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INDONESIA'S

TECHNOLOGY NEEDS ASSESSMENT

for Climate Change Adaptations 2012

INDONESIA

Technology Needs Assessment for Climate Change Adaptation 2012

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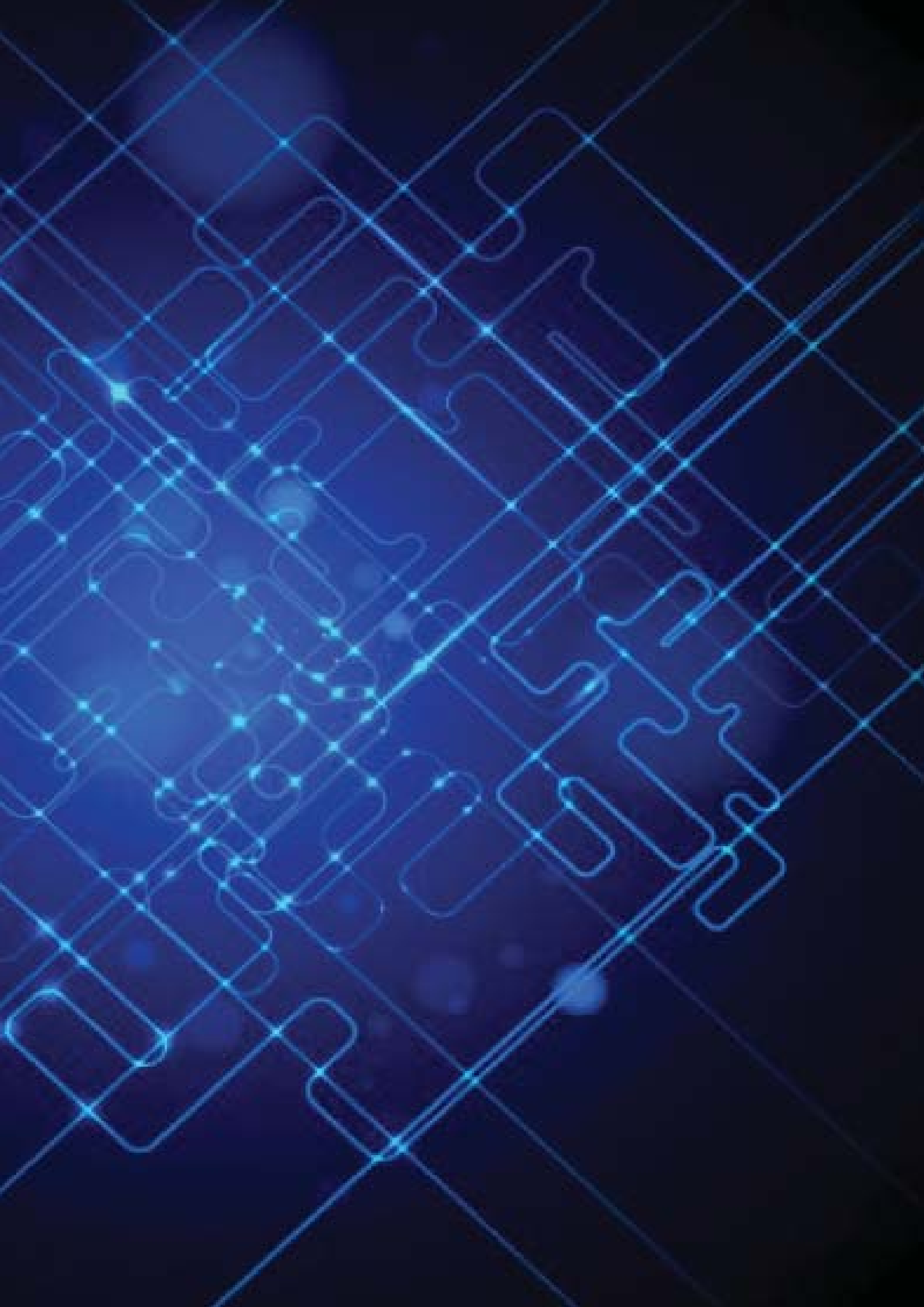

PREFACE

Global climate change is one of the most important issues facing the world today, that has major effects on the world economy. One of the primary issues in the global climate change is how to adapt to a variety of impacts from climate change that might occur. The purpose of the "TNA and TAP Adaptation Synthesis Report 2012" document is to identify and analyze the needs of the adaptation prioritized technologies, which can form the basis for a portfolio of environmentally sound technology (EST) projects and programs to facilitate the transfer of, and access to, the ESTs and know-how into Indonesia.

Based on the writing sequence, the TNA adaptation synthesis report document is divided in three sections. Section I outlines the the synthesis report on TNA for Adaptation, Section II gives synthesis report on TAP for Adaptation, and Section III contains Cross-cutting Issues for the National TNA and TAPs.

Section I of the TNA adaptation synthesis report consists of Executive Summary of TNA, Introduction of TNA, Institutional Arrangement, Sector Prioritization, Technology Prioritization of each Sector, and Conclusions. The introduction covers the objectives of TNA being developed, the national circumstances, sustainable development strategies, national climate change adaptation policies, and how TNA relevance to national development priorities. Sector prioritization consists of an overview of sectors, projected climate change and the GHG emission status and trends of the different sectors, processes and criteria of prioritization, inventory/ current status of technologies in each selected sector. Technology prioritization for selected sector contains an overview of possible adaptation technology options in that sector and their adaptation benefits, criteria and processes of technology prioritization, as well as result of technology prioritization.

Section II of the TAPs Adaptation Synthesis Report is started with Executive Summary and followed by outlining TAPs for each sector starting with food security, water resources and coastal vulnerability. This section covers Preliminary Targets for technology transfer and diffusion based on Section I, Barrier Analysis (Economic, Regulatory, Institutional, Capacity, IPR, and Social and Cultural aspects), Barrier Identification and Analysis for the transfer and diffusion of each technology, and Linkages of the Barriers identified. Next is Enabling Framework for Overcoming the Barriers consisting of possible solutions to address the barriers for the transfer and diffusion of each technology, and Recommended Solutions for each sector. Concrete Actions Plans and Ideas are also outlined in this section that includes Plans for Domestic Actions and Measures, Project Ideas for International Support as well as Possible Measures to address IPR Barriers, if any.

Section III, Cross-cutting Issues for the National TNA and TAPs, consists of cross-cutting technologies for the TNAs in the three sectors and cross-cutting issues for the TAPs in the three sectors. Finally the report is completed with the Annexes that consist of Technology Fact-sheets, Market Maps for Technologies, Project Ideas, and List of stakeholders involved in this study.

This TNA-TAPs Adaptation Synthesis Report 2012 document would have been impossible to write had it not been for the outstanding contributions of several stakeholders and resource persons in the related sectors particularly food security, water resources and coastal vulnerability. Tribute need to be paid to the individuals for their insight, influence, and perspective for which this study are based. Special thank you is directed to UNEP-RISØ who have supported and read carefully and given suggestions to make this report become a better document. A high appreciation is given to resource persons from the Ministries and other Institutions who have all contributed in the completion of TNA Mitigation Synthesis Report. Special thank you to Deputy Chairman of BPPT on Natural Resources Development and Director of Environmental Technology Center who have injected the spirit to all of the team members in completing this report document. Finally, many appreciations are dedicated to all members of the team who have worked very hard from learning how to start the work to completing the report

FOREWORD FROM CHAIRMAN OF DNPI

Developing the Technology Needs Assessment (TNA) for Adaptation in Indonesia is part of the readiness to address global climate change issues. In Indonesia, the Technology Action Plans (TAPs) for adaptation to climate change is an integral part of the Medium Term Development Plan (RPJMN) and Disaster Management Action Plan that is nationally applied. As a vast archipelago, and susceptibility to natural disasters, this is crucial Indonesia.

As the focal point of Indonesia in climate change, the National Climate Change Council (DNPI) has been mandated by the Indonesian government to prepare the Technology Needs Assessment (TNA) and the Technology Action Plans (TAPs) on both mitigation and adaptation of climate change specific to the Indonesian context.

With the support of UNEP-RISØ Centre, DNPI through the Working Group of Technology Transfer has collaborated with the Agency for the Assessment and Application of Technology (BPPT) in the completion of the Global TNA for Adaptation. This work involved all the cross-sectoral stakeholders including the related Ministries, Governmental Institutions, and the related experts.

I thank the efforts of all parties involved in the development of this document, in particular to BPPT and the Working Group of Technology Transfer DNPI, who have coordinated and arranged all the activities. I would like also to extend appreciation and gratitude to the UNEP-RISØ Center for their technical support and the funding of this TNA.

Jakarta, February 2012

National Council for Climate Change

Prof.(Hon).Ir. Rachmat Witoelar
Executive Chairman

FOREWORD FROM CHAIRMAN OF BPPT

As a country located on the "ring of fire", Indonesia, among other countries has very frequent disasters, especially earthquakes and volcanic eruptions. When this situation is coupled with the disaster caused by climate change, it makes Indonesia becoming more vulnerable to food supply, coastal condition and clean water availability.

As an institution in charge of assessment and application of technology, BPPT has long concerned with the assessment and development of these types of climate change adaptation technologies, such as technology for weather modification, clean water, food diversity, alternative staple foods, and new and renewable energy.

A variety of previous experiences and the input from relevant sectors and stakeholders become the assets in the preparation of this TNA adaptation report 2011. So far, we often pay more attention to mitigation technologies than adaptation ones. Actually, adaptation technology is something that has unavoidably to be prepared for Indonesia. As a maritime nation and also an agricultural country, Indonesia is highly vulnerable to climate change impact particularly for its coastal area, food security, and water resources. Therefore, it needs high attention in the adaptation plans as well.

As a chairman of the coordinating institution for the development of TNA Global, for this opportunity I would like to thank to representatives from the Indonesian National Council of Climate Change (DNPI), related ministries and other institutions who have given inputs to this document. Special thank is also directed to UNEP-RISØ Center along with the ranks of its advisors and reviewers for reviewing and guiding this study from the beginning until the completion of this document. Finally, I highly appreciate the work of the TNA executing team who have completed this study.

Jakarta, February 2012

Agency for the Assessment and Application of Technology (BPPT)

Dr. Marzan Aziz Iskandar
Chairman

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List of Abbreviation

AIT	Asian Institute of Technology
APBD	Local Budget
APBN	State Budget
BALITPA	Rice Research Unit
BAPPENAS	National Development Planning
BCS	Body Condition Score
BIS	Oil Palm Core
BMKG	Agency of the Meteorology, Climatology and Geophysics
BMS	Beach Management System
BPPT	Agency for the Assessment and Application of Technology
BPTP	Agricultural Technology Assessment Agency
CBIB	Good Fish Farming Method
CBIBB	Good and Proper Fish Culture Practices
CCO	Cow Calf Operation
CL	Corpus Luteum
CLS	Crop Livestock System.
CSR	Corporate Social Responsibility
DED	Detailed Engineering Design
DNPI/NCCC	National Climate Change Council
DSS	Decision Support System
EST	Environmentally Sound Technology
ET	Embryo Transfer
FGD	Focus Group Discussion
Gapoktan	Combined Farmers Group
GBP	Good Breeding Practices
GCC	Global Climate Change
GDP	Gross Domestic Product
GFFM	Good Fish Farming Method
GSFLOW	Coupled Groundwater and Surface-water.
IB	Artificial Insemination
ICM	Integrated Crop Management
IMTA	Integrated Multitrophic Aquaculture
INKA	Natural Mating Intensification (INKA).
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectual Property Rights
IRR	Internal Rate of Return
ISO	The International Standards Organization
ITB	Bandung Institute of Technology
ITS	Sepuluh November Institute of Technology
KJA	Floating Net Cage
KKP	Ministry of Marine Affairs and Fisheries
KPSI	Indonesian Cattle Farmers Consortium
KTNA	Leading the Group Farmers and Fishermen
KUD	Village Cooperation Unit
KUPS	Business Credit of Cattle Breeding.
LEISA	Low External Input Sustainable Agriculture,
LIPI	Indonesia Science Institute
MCA	Multi Criteria Analysis
MoA	Ministry of Agriculture
MoMAF	Ministry of Maritime Affairs and Fisheries
MoPW	Ministry of Public Works
NAP	National Action Plan

NGOs	Non-Government Organizations
NPV	Net Present Value
NTB	West Nusa Tenggara
NTT	East Nusa Tenggara
O&M	Operation and Maintenance
P3SLP	Center for Marine and Coastal Resources
P3TKP	Marine and Coastal Research and Technology
PAM	Water Drinking Company
PCM	Public Consultation meeting
PERDA	local Regulations
PP	Government Regulation
PPTKE	Technology Center for Energy Conversion and Conservation
PSDS	Self Sufficiency Program
PV	Photovoltaic
PVT	Protection of Plant Varieties
PWM	Peat Water Management
R&D	Research and Development
RAD-GHG	Regional Action Plan for Reducing Emissions
RAN	National Action Plan
RBCS	Regenerative Burner Combustion System
RDF	Refuse Derived Fuel
RIL	Reduced Illegal Lodging
ROI	Return of Investment
RPJMN	Integral part of the Medium Term Development Plan
RPJP	Indonesia Long-Term Development Plan
RPJPM	National Long-Term Development Plan
RTRW	Regional Spatial Plan.
SAR	Synthetic Aperture Radar
SC	Steering Committee
SFM	Sustainable Forest Management
SHS	Solar Home System
SIPT	Farm Paddy Integration System
SLR	Sea level rise
SNC	Second National Communication
SNI	Indonesian National Standard
SRI	Soil Research Institute
SUA	Agroindustrial Business System
SUB	Superior New Variety
SUT	Farming System
SWDS	Solid Waste Disposal Sites
TAPs	Technology Action Plan
TC	Technical Committee
TEWS	Tsunami Early Warning System
TNA	Technology Need Assessment
TPA	Final Disposal Facilities
TPS	Intermediate Treatment Facilities
TT	Transfer of Technology
TTD	Technology Transfer and Diffusion
UI	University of Indonesia
UNDP	United Nation Development Program
UNEP	United Nations Environment Programme
UNEP-RISOE	United Nations Environmental Programme - RISOE
UNFCCC	United Nation Framework Convention on Climate Change
VBC	Village Breeding Centre
VUB	New Priority Variety
WWTP	Wastewater Treatment Plant

Section I

Synthesis Report on Indonesia TNA of Adaptation for Climate Change 2012

Executive Summary

An assessment of Indonesia's TNA on adaptation to climate change has been concurrently carried out with that of the TNA on mitigation. Unlike the TNA on mitigation that was previously made, the TNA on adaptation has just been newly initiated. Therefore, more efforts must be done to complete the report of the TNA on adaptation than those to finish the TNA on mitigation.

Similar to the TNA on mitigation, the sectors and their numbers must first be known and thefore the first stakeholders' meeting was held to decide what sector and how many the number of each sector. This first meeting was also attended by diverse participants, namely officials from National Council on Climate Change of Indonesia (NCCC), Agency for the Assessment and Application of Technology (BPPT), Indonesian United Nations Environmental Programme - RISOE (UNEP-RISOE), and stakeholders from related Ministries, Non-Ministerial Government Institutions, Non-Government Organizations (NGOs) and Private Companies. The first meeting was held at NCCC office, on 24 March 2010. The meeting decided that this Global TNA on adaptation to climate change impact of Indonesia covered 3 (three) sectors. Those are food security, water resource shortage and coastal vulnerability. The selection of these three sectors dedicated for TNA on adaptation of Indonesia is because the fact that they have already being affected by the climate change and are predicted to increasingly receive its major impact in the future.

Technologies for the TNA on adaptation of each sector were discussed and decided by related experts and stakeholders. First, it was done technologies inventory from different sources and mainly from national documents prepared by related Mministries and Government Iinstitutions as well as inputs from the stakeholders and experts during the meetings. Due to limited resources, it was decided that each sector only covered 2 or 3 technologies. If the number of inventoried technologies of each sector was more than 10 technologies or so, they were first prescreened based on the expert judgment. The guidance for the experts and stakeholders to qualitatively judge the potential candidates of technologies applied for adaptation measures was based on their appropriateness of each compiled technologies to be implemented. In addition, the potentially prescreened technologies were judged by viewing of 2 (two) criteria: cost and benefit. The criteria of cost is actually cost effectiveness consisting of capital cost, and operation and maintenance (O&M) cost, wheras that of benefit is technical effectiveness, implementation considerations, and reduction of social vulnerability.

