Title of the Project	:	Economic Adaptation of Agriculture to the Impacts of Sea Level Rise in Indonesia
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ABSTRACT

Objective of this project is to predict economic adaptation of agriculture to sea level rise (SLR) in the Provinces of South Sumatera and South Kalimantan, Indonesia. The economical importance of the Indonesian coast is significant as a large of tidal swamp land near coastal areas have been reclaimed for agricultural purposes. Specifically, this project aims to: determine the level of awareness of farmers about the SLR and its effect to their agricultural land; predict agricultural loss caused by the SLR of 1 m if there is no adaptation effort done; provide estimates cost and benefit for protection of agricultural areas nearby coastal areas; provide estimates cost and benefit for establishment of new agricultural areas (paddy field) in inland; and measure which is preferable or more worthwhile for adaptation of agriculture in response to sea level rise: protection of agricultural areas nearby costal areas or establishment of new agricultural area. To estimate economic adaptation of agriculture to sea level rise, the project will employ the Cost-Benefit Analysis. The information obtained in this project will help the authority to formulate a better strategy to ensure the impact of sea level rise on food production from agricultural areas near coastal areas could be reduced. The results of the study will be disseminated through published reports and seminars. The project duration is 12 months, and the budgetary requirement is CAD 33,158.

RESEARCH PROBLEM

The Scientific and Policy Relevance of the Problem

Coastal areas in Indonesia perform essential environmental and economic functions. Big rivers such as the Barito River, Kapuas and Mahakam in the Kalimantan Island and the Musi River in the Sumatera Island allowed tidal water entering inland to form tidal swamp lands. These sites represent a total area of over 20 million hectares (Nedeco-Euroconsult, 1984). Tidal swamp lands provide a considerable reservoir of water, organic carbon and nitrogen. Under undisturbed conditions tidal swampy lands are covered by forest that acts to maintain biodiversity and provide wildlife habitat. Forests growing in tidal-swampy lands also yield a number of important products such as timber and bark, and around 10% of Indonesia's export of forest product is obtained from these areas (Rieley, 1999). Due to pressure for land, a large part of tidal swamp land in Indonesia has been and is presently being reclaimed for agricultural purposes (MacKinnon *et al.*, 1996).

The Indonesian Government introduced the Tidal Swamp Land Development Project since 1960s in order to achieve rice self-sufficiency. Four Ministries (Ministry of Public Works, Ministry of Internal Affairs, Ministry of Agriculture, and Ministry of Transmigration) were appointed to plan and execute a program known as *Paddy Field Development Project on Tidal Swamp through Transmigration.* The physical achievement after 25 years of swamp development has been that approximately of 835,200 hectares of tidal swamp land in the Provinces of South Sumatera and South Kalimantan have been reclaimed for agricultural areas with rice as a main commodity (Miniatry of Setlement and Regional Infrastructure, 2006). Rice production in the reclaimed tidal-swampy land varied from 4 ton ha^{-1} to 7 ton ha^{-1} (Regional Agricultural Agency of Batola Ditsrict, 2006; Indonesian Logistic Board, 2003).

As noted by the International Panel on Climate Change (IPCC, 2007), continued growth of green house gas emissions and associated global warming will lead to climate change. Climate change will have many negative effects, including greater frequency of heat waves; increased intensity of storms, floods and droughts; and rising sea levels. Sea level rise (SLR) poses a particular threat to countries with heavy concentrations of population and economic activity in coastal regions. Sea level rise would increase the susceptibility of coastal populations and ecosystems through the permanent inundation of low-lying regions, amplification of episodic flooding events, and increased beach erosion and saline intrusion (Mclean *et al.*, 2001). Sea level rise will lead to decline coastal line hundreds meter into mainland, and this will cause lost of agricultural land in tidal swampy land, thereby food production (rice). Freshwater will be difficult to gain as soil will be polluted by intrusion of sea water; therefore, this will affect water quality. Ultimately, this may lead to the displacement of millions of people, significant damage to property and infrastructure, and a considerable loss of coastal ecosystems by the end of the 21st Century (Nicholls and Lowe, 2004).

