can be extracted to the extent at which resources are renewable, typical economic values obtained are:

- Medicinal plants;
- Credits by CDM; and
- Watersheds protection.

Regarding belongingness (or beneficiaries), these three values have different beneficiaries. Medicinal plants basically belong to an owner, say, an individual. The owner can use it by him/herself or he/she can sell the plants in markets. In addition, unless the plants are merchandised, others cannot enjoy their benefits. With regard to CDM credits, it belongs to three categories. Firstly, an implementing agency – in this case, the land owner – can have benefits, receiving revenue from selling the credits. The value belongs to an individual and the beneficiary is the land owner. Secondly, CDM credits are regarded to be an achievement of greenhouse gas (GHG) reduction. The achievement belongs to the government as a party of UNFCCC. Hence, CDM credits value belongs to the nation. Beneficiaries exist at the national level. Thirdly, the rest of the world can benefit by CDM through reduction of GHG. Hence, benefits do exist at the international level.

This classification is important for this research because specifying beneficiaries is a crucial factor especially for cost-benefit analysis (CBA). CBA may consider benefits for individual, national, and international levels respectively[5] when beneficiaries are specified. In general, benefits of some project are estimated and benefits at the local level are considered as effects of the project. In this and the ABS context, an important thing is who beneficiaries should be, while the cost of establishing new laws/institutions is borne by the government and estimation of effects to the local level is reliable.

5.1.3. Clarifying the Option Values

There have been concepts of option value and quasi-option value in the context of values of the environment. They emerge especially when uncertainty and irreversibility on the environment exist. For instance, when there is an old growth forest in which useful genetic resources are expected to exist but the resources are unidentified yet and which the destruction process is irreversible, option value and quasi-option value emerge.

Option value is conventionally defined as some values available when a decision is made to conserve some areas such as forests instead of "develop (*i.e.* being destroyed)". Quasi-option value is conventionally defined as some values available when the decision of "develop (*i.e.* being destroyed)" is postponed for a certain period.

Pearce *et al* (2006) pointed out confusion between the two values and clarified them into one value, a quasi-option value. Pearce *et al* has said that these two were the same eventually. Hence, this paper shall use the term, quasi-option value (QOV) from now on.

[5] It is logically correct but in many cases benefits are estimated in some limited areas technically.

According to Pearce *et al* (2006), "Quasi-option value (QOV) refers to the value of information secured by delaying a decision where outcomes are uncertain, where one or more benefits (or costs) is uncertain, and where there is an opportunity to learn by delay (Pearce *et al*, 2006, p.147) (Underline by the authors) ". Key words are "uncertainty" and "irreversibility". In addition, a key concept is "the value of information".

It is widely known in the arena of biodiversity and CBD that information on genetic resources in habitats is uncertain unless some taxonomic research is carried out and that the loss of genetic resources is an irreversible process.

These facts reflect the situation of ABS very well into values. Postponing habitat destruction itself so that some research (*e.g.* taxonomic research or bio-prospecting) can be carried out as ABS can generate QOV, even if the research can eventually find biological and genetic resources with high market values. After the postponing of development, if there are no high value genetic resources, you may go ahead for development such as conversion of land for agriculture.

The point should be repeated:

1) When there are uncertainty and irreversibility, postponing "development" can always generate QOV;
2) This situation of postponing activities is very similar to postponing development for a certain period of time for research as ABS activities; and
3) Postponing habitat destruction can generate multiple values of biodiversity at least for some period.

If activities of ABS can always generate QOV, QOV can always increase the economic value of ABS, and QOV should be considered when the benefits of ABS are estimated.

QOV is strictly expressed as follows[6].

Three notions should be defined:

1) Expected benefits from development (ED);
2) Expected benefits from preservation (EP), and;
3) Expected benefits from waiting (postponing) (EW). (Benefits may be called values but in this context, the term benefit is used.)

ED is obtained when the habitat is "developed" for agricultural land. EP is obtained when the habitat is conserved. EW is available when a decision is postponed and the habitat is preserved during the period of postponement, even if the habitat is developed after postponing. These benefits can be expressed by the equations below respectively.

$$ED = D_0 + D_1$$

[6] Expressions on equations and variables in this section are cited from Pearce *et al* (2006) with modification by the authors unless otherwise stated.

$$EP = V_o + pV_{1high} + (1-p)V_{1low}$$
$$EW = V_o + pV_{1high} + (1-p)\,D_1$$

Where:

D_0 : Benefits from agriculture in time 0.

D_1 : Benefits from agriculture in time 1.

V_o : Benefits from preservation in time 0.

V_{high} : Benefits of some genetic resources found to be high after research.

V_{low} : Benefits of some genetic resources found to be low after research.

p : Possibility of finding high value genetic resources, $0<p<1$.

First of all, regarding D, if you decide to convert the habitat to agricultural production, agricultural development surely brings benefits in times 0 and 1 and the amounts are clear. In addition, if once the habitat is destroyed for land conversion for agriculture, the process is irreversible, and you can never have old growth forests with rich biodiversity again. Even if there is pressure on agricultural development in developing countries, the loss is crucial.