By expert judgment method with help of the guidances mentioned above, all inventoried technologies of each sector were prescreened. For food security sector, there were about 41 inventoried technologies. After they were prescreened by the experts and stakeholders they came up with 11 technologies. For the water resource sector, there were about 41 inventoried technologies and after prescreening process they turned out to be 11 technologies. For coastal vulnerability sector, there were 21 inventoried technologies and they were prescreened to turn into 8 (eight) technologies.

These prescreened technologies of each sector were finally prioritized by employing Multi Criteria Analysis (MCA). The result of technology prioritization was listed and the highest values of three technologies of each sector were then selected. The results for food security sector are namely technologies for (1) crop (rice) tolerance to drought and flood, (2) mariculture development, and (3) cattle meat development. For the sector of water resource shortage, the three prioritized technologies are (1) technologies for rain water harvesting (well and infiltration pond), (2) water recycling from wastewater, and (3) mmodelling for water resource projection. For coastal vulnerability sector, the best three technologies found from prioritization are (1) Seawall and Revetment, (2) Coastal Reclamation, and (3) Groyne technology.

Like in the TNA on mitigation, for decision making processes in TNA on adaptation were done in two levels. The first is technically decided by the Technical Committee (echelon 2 members) and the second level is politically approved by the National Steering Committee (echelon 1 members). The high level consideration done by the National Steering Committee includes potential barriers of technical, economic, political and policy based barriers. It is noted that echelon 1 is the highest position in the Ministry or Government Institution directly under the Minister or Head of the Institution who deals with policy decisions whereas echelon 2 is the second highest position who deals with technical decisions.

Those selected prioritized groups of technologies of each sector will be then determined for their types of technologies. This work must first be done to have the barriers for the purpose of the technology transfer analyzed. Thus, the necessary practical measures to reduce and eliminate barriers to policy, funding, technology and other necessary measures in adaptation could be completed if the specific technology is chosen.

1.1 Introduction

Indonesia is one of the participants of the Global Technology Needs Assessment (Global TNA) conducted by United Nations Environment Programme (UNEP) which is participated by 15 member countries in first stage. The aim of the new cycle of TNA on adaptation for Indonesia is to develop the new TNA on adaptation to climate change.

The purpose of the TNA on adaptation project is to assist the participants to identify and analyze priority adaptation technology needs, which can form the basis for a portfolio of environmentally sound technology (EST) projects and programs to facilitate the transfer of, and access to, the ESTs and know-how in the implementation of Article 4.5 of the UNFCCC. Hence, the TNA on adaptation is a central to the work of Parties to the Convention on technology transfer and present an opportunity to track an evolving need for new equipment, techniques, practical knowledge and skills, which are necessary to reduce the vulnerability of sectors and livelihoods to the adverse impacts of climate change. The main objectives of the project are:

- To identify and prioritize through country-driven participatory processes, technologies that can contribute to adaptation goals of the participant countries, while meeting their national sustainable development goals and priorities (TNA).
- To identify barriers hindering the acquisition, deployment, and diffusion of prioritized technologies.

- To develop Technology Action Plans (TAPs) specifying activities and enabling frameworks to overcome the barriers and facilitate the transfer, adoption, and diffusion of selected technologies in the participant countries.

Indonesia is located between 6°08' North and 11°15' South latitude, and from 94°45' to 141°05' East longitude. The country covers 1,910,931 square kilometers. It has five large islands (Sumatra, Java, Kalimantan, Sulawesi and Papua Barat) and about 17,504 small islands, of which over half (56%) are nameless and only 7% permanently inhabited. Extensively coastal plain sand mountain areas up to 1,000 meters above sea level are characteristics of Sumatra, Kalimantan and Papua Barat. Of 200 million hectares of land territory, about 50 million hectares are devoted to various agricultural activities. There are nearly 20 million hectares of land that are suitable for growing crops consisting of wetland/ rice fields (40%), dry land (40%), shifting cultivation (15%), and others.

Indonesia's vulnerability to climate change gives alertness to the government and its people to take immediate action on adaptation. As archipelagic country, Indonesia is very prone affected by rising sea level. Agriculture sector will be adversely affected by climate change. Agriculture is a sector that absorbs the majority of Indonesia's employment, so that the socio economic impact may be substantial. As hydrological cycle is likely to be influenced by global warming, agriculture sector will have to adapt to this change. Moreover, the impact on agriculture closely relates to food security and is also very dependable to water resources management.

The water resources shortage and stress in Indonesia will likely be imposed by the projected climate change. At present, Java and Bali region has already faced a deficit in its water balance, while for other regions like Sumatra, Sulawesi, Nusa Tenggara, and the Moluccas are projected to be in critical conditions in the near future. Based on climate projections, most regions in Indonesia will suffer from a gradual decrease of water supply due to temperature increase and rainfall changes that will affect the water balance. Combined with estimated population growth rates, increased water demand will cause the occurrences of severe water shortages for the period 2020-2030, especially in Java and Sumatra.

As stated in the Indonesia Long-Term Development Plan (RPJP) 2005-2025, the sustainability of the national development will face challenges due to the impact of the climate change. To anticipate these challenges with regards to adaptation of climate change, it needs to set up several goals that must be achieved in the next 20 years. They must result comprehensive targets for all related sectors. The goals are as follows:

- Advanced research on the impact of climate change and the mapping of local vulnerability will be performed to strengthen the information system for adaptation in 2015.
- Institutional capacity of the ministries and the agencies to anticipate climate change impacts has to be strengthened by year 2015, and the climate-proof policy-making process and regulation will be achieved in 2020.
- National development goals will be optimized with the influence of adaptation actions in 2025.
- The risks from climate change impacts on all sectors of development will be considerably reduced in year 2030 through public awareness, strengthened capacity, improved knowledge management, and the application of adaptive technology.

The National Roadmap for mainstreaming climate change into development planning can be summarized as illustrated in the diagram of Figure 1-1 below. Activities for adaptation proposed in each sector are the elaboration of the three categories as illustrated by arrows.

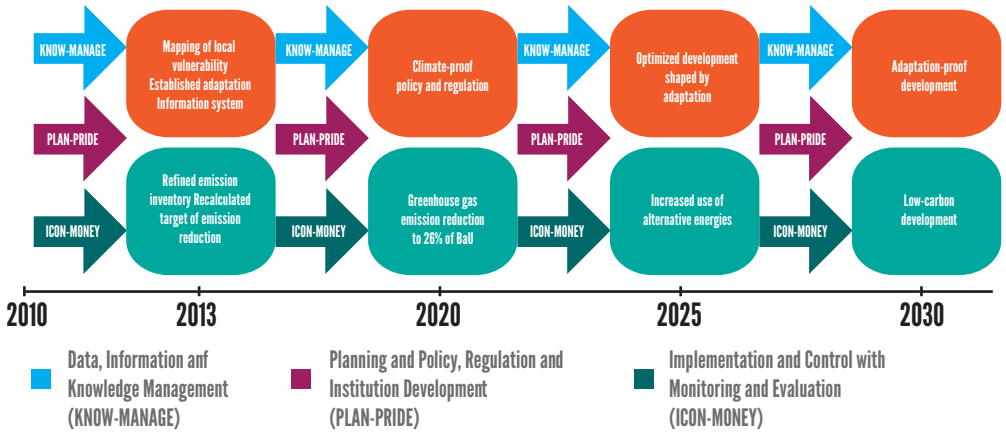


Figure 1- 1 National roadmap for mainstreaming climate change

1.2. Institutional arrangement for the TNA and the stakeholders involvement

1.2.1. TNA team and national project coordinator

The Indonesia TNA program is coordinated by National Council on Climate Change (DNPI), and DNPI gives a mandate to the Agency for the Assessment and Application of Technology (BPPT) to technically coordinate the development of Indonesia TNA Adaptation Synthesis Report 2011 from a series of stakeholder engagement until the finalization of the study. The decision making scheme of Indonesia TNA is described in the Figure 2 below. There are two levels of decision-making processes: the first one is decisions taken by technical committee and the second is decisions done by national steering committee. Both committees were officially endorsed by the decree of the Executive Chairman of DNPI.

Prior to having approval from technical committee, the TNA team has prepared the list of technologies of each sector and it was then discussed in facilitated workshop and focus group discussion (FGD) participated by members of relevant sectors and experts. The members of workshop and FGD focused on discussing and providing inputs on technical matters, such us compiling technologies of the sectors, prescreening the technologies, proposing criteria and the weight of each criteria, scoring each technology based on the proposed criteria, and giving consideration for the selected technologies.

The TNA outputs from workshop and FGD needed evaluations from Technical Team Committee and to be approved by National Steering Committee. On 16 February 2011, the stakeholder meeting for TNA on adaptation was held and attended by 9 (nine) participants from coastal vulnerability sector, 16 participants from food security and 14 participants from water resources sector. The MCA Analysis was done during the meeting. The technical committee meeting for TNA on adaptation that was held on 9 March 2011 agreed the proposed prioritized technologies of all three sectors.

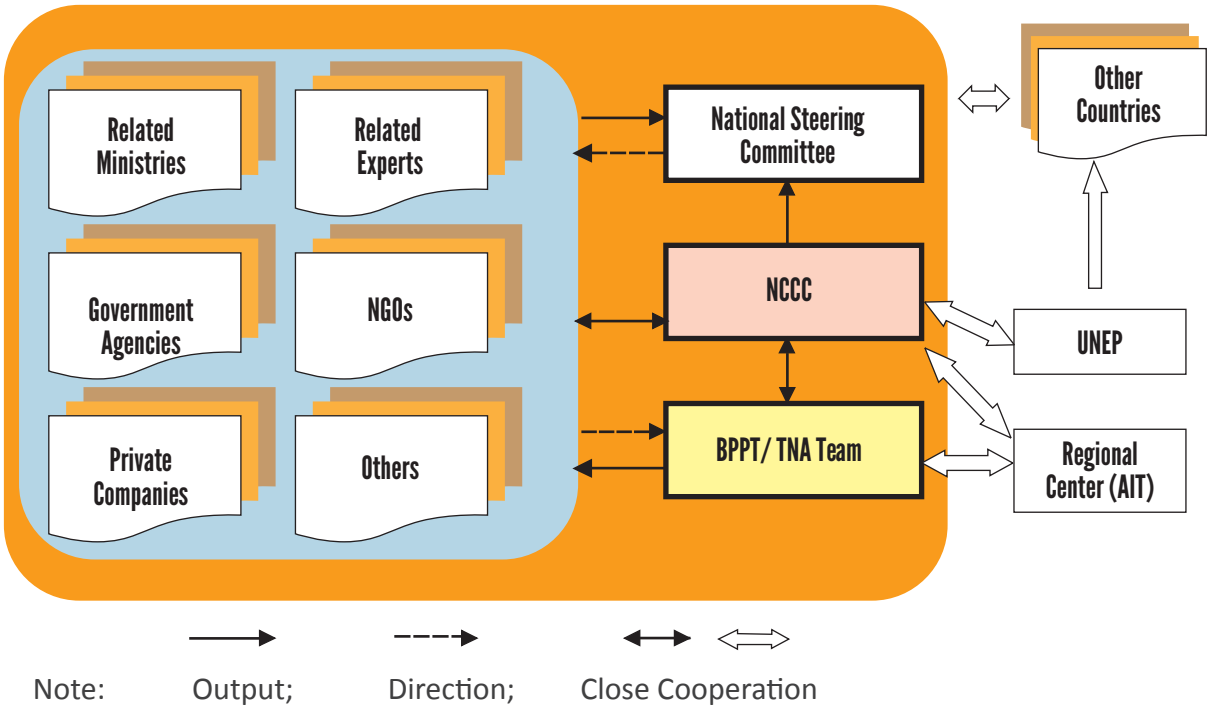


Figure 1- 2 Indonesia National TNA Organization

1.2.2. Stakeholder engagement process followed in TNA

This work was officially started by a kick off meeting that was conducted on 24 August 2010. From this event, the related institutions from different sectors have started to involve. As an initial step before carrying out series of stakeholders meeting, the team of TNA on adaptation reviewed the available national documents or studies published by different ministries as stated above, developed draft criteria, identified relevant resource persons and potential contact persons from different institutions. Review of these documents was done by the TNA team of BPPT for technologies inventory of each targetted sector. Following inventory of technologies of the adaptation of targetted sector, the criteria establishment for prioritizing adaptation technologies was conducted during the experts and stakeholders meeting.

It is noted that in the end of 2010 there were some reorganizations in the ministries and in other governmental institutions of Indonesia and therefore there were changing in the persons in charges who become members of the TNA Technical and Steering Committees.

In November 2010, there was a meeting to discuss the potential members of Steering and Technical Committees. It was not easy to appoint them and in fact the process of Steering and Technical Committee's member appointment required much longer time than that as expected. This is due to high-level persons in charge from related ministries and other government institutions who were not officially appointed yet. However, the expert working groups were finally established for each sector.The groups' members were from various experts, stakeholders and representatives from related ministries, government institutions, non government organizations (NGOs) and private companies. Then, formulation of multi-stakeholders' core team was prepared and a work plan of the TNA study on adaptation was developed. Institutional arrangements and wider stakeholder engagement were also initiated. In 16 February 2011, TNA team finally carried out adaptation workshop for 3 sectors (water

resources, coastal vulnerability and food security). The result of workshop was the draft of the prioritized technologies (3 technologies from each sector). This draft of the TNA study was then discussed and decided during technical meeting conducted on 9 March 2011 and attended by Technical Committee Officials from different ministries and government institutions (Director or echelon-2 level).

The adaptation workshop was attended by different experts from different ministries, governmental institutions and NGOs. For example, for food security sector was attended by representatives from Ministry of Environment, Soil Research Institute, Bogor Institute of Agriculture (IPB), Directorate General of Food Crops, Head of Agricultural Research, DNPI and Tropical Peat Research Center. For water resources sector were participated by representatives from Ministry of Health, Ministry of Public Work, Association of Drinking Water Companies, Agency for the Assessment and Application of Technology, Ministry of Research and Technology, Indonesian Science Institute and Jakarta Environmental Management Agency.

For Coastal Vulnerability sector was attended by representatives from the Center of Environmental Technology-BPPT, NCCC, the Ministry of Public Works, Ministry of Marine Affairs and Fisheries (Director of Coastal and Marine, Director of Spatial Planning for Marine, Coast and Small Islands Affairs).

In addition to having official meeting, TNA team also did to have informal meetings with experts and resource persons from different ministries and institutions as well as from NGOs to speed up the process of TNA study.

1.3. Sector prioritization

1.3.1. An overview of sectors, and projected climate change and impacts of climate change in the different sectors

Agricultural food production is also vulnerable to the climate change as a result of the increasing temperature. It is because that plants need a certain condition of climate such as temperature and precipitation for being optimum of their growth and harvest.

As known that global warming will potentially alter water vapor flux and may increase humidity, hence more intensive rainfall potentially occurs in this area. However, projected rainfall change shows that precipitation will be more concentrated during the wet season, while the dry season tends to be dryer. The decrease of food production due to rainfall change in 2050 compared to current condition is predicted as follows: rice (-4.6%), maize (-20%), soy (-65.2%), sugar (7.1%) and palm oil (-21.4%).

From the current total paddy production area in Indonesia, it is predicted that in 2050 the decreasing in planting area as a result of raising temperature will reach 3.3% in Java and 4.1% outside of Java. It gives impact on declining the productivity of rice that is predicted to be 19.94% in Central Java, 18.2% in DI Yogyakarta, 10.5% in West Java, and 11.7% outside of Java and Bali (Handoko, et al, 2008).

Water resource shortages could be influenced by the climate change particularly for a tropical and island country like Indonesia. Therefore, adaptation measures for water resources vulnerability must be carried out in the long-term and short-term. Several levels of risk conditions need further attention for adaptation responses for water resource shortage sector. For examples are condition of exteremely high risk of parts of Java-Bali region, especially in a few locations in the northern and southern of West Java, middle and southern of Central Java and East Java; as well as in the capital of the North Sumatra, West Sumatra, Bengkulu and Lampung (Sumatra), Nusa Tenggara Barat and South Sulawesi. This category of water resource must be quickly overcome.