Several measures should be proposed to reduce the risk of loss of life or damage in order to maintain economic activities in coastal areas in response to sea level rise. The general proposal for maintaining economic and environment in coastal areas is including the protection through hard structures such as dikes and sea walls. For example, maintenance and investments of coastal defense structures as well as the monitoring of beach and dune pollution in Belgium raises costs to about 25 million Euros (Lebbe and Meir, 2000). In addition, Kojima (2004) proposed 115 billion US$ would be needed to protect port-related facilities alone against 1 m sea-level rise in Japan. However, the Indonesian Government has not done any action to reduce the consequence of sea level rise even though several disasters have been reported recently. Freshwater in the Cities of Banjarmasin, Palembang, and Jakarta have been reported to be insufficient for the public in the dry season (Kompas, 2007). The problem is likely to be related impact of sea level rise.

Establishment of coastal protection in Indonesia as alternative options to the adaptation is mostly neglected as it is very expensive. For instance, Lau (2005) reported that costs for a 500 km dike to prevent losses from a 1 m sea-level rise for the North China Plain were estimated with an equivalent of 370 Million US$. While there is no hard structures have been built in Indonesia for coastal protection, infrastructure established by the Ministry of Settlement and Regional Infrastructure in collaboration with Ministry of Agriculture could reduce impact of the SLR on agriculture areas in tidal swamp land. Water management determined successfulness agricultural management in swamp land; therefore, flap-gate from fiber is frequently installed in drainage system to control water availability in rainy and dry season (Susanto *et al.*, 1999). Flap-gate is successful to drain excess surface and/or groundwater, to provide flood-protection, to prevent salt intrusion and to control water quality (Susanto, 2003). Based on its function, installation of flap-gate could be used to reduce the impact of sea level rise on the agricultural areas. However, there is no information on the cost for establishment of flap-gate system in the reclaimed tidal swamp.

Alternative option to reduce the impact sea level rise on agriculture is to establish new agricultural areas in inland that can not be influenced directly by sea level rise. However, the predicted cost for such measures is not available. While there have been more studies in recent years on effect of sea level rise on environment and economic, data on economic adaptation on sea level rise in Indonesia is unavailable. Most information on adaptation to sea level rise has been obtained from studies of countries in high latitude areas that have a very different economic structures and environment compared to Indonesia. In order to acquire a better understanding of economic adaptation of agriculture to impact of sea level rise in Indonesia, prediction cost of loss in agriculture and several measures to adapt impact of sea level need to be studied.

Literature Review

Global Warming

Phenomenon of climate change (global warming) is principally triggered by increasing the earth's temperature. Accumulation of solar radiation in the atmosphere was responsible for increase in the earth temperature. The Earth's atmosphere acts in many respects like an immense greenhouse, trapping heat from the sun. Sunlight enters the atmosphere, and about 30 percent of the sun's energy is immediately reflected back into space. But the Earth also radiates heat back to the atmosphere, where some of it is absorbed by greenhouse gases (GHGs) in the atmosphere, such as carbon dioxide, methane and nitrous oxide. This further warms the planet.

The greenhouse effect is a natural phenomenon. The presence of greenhouse gases like carbon dioxide keeps the Earth's average surface temperature at approximately 60 degrees Fahrenheit. Without the greenhouse effect, the average temperature would be about 5 degrees Fahrenheit.

Table 1. Global abundances and trend of key greenhouse gases in 2005 (WMO-GAW, 2006)

	CO_2 (ppm)	CH_4 (ppb)	N_2O (ppb)
Global abundance in 2005	379.1	1783	319.2
2005 abundance relative to year 1750	135.4%	254.7%	118.2%
2004-05 absolute increase	2.0	0.0	0.6
2004-05 relative increase	0.53%	0.0%	0.19%
Mean annual absolute increase during 10 years.	1.90	2.80	0.74

Greenhouse gases that have significant impact on the global warming are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). CO_2 is the single most important infrared absorbing, anthropogenic gas in the atmosphere and is responsible for 62% of the total radiative forcing of Earth by long-lived greenhouse gases and over 90% of the increase in radiative forcing in the past decade (WMO-GAW, 2006). Globally averaged CO_2 in 2005 was 379.1 ppm and there was an increase in the atmospheric CO_2 as much as 2 ppm from 2004 to 2005 (Table 1). Table 1 also showed that compared to the late 1700s, atmospheric CO_2 has increased by 35.4%.