Secondly, if you decide to preserve the habitat, you can have V_o in time 0. You can have V_o that consists of multiple benefits but you cannot easily expect that V_o will exceed D_0 because D_0 is guaranteed and its values are high. If you do some research to exclude uncertainty or a lack of information on the resources, pV_{1high}, say high value from genetic resources at the possibility of p will be obtained. This may exceed D. In contrast, eventually you may not able to find resources with high value, say, just a low value resource. If so, the benefit will be $(1-p)V_{1low}$ at the possibility of (1-p).

ED and EP are expected benefits when you decide whether or not to develop now at time 0. In contrast, EW consists of benefits that can be obtained by postponing the decision during the period 0. The decision will be made at time 1. In other words, EW is some benefits that can be obtained if only you postpone the decision. During the postponement, the habitat is not destroyed and is preserved. EW has a positive value, because in short, postponing the decision can leave preserved areas from which two options, say, development and preservation, are available again.

Postponing can always have V_o, because habitats are preserved during period 0. If resources are found to have high value at the possibility of p, this high value is thought to be obtained through postponing. On the contrary, even if high value resources are not found in the period 0, the land can be converted to agricultural land and you can have D_1 at the possibility of (1-p).

It should be repeated that postponing the decision - especially a decision for development -, can always generate benefits when uncertainty and irreversibility exist, because development can never leave an option of preservation while preservation always leave two options of development and preservation again.

Coming back to the terminology of "value", QOV can be expressed as:

QOV = EW – max(ED, EP)[7]

This equation expresses the strict meaning of QOV as the increase in expected value of benefits from waiting and says, "QOV is the difference between the expected value of waiting and whichever is the larger of ED and EP " (Pearce *et al*, 2006, p. 151).

5.2 Clarifying Costs and Benefits

In the descriptions above, the benefits are almost reflections of economic values and *vice versa*. Benefits are crucial factors in decision making and for ABS. In addition to benefits, costs should be considered. Costs and benefits should be simultaneously considered when decision making. Costs and benefits are clarified in Table 5.2-A.

Table 5.2-A Classification of Costs and Benefits

Costs and Benefits When Developed (*e.g.* Agricultural Development)

	Benefit		Cost			
	Monetary	Non-monetary	Capital cost; CC	Operational; CO	Transaction; CT	Opportunity cost of development; OCD
Component(s)	Some parts of multiple benefits of biodiversity (In many cases, just a benefit by mono-culture)		Initial investment on each project	Equipment Inputs Labour		Loss of possible income from utilisation of GRs (QOV)

Costs and Benefits From Conservation Especially for ABS

	Benefit		Cost			
	Monetary	Non-monetary	Capital cost; CC	Operational; CO	Transaction; CT	Opportunity cost of preservation; OCP
Component(s)	Some parts of multiple benefits of biodiversity Monetary benefits available by ABS	Some parts of multiple benefits of biodiversity Non-monetary benefits available by ABS	Initial investment on each project Initial investment on institutional development (administrative cost)	Equipment Inputs Labour Administrative cost	Negotiations to have PIC Depreciation of values by stagnation of access (discounting)	Incomes from development such as agricultural products (Foregone governmental income from tax (*i.e.* exemption for FDI facilitation))

Source: Arranged by the Authors

On the one hand, when some forest areas are developed, for instance, agriculture, the

[7] Max(ED, EP) implies that among ED and EP, the greater one is chosen and is calculated in the equation.

benefit is income from agricultural products with high certainty. This benefit falls within the category of monetary benefits and non-monetary benefits are not obtained in this case.

Regarding costs, the first cost is initial investment to start agriculture. If an implementer does not have land, the cost for land acquisition is needed. Even if he/she does acquire land, some costs are needed to cultivate the land. Equipment, inputs (*e.g.* fertilizer and so forth), and labour are needed for agricultural production. A large amount of transaction costs are not expected for agricultural development, unless there is conflict on the land. In addition to these costs, agricultural development has to bear opportunity costs of development. A typical opportunity cost is foregone benefits that may be obtained if the land was conserved such as future development of products derived from genetic resources. In addition, there always exist potential useful resources. Hence, QOV is opportunity cost as well when the availability of resources is uncertain.

On the other hand, some forest areas are conserved, especially for some ABS for a certain period of time. This situation assumes that forests are conserved before making a decision on whether they should be developed because there are uncertainties on available resources and some resources by ABS can exclude this uncertainty.

Benefits are, first of all, some multiple benefits of biodiversity available from conservation. Some fall within the category of monetary benefits and some in the category of non-monetary benefits. For instance, medicinal plants bear an economic value and are a monetary benefit. The economic value of watershed protection is a non-monetary benefit or a monetary benefit if it is evaluated and turns out to be a target of environmental tax. Furthermore, up-front payment for ABS is a monetary benefit while technology transfer is a non-monetary benefit.