The second level is the high risk which is observed in about 75% of the Java-Bali region (in a small part in the northern, western, and southern), the island of Lombok (Nusa Tenggara) and South Sulawesi. As a result of the risk analysis, some activities have to be addressed in order to successfully adapt the water sector to climate change, such as maintaining the balance between water availability and demand (water balance), maintaining sufficient water infrastructure and the provision of alternative water sources in certain areas, preparing availability of data, technology and research as a basis for water resource management, reducing vulnerability and risk from water shortage, flood and drought, finding synergetic solutions for cross-sector issues with agriculture, forestry, health, energy, and industry sector, integrating water resources management and flood control, and conserving water based on innovation, community participation and local wisdom.

For Indonesia as an archipelagic country, coastal area is very succeptible to climate change. Indonesia posses atotal coastline of 95,181 kilometers and inundation of coastal area due to sea level rise (SLR) will cause serious problems because a large portion of population (about 50-60%) of the total live on it. Significant infrastructure and economic assets are located in these areas. Many important tourist destinations and attractions, both natural and man-made, lie in coastal areas. The estimated average rate of SLR in Indonesia is around 0.6 cm per year. For that climate change impact predicted to coastal area of Indonesia, the strategic measures for climate change adaptation in marine and fishery sector are suggested. Those are physical adaptation in coastal zones and small islands by an integrated management and environmentally sound physical engineering, population management, infrastructure and public facility management, resource management of fisheries, water resources and defense and security (small strategic islands on the border), integrated ecosystem management of coastal zones, small islands and ocean, formulation of regulation and policy for adaptation, and data and research inventory and human resource development.

1.3.2. Process and criteria of sector prioritization

Sector priorization for TNA Adaptation was conducted through dissussion during the first stakeholder meeting on March 24, 2010. The consideration of choosing the sector for TNA adaptation of Indonesia was based on the sectors that will be severely affected by the climate change. As a maritime and agricultural country, Indonesia is very prone to climate change impact on coastal and agricultural sector. Similary, the crisis of water resources has been experienced by most area of Indonesia. For those conditions, the first stakeholders meeting agreed to conclude that coastal vulnerability, food security, and water resources crisis are those 3 sectors that needs to be prioritized for TNA adaptation study. It is noted that the TNA

adaptation study for this time is suggested by UNEP-RISO for only three sectors due to the limited resources.

In general for all three sectors of adaptation measures in this study, inventory of technologies were first carried that was found from officially national documents. The lists of inventoried technologies were made and presented during experts and stakeholders meeting for completion. The work of technologies inventory was mostly done by the core team of BPPT.
The long list of inventoried technologies was then prescreened through discussion and expert judgment. It was agreed to select around 10 technologies from the list. The criteria for choosing the adaptation technologies were generally agreed to be grouped into cost and benefits. The cost criteria are divided into capital cost and financial viability. The benefit criteria consist of reduction of vulnerability, confirmity with national regulations and policies, technology effectiveness, environmental effectiveness, economic sustainability and social sustainability. From these 10 or so technologies of each sector they were then screened by multi criteria analysis (MCA) to become 3 (three) prioritized ones. The experts and stakeholders who participated in the prioritized technology meeting consisted of experts from different specialists and representatives from different Ministries, other Government Institutions, Non Government Organizations and Private Companies. Each sector meeting was attended by related representatives and experts who discussed that specific topic.

Several meetings were conducted to prioritize these technologies. First meeting was the expert and stakeholder meeting, followed by technical meeting attended by Technical Committee, and ended by Steering Committee meeting to approve the 3 prioritized technologies. The expert and stakeholder meetings were conducted to determine the criteria and the weight of each criteria for prioritizing technologies. Determination of the prioritized technologies was conducted by giving score to each technology of all criteria. Prioritized technologies were chosen from the three highest scores according to MCA result.

The three prioritized technologies selected during experts and stakeholders meeting were reviewed, corrected and then validated during Technical Committee meeting. These validated technologies resulted by Technical Committee meeting were then presented to the Steering Committee to have their approval as the final three prioritized adaptation technologies in each sector.

1.3.3. Inventory/ current status of technologies in the selected sectors

1.3.3.1. Food security

Technologies selected for climate change adaptation in food security sector are (1) crops (rice) tolerance to drought and flood, (2) technology for mariculture development, and (3) cattle meat development.

Crops (rice) tolerance to drought and flood as a result of climate change impact is very crucial to be developed in Indonesia. There are many ways to overcome this tolerance. One of them is to develop the crop seed that possesses ability to adapt on dry or soil conditions. Also, selected crop seed with shorter age has been discovered and it has been started to be distributed around the country. The second important one is how to teach farmers to implement integrated crop

management, water resources management, and land or soil management for that type of crop seed. The purpose is to give knowledge to the farmers about the climate change impact on the crops so they could anticipate and prepare when cultivation of food crops especially rice is appropriately started.

Besides, climate prediction is very useful to be known by farmers in order to make the selection of type and time for rice planting as well as other food crops such as maize, sugarcane, soybeans. Another program is to socialize to the farmers how to prepare and carry out crop cultivation with a particular rainfall pattern accordingly.

Marine technology (sea farming) could be defined as a system based mariculture activities with the ultimate goal on increasing the stock of fishery resources and become supporters for other aquatic resource uses such as fishing and tourisms. Technically, sea farming is basically a system consisting of three sub-systems, namely sub-system input, mariculture (processes) and output. In addition, there is sub-support system that is a prerequisite of early institutional establishment of sea farming that has a primary function as providers of supporting factors for the operation of sea farming in the field.

Although historically in the policy level and the implementation, the technology of sea farming principles have been applied in part of areas and regions, but technically a good mariculture technology has not been applied yet. At the island community level, such as for people of Panggang island of Thousand Islands, the sea farming conception has not perfectly been understood until now. It might be because the implementation of the current mariculture technology is new and it is still in the early stages of development. The understanding of sea farming has still being spreaded out by the government, community leaders, colleges, NGOs and officials to all levels of society.

People's understanding of sea farming in terms of socio-economic view point is basically how to understand its problems and the current socio-economic conditions, and how those problems are overcome. The efforts to these problems are introduced to the community through various approaches. Economically, if the mariculture technology was developed there will be some advantages obtained for the economic condition of coastal level, and is able to open up opportunities to encourage economic growth of islands region in a sustainable manner. In terms of environment, the development and implementation of mariculture technology can automatically guard the environment because the implementation of mariculture technology is one of good environmental management practices.

Marine technology for food security, particularly for operating system technology in marine aquaculture (mariculture) must be implemented through a Good Fish Farming Method (GFFM) using Indonesian National Standard (SNI) recognized internationally. It is also useful to generate a sustainable marine fishery products that can address the problems of fishing during hurricane season in the sea which causes the fishermen cannot go to the sea for fishing activity.

Beef cattle farming technology is operated similar to that of crop tolerance to drought and flood. As a country with dense population meat is very important for people food. The cattle should also have ability to adapt on the climate change impact, especially drought and flood.

Therefore, the development of cattle that has an ability to adapt on dry or inundation conditions is a must. Also, selected cattle resistant to diseases have been discovered and they have to be distributed around the country. The second important one is how to teach farmers to do cattle farming appropriately. Farmers must be given knowledge about the climate change impact and how to do cattle farming effectively so they could anticipate and prepare to it.

Technically cattle farming has to be realized by the local community based on local agro-ecological conditions. Economically, it gives advantages to the conditions of rural economy and able to provide opportunities to enhance the economic growth of local area in a sustainable manner. It is socially not contradictory and even able to encourage and motivate the farmers. Finally, it must be done in accordance with saving the environment as our place of live.

1.3.3.2. Water resources

Technologies for climate change adaptation in water resource sector are concluded to be rain harvesting technology, domestic water recycling, and modeling of water resources projection. Rainwater harvesting technology has essentially been available in the world including in Indonesia. However there are still many people who do not understand the importance of the rainwater harvesting technology. It is therefore absolutely necessary to do counseling and coaching to a community so that they could harvest rainwater with appropriate technology. Rainwater harvesting technology is strongly required because the environmental conditions have already been devastated as indicated by unabling nature to accommodate the rain fall.

In fact there are about 12 rainwater harvesting methods developed by the Ministry of the Environment. Those are (1) collecting rainwater pool, (2) rain water absorption wells, (3) rain water absorption trench or ditch, (4) rain water absorption land or area, (5) yard embankment, (6) pit Soil, (7) fence yards, (8) modification of the landscape, (9) determination of soil water conservation area, (10) rainwater catchment pond, (11) revitalized lakes, pond and lagoon, and (12)development of harvesting rainwater forest and crop.

However for harvesting rainwater, it is generally used pond technology, absorption lagoon (*embung*) and absorption well. *Embung* is water conservation like pool structure with volume up to 500,000 m^3 that could hold rainwater and water runoff as well as other water sources to support agriculture, plantations and farms. One of social barriers in the application of harvesting rainwater technology is the problem of land dedicated for making *embung*. Not all people agree and want to sell their land for *embung*. Therefore the process of making *embung* usually takes a very long time.

Public absorption wells are made in the yards of households, offices or industrial complex. Its technology is actually very simple that is by making a hole with a depth which depends on the height of the water table. It is usually one or two meters. The wall of the absorption well is made from bricks and the bottom one is covered with water filter media such as stone, gravel and sand. In order for the effect of rainwater harvesting to significantly increase ground water reserves, the application of these techniques must be simultaneously done in a large area.

Some options for securing water resources are to increase water supply, for example rehabilitation of reservoir and relining canals or harvesting rainwater. Water harvest must be combined with the water demand reduction such as by cutting leakage from pipes or

making more efforts to treat wastewater. Water and wastewater treatment technology has been conducted in Indonesia by some institutions or universities such as BPPT, LIPI, ITB, UI and private sectors. Whereas, water harvesting management in upland combined with river restoration has been carried out by Ministry of Public Works (MoPWs) through Directorate General of Water Resources. It has implemented several pilot plants for river restoration in many rivers of Indonesia.

Domestic water recycling has been started in Indonesia specially in the high strory building of large city like Jakarta. Since the shortage of water resource occurs in big cities the recycle of water is very important to be done. The technology of water recycle system has already been mastered by Indonesians but the filter materials have still been imported. There is a need to transfer of this technology to Indonesia in order to enhance the implementation of this waste water recycle plant.

Lately the use of recycled water gets special attention. This is because of the rapid increase in water demand and declining quality of water resources as a result of increased population, the rate of urbanization and industrial development. The development of today's recycled water technology has been capable of producing water recycling with high quality and shorter time but it is still in limited areas. At first, recycled water was utilized for irrigating agriculture or watering plant and currently has expanded on wider use such as for the purposes of industrial, office and home activities. The pilot projects have been widely carried out in various countries and as real examples are those in Singapore and Japan.

City Government of Tokyo Metropolitan in an effort to promote water conservation has pushed all of the new buildings to construct double piping systems through the granting of incentives. For those who use the water of the recycling of waste water are given a discounted price of water up to 20% of the price of non recycled water. The capacity of Tokyo's recycled water for offices reaches 8,000 m^3 per day.

Another example of application of the recycled waste water is in New Water Factory of Singapore. This plant treats secondary effluent from Bedok domestic waste water treatment plant with the use of dual membranes technology of ultra filtration and reverse osmosis, followed by disinfection system using ultra violet rays. The capacity of this new water factory reaches 10,000 m^3 per day. The quality of the produced water could meet the standards of the drinking water quality. Electrical power needed for the operation of the machinery is around 0.7-0.8 KWh per m^3 of produced water and it is still economically cheap.

In Jakarta, there have also been several offices that have applied domestic waste water recycling with membrane technology. Operational cost of waste water recycling into clean water is around IDR 9,000-12,000 or USD 1 – 1.3 per m^3 of water. It is still a little cheaper than the water price from Water Drinking Company (PAM) of Jakarta.

Until recently obstacles faced in the use of recycled water is related to the social aspect that is still lacking of community acceptance. Many bad or negative perceptions still arise in the community. For examples, recycled water is still believed to be dangerous, it is treated from droppings contaminating water so people are reluctant to use, and it is unclean and non righteous for religion purposes (religion constraints). For that, it needs to have a water

recycling campaign so that its utility in the larger society can ultimately reduce the problem of the scarcity of water resources.

Modeling of water resource potential projection in the future for both water resources availability and its use widely employes a technique of simulation models using Power Sim. Power Sim is software of dynamic modeling that is not only used for the projections of water resources but also for other use. To know the projection of future water resources with Power Sim, data input is required among others are population growth, economic growth, the growth of the industry, and projection of land use. Production of an accurate model is greatly influenced by the accuracy of data inputs above.

In addition, there are lot of water resources models that have been developed by research institutions such as the Agency for the Assessment and Application of Technology (BPPT), Indonesia Science Intitute (LIPI) and Universities like Bandung Institute of Technology (ITB), University of Indonesia (UI) and Sepuluh November Institute of Technology (ITS).

For many years Indonesia has tried to implement the most inclusive approach to sustaining water supplies referred as" Integrated water resources management". There are some good examples that integrated water resources management has been applied in Indonesia that is Brantas river management and *Cisadane* river management.

1.3.3.3. Coastal Vulnerability

Climate change will affect on the community who live in coastal areas and who depend on agriculture and fisheries for living. This group of people is very sensitive to climate change impact. It means that the climate change will affect to about 65 percent of the Indonesia's people who live in coastal areas both in the dense population of coastal city and in rural fisherman communities.

Government of Indonesia has been doing a lot of efforts in dealing with the impacts of climate change on coastal areas. However, those efforts are mostly in the pilot stages. Initial step to deal with climate change impacts on coastal areas is to do the mapping and assessment of coastal vulnerability. There have been many studies conducted in coastal vulnerability throughout Indonesia, especially in the northern part of Java Island where most people live.

The applied adaptation efforts for holding back the sea level rise impact could be grouped into two: the structural (physical) and non-structural (non physical) efforts. For structural efforts, they could be carried out by natural protection and artificial protection methods. Based on its characteristics, artificial protection method could be carried out by building hard structure and soft structure. An example of structural efforts is natural protection such mangrove, sand dune, coral reef, and tree planting. On artificial protection, government Indonesia has been built many facilties such as breakwater, embankment, stage house, and coastal reclamation.
For coastal vulnerability sector, the two prioritized technologies are (1) Coastal Protector Building Technology (Seawall or Revetment) (2) Coastal Reclamation.

Coastal protector building technology (Seawall/Revetment)

By nature, the beaches serve as natural defenses (natural coastal defense) against the pounding waves. Beach erosion and accretion of sediment transport depends on the conditions at a particular coastal location, which is generally influenced by nature such as wind, waves, currents, tides, sediment supply and other events as well as the possibility of interference due to human activities. Various attempts have been made to address coastal erosion and sea level rise by making coastal protection structures.

Seawall /revetment is a beach safety construction is located parallel or approximately parallel to the coastline as a barrier between the mainland on one side and waters on the other side. The function of this structure is to protect / defend the coastline from wave attack, and hold the land behind the seawall. With the expected sea wall erosion processes can be reduced.

The form of massive sea wall structure is able to withstand the expected onslaught of the waves, while the protective cliffs form a flexible structure containing an array of blank stone or concrete block with the same function. Strategies for coastal protection usually emphasize the existence of a complex variation on the assets of national assets in the coastal area that includes residential, commercial areas, agriculture and fisheries. Whatever the goals set for coastal areas should pay attention to the importance of protection of life and environment, natural or artificial land for various activities including seed, so that according to the needs of coastal protection in the future.

Coastal reclamation

Along with the development of civilization and social economic activities, human use of coastal areas for various purposes such as a place to earn a living, housing, urban, industrial areas, airports, seaports as well as a place of recreation. Consequences arising from the rapid development in coastal areas, among others, the problem of providing land for economic and social activity but it disturbs the environment. Provision of land is usually done by making use of land or existing habitat in coastal areas such as coastal waters, wetlands, muddy beach and others that are considered less valuable economically and or the environment to be converted into other forms of land that can provide economic benefits and or the environment, better known by the term reclamation.

Reclamation is an activity performed by humans in order to enhance the benefits of land resources in terms of economic and social environment by stockpiling soil or sand, land drainage or drainage.