Methane contributes about 20% of the direct radiative forcing due to long-lived greenhouse gases affected by human activities. Its chemistry also indirectly affects climate by influencing tropospheric ozone and stratospheric water (WMO-GAW, 2006). Table 1 shown that globally averaged CH4 in 2005 was 1783 ppb, with virtually no increase observed since 2004. Compared to the late 1700s, there was an increase in atmospheric CO_2 by 155%.

Nitrous oxide (N2O) contributes about 6% of the total radiative forcing from long-lived greenhouse gases (GMW-GAW, 2006). Globally averaged N_2O during 2005 was 319.2 ppb, up 0.6 ppb from the year before (Table 1). The mean growth rate has been 0.74 ppb per year over the past 10 years.

Source of increase in concentration of greenhouse gas in the atmosphere is mostly as result of human activities. The primary source of the increased atmospheric concentration of carbon dioxide since the pre-industrial period results from fossil fuel use, with land use change providing another significant but smaller contribution. An increase in methane concentration is likely due to anthropogenic activities, predominantly agriculture and fossil fuel use, while those of nitrous oxide are primarily due to agriculture. Increased atmospheric concentration of greenhouse gases is responsible for global climate change.

Sea Level Rise

It is expected that a climate change will take place over the next century in spite of the international effort to reduce greenhouse gas emissions. This change is expected to exacerbate already existing environmental problem in many countries. In particular, coastal areas all over the world are expected to suffer from impact of sea level rise (SLR), as well as other impacts, in addition to already existing problem of coastal erosion, subsidence, pollution, and use change pressure, and deterioration of ecosystems.

Three primary factors lead to increasing the sea level rise: (a) ocean thermal expansion; (b) glacial melt from Greenland and Antarctica (plus a smaller contribution from other ice sheets); and (c) change in terrestrial storage. Among these, ocean thermal expansion was expected to be the dominating factor behind the rise in sea level. However, new data on rates of deglaciation in Greenland and Antarctica suggest greater significance for glacial melt, and a possible revision of the upper-bound estimate for the SLR in this century. Since the Greenland and Antarctic ice sheets contain enough water to raise the sea level by almost 70 m, small changes in their volume would have a significant effect (Dasgupta *et al.*, 2007). The IPCC (2007a) has shown that global average sea level rose at an average 1.8 mm per year over 1961 to 2003. The rate has been increased over 1993 to 2003, about 3.1 mm per year, indicating an increase in observed sea level rise from the 19^{th} to the 20^{th} century. The total 20^{th} sea level rise is estimated to be 17 cm (IPPC, 2007a). However, the total sea level rise is still debated among the researchers. For example, Tol *et al.* (2005) stated that breakdown the West Antarctic Ice Sheet would raise average sea level by approximately 5 to 6 meters. This rate is several times greater than that estimated in the IPPC Fourth Assessment Report.

Impact of SLR on Natural and Human Environment

While there remain uncertainty about the level sea will elevate, it is really acceptable that the SLR will influence significantly natural and human environments. Coastal wetland including salt marshes and mangroves are projected to be negatively affected by sea level rise especially where they are constrained on their landward side or starved of sediment. Coastal areas, especially heavily-populated mega-delta region in South, East and Southeast Asia, will be at greatest risk due to increased flooding from the sea and in some mega-deltas flooding from the rivers. The sea level rise also influenced considerably industry, settlement and society, especially those are situated in coastal and river flood plain whose economies are closely linked with climate-sensitive resources. In addition, endemic morbidity due to diarrhoeal disease primarily associated with flood and drought are expected to rise in East, South and Southeast Asia due to changes in hydrological cycle associated with global warming (IPPC, 2007b).