Regarding costs, the first cost is initial investment to start some conservation activities and/or research for ABS. A special cost in this context would be certain costs to establish/revise some domestic laws/institutions to manage ABS in response to requirements of the Nagoya Protocol. Well-organised laws/institutions are expected to facilitate ABS, making the process clear and efficient. However, they cause initial costs. They may be considered an administrative cost in a broad sense. Costs for equipment, inputs, and labour are obviously necessary. Administrative cost is needed in order to regulate ABS so that appropriate benefits can be shared. A transaction cost is crucial to consider ABS. ABS negotiation needs more time and costs to reach an agreement in comparison to starting agricultural development. Hence, ABS has to bear more transaction costs. In addition, if this negotiation takes time even if some costs such as transportation costs are not needed, delaying benefits causes opportunity costs decreasing the value of benefits by increasing discounting more in the future. Conservation does have opportunity costs. Income from agricultural products is very high and conservation always has to bear the income as an opportunity cost. The last opportunity cost is very tricky. In many cases, in order to facilitate FDI, the government introduces an exemption. If the same case is adapted to ABS to facilitate access, the government's income from the tax will decrease. Exemption 'pays', because increases in access may result in increases from benefit-sharing. This increase may exceed a decrease in income from tax. However, until the government

has a fruitful result, it has to bear a decrease in tax revenue.

5.3 Estimating Non-Monetary Benefits by Input-Output Analysis: The Benefits possible through Capacity Building by ABS

This research regards ABS as one of the formats of foreign direct investment (FDI). This is a crucial interpretation for the research. This interpretation – view or assumption, you may call it – makes estimation possible and may deserve criticism. How ABS is regarded to be FDI and how ABS and FDI are similar and different should be explained so that this interpretation can be justified.

5.3.1 ABS as one of the formats of foreign direct investment (FDI)

FDI is necessary for economic growth. Even if it is not a panacea for economic growth or development, economies can hardly "take off" without FDI.

A basic role of FDI is to improve a lack of financial resources in domestic financial markets[8]. More strictly, the transfer of financial resources from abroad is classified into two: foreign aid and foreign direct investment (FDI). The former is of the public sector and can be divided into two: bi-lateral foreign aid and multilateral foreign aid. The later is of the private sector.

FDI is brought basically through multi-lateral enterprises (MLEs) (or multi-national enterprises (MNEs)). FDI and MLEs are very often regarded to be a *catalyst* for economic growth.

A typical textbook of economic development teaches us the benefits of FDI and they are:

- Employment creation;
- Technology transfer;
- Managerial capacity; and
- Access to the world market (Gillis, *et al*, 1992).

Regarding employment creation and technology transfer, this recognition is widely accepted. In addition to these benefits, managerial capacity and access to the world should be added as benefits. Technology and production are not the end of the story for activities of firms and industries. Unless firms have management skills, the firms with the latest technologies can barely be operated. Unless access to markets (*e.g.* physical distribution infrastructure and rights/standards to participate in the markets and so forth), products cannot be sold. FDI in the format of MLEs can make it possible.

[8] More strictly, this "lack" is explained by two gap models. The first gap is the gap between the amount of saving and the amount of investment needed. The second gap is the gap between the amount of foreign exchange needed and the amount of foreign exchange available.

In contrast, there exists an interpretation on MLEs by which MLEs do not necessarily benefit the host country's economy, due to:

- Protection of technology and/or know-how; and
- Monopoly control (*ibid*.)

Some criticise MLEs, saying that technologies will not be distributed to the host country eventually because technologies are protected by patents and are not disclosed to employees. Furthermore, the criticism may say that MLEs monopolise domestic markets and may exclude domestic firms.

Both interpretations, say, positive effects and negative effects could be correct. An important thing here is that FDI and MLEs can save situations of the host country where financial resources and technologies are lacking. When an FDI can fill the gaps, the country (or economy) can have an opportunity for further development.

5.3.2 Similarities and Differences between non-monetary benefits by ABS and FDI

Even if ABS can be regarded as one format of FDIs, they are not completely similar. Table 5.3.2-A tries to highlight the similarities and differences between ABS and FDI in general. Non-monetary benefits in the table are benefits specified in annexes in the Bonn Guidelines and the Nagoya Protocol.

On the one hand, there are similarities. As long as technologies are disclosed to employees, it can contribute to technology transfer. A prominent similarity could be benefit (k) especially from the viewpoint of FDI, because accessing scientific information, especially the very latest information by MLEs, can benefit people in the host country.

On the other hand, there are differences. First of all, FDI is a private investment. Hence, it is unable to contribute to capacity development regarding institutions and administration (benefits of (h) and (i)) that are roles of the government. Secondly, full participation can hardly be expected (benefit (j)). The participation is limited to MLE staffs. Thirdly, benefit (p), social recognition can be expected to be obtained only after final products are released after a long R&D period. During this period, the fact that there has been access itself is confidential and is not open to public.

After considering similarities and differences, regarding ABS as one of the formats of FDI can be justified with some conditions.