Reclamation by the accumulation of soil or sand is the most poluler reclamation system, with hoards of coastal waters up to the face of the land is above sea level the highest for the purposes of industry, housing and public infrastructure such as ports and airports in the area of coastal waters.

The positive impact of reclamation activities include the improvement of quality and economic value of coastal areas, reduce land that is considered less productive, the addition of territory, coastal protection from erosion, improving aquatic habitat conditions, improved hydraulic regime of coastal areas, employment etc.. While the negative impacts such as sedimentation,

increased turbidity, marine pollution, changes in groundwater regime and the increased potential for flooding and inundation in coastal areas

Groin technology

Sea level rise (SLR) will contribute to increasing erosion of shore line. Therefore, the beach must be protected. One of the protective coastal buildings that are often used in Indonesia is the groin. Groin is one of the technologies that can be used to reduce erosion. Groins are usually built perpendicular to the coastline, starting from the shoreline to the surf zone. Groins serve to protect the coast from the disturbance of sediment transport parallel to the shore (long shore transport). Groins can also be used to restrain the entry of sediment delivery to the port along the coast or estuaries. Sediment will be retained and deposited on one side of the groins (up drift side of groins), but on the other side of the groins (down drift side of groin) continues the transport of sediment, which in turn can also cause erosion. Therefore, prior to the construction of groins, a study on beach conditions has to be conducted in order to minimize the negative impacts.

Groins are often encountered in the waterfront, like in the Port Island Bay, Bengkulu and Port of Tanjung Golden, Semarang. Technology groins have good prospects to be developed in Indonesia, given the huge potential of erosion. But it certainly should be started with the study in advance.

1.4. Technology prioritization for food security

1.4.1. An overview

From a view point of food security, climate change is believed to have a high potential and more severe impact on national food production in an island and tropical country of Indonesia. Climate change impact on food security could be achieved both directly and indirectly. The example of the direct impact is changes in the rainy season and dry season that will then affect the length of growing season, floods, droughts, etc. The indirect impact could affect the changes of stock price due to the reduced influence of the distribution of food, etc.

Judging from the phenomena of changes in the rainy season and dry season, agricultural areas in Indonesia will be affected in terms of length of growing seasons, floods, droughts. For example in some parts of Indonesia such as East Nusa Tenggara (NTT), West Nusa Tenggara (NTB) as well as several other areas in Java, the influence of the coming dry season changes will give a big impact on existing agricultural production. An extreme rainy season usually causes a crop failure and finally decreases the national food production.

In coastal areas, a climate change impact also lead some problems for fish farmers and fishers because of the large waves that cause the catch of fish and other marine products become less.

It is noted that the current population of Indonesia reached 216 million people with a growth rate of 1.7% per year. The figure indicates the amount of food that must be available for those many populations. Food needs are great just when the problem is exacerbated by the declining

domestic food production. Surely if it is nothing to be done to increase the food production it will cause widening gap problems between the need and the availability.

The low rate of increase food production and the continued decline in production in Indonesia, among others is caused by: (1) Productivity of crops that are still low and declining, (2) Crop growing areas that are stagnant and even declining, especially in the productive agricultural land of Java. The combinations of these two factors ensure production growth rate from year to year are likely to continue to decline.

It is known that adaptation to climate changes is basically the act or effort of adjustment activities and technology with climatic conditions caused by the phenomenon of climate change / global warming which include resources, infrastructure/ facilities, farming system (SUT)/ agro industrial business system (SUA), production system, socio-economy, and others that are associated with the following aspects:

- Management (resources, infrastructure and farming system).
- Technology (farming system, production system, crop culture).
- Attitudes and behaviors which are adaptive to cropping patterns and various social and economic aspects.

To achieve this, the Program for Research and Development of the Ministry of Agriculture 2010 - 2014 for adaptation to climate change in an effort to ensure food security are:

- Assembly of adaptive technology such as VUB (drought, shorter age, floods, etc.) and development of soy crop and tropical wheat with supporting industries
- Assembly of adaptive agricultural systems such as model development of food and plantation based carbon efficient farming/ green farming (zero waste, low emission, biogas, efficient raw materials).
- Development of Decision Support System (DSS) for dynamic planting calendar.
- Development of synergistic role of soil biomicroorganisms (physical-chemical and biological) in the supply of nutrients through subsidy of inorganic fertilizer with organic one.

While the food development program of marine and fisheries sector, the Ministry of Maritime Affairs and Fisheries (MoMAF) is as follows:

- Technology of operational system for marine aquaculture (mariculture) that is implemented using the Good Fish Farming Method (CBIB) complied with Indonesian National Standard (SNI) recognized internationally;
- Technology to prevent and stop the rampant illegal fishing;
- Technology to prevent and stop the destruction of marine resources and fisheries;
- Technology for management and investment of small islands; and
- Technology to enhance human resource capacity of marine and fisheries sector that is generally still low.

There are many adaptive technologies that have being developed by Ministry of Agriculture (MoA) for long time. The adaptive technologies that have already become the policies and

direction of research and development of the Research Agency, the Ministry of Agriculture are as follows:

- For R & D technology of cultivar/ Superior New Variety (VUB), it is selected adaptive varieties technology with specifications of short age (*genjah*), drought and flood tolerance, and pest plant resistant.
- For production technology, it is selected storage and distribution technology for seed and seedling.
- For technology of soil management, it is selected some technologies that include:
  - Zero tillage, mulching and manure application;
  - Rainfall and runoff harvesting, conjugative water use and alternative water resources;
  - Water Management Technology; and
  - Technology of climate prediction.

In carrying out the Action Program of Adaptation of Food Security, the policy has been taken by MoA as follows:

- Utilization of sub-optimal land, such as dry and swamp land for food crops.
- Development of oil palm on the peat lands either already opened or displaced.
- Agricultural diversification, for example of tropical soybean development with supporting industries such as factory fodder, development of tropical wheat, etc.
- Integration and diversification of crops and livestock as follows:
  - For dry land, it is developed cattle and oil palm;
  - For the irrigated land and rainfed wetland, they are developed rice crop of Ultra genjah of New Priority Variety (VUB) / IP 200-250 and cow with intergrated crop managemen (ICM)and System of Rice Intensification(SRI);
  - Swamp land developed for rice, horticulture and livestock with cultivation method of ICM.

While the Ministry of Maritime Affairs and Fisheries (MoMAF) gave priority to programs that contribute directly to increasing public revenues through Minapolitan Program. Climate change adaptation policies are taken by MoMAF as follows:

- Development and People Salt Business Development and Rural Fishery Business Development.
- Development of fisheries infrastructure.
- Provision and distribution of superior fish parent candidates through the development of the People's Hatchery Unit.
- Development of food technology at an affordable price.
- Development of cold storage chain system and product diversification.
- Marketing and distribution network development partnerships.
- Increased monitoring of marine resources and fisheries.
- Preparation of Master Plan and Zoning Minapolitan regions.
- Provision and improvement of the role of tutoring workers.

- Capacity building of Maritime Affairs and Fisheries.
- Control of pests, diseases and residues of fish.
- Implementation of quality assurance systems and safety of fishery products.

From Focus Group Discussion (FGD), and Strategic Plans of MoA and MoMAF 2010-2014, it was then compiled a list of 58 technologies classified into 6 (six) groups that could be potentially implemented to be used as adaptive technologies in the food security sector. The six groups of technologies mentioned are (1) climate prediction technology, (2) technology for adaptation to climate change itself, Dissemination technology for mainstreaming of global climate change, (4) technology for capacity building, (5) climate projection technology and (6) technology for fishery security. All 58 technologies grouped into six are presented in the Appendix.

The possible adaptation technology which could be applied in food security issue based on their adaptation benefits are explained as follows.

Climate prediction technology is very useful for farmers to make the selection of the type and time of planting rice and other food crops such as maize, sugarcane, soybeans. This technology can produce climate database management, climate prediction models, model validation, climate forecasting for disemination of climate prediction, information of climate fastly and accurately warning system of flood.

Adaptation to climate change technology teaches farmers to implement integrated crop Management, water resources management / agricultural infrastructure and facilities, land management / soil management. Thus, climate change can be followed its directions to prepare for the cultivation of food crops appropriately, especially rice.

Dissemination for mainstreaming of the Global Climate Change (GCC) is to socialize to the farmers how to prepare and carried out crop cultivation with a particular rainfall pattern accordingly either for the fed raifall land or irrigated land. Similarly, if the pattern of dissemination of climate change for rice was developed, the development of farming, especially cattle could also be developed.

Capacity building technology is a way to improve farmers' ability in carrying out the cultivation of the ability to anticipate the climate change impact through ability to read the global climate whether it is informed by BMG, electronic media or periodic weather forecasts.

Climate Projection is aimed to produce recommendation of planting calendar, decission support system (DSS), dynamic planting calender, development of DSS for dissemination of appropriate technologies, climate model information such as fish culture calendar, and periodical monitoring technology such as survey and analysis in laboratory.

Marine technology for food security, particularly for operating system technology in marine aquaculture (mariculture) implements a Good Fish Farming Method (GFFM) using Indonesian National Standard (SNI) recognized internationally. It is useful to generate a sustainable marine fishery products that can address the problem of fishing during hurricane season in the sea which causes the fishermen cannot go to sea for fishing.

1.4.1. Criteria and process of technology prioritization

Based on the results of inventory between stakeholders and resource persons, there were 31 technologies acquired that could be applied in the context of climate change adaptation, particularly on the issue of food security.

Before using the MCA technology priorities, it was first performed prescreening of 31 technologies. Prescreening was done by related experts and stakeholders with the guidance of four general criteria used in the TNA 2009. These criteria include 1) Technology Effectiveness; 2) Economic efficiency and cost effectiveness; 3) Environmental effectiveness; and 4) Institutional and human development.

Thus, all inventoried technologies have been in line with the policy direction and strategy of the Ministry of Agriculture and the Ministry of Maritime Affairs and Fisheries as the responsible sectors. After prescreening, then later the results of prescreening technologies will be selected again using MCA to get three prioritized technologies.

The long initial lists of technology needs that are inventoried by the team from many sources or references are assessed by related experts and stakeholders. From the list that had been developed, the experts and stakeholders responded by giving five technologies selected based on criteria of priority program 2010-2014 of MoA.

Stakeholders provide input back to the long list of technologies deemed to have become the adaptation technology in the face of climate change used by Directorate General of Food Crops, MoA. Selected technologies taken from Strategic Planning of MoA and inputs from related experts were made over again into their list to be presented back to all stakeholders in Agency for Agriculture Research and Development, MoA through the Forum Group discussion (FGD). The results of focus group were then discussed again via email to be proposed as selected technologies analyzed further by the MCA.

Criteria used during the pre-screening criteria based on strategic planning of the Ministry of Agriculture and opinions of experts in the field of agricultural R & D in order to obtain a list of agricultural technologies for adaptation to food security. Criteria used by the Agency for Agriculture Research and Development in the selection adaptation technologies to address climate change impact on rice for food security is given in the Table 1-1 below.

To select the technology priorities in the adaptation for climate change of food security sector, the first step was to make a list of enabling technologies used for adaptations. There were 31 food security technologies in the list that were prescreened through expert judgments to obtain 11 selected technologies. The criteria used for weighting and scoring for food security technologies in the following MCA process was initiated by the technical team, and then taken to the focus group discussion (FGD) at the Research and Development Center for Agricultural Land Resources, chaired by the Head of the Center for having input and correction.

The final prescreening criteria that were initially prepared by the TNA team iventorized from several resources and then discussed in the following expert meeting/FGD for its enrichment is presented in Table 1-1.

Table 1- 1 Prescreening criteria for food security technologies

No	Need and Opportunitty	Urgency/ GAP	Technology Options	Priority/ Key Technology
1	Climate Prediction	Reduce risk of harvesting and planting failure	a. Information technology of climate forecasting. b. Fast and accuate information technology of climate c. Information technology of early warning System for flood	Well distribution of climate forecasting
2	Adaptation to Climate change	Productivity of agriculture need to be maintain under climate variation	a. Technology of land and water conservation: ■ Land reclamation ■ Land optimization ■ SRI ■ Intermittentt irrigation ■ Cultivation b. Technology of agricultural infrastructure and facilities: ■ Water harvesting ■ Irrigation efficiency ■ Water pump c. Technology of environmentally agriculture	Agricultural land and water conservation Adaptive technology of agriculture infrastructure and facilities
3	Dissemination/ mainstreaming of climate change	No adequate on understanding of climate forecasting to climate change and anticipated effort by the farmer	a. Training for farmers through field climate school, b. Campaign through electronic media technology (television, radio, sms, etc.), movies, magazines, stickers, etc.	a. water conservation b. rain/ water harversting c. weather modification d. controlled groundwater exploitation e. efficient of water uses f. prioritize of water uses g. intermiitent irrigation h. Pressurized irrigation, particularly for horticulture
4	Capacity Building Technology	Public Campaign / Extension	a. Training and capacity building for local government for a in streaming GCC in agriculture policy b. Farmer fields school (Climate Fields School), Integrated Crop management Field school, etc. c. Institutional building and strengthening for climate change mainstreaming	Farmer fields school
5	Climate projection	Determine planting calender	Climate model information and prediction	Planting calender

From these prescreening criteria that were implemented for 31 technologies in the food security sector with the expert judgment considerations it was found 11 selected technologies as shown in column 2 of Table 1-2. The scoring of each selected technologies with the value between 0 and 100 is shown in the column 3 through 15 of Table 1-2

Table 1- 2 scoring for water resource technologies

No.	Technology Option	Cost effectiveness		Reduction of vulnerability			Implementation consideration				Social vulnerability reduction			
		CC	OM	AT	RR	AP	CF	SR	LP	CP	PR	HH	RP	WW
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Weighted score	4	8	10	12	6	7	3	4	5	10	13	10	**8**
1.	Rain water harvesting tech./ *Embung*	70	60	80	80	60	50	50	50	50	20	40	40	**40**
2.	Reliable climate prediction for tropical islands	70	80	60	70	60	50	50	50	50	50	20	30	**40**
3.	Crop (rice) tolerance to drought and flood	60	80	90	80	70	50	50	50	50	50	50	60	**50**
4.	Appropriate cropping calendar	70	80	70	80	50	50	50	50	50	40	30	40	**40**
5.	Cattle meat technology development	40	60	80	80	70	50	50	50	50	50	60	40	**30**
6.	Mariculture development	50	70	80	80	60	50	50	50	50	40	50	50	**60**
7.	Efficient irrigation	50	80	80	80	70	50	50	50	50	40	40	40	**30**
8.	Conservation and optimization	50	80	80	70	60	50	50	50	50	50	20	30	**20**
9.	Production, storage & seeds and seedling distrib.	70	70	80	70	60	50	50	50	50	40	30	40	**40**
10.	Farmers training through field climate school	80	60	70	80	60	50	50	50	50	30	40	30	**30**
11.	Dev. of decision support system for dissemination of appropriate tech.	70	60	60	70	60	50	50	50	50	30	40	30	**30**

Note:

(3) CC: Capital cost
(4) OM: Operation & Maintenance cost
(5) AT: Availability of Technology
(6) RR: Risk reduction due to harvesting and planting failure
(7) AP: Agriculture productivity needs to be maintained under climate variation
(8) CF: Understanding climate change forecasting and anticipating efforts by the farmers
(9) SR: Skill and local condition requirement
(10) LC: Local community readiness
(11) CP: Capacity building and institutional strengthening for the local community
(12) PR: Poverty potential reduction
(13) HH: Healthy human settlement

(14) RP: Raising public awareness

(15) WW: Welfare / wealth personal protection

1.4.2. Results of technology prioritization

Results of prioritized technologies using MCA is given in Table 1-3. These values of Table 1-3 were calculated by the multiplication of weighted score as shown in the row 3 with scoring values of related technologies in other rows of Table 1-2. The result of prioritized technologies is given in Table 1-3. The three highest prioritized technologies are: (1) crops (rice) tolerance to drought and flood, (2) mariculture development, and (3) cattle meat development. Thus, they become technologies to be implemented within the framework of adaptation to climate change on the sector of food security.