Several studies have been carried out to provide estimates of the potential impact for specific developing countries (French *et al.*, 1995; Dennis *et al.*, 1995). Indicators of impact of sea level rise in these studies included land loss, population affected, capital loss value and wetland loss. Different studies have used different subsets of indicators or region; therefore, it is difficult to compare the relative magnitude of impacts across countries or region. Dasgupta *et al.* (2007) attempted to compare impact of sea level rise in developing countries using six indicators: land, population, gross domestic product, urban extent, agricultural extent and wetlands, and the impacts were calculated for the SLR scenarios ranging from 1 to 5 meters. This study revealed that hundreds of millions of people in the developing countries are likely to be displaced by the SLR within this century in accompanying damage in economic and ecology. Results of the study also shown that Vietnam is the most seriously impacted by the SLR in East Asia: up to 16% of its areas would be impacted by a 5 m SLR, 35% of Vietnam's population will be influenced by a 5 m SLR. Agriculture and wetland in Vietnam are also affected significantly by the SLR. Most of this impact is estimated in the Mekong and Red River Deltas as large percentages of Vietnam's population and economic activity are located in these two river deltas. Many developing countries such as Indonesia, Malaysia, and Philippines are experience limited impacts.

Accurate information on response of coastal habitats to predicted climate change and projected relative sea-level rise over coming decades will enable educated coastal land use planning decisions to minimize and mitigate losses of valued habitats, reduce the risk of damage to coastal development, and select and implement policies to manage shoreline changes deemed suitable for different sections of coastline. Nicholls (2003) proposed that planned adaptation options to sea-level rise are usually presented as one of three generic approaches:

- *Planned (Retreat)* – all natural system effects are allowed to occur and human impacts are minimised by pulling back from the coast;
- *Accommodation* – all natural system effects are allowed to occur and human impacts are minimised by adjusting human use of the coastal zone;
- *Protection* – natural system effects are controlled by soft or hard engineering, reducing human impacts in the zone that would be impacted without protection.

The array potential adaptive responses available to sea level rise is very large, ranging from purely technological (e.g., sea defences), through behavioural (e.g., altered food and recreational choices), to managerial (e.g., altered farm practices), to policy (e.g., planning regulation) (IPPC, 2007b).

Although many early impacts of climate change can be effectively addressed through adaptation, the options for successful adaptation is still not clear. Effectiveness adaptation measures are highly dependent on specific, geographical and climate risk factors as well as institutional, political and financial constraints (IPPC, 2007b). For developing countries, availability of resources and building adaptive capacity is particularly important. Further, adaptation is widely seen as a public responsibility; therefore, all levels of government have a key role in developing planned adaptation measures.

Research Project Contribution

The focus of the study will be the Provinces of South Kalimantan and South Sumatera, which the areas are most suffering from the impact of the sea level rise. Currently, freshwater problem because of sea water intrusion have been observed in these two provinces, especially in dry season. The water problem not only influences the water consumers, but agricultural areas in tidal swamp land could also be affected. However, there is no indication that the farmers in these two provinces knowing impact of the sea level rise on their agricultural land. This study will provide information on awareness level of farmers in terms of impact of the sea level rise on food production. This information could be useful and valuable for the authority to design the right policy for maintaining food sufficiency, which is evenly influenced national stability. Given the importance of food sufficiency, it is right time that people should realize the need to reduce or prevent the impact of the sea level rise on environment and economic.

This research project will contribute to the provision of adequate information about estimation cost to reduce/prevent impact of the sea level rise on agriculture of South Kalimantan Province and South Sumatera Province in terms of establishment protection's infrastructure and establishment of new agricultural areas. This information could give an overview for the policy maker that implementation of adaptation to the sea level rise required serious attention and should be involved the governmental institution.

RESEARCH OBJECTIVES

The general objective of the research is to predict economic adaptation of agriculture to sea level rise in the Provinces of South Sumatera and South Kalimantan, Indonesia.

The specific objectives are:

1. To determine the level of awareness of farmers about the SLR and its effect to their agricultural land.
2. To predict agricultural loss caused by the SLR of 1 m if there is no adaptation effort done.
3. To provide estimates cost and benefit for protection of agricultural areas nearby coastal areas.
4. To provide estimates cost and benefit for establishment of new agricultural areas (paddy field) in inland
5. To measure which is preferable or more worthwhile for adaptation of agriculture in response to sea level rise: protection of agricultural areas nearby costal areas or establishment of new agricultural area.