Table 5.3.2-A) Comparison of Non-monetary Benefits of ABS and FDI

	Non-Monetary Benefits	ABS	FDI
(a)	Sharing of research and development results;	✔	✔
(b)	Collaboration, cooperation and contribution in scientific research and development programmes, particularly biotechnological research activities, where possible in the Party providing genetic resources;	✔	✔
(c)	Participation in product development;	✔	✔
(d)	Collaboration, cooperation and contribution in education and training;	✔	✔
(e)	Admittance to *ex situ* facilities of genetic resources and to databases;	✔	✔
(f)	Transfer to the provider of the genetic resources of knowledge and technology under fair and most favourable terms, including on concessional and preferential terms where agreed, in particular, knowledge and technology that make use of genetic resources, including biotechnology, or that are relevant to the conservation and sustainable utilization of biological diversity;	✔	✔
(g)	Strengthening capacities for technology transfer;	✔	✔
(h)	Institutional capacity-building;	✔	
(i)	Human and material resources to strengthen the capacities for the administration and enforcement of access regulations;	✔	
(j)	Training related to genetic resources with the full participation of countries providing genetic resources, and where possible, in such countries;	✔	
(k)	Access to scientific information relevant to conservation and sustainable use of biological diversity, including biological inventories and taxonomic studies;	✔	✔
(l)	Contributions to the local economy;	✔	✔
(m)	Research directed towards priority needs, such as health and food security, taking into account domestic uses of genetic resources in the Party providing genetic resources;	✔	
(n)	Institutional and professional relationships that can arise from an access and benefit-sharing agreement and subsequent collaborative activities;	✔	✔
(o)	Food and livelihood security benefits;	✔	
(p)	Social recognition;	✔	
(q)	Joint ownership of relevant intellectual property rights.	✔	✔

Source: Arranged by the Authors

5.3.3 Approaches Present to Estimate Benefits by FDI - Simulation Methodology by Input-Output Analysis

5.3.3.1 Methodology of Input-Output Analysis

Input-output analysis is one of the standard analytical models to analyse all the relationships among all the inputs and outputs in production systems in one economy of one country. The analysis was explored by Leontief who won a Nobel Prize in Economics. During analysis, an input output table is used and is applied to a general equilibrium model. The first table was that of the United States of America and was prepared by Leontief in 1919. Nowadays, many tables of many countries are available.

All the economies bear production processes that consist of inputs, intermediaries and outputs. In addition, there are raw materials, intermediaries, and labour. Furthermore, each industry needs input from other industries and each industry produces outputs for other industries. Ratios between inputs and outputs are highly influenced by technological factors. If you try to describe all the complex relationships, it could be expressed by a huge table which would be an input-output table.

Figure 5.3.3.1-A) shows the structure of an input-output table. Each row of the input-output table represents the structure of sales that specifies where products flow and how many are needed for specific production in each industry.

Figure 5.3.3.1-A) Structure of Input Output Table

Demand sector(buyer) / Supply sector (seller)		Intermediate demand				Final demand								
		1 Agriculture, forestry and fishery	2 Mining	3 Manufacturing	Total A	Final consumption expenditures	Fixed capital formation	Increase in stocks	Exports	Total B	(Less) Import C	Domestic production A+B-C
Intermediate input	1 Agriculture, forestry and fishery											
	2 Mining											
	3 Manufacturing											
	Total D											
Gross value added	Consumption expenditure outside households											
	Compensation of employees											
	Operating surplus											
	Depreciation of fixed capital											
	Indirect taxes											
	(Less) Current subsidies											
	Total E											
Domestic production D+E												

Cost structure for raw material and gross value added(input)

Composition of sales sector of products (output)

Source: Arranged by the Authors

On the one hand, "intermediate demand" implies consumption of intermediaries that are used as raw materials. "Final demand" consists of household consumption, government consumption, domestic capital formation, and exports[9].

On the other hand, each column of the input-output table shows the structure of production that consists of origins of production and the amounts needed in each industry. "Intermediate inputs" is the portion of inputs that are purchased as raw materials. "Employer income (payments for labour)", "dividends (business profits)", "indirect taxes", and "capital consumption depreciation" are defined as "value-added".

Although the total amount of rows is acknowledged as gross domestic production (GDP), the sum of the rows must be in general transposed and calculated into the sum of columns in the input-output table. In addition, the difference between Gross Domestic Product (GDP) and total intermediate demand is regarded to be total final demand. Thus, the relationship between GDP and elements in the table can be expressed as: GDP (total value-added) = total final demand.

[9] Export goods are sometimes used as raw materials abroad.

5.3.3.2 Equilibrium Output Model

1) Closed Economy Model

Supposing that technology in each industry is unchanged in a short period of time and that inputs are not substitutable, a parameter called "input coefficient" is here introduced. If it assumed that in order to produce Xj in the jth sector, the intermediate inputs from the ith sector, Xij, could be a persisted technology coefficient in the short-term. Thus, the input coefficient is defined as:

$$a_{ij} = \frac{X_{ij}}{X_j} \tag{1}$$

When the input coefficient is introduced, a determination of the equilibrium output can be represented by the equations below.

$$\begin{aligned} \mathbf{Ax} + \mathbf{f} &= \mathbf{x} \\ \mathbf{[I - A]x} &= \mathbf{f} \end{aligned} \tag{2}$$

Next, A is defined as the "input coefficient matrix". A is a square matrix that consists of aij. X is a production vector and f is a final demand vector respectively.

$$\mathbf{A} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix}, \quad \mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix}, \quad \mathbf{f} = \begin{bmatrix} f_1 \\ f_2 \\ \vdots \\ f_n \end{bmatrix} \tag{3}$$