Table 1- 3 Results of prioritized technologies for food security sector

No.	Technology Option	Cost effectiveness	Reduction of vulnerability	Implementation Consideration	Social vulnerability reduction	Total	Rank
1.	Rain / water harvesting / technology Embung	7.6	21.2	9.5	14.4	52.7	7
2.	Reliable climate prediction with adequate lead time for tropical archipelago	9.2	18.0	9.5	13.8	50.5	9
3.	Crop (rice) tolerance to drought and flood	8.8	22.8	9.5	21.5	62.6	1
4.	Appropriate cropping calendar	9.2	19.6	9.5	16.1	53.4	5
5.	Cattle Meat Technology development	6.4	21.8	9.5	19.2	56.9	3
6.	Technology for mariculture development	7.6	21.2	9.5	20.3	58.6	2
7.	Technology of efficient irrigation (intermittent, SRI, PTT)	8.4	21.8	9.5	15.6	55.3	4
8.	Technology of conservation and optimization	8.4	20.0	9.5	12.2	50.1	10
9.	The technology of production, storage and distribution of seeds and seedling	8.4	20	9.5	15.1	53.0	6
10.	Training of the farmer through field climate school	8	20.2	9.5	13.6	51.3	8
11.	Development of decision support system for dissemination of appropriate technologies	7.6	18	9.5	13.6	48.7	11

1.5. Technology prioritization for water resource sector

Water is the crucial needs for human activities. The problem currently faced in terms of water resources in Indonesia is its scarcity both the quantity and the quality. For several locations, the amount of water resource availability is much less than that needed by people activities. One of the causes of water resource degradation problems in a tropical country of Indonesia is believed to be due to the impact of climate change. Therefore, we need to do adaptation measures in order to manage limited water resources. Adaptation to water resources vulnerability must be carried out in the long-term as well as short-term measures.

It must need a responsible institution to coordinate these measures. This type of institution that holds major task in water resources management in Indonesia has already existed that is the Ministry of Public Works (MoPW). This Ministry has already formulated the short-term and long term national programs on water resources management in the country. The adaptation measures of water resources vulnerability presented here is basically produced through a long discussion by related stakeholders and experts, and is in line with the national program set up by the MoPW. These all technologies are mainly prioritized for the purpose of adaptation measures of water resources vulnerability in anticipating climate change impact.

1.5.1 An overview

The United Nation Development Program (UNDP) has stated that the greatest risk from climate change will be experienced by a group of poor people as a vulnerable population. Vulnerability will increase when the population groups live in high population density of urban areas. One of the issues faced by the urban population is the clean water problem in terms of its quantity and quality. High population density, rapid population growth and industrialization lead to pressure on land, including the excessive utilization of clean water.

The crisis of clean water will be considerably pronounced as the impact of the climate change occurs on it. A change in water cycle has led to two extreme conditions. First, it could increase the drought conditions that would reduce the availability of ground water naturally. Second, climate change could trigger sea level rise that further causes the increase of sea water intrusion and finally worsen the quality of fresh water on land.

It is believed that the change in the quality and quantity of naturally clean water due to the impact of the climate change has already occurred. So far, some adaptation efforts have been done to these changes. The next issue is whether those various efforts could have already reduced the risks to ensure their sustainaibilty for a long or a short time period. Adaptation technologies to this impact that are suitably chosen, will guarantee sustainable human life security.

In adapting to climate change, Indonesian government has made some efforts to reduce the risk and anticipate the impact. A combination action of reactive and proactive interventions in various sectors has been done. For example, the government has put some adaptation options into National Action Plan (NAP) of Indonesia Climate Change Mitigation and Adaptation. Adaptation on water resources vulnerability has also been done in this country such as measures on protection of water resources, management improvement on the maintenance of existing water supply systems, watershed protection, improved water supply and groundwater, rainwater harvesting, and desalination.

In addition, anticipatory measures have also been made. Those are, for examples, better use of water recycling, conservation of water catchment areas, improvement of water management systems, water policy reform including pricing policy and irrigation development, flood control and drought monitoring.

1.5.2. Criteria and process of technology prioritization

The experts and stakeholders who participated in the prioritized technology meeting consisted of 13 people. They were representatives from Ministry of Health, Ministry of Public Work, Association of Drinking Water Companies, Agency for the Assessment and Application of

Technology, Ministry of Research and Technology and Indonesian Science Institute and Jakarta Environmental Management Agency.

The criteria for choosing the adaptation technologies of water resources vulnerability were agreed to be grouped into cost and benefits. The cost criteria are divided into capital cost and financial viability such as Internal Rate of Return (IRR) and Net Present Value (NPV). The benefit criteria consist of reduction of vulnerability, confirmity with national regulations and policies, technology effectiveness, environmental effectiveness, economic sustainability and social sustainability. These detailed criteria divisions are shown in Figure 1-3.

The process of technology prioritization in the sector of water resources was done by preparing the list of technologies. There were 41 adaptation technologies of water resources vulnerability inventoried from many sources. These 41 technologies which were put on the technology list were then prescreened through discussion and expert judgment to become 11 technologies. From these 11 technologies were then screened by multi criteria analysis (MCA) to become 3 (three) prioritized ones carried out by related experts and stakeholders.

Several meetings were conducted to prioritize these technologies. First meeting was the expert and stakeholder meeting, followed by technical meeting attended by Technical Committee, and ended by Steering Committee meeting to approve the 3 prioritized technologies. The expert and stakeholder meetings were conducted to determine the criteria and the weight of each criteria for prioritizing technologies. Determination of the prioritized technologies was conducted by giving score to each technology of all criteria. Prioritized technologies were chosen from the three highest scores according to MCA result.

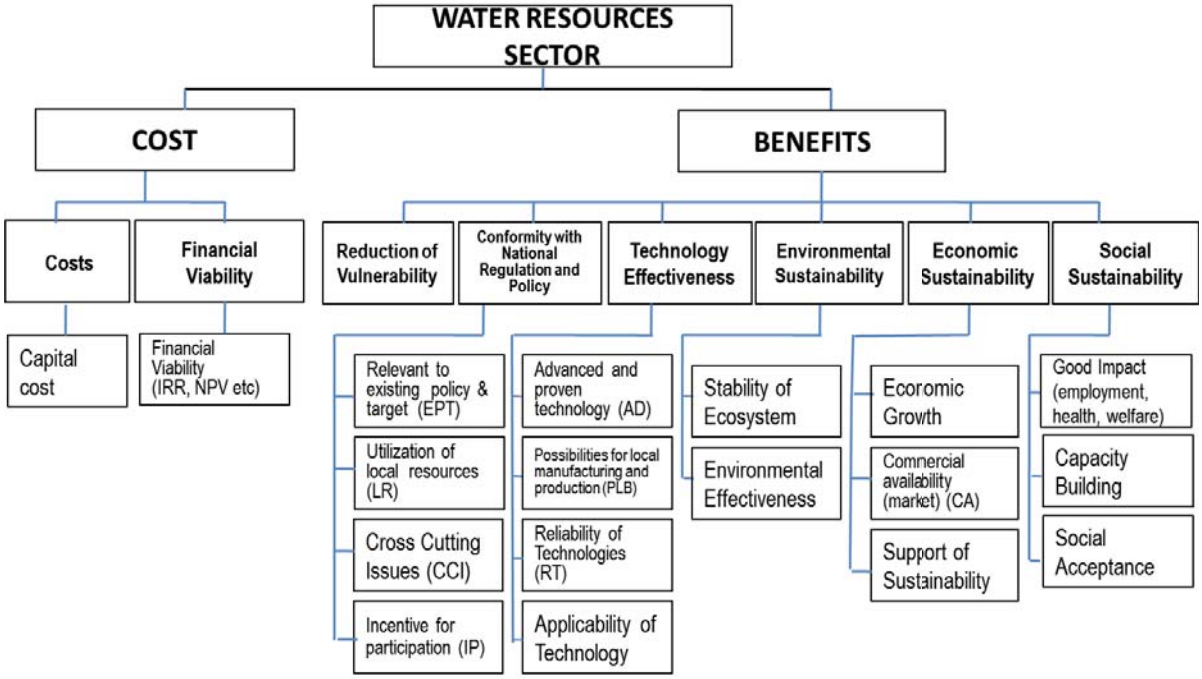


Figure 1- 3 Criteria for selection of water resources adaptation technology

The three prioritized technologies selected during experts and stakeholders meeting were reviewed, corrected and then validated during Technical Committee meeting. These validated technologies resulted by Technical Committee meeting were then presented to the Steering Committee to have their approval as the final three prioritized adaptation technologies in the water resource sector.

1.5.3. Results of technology prioritization for water resource sector

To prioritize the adaptation technology in the sector of water resource, the first step is to prepare a technology list. As mentioned earlier that there were 41 adaptation technologies of water resources vulnerability inventoried. These 41 technologies which were put on the technology list were then prescreened through discussion and expert judgment to become 11 technologies. One of the main criteria used in selecting the technology was that the technology must be measurable, reportable and verifiable. Technology selection process also considered some other criteria such as level of applicable technology to a location where people live as well as level of its benefit to them. Some technologies that own similarity were merged during pre-screening process and therefore reduced their numbers put in the list. Table 1-4 shows the list of technologies after pre-screening process and the brief explanation of each selected technology is as follows.

1) Polder and pumping technology is a technology to get in the way of water flowing into the lower area, flowing on the surface water and seeping into a reservoir, as well as keeping it at a certain level in a reservoir. Although the principle work mechanism of this technology looks simple, its implementation at the real field is not actually that easy. There should be sufficient calculations and precise design that need to be prepared before it is constructed at a chosen area. For example, to make an embankment, it needs careful considerations and measurements to determine the height of the embankment. Height of overflow water from outside to a destination area should be determined carefully. The strength of waves that might weaken the embankment, how much solidity of land that could hold the embankment and other calculations of design parameters should also be precisely determined.

2) Ground water injection technology is used to overcome the water crisis and the declining of groundwater level, to optimize the potential water resources and to reduce the impact of seawater intrusion. It should be noted that for the injection of water into the soil, the availability of surface water and rainfall should be considered sufficiently. Geological and hydro-geological data should be collected to determine the proper location and type of injection.

3) Recycle water technology is mainly targeted for domestic wastewater because wastewater from domestic sources is much more dominant than that from industrial ones even though it is located in an urban area. Domestic waste water is, in fact, a potential raw water source that can be processed into clean water through recycling technology. Generally, water recycling technology could employ physical, chemical and biological processes as well as a post-treatment with membrane technology.

Table 1- 4 Adaptation technology for water resources sector (pre-screened)

No	List of Technology
1	Polder and pumping technology
2	Ground water injection technology
3	Recycle water technology
4	Rain harvesting technology
5	Bio-filtration technology
6	Artificial rain technology (weather modification technology)
7	Household water treatment technology
8	Eco-hidrology for river
9	Monitoring and early warning system
10	Modeling of water resources projection
11	Artificial wetland

4) Rain harvesting technology in this recommendation is basically a utilization of water through well and pond. The initial aim is actually to reduce flood problems as well as to reserve the water. At least 85% precipitation water could be naturally absorbed by the soil to prevent the flood. Home yards are highly able to take up water from rainfall that first falls on roof and then flows down to the earth. On earth, this water infiltrates and percolates into the soil and stored as ground water. If the infiltration and percolation reach at saturated level, the rainfall water will flow through gutters, sewers or other channels including ponds. These mechanisms of water storage will reduce the floods by reducing contribution of rainwater run-off. In underground, water absorption will seep into the soil layer called unsaturated layer, where the land (of various kinds) still has capability to absorb water. This water then moves through the layer which is trapped in the saturated soil layer known as a groundwater which people actually consume.

5) Bio-filtration technology is the filtration to clean up the polluted water with the help of microorganisms. Actually as a result of prolonged drought, the river's water significantly decreases and is heavily polluted by organic subtances, ammonia, detergents and so forth. In order to reduce these pollutants, biological process is usually employed and added into common physical and chemical treatment. This process could be carried out by using bio-filtration technology. So, bio-filtration is a method of biological treatment of waste water that uses a tank containing bio-filter materials. Microorganisms will grow and attach onto the surface of bio-filter materials. Polluted water which flows through the bio-filter materials will be diffused into layer of microorganisms for degradation, and therefore level of pollutants decrease.

6) Artificial rain technology is a rain that created by seeding the potential cloud to develop accumulated water that is enough to become rain. This artificial rain created through weather modification is usually utilized to supply water to the mainland or the lake in case of drought. Artificial rain is carried out by sowing clouds through the use of hygroscopic water absorbing media. Thus, water droplets are quickly formed and become larger to initiate rainfall. To make an artificial rain, it needs some requirements, for example a low wind speed of about 20 knots. Conventionally, it usually uses salt as a hygroscopic seeding media and it experimentally requires around 3 tons of salt spreading out into potential cloud for about 30 days.

7) Household water treatment technology is actually simple water treatment that could be made and implemented in villages of remote areas. With the prolonged drought, it could also disrupt water supply to the households of remote area. One effort to overcome this problem is to treat water from available sources at that area, such as from rivers of household level. Water treatment at household level will be appropriate if it is used a simple system, usually consisting of tank, mixer, pump, aerator, and filter. This method does not commonly require electrical energy for running the pump because it is replaced by a hand pump.

8) Eco-hydrology for river is an interaction between river water body and its ecosystem. The quality of river water can be improved by the role of the river ecosystem, such as plant of water hyacinth or grass. However, to improve the quality of river water by eco-hydrology, it is not as easy as just putting the plant to the river. It must be designed carefully by taking into account for some factors, such as shape of river, air temperature, wind direction, soil type, and plant species. These example factors must be integrated to determine the level of success. The cost to increase the river water quality by an eco-hydrology method is usually cheaper than that by using water treatment technology.

Table 1- 5 Performance matrix of technology selection of water resources sector

Criteria	Sub-criteria	Weight	Scores of pre-screened technology										
			Pollder & pumping	Ground water injection	Water Recycle from domestic wastewater	Water harvesting (well &infiltration pond)	Bio-filtration for WWT	Artificial rainfall	Household WTP system	Eco-hydrological river	Monitoring and EWS	Water modeling	Artificial wetland
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Cost	CC	4.1	40	40	80	80	80	50	90	90	50	80	85
	FV	4.7	70	90	80	40	50	100	30	30	70	80	50
GHG	VR	5.9	60	80	90	90	60	80	80	60	90	80	80
Regulation & Policy	EP	4.7	80	90	90	90	90	90	90	90	90	90	90
	LR	5.3	80	90	80	100	100	70	90	100	90	80	90
	IP	4.1	80	50	70	100	90	50	80	90	50	70	90
	CI	5.9	90	50	70	90	80	100	50	90	90	100	90
Techno-logy	AB	5.3	80	70	100	100	80	90	80	70	70	80	70
	LP	5.3	80	90	70	100	60	70	90	50	90	80	50
	TR	5.3	90	75	90	90	60	80	80	70	80	80	70
	AT	5.9	80	75	80	90	60	85	90	80	90	70	80
Environ-ment	ES	5.9	70	90	90	90	80	80	80	100	80	80	90
	EE	5.9	70	100	60	100	90	70	60	100	60	60	90
Economic Sustain-ability.	EG	4.4	90	50	80	50	50	80	50	50	80	70	60
	CA	4.1	80	70	80	80	50	60	60	50	50	70	50
	SS	4.9	80	60	60	50	50	60	60	50	60	70	60
Soscial Sustain-ability	GI	5.9	80	60	90	70	80	80	70	60	60	70	60
	CB	5.3	70	50	60	70	70	60	100	70	70	70	60
	SA	5.9	70	80	80	90	90	70	80	90	70	70	70

Note:

CC:	Capital cost	AT:	Applicability of technology
FV:	Financial viability	ES:	Ecosystem stability
VR:	Reduction of vulnerability	EE:	Env. effectivenes
EP:	Relevant to existing policy & target	EG:	Economic Growth
LR:	Utilization of local resources	CA:	Commercial availability
IP:	Incentive for participation	SS:	Support of Sustainability
CI:	Cross cutting isues	GI:	Good impact on employment, health, welfare
AB:	Advanced and BAT	CB:	Capacity building
LP:	Possibilities for local production	SA:	Social acceptance
TR:	Technological reliability		

9) Monitoring and early warning system is intended to monitor and get initial indication of a potentially natural disaster before it occurs. The early warning system allows people to forecast an exceptional or critical situation and aids in early detection of undesirable situation such as flood and drought occurrences. If the flood occurrences can be predicted quickly, then community will also immediately take preventive measures so that the negative impact of flood occurrences can be significantly reduced. This early detection tool could employ radars, sensors or weather prediction equipment.