RESEARCH METHODS

Research Questions

The research questions will be answered in this project are:

1. Are farmers nearby coastal areas aware of SLR and its effects to their agricultural land?
2. How much is the predicted agricultural loss caused by SLR of 1 m if there is no adaptation effort done?
3. What's cost and benefit for protection of agricultural areas nearby coastal areas?
4. What's cost and benefit for establishment of new agricultural areas (paddy field) in inland?
5. Which is preferable or more worthwhile for adaptation of agriculture in response to sea level rise: protection of agricultural areas nearby costal areas or establishment of new agricultural area?

Variables to be Measured

Any damage or loss by the SLR related to agriculture will be identified and will be estimated in terms of monetary value. The inputs required to protect agricultural areas nearby coastal areas or to establish a new agricultural areas (paddy field) will also be identified and calculated in terms of costs. The expected outputs or benefits in each action of adaptation will also be measured and compared.

Population and Samples

This research will be conducted in Indonesia. Two provinces out of 33 provinces in Indonesia are selected, that is, South Kalimantan Province and South Sumatera Province, which have the biggest area of reclaimed tidal swampy-land for agricultural areas.

For each province, the sampling units will be chosen through multi-stage sampling, as follows:

- One district (*kabupaten)* that has a large proportion of reclaimed tidal swampy-land will be selected purposively
- From the chosen district, one sub-district (*kecamatan*) will be selected
- Household samples will be taken from that selected sub-district.

The total number of households or sample size in each sub-district will be determined using formula:

$$n = \frac{N}{1 + Ne^2}$$

Where: n = sample size
N = total number of households
e = desired margin of error

Methods of Information Collection

Primary data will be gathered from farmers who live and work on agricultural land nearby coastal areas. For collecting these primary data, a questionnaire will be used as an instrument in interviewing the farmers.

A draft questionnaire will be made in Month 1. Then, this questionnaire will first be pre-tested to evaluate its effectiveness in Month 2. Feedback from the pre-test will be used to revise the questionnaire in that month. Before conducting the interviews, the survey enumerators or interviewers involved in this research will be trained. The interviews will be conducted from Month 3 to Month 6.

Secondary data will also be collected. The geographic information system (GIS) software will be employed to describe distribution of agricultural areas that could be influenced by the SLR. The best available data set from public sources such as the National Agency for Survey and Mapping, Center for Data and Information of Swampy Land, the Department of Settlement and Regional Infrastructure and the Department of Agriculture will also be used to overlay the critical impact on agriculture.

Estimation costs of protecting agricultural areas nearby coastal zones will be carried out against 1 m rise in sea level. This estimate assumed no change for the natural environment other than the sea-level rise, no consideration of time-dependent processes, and the cost estimation based on the monetary values in 2007. The improvement of canal and drainage infrastructure will be classified into three groups in order to simplify the estimation of the protection costs, namely procurement, transportation and installation cost for the protected infrastructure. The data will be collected from the Department of Settlement and Regional Infrastructure and the Department of Agriculture, both at national and provincial level.

Cost for establishment of new agricultural areas will be estimated through calculation of feasibility study, infrastructure working, and migration. The data from the Department of Settlement and Regional Infrastructure and the Department of Agriculture , both at national and provincial level, will also be used for the calculation.

Economic Valuation Methods and Biases

Cost-Benefit Analysis (CBA) that will be used in this economic valuation encountered some possible sources of bias and the proposed ways of addressing these are:

1. Bias in putting transfer payment as a benefit or as Ia cost. In financial analysis a tax payment is a cost, and a subsidy treated as a benefit. In economic analysis taxes

and subsidies are treated as transfer payments. Taxes will remain a part of the overall benefit stream of the project that contributes to the increase in national income, and a subsidy is a cost.

2. Prices bias. In financial analysis market prices are normally used. In economic analysis, however, some market prices may be changed so that they more accurately reflect social or economic values. These adjusted prices are called shadow prices or accounting prices.

3. Interest on capital bias. In financial analysis, interest on capital paid to external suppliers of money may be deducted to derive the benefit streams available to the owners of capital. In economic analysis, it is never separated and deducted from the benefits because it is part of the total return to capital available to the society.