Equilibrium output can be calculated by the following formula.

$$\mathbf{x} = \mathbf{[I - A]}^{-1}\mathbf{f} \tag{4}$$

An inverse matrix on the right side which is called the Leontief inverse matrix plays a crucial role in input-output analysis. Once a final demand vector is given, multiplying the Leontief inverse matrix and the final demand vector become a production vector that can express demand for inputs. For instance, suppose that there is an increase in exports in the automobile industry. As the production of automobiles increases, intermediate goods such as steel plates, tires, seat sheets, window glass, paint, etc, are demanded as inputs. Next, raw materials are used to produce these intermediate goods, such as fuel, rubber enhancer, and chemical fibber products. Leontief inverse matrix is a coefficient that estimates theoretical value of necessary production from which all the ripple effects of these raw materials can be calculated. Ripple effects refer to the increase in demand derived by some economic events which ultimately spreads to other industries.

$$l_j = \frac{L_j}{X_j},\ L = \begin{bmatrix} l_1 & 0 & \cdots & 0 \\ 0 & l_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & l_n \end{bmatrix},\ \mathbf{l} = [L_1, L_2, \cdots, L_n] \tag{5}$$

Lj implies the amount of employment and *lj* is the coefficient of employment in each industry respectively.

Equilibrium employment is expressed in the equation below.

$$\mathbf{l} = \mathbf{Lx} = \mathbf{L}[\mathbf{I} - \mathbf{A}]^{-1}\mathbf{f} \tag{6}$$

2) Import Endogenous Model

While the previous model describes the relationship between production and exports, the model in this section describes that of imports. There are many imported goods that contain both intermediate transactions and final demand in a real economy.

Under the assumption that the import ratio accounts for the total supply in the ith industry expressed as mi and that the ith row contains imported goods by the corresponding ratio, the equilibrium output can be expressed below.

$$\hat{\mathbf{M}} = \begin{bmatrix} m_1 & & 0 \\ & m_2 & \\ & & \ddots \\ 0 & & m_n \end{bmatrix},\quad (\mathbf{I} - \hat{\mathbf{M}})\mathbf{f} + \mathbf{e} = \mathbf{f}^d + \mathbf{e} = \begin{bmatrix} (1-m_1) f_1 + e_1 \\ (1-m_2) f_2 + e_2 \\ \vdots \\ (1-m_n) f_n + e_n \end{bmatrix}$$

$$(\mathbf{I} - \hat{\mathbf{M}})\mathbf{Ax} + (\mathbf{I} - \hat{\mathbf{M}})\mathbf{f} + \mathbf{e} = \mathbf{x}$$

$$\mathbf{x} = \left[\mathbf{I} - (\mathbf{I} - \hat{\mathbf{M}})\mathbf{A}\right]^{1}\left[(\mathbf{I} - \hat{\mathbf{M}})\mathbf{f} + \mathbf{e}\right] \tag{7}$$

Furthermore, the equilibrium employment can be represented in the equation below.

$$\mathbf{l} = \mathbf{Lx} = \mathbf{L}\left[\mathbf{I} - (\mathbf{I} - \hat{\mathbf{M}})\mathbf{A}\right]^{1}\left[(\mathbf{I} - \hat{\mathbf{M}})\mathbf{f} + \mathbf{e}\right] \tag{8}$$

As steps in the calculation, firstly, the amount of increase in final demand by each industry is estimated. Then, the amount is assigned to the final demand vector in the output determination model with formula (7). Solving this formula can bring the result of ripple effects.

5.3.3.3 Economic Ripple Effects - Case of the PES Programme for the Dong Nai River in Vietnam[10]

In order that ripple effects can be explained, input output analysis is applied to the Dong Nai River case in Vietnam.

A programme of payment for ecosystem services (PES) has been carried out in the Dong Nai River in Vietnam. It was sponsored by the International Union for Conservation of Nature (IUCN), Winrock International, and USAID. The government of Vietnam is also involved.

In this programme, a PES scheme was carried out. Stakeholders in down-stream areas of the river provided money to community people in up-stream areas who are considered as providers or sellers of clean water. The stakeholders in the down-stream areas are: hydro power plants, state-owned water supply companies, and eco-tourism companies. Through the distribution of funds (approximately US $4.46 million) obtained by this scheme, communities came to have incentives to conserve areas, especially to conserve watersheds of the areas (See economic value of watersheds mentioned above.).

Some economic ripple effects in this programme can be simulated by input output analysis in addition to concrete outcomes of this programme. This simulation could be a rough image of an estimation of non-monetary benefits by FDI. Simulations are based on the 2007 Vietnam Input-Output Table and employment statistics released by the Vietnamese government. The imports endogenous model explained above is used.

Two assumptions are set for the simulation. The first assumption is that consumption of households in the communities totally increases by $1 million[11], and each sector increases its share of the total accounted for in the input-output table. For instance, in the 2007 Vietnam Input-Output Table, the value of consumption of households in the agriculture (forestry, and fishery) sector accounted for about 0.06 of the total consumption of households. Hence, if the total amount increases, the value of the agriculture sector can be influenced by the corresponding ratio as 0.06. Simultaneously, other sectors also increase in a similar way. This increased consumption should lead to an increase in demand and create employment. The ripple effects are calculated and are shown in Table 5.3.3.3.-A).