10) Modeling of water resource projections is essential tool for predicting the current availability and future needs of water. By this modeling data, it can measure the water management more precisely in order to anticipate and minimize water resource vulnerabilities due to the climate change. The water resource projection modeling can be run by using data of population, industrial growth and hydrogeology. It requires enough and accurate hydrological data in order to get a good projection of water resources so that the problems relating to water resources could be minimized.

11) Artificial wetland is a constructed wetland or a wet park. In an artificial wetland, marsh or swamp is created as a new or a restored habitat for native and migratory wildlife, anthropogenic discharge such as wastewater, storm water runoff, sewage treatment, land reclamation after mining, refineries, or other ecological disturbances such as required mitigation for natural wetlands lost. Natural wetlands act as a bio-filter, removing sediments and pollutants such as heavy metals from the water. Constructed wetlands can be designed to emulate those features.

The 11 technologies selected in the pre-screening process presented in Table 1-4 above were then prioritized by using the multi criteria analysis (MCA). Tables 1-5 above presents scoring matrix of technology selection and Table 1-6 shows the result of technology prioritization for water resource sector.

Table 1- 6 Result of technology prioritization for water resource sector

No	Technology	Costs	Reduction of Vulnerability	Development benefits	Total	Priority
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Polder and pumping technology	5.0	3.5	67.5	76.0	4
2	Ground water injection technology	5.9	4.7	61.7	72.3	10
3	Recycle water technology from domestic wastewater	7.1	5.3	66.5	78.9	2
4	Rain water harvesting technology	5.2	5.3	72.5	83.0	1
5	Bio-filtration technology	5.7	3.5	63.2	72.4	11
6	Artificial rain technology (weather modification technology)	6.8	4.7	64.1	75.6	5
7	Household water treatment technology	5.1	4.7	64.5	74.4	6
8	Eco-hydrology for river	5.1	3.5	65.0	73.7	9
9	Monitoring and early warning system	5.4	5.3	63.2	73.9	7
10	Modeling of water resources projection	7.1	4.7	64.5	76.3	3
11	Artificial wetland	5.9	4.7	63.2	73.8	8

The final score of each criteria given in Table 1-6 was a result of mutiplication between weighted criteria (column 3) and their respective screened technologies.

The order of technology prioritization for water resources sector is:

1. Rain water harvesting technology
2. Domestic waste water recycling technology
3. Modeling for water resources projection
4. Polder and pumping technology
5. Artificial rainfall technology
6. Household water treatment system
7. Monitoring and Early Warning System
8. Artificial Wetland
9. Eco-hydrology river
10. Groundwater injection technology
11. Biofiltration technology

From the results, three technologies were selected as priority lists for adaptation for climate change technologies in water resource sector. These technologies are rain harvesting technology, domestic wastewater recycling technology, and modeling of water resources projection.

1.6. Technology prioritization for coastal vulnerability

The negative impact of climate change could not be neglected anymore because it has already known its impact on many sectors including on coastal areas and small islands. In Indonesia, adaptation ability of those types of areas to climate change is actually limited because of technological, economic and social constraints. However, some efforts to keep up the areas from climate change impacts are consistently carried out to reach maximum performances. Various local wisdoms have already been inventoried and implemented to protect the coastal areas from their degradation. Culturing mangrove trees done by people of the village of Pabean Ilir, District of Indramayu is one of the local wisdoms mentioned (Subandono, 2009).

1.6.1. An overview

From a coastal sector view point, climate change could produce six phenomena: (1) mean sea level, (2) sea surface temperature, (3) fishing reduction, (4) tropical cyclone, (5) freshwater flux into the sea, and (6) ocean acidification (TNA, 2009). One indicator that climate change has already taken place and affected coastal areas and small islands is the sea level rise occurrences. The sea level rise can cause physical changes of the environment, namely the occurrence of a puddle in the low lands and swamps as well as the event of abrasion. The climate change impact on coastal areas is the disruption of coastal morphologies, natural ecosystems, settlements, infrastructures, fisheries, agricultures and marine tourism. Therefore, the adaptation efforts on coastal areas must be quickly carried out to reduce the potential losses caused by climate change impact on them.The typology of adaptation technology, especially for overcoming the sea level rise impact, could be grouped into three strategic efforts as follows (Subandono, 2009; TNA Guidebook Series, 2010).

Protect. To protect is aimed to defend vulnerable areas, especially centers of population, economic activities and natural resources. This can be done for example by building the coastal structure that can directly protect the vulnerable areas from sea level rise impact. They can also be done by planting mangroves on those areas.

Accommodate. To accommodate is aimed to continually occupy vulnerable areas, but accept the greater degree of flooding by changing land use, construction methods and/or improving preparedness.

Retreat. To retreat is aimed to abandon structures in currently developed areas, resettle inhabitants and require that new development be set back from the shore, as appropriate. The purpose is to allow the natural process fitting to the condition of the natural change occurrences as a result of sea level rise.

The applied adaptation efforts for holding back the impact of sea level rise could be grouped into two: the structural (physical) and non-structural (non physical) efforts. For structural efforts, they could be carried out by natural and artificial protection methods. Based on its characteristics, artificial protection method could be carried out by building hard and soft structures.

The possible adaptation technology which could be applied in coastal vulnerability issue based on their adaptation benefits are seen into 2 (two) views. Those are ability to withhold sea level rise and ability to improve productivity of fisheries.

Ability to withhold sea level rise.

Climate change adaptation efforts on the issue of coastal vulnerability that have already been developed in Indonesia were those of coastal structures that directly protect the impact of sea level phenomena. The coastal structures for examples are sea dike, seawall and revetment.

A sea dike is a coastal structure that is used to safeguard the coastal facilities located at the back of the dike from the threat of ocean waves or the overflow of sea level rise. Seawall and revetment work to protect the land from the threat of a wave due to sea level rise. It also keeps the coastal from abrasion. The seawall is usually built along the coastal line. It is commonly made from concrete, masonry or plaster massive wood materials in vertical or curved-shaped position. Revetment is a building that separates the mainland and coastal waters. Its main function is to protect the coastal area from abrasion and wave overflow to the ground. Seaward revetment is usually skewed. It is made of concrete blocks, stone piles or other materials, with the outer layers consist of large stones. In planning the construction of a seawall, revetment or other coastal structures, people must take into account the following factors: the function and form of structures, land subsidence, sea level rise, highest water level height, and extreme wind causing sea waves.

Embankment construction must also be accompanied by the development of drainage systems in order to lessen the impact if there will be inundation occurring as a result of wave overflow into the land. In addition, sea dike could also be used as a coastal road and a recreational area. Beside seawall and revetment which are hard structures, there are soft coastal structure that could protect coastal area from abrasion and wave overflow from the threat of sea level rise impact. The examples of this coastal structure are beach nourishment, sand dune, and coastal drainage systems or beach management system.

The function of beach nourishment is to make and to protect the width of the beach and intended coastal line position. It also decreases the wave energy and increases the coastal height, especially for recreational and aesthetic purposes.

Development of coastal restoration technology is also feasible to be implemented to the vulnerable coastal area due to climate change because it can restore and recover the condition as the original one.

Beach management system (BMS) is a technology for an integrated beach and coastal area protection and rehabilitation systems. It starts from design, model, installation, construction, and maintenance in order to give effective and efficient results for protecting the coastal area from abrasion threat. When the BMS is applied and the beach is protected from the threat of erosion, a new beach is occasionally created. Protective adaptation technology such as BMS is employed to revitalize coastal drainage systems. For example of this is a beach management system (BMS) developed by GDI Denmark (Subandono, 2009).

Ability to improve productivity of fisheries

Another action on coastal areas affected by climate change is basically to apply various technologies that can improve productivity of fisheries. This activity is in line with the policy direction and strategy of marine and fishery sectors, Ministry of Marine Affairs and Fisheries of Indonesia, namely poverty alleviation programs. One of these programs is to develop regions of fishery liveholds and enterprises (*Minapolitan*). This activity is an attempt to accelerate the development of the marine and fishery production centers in the coastal areas of Indonesia. For that purpose it needs the best available technologies in this sector, such as adaptation technologies for marine based culture, fish aggregating device (artificial niche), early warning system for seaweed, and cultivation and production of aquaculture. By applying these technologies, the expected productivity of fisheries in coastal areas can be increased and it will, in turn, enhance the national economy of the maritime country of Indonesia.

To that end, integrated management of coastal and small islands has to be carried out as well as the necessary efforts to develop and disseminate information to various sectors must be done in order to improve the understanding of climate change impacts on the coastal areas and how they can adapt to it.

1.6.2. Criteria and process of technology prioritization

There are two levels of criteria used in this work: technologies prescreening and prioritization criteria. The prescreening process was actually done qualitatively by related experts and stakeholders. However, they still employed four criteria previously used for that of TNA 2009 as a guidance. Those four criteria are: 1) technology effectiveness, 2) economic efficiency and cost effectiveness, 3) environmental effectiveness, and 4) Institutional and human development.
For prioritizing prescreened technologies on coastal vulnerability issue with the MCA, it used 2 (two) groups of criteria: cost and benefits. The criteria of cost is actually cost effectiveness that contains sub-criteria of capital cost, and operational and maintenance (O&M) cost. For benefits, there are three criteria: 1) technical effectiveness (reduction of vulnerability), 2) implementation considerations, and 3) reduction of social vulnerability.

The criteria of the technical effectiveness is further broken down into 3 (three) sub criteria: a) availability of technology, b) solution of the problems and c) meeting current development or management goals. The criteria of the implementation considerations consists of 4 (four) sub criteria: a) easiness of design and implementation, b) skill requirements and local conditions, c) local community readiness and d) capacity building and institutional strengthening for the local community. The criteria of the reduction of social vulnerability is classified into 4 (four) sub criteria: a) poverty reduction potential, b) healthy human settlement, c) raising public awareness and d) the welfare/ protection of personal wealth. The detailed criteria for adaptation technologies prioritization of coastal vulnerability issue is presented in Figure 1-4.

The process of technology prioritization for the coastal vulnerability issue was done by inventory of technologies from many sources. There were 21 technologies obtained that can be applied in terms of climate change adaptation for coastal vulnerability (see Appendix). These 21 technologies for coastal vulnerability issue consisted of technologies relating to fisheries and physical infrastructures around coastal areas. For this coastal issue, the priority was given to physical infrastructures (TNA Guidebook Series, 2010), so that in the later assessment the non physical infrastructures (fisheries) would be given low value in weight. However, the

technologies chosen will still support the policies and the strategies of the Ministry of Marine Affairs and Fisheries as a responsible sector (Strategic Plan 2010-2014, Ministry of Marine Affairs and Fisheries). Instead, technologies related to fisheries will be included in food security sector so they can be selected as prioritized technologies of that sector.

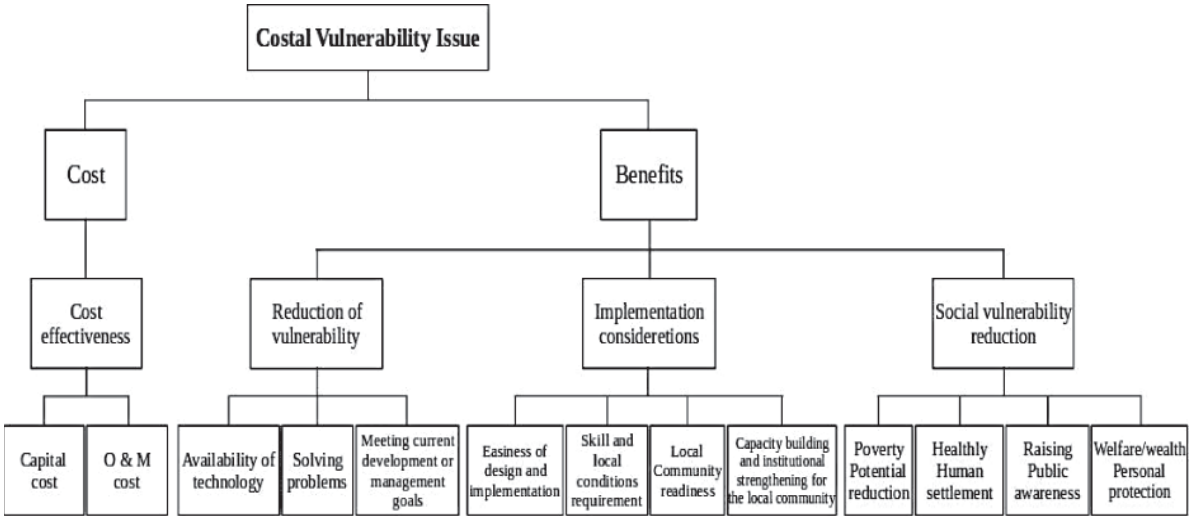


Figure 1- 4 Criteria of coastal vulnerability issue

Before using MCA tools for technology prioritization, the prescreening of the inventoried technologies was first carried out. By combination of scoring and expert judgment the technologies prescreening was conducted. As mentioned above there were 21 technologies that were prescreened through discussion and expert judgment to choose the highest eight of 21 prescreened technologies (see Table 1-7). Of eight prescreened technologies, the MCA tool was then employed to get three prioritized technologies. The experts and stakeholders who participated in the prioritized technology meeting consisted of 9 (nine) participants. They were representatives from the Environmental Technology Center-BPPT, DNPI, Ministry of Marine Affairs and Fisheries (Agency fo Marine and Fisheries Research and Development, Directorate of Coastal and Marine, Directorate of Spatial Planning for Marine,Coast and Small Islands Affairs), and Ministry of Public Works.

Table 1- 7 Result of prescreening technologies

No	Name of technology
1	Detached Breakwater Technology
2	Water Gate and Tidal Barries Technology
3	Floodwalls System Technology
4	Groyne Technology
5	Artificial Sand Dunes Technology
6	Coastal Restoration Technology
7	Beach Reclamation
8	Beach Protection Technology (Seawall and Revetment)

There were several meetings conducted to prioritize those three technologies. First meeting was the expert and stakeholder meeting, followed by technical meeting attended by Technical Committee, and then Steering Committee meeting to approve the 3 prioritized technologies. After that, there was a visit from AIT Bangkok team and during the discussion the team suggested that for adaptation technologies for coastal vulnerability area it is better to employ the physical structure rather than non-physical one. Fishery cultural technology development will be integrated into adaptation technologies for food security so that the coastal vulnerability will focus on physical structure technologies. Since the priority for coastal issue concentrated only on physical structures, the three previously prioritized technologies on the coastal vulnerability sector needed to be revised. Therefore, other experts and stakeholders meeting was conducted to prioritize a new three adaptation technology of coastal vulnerability sector.

The process of expert and stakeholder meetings could basically be explained as follows. First, the criteria of prioritization was developed and the weight of each criteria for prioritizing technologies was determined (see Table 1-8). Determination of the prioritized technologies was conducted by scoring to each technology of all criteria. The score of each criteria is shown in Table 1-9. Prioritized technologies were determined based on the highest scores of first three technologies according to MCA result. Total weight of criteria in column 3 of Table 1-8 is assigned 100 weighted points consisting of 10, 30, 20 and 40 points for cost effectiveness, technical effectiveness, implementation consideration and social vulnerability reduction. Each criteriaum consists of two or more sub criteria (column 4), which is weighted 100 points as well. For example, cost effectiveness which is weighted for 10 proportion total points contains two sub criteria with 20 proportional points for capital cost and 80 proportional points for O & M cost. So that the total weight of this sub criteria is 100 points of 10 proportional points of the criteria consisting of 2 and 8 points for respective capital cost and O&M cost.

Table 1- 8 Weight for each criteria and sub criteria

Criteria	Component	Weight	Sub-criteria	Weight	Proportional weight to total criteria
Cost	Cost effectiveness	10	Capital cost	20	2
			O & M cost	80	8
Benefits	Technical effectiveness (Reduction of vulnerability)	30	Availability of Technology	30	9
			Solving problems	50	15
			Meeting current development or management goals	20	6
	Implementation Considerations	20	Easiness of design and implementation	40	8
			Skill and local conditions requirement	10	2
			Local community readiness	20	4
			Capacity building and institutional strengthening for the local community	30	6
Benefits	Social vulnerability reduction	40	Poverty potential reduction	15	6
			Healthily human settlement	40	16
			Raising public awareness	30	12
			Welfare/wealth personal protection	15	6

The three prioritized technologies selected during experts and stakeholders meeting were reviewed, corrected and then validated during Technical Committee meeting. These validated technologies resulted by Technical Committee meeting should be presented to the Steering Committee to have their approval as the final three prioritized adaptation technologies in the coastal vulnerability sector.