There are three steps in adjusting financial prices to economic values (Gittinger, 1982):

1. Adjustment for direct transfer payments. The first step in adjusting financial prices to economic values is to eliminate direct transfer payments. In agricultural projects, the most common transfer payments are taxes, direct subsidies, and credit transactions that include loans, receipt, repayment of principal, and interest payments. Two credit transactions that might be escape notice are accounts payable and accounts receivable. All these entries should be taken out before the financial accounts are adjusted to reflect economic values. Moreover, the financial price of an item for which the price has been changed because of an indirect subsidy is converted to an economic value according to the procedures for traded items in step 2 and, as appropriate, for non-traded items in step 3.

2. Adjustment for market price distortions in traded items. Traded items are those for which, if exports,

   f.o.b. price > domestic cost of production,

   or the items may be exported through government intervention by use of export subsidies an the like, and, if imports,

   domestic cost of production > c.i.f. price,

   Conceptually and usually in practice prices for traded items in project analysis are more easily dealt with than those for non-traded items. Valuation was started by determining the border price. For imports, this normally will be the c.i.f. price and, for exports, normally the f.o.b. price. The border price is then adjusted to allow for domestic transport and marketing costs between the point of import or export an the project site. The result is the efficiency price to be used in the project account. If the project produces something that can be used in place of imported goods, that is, if it produces an import substitute, the value to the society is the foreign exchange saved by using the domestic product valued at the border price, in this case the c.i.f. price. But if the project uses items that might otherwise have been exported, that is, if it uses diverted exports, then the opportunity cost to the society of these items is the foreign exchange lost on the export forgone valued at the border price, in this case the f.o.b. price. If conversion factor used to allow for the foreign exchange premium, the economic value of a traded item would be obtained by converting the foreign exchange price to its domestic currency equivalent using the official exchange rate. If the shadow exchange rate used to allow for the foreign exchange premium, the economic value of a traded item would be obtained by converting the foreign exchange price to its domestic currency equivalent using the shadow exchange rate.

3. Adjustment for market price distortions in non-traded items. Non-traded items are those for which,

c.i.f. price > domestic cost of production > f.o.b. price,

or the items are non-traded because of government intervention by means of import bans, quotas, and the like. If the shadow exchange rate approach used to allow for the foreign exchange premium, and if the market price of a non-traded item is a good estimate of the opportunity cost, or willingness to pay is the criterion, market price will be accepted directly as our economic value. Otherwise market price will be adjusted to eliminate distortion and then the estimate of the opportunity cost will be used to obtain the shadow price that will be entered in the economic accounts. If the conversion factor approach used to allow for the foreign exchange premium, an additional step is necessary. All prices for non-traded items are reduced by multiplying them by the appropriate conversion factor. When willingness to pay is the criterion or when the market price is considered to be a good estimate of opportunity cost, the market price is accepted as the basis for valuation and then reduced by multiplying it by the conversion factor to obtain the economic value. But if the standard conversion factor and the market price must be adjusted to obtain a better estimate of the opportunity cost, then the opportunity cost must, in turn, be multiplied by the standard conversion factor.

Procedures and Technique for Data Processing and Analysis

After collecting all data needed in this research, including primary data and secondary data, the data will be compiled and tabulated.

Any damages or loss and inputs used because of SLR in 1 m will be classified as costs. On the other hand, any outputs got from the actions taken in facing SLR in 1 m will be treated as benefits.

Every action taken in order to adapt agricultural land to the impacts of SLR in 1 m will be treated as a project lasting at least in the next few years. Therefore, Investment criteria or CBA can be applied as follows (Gittenger, 1982; Sudgen and Williams, 1981):

(1) Net Present Worth (NPW) = $\sum_{t=1}^{t=n} \frac{Bt - Ct}{(1+i)^t}$

(2) Internal Rate of Return (IRR) = $i_2 + (i_2 - i_1) \frac{NPW_1}{(NPW_1 + NPW_2)}$

(3) Benefit-Cost Ratio (BCR) = $\dfrac{\sum_{t=1}^{t=n} \dfrac{Bt}{(1+i)^t}}{\sum_{t=1}^{t=n} \dfrac{Ct}{(1+i)_t}}$