The second assumption is that there would be investment on equipment to improve the water quality and that the investment totally increases by $1 million, and each sector increases its share of the total accounted for in the input-output table. The investment is expected to increase demand and employment. The ripple effects of this are shown Table 5.3.3.3.-B). Providing money may not be a non-monetary benefit. However, providing

[10] Information on the case is from http://biodiversity.envix.co.jp/2008/09/vietnam-pes-20080904.html.
[11] This amount of consumption, say, the assumption is excessive and unrealistic. This section intends to draw a figure of ripple effects. Even if assumed consumption is $ 0.1 million or $0.01 million, the simulation can be done immediately. An important thing here in the context of this report, some transfer of technology, know-how, and money can generate benefits (both monetary and non-monetary) that can be estimated by input-output analysis.

equipment is one of the non-monetary benefits.

Table 5.3.3.3.-A) Effects of Increases in Household Consumption on Demand and Employment

Sectors		Increase in household consumption (unit: dollars)	Increase in gross output (unit: dollars)	Employment creation(unit: person)
1	Agriculture, forestry and fishery	61,609	238,427	270
2	Mining and quarrying	3,725	11,985	0
3	Manufacturing	512,253	588,128	41
4	Electricity, gas, and heat supply	42,682	74,690	2
5	Water supply and waste management	2,820	4,445	1
6	Construction	0	5,293	1
7	Wholesale and retail trade	28,618	87,666	36
8	Transportation and storage	53,763	65,681	13
9	Accommodation and food services	73,162	72,891	14
10	Information and communication	14,393	21,203	2
11	Financial, banking and insurance	27,769	29,180	3
12	Real estate activities	41,349	54,810	1
13	Professional and scientific activities	6,198	12,284	1
14	Administrative and support services	8,105	7,203	2
15	Public administration	8,820	10,001	5
16	Education and training	57,948	47,483	21
17	Human health and social work activities	35,973	33,064	6
18	Arts, entertainment and recreation	15,062	18,704	2
19	Other service activities	2	147	1
20	Household services	4,717	5,225	3
21	Unclassified activities	1,031	2,608	0
	Total	1,000,000	1,391,118	426

Source: Arranged by the Authors

Table 5.3.3.3.-A) illustrates the final outputs that rise by $ 1.39 million, if the total household consumption expenditure increases by $1 million in the programme. The top 3 sectors that enjoy new demand originated from sector 1 (agriculture forestry and fishing), sector 3 (manufacturing), and sector 7 (wholesale and retail trade; repair of motor vehicles and motorcycles) among the 21 sectors. The aggregate new demand creates 426 employees. More than 63% of which are created in sector 1, agriculture forestry and fishing. Additional labour is also created in sector 3 and sector 7 due to their increased demand.

Table 5.3.3.3.-B) implies that the aggregate demand rises by $1.14 million. Employment increases by 144 persons, if the equipment investment grows by $1 million. The new demand and employment are mainly created in sector 6 (construction) and sector 3 (manufacturing) orderly.

Table 5.3.3.3.-B) Effects of Increase in Equipment Investment on Demand and Employment

	Sectors	Increase in equipment investment (unit: dollars)	Increase in gross output (unit: dollars)	Employment creation(unit: person)
1	Agriculture, forestry and fishery	2,913	9,568	11
2	Mining and quarrying	0	42,221	2
3	Manufacturing	425,911	383,585	27
4	Electricity, gas, and heat supply	0	12,190	0
5	Water supply and waste management	0	1,465	0
6	Construction	564,626	593,783	77
7	Wholesale and retail trade	0	40,182	17
8	Transportation and storage	6,550	29,653	6
9	Accommodation and food services	0	6,550	1
10	Information and communication	0	4,526	0
11	Financial, banking and insurance	0	3,310	0
12	Real estate activities	0	3,389	0
13	Professional and scientific activities	0	7,125	1
14	Administrative and support services	0	2,063	0
15	Public administration	0	365	0
16	Education and training	0	376	0
17	Human health and social work activities	0	360	0
18	Arts, entertainment and recreation	0	160	0
19	Other service activities	0	131	1
20	Household services	0	242	0
21	Unclassified activities	0	278	0
	Total	1,000,000	1,141,521	144

Source: Arranged by the Authors

Here, some limitations must be pointed out regarding the results of this input-output analysis. The points are listed below.

- The ripple effects on production may be slight in comparison to the results in industries which have a large inventory of goods, because inventory tends to prevent pulling immediate demand.
- When demand exceeds the production capacity in the domestic economy, the excess demand will result in facilitation of imports that is able to decrease the ripple effects.
- It is not clear whether or not the ripple effects can be generated immediately. It may occur in the medium or long term.

5.4 Framework on Expected Benefits: Integration of Quasi-option Value (QOP), Costs, and Non-Monetary Benefits for Decision Making

Framework here tries to integrate all the benefits and costs pointed out above, including a new attempt on the estimation of non-monetary benefits. The framework is basically based on cost benefit analysis (CBA) and its modification, because this research assumes that decision makers involved in ABS are required to justify the introduction of new laws, institutions, regulations, and legislative, administrative or policy measures from the viewpoint of social benefit.