Table 1- 9 Score of each technology versus criteria for coastal vulnerability sector

		Cost Effectivenes		Reduction of vulnerability			Implementation Considerations				Social vulnerability reduction			
No.	Technology Options	Capital Costs	O & M Costs	Availability of Technology	Solving Problems	Meeting current development or management goals	Easiness of design and implementation	Skill and local conditions requirement	Local community readiness	Capacity building and institutional strengthening for the local community	Poverty potential reduction	Healthly human settlement	Raising public awareness	Welfare/ wealth personal protection
1	Detached Breakwater Technology	70.0	80.0	80.0	80.0	25.0	25.0	25.0	25.0	25.0	30.0	30.0	40.0	10.0
2	Water Gate and Tidal Barries Technology	30.0	50.0	70.0	70.0	25.0	25.0	25.0	25.0	25.0	50.0	50.0	50.0	40.0
3	Floodwalls System Technology	40.0	60.0	70.0	60.0	25.0	25.0	25.0	25.0	25.0	30.0	50.0	50.0	50.0
4	Seawall and Revetment Technology	80.0	80.0	80.0	80.0	25.0	25.0	25.0	25.0	25.0	50.0	50.0	50.0	40.0
5	Artificial Sand Dunes Technology	80.0	80.0	70.0	70.0	25.0	25.0	25.0	25.0	25.0	20.0	40.0	40.0	30.0
6	Coastal Restoration Technology	70.0	70.0	60.0	70.0	25.0	25.0	25.0	25.0	25.0	50.0	50.0	50.0	50.0
7	Beach Reclamation Technology	80.0	80.0	80.0	80.0	25.0	25.0	25.0	25.0	25.0	40.0	60.0	40.0	20.0
8	Groyne Technology	80.0	80.0	80.0	70.0	25.0	25.0	25.0	25.0	25.0	40.0	60.0	40.0	20.0

1.6.3. Results of technology prioritization

Results of prioritized technologies using MCA is given in Table 1-10. The value in Table 1-10 is actually the summation of multiplication between scoring value and the respective weighted value of each sub criteria. For example, capital cost is given 70 scored points and owns 2% proportionally weighted points resulting 1.4 values. Whereas O&M is given 80 scored points and owns 8% proportionality weighted point resulting 6.4. The total value of cost effectiveness criteria is then 7.8 as shown in columnns 3 of Table 1-10. Seawall and revetment have the highest total value of scores and it thus becomes the first priority to be implemented within the framework of adaptation to climate change for coastal vulnerability sector. The second and third prioritized technologies are technology for Beach reclamation technology and groyne technology, respectively.

Table 1- 10 Result of technology prioritization

No.	Technology Option	Cost Effectiveness	Reduction of vulnerability	implementation Considerations	Social vulnerability reduction	Total	Ranking
1	Detached Breakwater Technology	7.8	20.7	5.0	12.0	45.5	7
2	Water Gate and Tidal Barries Technology	4.6	18.3	5.0	19.4	47.3	5
3	Floowall System Technology	5.6	16.8	5.0	18.8	46.2	6
4	Seawall and Revelment Technology	8.0	20.7	5.0	19.4	53.1	1
5	Artificial Sand Dunes Technology	8.0	18.3	5.0	14.2	45.5	8
6	Coastal Restoration Technology	7.0	17.4	5.0	20.0	49.4	4
7	Beach Reclamation Technology	8.0	20.7	5.0	18.0	51.7	2
8	Grovne Technology	8.0	19.2	5.0	18.0	50.2	3

1.7. Summary / Conclusions

Prioritization of technologies using MCA done by related experts and stakeholders for three sectors of food security, water ressources and coastal vulnerability are completed. High efforts were required to finish this work not only because of a new work for this adaptation but also because of complicated topics and highly limited time of the experts and stakeholders involved. The process of decision making processes from preparation, formulation, technical evaluation and recommendation from technical steering committee until the final decision by policy makers of steeting committee meeting have been all passed.

Finally, the policy decision of the prioritized technologies of each sector for TNA on adaptation of Indonesia are as follows.

For food security, the adaptation technologies are (1) crops (rice) tolerance to drought and flood, (2) technology for mariculture development, and (3) cattle meat development, respectively. For water resource sector, (1) a rain harvesting technology, (2) domestic waste water recycling, and (3) modeling of water resources projection are three technologies chosen. For coastal vulnerability sector, the three prioritozed technologies are (1) seawall and revetment technology, (2) beach reclamation.

Section 2

Synthesis Report on TAPs for Climate Change Adaptation 2012

Executive Summary

Following technology needs assessment (TNA) processes, the technology actions plans (TAPs) for two or three prioritized technologies of each of three selected sectors were then conducted. Prior to do an identification and analysis of barriers of the selected technologies, an analysis of framework condition of technology transfer and diffusion (TTD) was performed.

The selected technological types of each sector were recognized from analyzing the role of them to support key adaptation measures within the framework of TTD scenario. After that, the identification of barriers was performed based on the inputs from the experts and stakeholders. Depending on each prioritized adaptation technology, its barriers were further analyzed for its relevance to four, five or six selected categories suggested by UNEP's guide for identification of TTD barriers (UNEP 2010) as well as their association with the types of technologies recognized in the TTD framework of condition. The total six selected barrier's categories are (1) economic and financial, (2) regulatory, (3) institutional network and coordination, (4) professional capacity of organization/Institution and human skill, (5) social, behavioral, public information, and awareness, and (6) IPR issues.

Up to this point, prerequisite for identification of TTD of the prioritized technologies has been done. The results of such prerequisite analysis works were then used for detail analysis of individual prioritized technology. This individual analysis includes four steps outlined: (1) identify all possible barriers, (2) screen for non relevance barriers, (3) establish hierarchy of barriers, and (4) analyze causal relation (UNEP 2010).

It is important to note that each sector selected under TNA adaptation has its owned unique characteristics. Therefore the format of the prioritized technologies of each sector is also sometimes uniquely different. Food or agricultural sector of Indonesia for example is considered to be highly impacted by climate change since its availability must secure national food supply planned by the government. Similar to food security sector, technology transfer for minimizing coastal vulnerability is also important due to very long coastal lines and many low land islands owned by Indonesia. For water sector, it is also equally vital to be protected to avoid more degradation in its quality and reduction in its quality.

The following is the summary of TAPs of each sector: food security, water resource and coastal vulnerability.

Food security sector

One reason of declining rice production in Indonesia is allegedly due to climate change impacts on agricultural land. For example, prolonged and uncontrolled drought results in crop failure. Similarly, flooding problems can cause inundated agricultural crops, resulting crop failures. Therefore, efforts to cope with the crop failure should be done, among others, by creating rice varieties resistant to drought and flood. To make adaptation to climate change in the agricultural sector in the context of food security, the farming of drought and flood tolerance rice needs be continuously disseminated to farmers.

Some constraints in the dissemination of drought and flood tolerance rice varieties can generally be grouped into six aspects: policy andnregulatory, capacity building, economic and financial, institutional, intellectual property rights, and social and cultural aspect. Highly controlled rice seed production by big investors may lead to unfair and unbalanced competition. Therefore, creating a balance competition between big and small-scale businesses and protection of small-scale farmers must be addressed through regulation enforcement.

The barriers of the economic and financial aspect are high-up front cost, inappropriate financial incentives and uncertainty of financial environment that might be due to high investment needed for R&D and rice seed monopoly practices. The barrier of capacity building aspect is due to limited capacity of the related actors and/or stakeholders and therefore improving the capacity building of the field workers and the farmers through education and training in the available agricultural field schools is required. The barrier of the institutional aspect is indicated by the lack of professional institutions to help farmers improving their crop product. The government needs to bridge the gap between farmers who need technology and research results from research institutions. In regard to IPR, weather conditions to support such growth still need the help of foreign technology, such as weather measurement equipment and early weather prediction software. From social and cultural aspects, the tradition and habit are considered to be important barrier for the implementation of this crop farming. Therefore, dissemination through land agricultural schools becomes a strategic step to educate the farmers to implement planting calendar on their own so that they can predict weather condition more precisely.

In general the domestic action plan is to disseminate a cultivation method of drought and flood tolerance rice plant and an implementation program of dynamic planting calendar. Cultivation technology dissemination of drought and flood tolerance rice plant is an attempt to socialize those varieties in order to be known by the farmers. Plan for demonstration development activities will be carried out in three years. The first year is done activities such as coordination work with stakeholders as well as plan and preparation of feasibility study. The second year is planned for delivery the equipment and development of demonstration plant, operator training and do trial or initial test of demonstration plant. While in the third year is to operate the demonstration plant and evaluation. Preferred location of demonstration plant is a location where there is BPTP, such as Sukamandi (Karawang), Donggala and Papua.

The second technology for food security is development of marine fish product through mariculture of floating net cage milkfish. The identification of barriers and analysis for the transfer and diffusion of milkfish mariculture technology in floating net cage has been done with six criteria similar to that for drought and inundated rice varieties.

Regulatory barrier is about spatial zone use for mariculture in the small islands. It is needed to set up spatial zone dedicated for mariculture that is prepared by the local government through the local regulations (Perda). For the financial aspect, the initial capital cost for milkfish farming is high. The other barriers are the high cost of production facilities and product marketing systems that tend to be monopolized. To alleviate the problem of capital cost in the business of milkfish cultivation, incentives for interest rates and incentive for production facilities need to be given. Lack of professional institutions and coordination among relevant agencies is the main barriers of institutional aspect of mariculture. Limited institutional capacity and human

resource capability are considered to be the barriers of the capacity building aspect, as well. Therefore, it need to be established mariculture training centers particularly in areas that have potential for mariculture development so that the needs of skilled human resources in the field of mariculture will be fulfilled. In term of social aspect, it needs to alleviate the common practices from older generation in fish cultivation such as less application of good and proper practice of fish cultivation (CBIB) and common practice of community to borrow money from informal lender with high interest rate.

The development of sustainable technology of milkfish cultivation in floating net cages is one way in implementation of Minneapolitan areas development program. This activity will be implemented over three years. First year is setting up a small scale pilot unit of environmentally friendly milkfish cultivation technology in floating net cage for production and training facilities with the method of 'Integrated Multitrophic Aquaculture' (IMTA) to the group of fish farmers. In the second year is to expand the medium-scale pilot unit by involving groups of fish farmers, through training for a skilled group of fish farmers. While in the third year is establishment of several milkfish production centers as well as establishment of industrialization of environmentally friendly milkfish cultivation technology in floating net cage in several areas of Indonesia including the Seribu islands, Riau Islands and South Sulawesi.

The third prioritized technology for food security sector is that for improvement of livestock particularly beef cattles. Policies and programs undertaken to increase production and business development of livestock are through birth increase, improved quality of beef cattle and their calf production, slaughter control of productive female beef cattle, disease control of livestock, management of animal feed, and open calf development system. The barrier in beef cattle cultivation is due to the limited number of local cattle that can be raised for meat production. Moreover, the regulation is not effective enough to encourage the rearing of local cattle. The current regulation is more favorable toward importers rather than the stakeholders and practitioners of the local cattle rearing industry. It needs to have a regulation that could conductively and optimally execute technology transfer and diffusion (TTD) for beef cultivation. The regulation may contain the objectives: Assist the Business Credit of Cattle Breeding (KUPS) and develop a system of easy credit for cattle cultivation so that the cutting process can be done smoothly. Government has to fully realize the plan to form Indonesian Cattle Farmers Consortium (KPSI) to ensure that cattle producers will not have any difficulty to distribute their commodities to the area with highest demand level.

Cow cultivation through engineering technology is an action plan that lays the cultivation of cattle breeding as the main program. In the first year is to formulate Village Breeding Center (VBC) criteria based on the scientific references. In the second year is to Increase in number of good quality calves for the cattle ranchers who have intensive experiences in cattle breeding. While in the third year is to training and assistancee to groups of breeders in order to implement good breeding practice. Areas that become a choice location of cow breeding is Blora (Central Java), Nganjuk (East Java), South Sulawesi and East Nusa Tenggara.

Water resource sector

One cause of water resource problems in Indonesia as a tropical country is believed to be due to the impact of climate change. Therefore, we need to do adaptation measures in order to manage limited water resources. The conclusion of the prioritized technologies for water

resource sector as described in Section I are rain harvesting technology using "*embung*" or a small reservoir, water recycle technology from wastewater and water resources projection model.

One of the regulatory barrier aspects in rainwater harvesting is the insufficient regulation and legal ground for the installation of reservoir. There are some frequent rejections from the people in using local cultural land for the installation of reservoir. Actually, regulations on the utilization of water resources through the installation of rainwater reservoirs has already been set up, which are the Minister of Public Work's Regulation and specific spatial planning in each region. However, the regulations are still not sufficiently understood by the public, making them difficult to implement. The barrier in the economic and financial aspect is the lack of accessible low-interest financing source, such as the absence of any soft loan for the reservoir installation project.

The institutional barrier is the lack of information supply on the need of reservoir from the local institution to the central governmental institution dealing with water resources issue. In order to address this need, excellent networking has to be built between the central and regional government, as well as through dissemination of government's rainwater reservoir installation program across provinces. The barriers component from the social aspect is the unbalanced usage of the reservoir water by the different community groups and overlapping utilization of the reservoir water by the people. To prevent against any violation to the appropriate uses of harvested rainwater, clear and definite rules need to be composed regarding the use of harvested rainwater.

The ready-to-implement concrete plan for adaptation to climate change on rainwater harvesting technology is to make a pilot rainwater harvesting reservoir which will be equipped with water treatment facilities. Rainwater harvested in the reservoirs is expected to serve the needs of the local community. Time line of the pilot rainwater reservoir installation project is predicted for three years.

For wastewater recycles technology, the barrier from the regulatory aspect is the lack of regulation to support the recycles activity. Besides that, the absence of institution that is responsible to certify the feasibility of the recycled water products, makes the people becomes reluctant in using such water. To overcome this barrier, government should produce regulations which impose any enterprises generating domestic wastes to recycle at least 50% of their wastes. For certify the product, government can solve this problem by appointing certain institutions to deal with the job, such as the Ministry of Industry or Public Works, together with the National Standards Board to issue certificate of installation, as well as certificate of recycled water product.

The barrier from the economy aspect is the high costs for the development of wastewater recycle technology system. It is due to the large number of the processing unit equipment required to recycle wastewater into clean water. Second, there is no sufficient financial incentive, such as the reduction of tax and interest rates. The third is the high cost for the operation and maintenance of the wastewater recycle equipment due to the initial treatment process, the number of processing units required and the low quality of raw water used.
The social barrier is the society's custom in using water and the lack of information concerning

the products of recycled water. People have not been able to accept the use of recycled water products since they have not been accustomed yet. People have negative perception that the recycled water product is unhygienic and may be harmful to health. Therefore, dissemination of water recycling program and campaign for recycled water use movement need to be extensively encouraged. People who are already very accustomed to using tap water or ground water for watering their gardens should be persuaded into replacing the tap water with the recycled water.

The concrete action plan designed for recycling domestic wastewater is to create a pilot domestic wastewater plant in an urban area. The area chosen is the Yogyakarta City, based on the consideration that it already has an integrated domestic wastewater treatment plant in a densely populated urban area. Timeline for the action plant is, first year include survey and planning of plant. In the second year is constructing and monitoring, while in the third year is dissemination of the technology.

Coastal vulnerability sector

Two technologies were selected as priority lists for adaptation technologies in coastal vulnerability sector. These technologies are coastal protection (sea wall/revetment) and coastal reclamation technology. Regulation and Technical Guidelines related to coastal protection issue do exist. Among other are: a). Minister of Public Works Regulation No. 09/PRT/M/2010 on Coastal Protection Guideline, b) Guideline on Construction of Coastal Protection Structures, c) Guideline on Valuation of Coastal Damage and Its Management Priority, both published by Ministry of Public Works. The main problem is that those regulation and guidelines are relatively new, thus not much people understand and implement them.