(4) Net Benifit-Investment (N/K) Ratio = $\dfrac{\sum_{t=1}^{t=n} \dfrac{Nt}{(1+i)_t}}{\sum_{t=1}^{t=n} \dfrac{Kt}{(1+i)_t}}$

Where,
- Bt = Benefit in each year
- Ct = Cost in each year
- Nt = Incremental Net Benefit in each year after stream has turned positive
- Kt = Incremental Net Benefit in initial years when stream is negative
- t = 1, 2, ..., n
- n = number of years (the project life)
- i = interest (discount) rate

The formal selection criterion for the NPW measure of project worth is to accept all independent projects with a zero or greater NPW when discounted at the social opportunity cost of capital. No ranking of acceptable, alternative independent projects is possible with the NPW criterion because it is an absolute, not relative measure.

The formal selection criterion for the IRR measure of project worth is to accept all independent projects having an IRR equal to or greater than the social opportunity cost of capital. Although, the IRR of different projects will vary, projects cannot with confidence be ranked on the basis of the IRR.

The formal selection criterion for the BCR measure of project worth is to accept all independent projects with a BCR of 1 or greater when the cost and benefit streams are discounted at the social opportunity cost of capital. Although in practice projects with higher BCR are often regarded as being preferable (other things being equal), ranking by BCR can lead to an erroneous investment choice.

None of the NPW, IRR and BCR measures can be relied upon to rank the projects. It is convenient to have a reliable measure to rank the projects to determine the order in which the projects should be undertaken. A need for ranking arises, for example, when the capital budget is not sufficient to implement immediately all the projects. The formal selection criterion for the N/K Ratio measure of project worth is to accept all projects with a N/K Ratio of 1 or greater when they are discounted at the social opportunity cost of capital. In order, beginning with the largest N/K Ratio and proceeding until available investment funds are exhausted.

EXPECTED RESULTS AND DISSEMINATIONS

The study is expected to provide information about the impacts of SLR in 1 m to agricultural land nearby coastal areas; what level of farmers' awareness to these impacts; how much the costs incurred and the benefits taken from protection of agricultural areas nearby costal areas or establishment of new agricultural area, and which action is more valuable than another to take first. This information is useful to help the government to decide what project or action should be done in anticipating the SLR in 1 m.

The project's findings will be disseminated in seminars with officials of the regional government of South Kalimantan Province and South Sumatera Province, university staffs as the experts in theory and concepts, and other relevant parties.

The other means of dissemination for this research are final research report and published paper. Final research report will be generated at the end of the study. For publication of this research results, the paper will be made and sent to accredited journals, both, national and international journals. For national journal, Journal SOCA (Journal on Socio-Economics of Agriculture and Agribusiness) will be chosen. Meanwhile for international journal, Bulletin of Indonesian Economic Studies will be attempted.

INSTITUTION AND PERSONEL

The implementing institution will be the Environmental Research Centre and Department of Agribusiness, Lambung Mangkurat University, Indonesia. The centre has been done researches on the wetland environment. The Department of Agribusiness offers under graduate and post-graduate courses.

The research team will be consisted of:

Study Leader:
Akhmad R. Saidy – Environmental specialist, Environmental Research Centre, Lambung Mangkurat University.

Team member:
Yusuf Aziz – Agricultural economist, Department of Agribusiness, Lambung Mangkurat University.

The curriculum vitae of the research team are provided in Annex 1.

TIME TABLE

MONTH	ACTIVITY
1	▪ Coordination with the concerned government and private agencies ▪ Conduct of focus group discussions ▪ Preparation of survey questionnaire ▪ Enumerator recruitment and training
2	▪ Pre-testing of questionnaire ▪ Revision of questionnaire ▪ Selection of respondents ▪ Coordination with local government units where the survey will be administered
3-7	▪ Conducting survey for data collection ▪ Gathering secondary data from governmental agency involved in establishment irrigation, drainage, new agricultural areas and topography of tidal swamp areas.
8-10	▪ Data analysis
11	▪ Report writing
11-12	▪ Dissemination of results

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