When CBA is considered, the framework focuses on *economic appraisal* as a decision criterion, while CBA has two criteria: *financial appraisal* and *economic appraisal*.

The former, financial appraisal, highlights the profitability of those involved in some economic activities. For instance, in the context of ABS, CBA appraises costs and incomes for a provider or a user available from the utilisation of genetic resources. Social benefits such as the multiple benefits of watersheds protection for agricultural production and non-monetary benefits for the long term are not appreciated in this criterion.

The latter, economic appraisal, focuses on social benefits and costs. In this criterion, monetary benefits matter. The interests should be given to multiple benefits of biodiversity conservation such as utilisation of genetic resources, watershed protection, and non-monetary benefits of technology transfer. Benefits for long term economic development are appreciated.

Framework by Conventional CBA

One ideal scenario could be this, when setting up a framework of CBA.

> In one developing country with rich biodiversity, one site with old growth forest is under discussion for whether the place is to be developed for agricultural production responding to the necessity of food production for the local community or preservation for CDM and watersheds acquisition. The development process is irreversible. Furthermore, there is uncertainty about genetic resources. Basic research on bio-prospecting under a scheme of ABS can reduce this uncertainty.

The conventional decision should be a dichotomy.

If the site is NOW decided to be developed FOREVER, ED will be obtained.

$ED = D_0 + D_1$

If the site is NOW decided to be preserved FOREVER, EP will be obtained.

$EP = V_o + pV_{1high} + (1-p)V_{1low}$

If the site is preserved for some period for research on bio-prospecting, EW will be obtained. In this case, a decision is NOT given NOW and the decision is pending during period 0.

$EW = V_o + pV_{1high} + (1-p) D_1$

Very rough criterion (see below for strict criterion) brings decisions. If ED > EP, the decision should be to develop the site. In contrast, obviously, if ED<EP, the decision should be to preserve the site.

A few important implications should be given here. Firstly, V very often possesses multiple – several – benefits when preserved. In this hypothetical and ideal scenario, V should possess: monetary benefits (economic value) of income from CDM credits and some possibility of revenue though bio-prospecting and non-monetary benefits of climate change mitigation, agricultural production by the preserved watersheds in some other areas, and technology transfer though bio-prospecting activities. Secondly, EW is always positive. Hence, waiting for results by bio-prospecting activities can always bring positive benefits/economic value.

For more strict criteria, equations should be rewritten including costs.

Development has to bear the condition below to be justified:

$ED - (CC + CO + CT) - OCD > 0.$

$= (D_0 + D_{1)}$

$- (CC_0 + CO_0 + CT_0 + CC_1 + CO_1)$

$- (OCD_0 + OCD_1)$

Preservation has to bear the condition below to be justified:

$EP - (CC + CO + CT) - OCP > 0.$

$= (V_o + pV_{1high} + (1-p)V_{1low})$

$- (CC_0 + CO_0 + CT_0 + CC_1 + CO_1)$

$- (OCP_0 + OCP_1)$

Where

Capital cost; CC

Operational; CO

Transaction; CT

Opportunity cost of development; OCD

Opportunity cost of preservation; OCP.

OCD and OCP are benefits by preservation and those of development respectively. When inequality is satisfied, development or preservation is acceptable.

Framework by Modification of CBA with Some Criterion of Strategy

EW and QOV have crucial roles when benefits and values are considered, especially when there are uncertainty and irreversibility on the genetic resources in the site. However, EW and/or QOV should not be included in CBA as long as they obey the conventional notion of CBA very strictly.

CBA is a tool by which a decision is made by information available NOW. This does not compare certain things that may be available in the future. If so, EW and QOV that require some uncertain information in the future cannot be treated under CBA, even if EW always positive.

EW and QOV are very important in the context of ABS and the Nagoya Protocol. Simultaneously, the principle of CBA should not be violated. Hence, here, an extended CBA framework is to be introduced. The extended framework tries to include elements of strategy for the most appropriate decision. Two possible strategies are shown below.

Strategy 1 is to make a decision on development or preservation NOW.
Strategy 2 is to postpone the decision NOW and make a decision on development or preservation in period 1.

Expected criteria with benefits are:
Strategy 1:
$ED = D_0 + D_1$
or
$EP = V_o + pV_{1high} + (1-p)V_{1low}$.

Strategy 2:
$EW = V_o + pV_{1high} + (1-p)\,D_1$.

In the context of extended CBA with strategies, a crucial criterion should be:
Development now is justified when ED>EW. Postponing (waiting) is justified when ED<EW. You may consider a comparison between EP and EW but it is not necessary if you seek some periods and un-destructed habitats for research for ABS.

More strictly, inputting costs, criteria should be as follows.
ED with Costs : $(D_0 + D_{1)} - (CC_0 + CO_0 + CT_0 + CC_1 + CO_1) - (QOV)$
EW with Costs: $(V_o + pV_{1high} + (1-p)\,D_1) - (CC_0 + CO_0 + CA_0 + CT_0 + CC_1 + CO_1)$
Where: CA is administrative cost to establish new domestic laws and so forth for ABS.

Development (Strategy 1) is justified when (ED with costs) > (EW with costs). Postponing (waiting) (Strategy 2) is justified when (ED with costs) < (EW with costs).

Three factors should be emphasised in the context of ABS: Non-monetary benefits that are included in V_0; administrative cost (CA) to prepare domestic laws, institutions, regulations and the policy measures; and an existence of QOV.

Firstly, V_0 possesses non-monetary benefits of technology transfer about which quantitative estimations were previously unavailable. These benefits are unknown. However, previous research on FDI tells us that the influence on the domestic economy as a whole by FDI is often huge.

Secondly, CA should be carefully compared with benefits of facilitation of ABS by the protocol in this framework. Even if the Nagoya Protocol is meaningful, provider countries (or host countries) must bear an initial investment, say, a cost, CC, to set the policy measures.

Thirdly, QOV is always obtained unless, so to speak, development pressure with high expected benefit of D_0 (*i.e.* revenue from agricultural product) is certain. It means that waiting for development allowing some research on genetic resources is justified. During this period of time, QOV is generated and some information is obtained. An important thing is that the decision should be worth waiting for.

Before providing a proposed framework, one crucial element should be added. It is a parameter to adjust technological decay that increases the future value of preservation. Porter (1982) proposed a very suggestive parameter on a discount rate. When the destruction process is irreversible, a discount rate for benefits for preservation should be discounted, while the discount rate for development remains the same. It means that future benefits by preservation are expected to increase by the development of technology to find new genetic resources in preserved areas, while expected benefits for development should be discounted in a standard way. For instance, while benefits for development must bear a discount rate, *r*, benefits for preservation must bear the rate, $(r - \alpha)$.

Wrapping up all the discussions above, the proposed tentative framework would be:

Strategy 1 ED with Costs

$$= \sum_{0}^{n}(D_t^{-rt}) - CT_o - \sum_{0}^{n}(\mathrm{CC_t} + \mathrm{CO_t})^{-\mathrm{rt}}$$

Strategy 2 EW with Costs

$$= \mathrm{V_o} - (\mathrm{CA_0} + \mathrm{CT_0}) + \mathrm{p}\sum_{1}^{n} Vhigh_t^{-(r-\alpha)t} + (1\text{-p})\sum_{1}^{n} D_t^{-rt} - \sum_{1}^{n}(CC_t + CO_t)^{-rt}$$

6. Cases

The methods shown above are to be adapted to the macroeconomic data of actual countries. In other words, results will be derived from real economic data, even if the methods contain simulation.

One or two Southeast Asian countries are of cases. One country is a rapidly growing economy with rich biodiversity and a long land mass stretching in a north and south direction. Another country is a middle income country that has been hosting a number of FDIs in its history of development.

The names of the countries will be specified when the results are released in academic journals. However, the names will remain anonymous when the results are explained in the arena of CBD.

7. Concluding Remarks

This report is of an inception report. It means that there may be some errors and omissions that should be corrected and elaborated. More correct and concrete results are expected to be released with detailed clarifications and simulations by COP12.

Having said so, some interesting things have been found. Firstly, EW is always positive. Secondly, monetary benefits can generate non-monetary benefits such as employment creation, while they used to be divided into two by dichotomy. Thirdly, increases in incomes available by the transfer of financial resources from the outside can create employment in agricultural and fishery sectors on which many poor people depend upon especially in developing countries.

The authors do hope that this research contributes to better benefits for all the parties through appropriate diffusion of the Nagoya Protocol that is one of, so to speak, a historic memory of the world.

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The Faculty of Life and Environmental Sciences at the University of Yamanashi was established in April 2012 and started enrolling students in the same month. The Faculty aims to educate students who are able to contribute to realising the well-being of local communities through sustainable food supply, while the University of Yamanashi as a whole strives to foster experts who can be crucial actors in society. The students are expected to obtain a broad perspective and knowledge on life sciences, food production and processing, the environment and energy, local economy, corporate management, and governmental administration.

The Faculty consists of four departments: the Department of Biotechnology, the Department of Local Produce and Food Sciences, the Department of Environmental Sciences, and the Department of Regional Social Management. The four departments provide interdisciplinary knowledge by which the students can tackle important issues in the 21st century in life sciences, food, the environment, and economies. Through these studies, graduates are expected to resolve problems in society.

The Graduate School of International Development (GSID) at Nagoya University was established in 1991 and celebrated its 20th anniversary last year in 2011. GSID's educational goal is to nurture graduates who have the ability to carry out independent research and practical work and also have a global view firmly rooted in cross-cultural understanding. GSID will continue its work as a dynamic international research and educational institute.

Since Japan has few mineral and energy resources, it needs to purchase these resources from overseas, mostly developing countries. Trade with foreign countries is therefore the lifeline for Japan, and it is ODA that plays an important role in maintaining this lifeline. What, then, are we—as social science researchers—able to do to this end? Although what social science can contribute to society may be limited in the short run, in the long run it can offer valuable pointers to those who face a disadvantaged economic and social environment. In order to fulfil this role, we work on research with sincerity and disseminate our achievements.