For high cost of materials and equipments in the construction of seawall/revetment may exist as barrier element in implementing these coastal protection structures as adaptation measures for climate change effects. Seawalls/revetments are not financially feasible for places not having high economic value. The issue of high construction-cost should be resolved by creating a policy to provide a full support of funds, so that the creation of coastal protection and development of coastal reclamation can be conducted.

Coastal reclamation is considered as one of the proven technology that can be used as coastal adaptation measure to rising sea level as consequences of sea level rise. However, coastal reclamation is financially not viable for places without high economic values or vital usage. Currently, numbers of relevant rules and regulations for reclamation activity are in act in Indonesia. Regulatory issue should not be considered as a barrier as long as all related rules and regulations are abided by stake holders.

Based on discussions and input from various experts and resource persons, it was decided that in principle, the barriers and barrier elements of this two technology priorities in coastal vulnerability are the same. Thus, the enabling framework in overcoming the barrier can also be said to be the same. The most crucial barrier is the amount of initial capital to be secured for the development of reliable coastal protection structures as well as for coastal reclamation project.

The issue of high construction-cost should be resolved by creating a policy to provide a full support of funds, so that the creation of coastal protection and development of coastal reclamation can be conducted. Specifically for coastal protection, there are two options, namely seawall and revetment; where the cost for construction of seawall is more expensive than the construction cost of revetment, considering the availability of local materials. To address the regulation issues, it is necessary to set up a policy so that the existing rules and regulations in coastal reclamation were implemented properly. So that, sustainable coastal management community-based can be achieved.

In order to anticipate some barrier in community awareness and miss-leading information on reclamation project, socialization and dissemination of positive impact from reclamation project should be highlighted and enhanced. Public consultation meeting (PCM) should be conducted prior to the construction stage and should involve all stakeholders. Furthermore, since those Regulation and Guidelines regarding to coastal protection are relatively new (less than two years), their dissemination and socialization to the stakeholders (planner, contractors, and community) is necessary.

The real action plan that will be implemented in the framework of the climate change adaptation efforts in coastal vulnerability sector is by developing coastal protection structures and/or beach reclamation. It is considered that shore protection structures will be built on the coasts of Tegal and/or Pemalang Regency (Central Java). As for coastal reclamation, it will be focused on the areas of Jakarta, Tangerang and Bekasi. Period for the implementation of the development is expected to complete within three years. Some other aspects into consideration in the construction of coastal protection structures and coastal reclamation are the resource requirements, regulations, and authorities. From technological point of view, Indonesia is capable to conduct coastal protection as well as coastal reclamation project. But, given the large number of coastal regions which their level of vulnerability are high to very high, then transfer of technology and dissemination from one area to another area is needed to be immediately carried out.

2.1. TAPs for food security sector

2.1.1. Preliminary targets for technology transfer and diffusion

2.1.1.1. Dissemination of farming technology for drought and flood tolerance rice varieties

Rice is the staple food for Indonesian people. With current population of approximately 230 Millions and the annual growth rate of 1.4%, the population of Indonesia by year 2010 is predicted to be around 288 Millions. Thus, Indonesia needs a very large supply of rice.

Over the last 30 years, the current supply of rice in Indonesia reaches its lowest level. In addition, a continuously increased rice price has occurred in the last 10 years. Therefore, like other Asian countries, Indonesia has faced a problem in securing the supply of rice to its people.

One reason of declining rice production in Indonesia is allegedly due to climate change impacts on agricultural land. For example, prolonged and uncontrolled drought results in crop failure.

Similarly, flooding problems can cause inundated agricultural crops, resulting crop failures. Therefore, efforts to cope with the crop failure should be done, among others, by creating rice varieties resistant to drought and flood.

The Rice Research Institute, Ministry of Agriculture (MoA) has actually created wetland inbreeding rice (InPaRa) that is high yielding varieties of rice that can best be planted in condition of swamp land, which is resistant to immersion and adapts to acid conditions. This Institute has also developed irrigated inbreeding rice seed (InPaRi) and inbreeding rice varieties resistant to drought (InPaGo). On the other hand, however, rice farmers are not aware yet with the impact of climate change on their rice crop farming. They still grow non-inbreeding of local rice seeds that are not resistant to drought and flood. To make adaptation to climate change in the agricultural sector in the context of food security, the farming of drought and flood tolerance rice of InPaRa, InPaRI and InPaGo types needs be continuously disseminated to farmers.

Actually, Ministry of Agriculture has already disseminated drought and flood tolerance rice farm to farmers. This is done by preparing high quality of rice seeds resistant to drought and flood so rice production will no longer decrease and even increase. Thus, the farmers will earn good profit and at the same time, our national food security will be soundly maintained. This effort can be enhanced by providing knowledge of farming to the farmers through field schools that have already existed in the centers of rice production of the country.

From a view point of farming improvement, the role of agricultural coaching field workers should be enriched in such a way that they are able to understand, do experiment, and inform the farmers about the new selected varieties which are suitable and profitable in their working areas. Then, competitiveness of farmers can also be enhanced by the utilization of telecommunications and data processing using information technology for accessing production resources and looking competitive market of their products. This strategy can be tutored to the farmers via the agricultural field schools. This method is actually in line with the national rice program that facilitates the implementation of these practices to increase rice production.

With cutting-edge of current information technology, for example about the weather, the farmers can determine the appropriate planting time based on the right weather prospects. In addition, with good access to world commodity market prices, farmers can also learn about the suitable times to sell their products. Thus, utilization of advanced biotechnology and information technology can enhance the farmers to maintain their rice production due to good products and price. This will finally encourage farmers to use drought resistant rice variety when the drought occurs and cultivate flood tolerance rice seeds when the flood comes. Thus, the adaptation of climate change on the food sector could be overcome.

2.1.1.2. Technology development of mmilkfish marine aquaculture with floating net cage

Marine fish aquaculture is one of marine resources that might be affected by the climate change impact and therefore its adaptation must be strongly resolved. One effort in the food sector adaptation to climate change is to increase marine fish product through mariculture. This is done for anticipating the decline of capture fisheries production. This climate change adaptation effort is already in line with the accelerated development of the marine sector

programs in coastal areas and small islands announced by the Ministry of Marine Affairs and Fisheries (KKP). For successful program of the technology development of mariculture, it has been done through a "Cooperative Management" approach. Government and society working together do planning, implementation and evaluation of development programs on Mariculture Technology with Floating Net Cages.

Milkfish has already been well-known for the public because of its delicious flavor, even though it contains many thorns. Milkfish is grouped into moderate priced fishes so it can be affordable by all levels of society. However, it will become a high priced fishes, particularly when it already receives technology touch such as that on processing and packaging. Therefore, the cultivation of milkfish will be a good prospect.

Actually, milkfish cultivation can be done not only in brackish water pond but also in marine floating net cages. Moreover, milkfish has several advantages, such as more savory flavor of the meat and its larger size than the brackish water of milkfish. Mariculture of milkfish can be done in time variations from six months to three years, depending on the purpose of the cultivation. Cultivation can produce milk fish with a variety of sizes ranging from 300 grams to 5 (five) kilograms per fish. Mariculture of milkfish is quite promising because the price of milkfish produced is higher than the price of brackish water of milkfish. Price of the milkfish with a weight between 300 and 500 grams can be sold at a price of 35,000 to 50,000 Indonesian Rupiahs (3.5 to 5 USD) per kilogram. With the application of thorns pull technology, the problem of thorns content inside the meat can be solved so the price of this commodity becomes much higher.

Many factors must be considered in the milkfish mariculture. These include fish seed quality, strong net cages, and cleanliness and cage safety. The advantages of fish farming in a floating net cage (KJA) among other things are as follows.

- It does not require land tilling.
- It does not need large area.
- There is always sufficient amount and quality of water for it.
- It can be stocked with high capacity of fish seeds.
- Its predators are easy to control.
- It is easy to harvest.

Milkfish cultivation technology in floating net cages has just started to flourish in recent years. So far, milk fish farming has mostly been done in brackish water ponds. Efforts to cultivate milkfish in order to make it bigger in floating net cages are devoted for fish bait production (for the capture of tuna and skipjack), direct consumption, and export needs. The cultivation principle of each purpose is relatively the same. They differ only in the dense stocking, period of cultivation and harvested sizes.

2.1.1.3. Farming technology application of beef cattle

The objective of livestock development is to increase farmer's income and welfare, environmental protection and foreign exchange. In addition, it also improves the quality of human resources in the field of animal husbandry.

Condition of livestock in Indonesia has been up and down. Economic and monetary crisis hit Indonesia in 1997 has impacted the national economy including the decline of some farm businesses. However, the impact of the crisis has gradually recovered so that since 1998 livestock farming has shown an increase. For example in 1999, contribution of livestock sector to Gross Domestic Product (GDP) of agriculture increased by 6.35%. In 2002, the livestock businesses even increased to 9.4%, which was actually the highest increase among the businesses of the agricultural sector.

The meat consumption for Indonesian people reached about 7.66 g/capita/year in the period of 1992 to 1996, and decreased to 5.33 kg/capita/year in the period of 1998-2001 due to the impact of the economic crisis in Indonesia (Directorate General of Livestock Production, 2001). Beef is the second largest meat source after the poultry that is consumed by the people. Therefore it needs the increase of beef cattle population in Indonesia so the demand of beef for public consumption can be met.

People are currently choosing beef farming to be raised because it is easy to farm and it can consume agricultural waste as its food. However, most of the beef cattle farming done by the grass root people is very few in numbers that is only on average between 2 to 5 heads per household. This is because the livestock business run by the community is generally only a sideline job. At any other times the cattle can be sold if the farmer breeders need money.

Characteristics for small-holder livestock including cattle in Indonesia are concluded as follows (Azis, 1993):

- Its business scale is relatively small.
- It is considered to be household enterprises that is actually for saving only and not for business purposes.
- It is a sideline job to the main job of farming.
- It uses very simple technology.
- It is done with intensive labor and kinship type business in negative sense.

To be successful in beef self-sufficiency program 2014 (PSDS-2014), the government has set up the implementing organization. The nature of this organization has to be operational, independent, tiered, and coordinated. Steps taken by the government for the business management are divided into two patterns: concessions made by folkfarm and by livestock industries. An example is the beef cattle feedlot or fattening program. Based on maintenance system, business development program of folkfarm beef cattle is differentiated into two methods: one uses land and another does not use land. All methods and mechanisms have been regulated in the Minister of Agriculture Regulation Number 19 Year 2010 concerning meat self-sufficiency 2014.

Policies and programs undertaken to increase production and business development of livestock are through birth increase, improved quality of beef cattle and their livestock seeds production, slaughter control of productive female beef cattle, disease control of livestocks, management of animal feed, and open cattle seed development system.

2.1.2. Barriers identification and anaysis

Barrier analysis has basically been identified and analyzed according to six criteria: regulatory, economic and financial, institutional, capacity building, intelectual property rights (IPR) and social and cultural aspects. The regulatory aspect includes the rules and laws prevailing in Indonesia related to these projects. Economic and financial aspect includes cost of capital, operating and maintenance costs and incentives associated with the project. The institutional aspect is the task of institution in doing coordination, research and development of the project. Capacity building is directed to improve the potential resources particularly human resources (skilled people) such as through training. Intelectual property rights (IPR) includes possible right of the technology to be used and transferred. The social aspects associated with projects are habits of society, public perception, consumer desires and so forth.

2.1.2.1. Barrier identification and analysis for the transfer and diffusion of farming technology of drought and inundated resistant rice varieties

Some constraints in the dissemination of drought and flood tolerance rice varieties can generally be grouped into six aspects: policy and regulatory, economic and financial, institutional, capacity building, intellectual property rights, and social and cultural aspect. These barriers are summarized in Table 2-1. Its barrier causal relation is also presented in Figure 2-1.

Regulatory aspect

Highly controlled rice seed production by big investors may lead to unfair and unbalanced competition. It is because Act No. 25/2007 is not fully implemented resulting in the access monopoly of agricultural resources. This condition cannot protect small scale businesses of rice farming, and balance the competition between small scale rice farmers and large scale rice estates. If this condition is not solved then the people economy principles will not be created in Indonesia.

Economic and financial aspect

The barriers of the economic and financial aspect are identified and grouped into high-up front cost, inappropriate financial incentives and uncertainty of financial environment. High up-front cost is due to high investment needed for R&D and possible rice seed

Table 2 - 1 Barries identified in the transfer and diffusion of farming technology of drought and inundated resistant rice varieties

Aspect	Barriers	Barrier element	Overcoming barrier
Policy and regulatory	Highly controlled rice seed production by big investors (may lead to unfair and unbalanced competition) because Act no. 25/2007 is not fully implemented. -	■ Access monopoly of agricultural resources. ■ Unprotected small scale businesses of rice farmers ■ Unbalance competition between small scale rice farmers and big scale rice estates. ■ Big scale rice estates against people economy principles.	■ Implement Act No. 25/2007 as it is ■ Issuance of related governmental regulations on rice seed breeding
Economic and financial	High up-front cost	■ R & D need high investment ■ Seed monopoly resulting expensive seed capital cost for the farmers	■ Require incentive for R&D ■ Develop seed nurturing garden by refunctioning existing experimental gardens in 118 locations around the country
	Inappropriate financial incentives	■ Subsidy is not given directly to farmers, especially small farmers.-	■ Incentives such as subsidies for fertilizer and pesticide should be given directly to farmers rather than to the manufacturers
	Uncertainty of financial environment	■ Price uncertainty of rice, seed, fertilizer, pesticide, etc.	■ Need government intervention through regulation to reduce price fluctuation of agricultural products and supporting production matters. ■ Restructure pervious microfinance institutions such as KUD, BUUD
Institutional	Lack of professional institutions helping farmers to improve their products.	■ Lack of cooperation and coordination among related actors/ stakeholders ■ Institution producing seed is located far away from the institutions dissiminating the seeds. ■ No suitable farming technologies development done by farmers is supervised by responsible institutions.	■ Need to develop communication forum ■ Need to empower and restore the functions of 118 BPTPs spreading over the country and assign a task to produce superior rice seeds resistant to drought and flood. ■ Utilize BPTPs and farm field schools to develop state of the art agricultural practices ■ Revitalize and enhance the role of agricultural extension and agricultural extension specialist that has ever existed.

Aspect	Barriers	Barrier element	Overcoming barrier
Capacity building	Limited capacity building of the related actors.	■ Low use of available field schools to improve rice farming production. ■ Lack of available certified seed at the fields. ■ Low knowledge of the farmers so that they do conventional farming.	■ Provide education to agricultural extension and farmers via agriculture field schools to enhance their knowledge in the agricultural practices of this purpose. ■ Empower BPTP to nurture high quality rice seed indicated by having its certification established at those locations.
IPR	Requires IPR on weather forecast software	■ Lack of information on IPR ■ Lack of negotiation of having IPR of weather forecast software.	■ Socialization to the users/ farmers on the IPR nature of this software. ■ Technology transfer might be required for weather forecast software. If it owns IPR then its technology transfer must be negotiated to waive the IPR cost.
Social and cultural	Traditions and habits	■ Farmers just do common agricultural practices from their parents without considering whether the seed is resistant to drought and flood. ■ Lack of awareness about issues on adaptation to climate change related to food (rice) security and its technological solutions	■ Socialization and dissemination of the seeds through agricultural workers and field schools. ■ Socialization of climate change impact on food security to the farmers - ■ Farmer education program through field schools for having technological solutions of their farming practices in anticipating climate change impact on their crops. -

monopoly practices. This condition will cause the farmers to become a rice seed market only by corporate farmers or brokers so that the capital cost of the seed for small farmers will be expensive. Inappropriate financial incentive is due to subsidy usually given not directly to the farmers but to the production materials manufacturers for example to fertilizer and pesticide producers. Uncertainty of financial atmosphere could cause price uncertainty of rice, seed, fertilizer, pestice and other supporting farming materials that might affect the spirit of the farmers to improve their crop cultivation.

Institutional aspect

The barrier of the institutional aspect is indicated by the lack of professional institutions to help farmers improving their crop product. This barrier can be further broken down into lack of cooperation and coordination among related actors and/or stakeholders, far away location of institution producing seed from the institutions disseminating it, and no supervision for farmers by responsible institutions. These all barriers of the institutional aspect will cause the decrease of the farming performance done by small farmers.

Capacity building aspect

The barrier of capacity building aspect is due to limited capacity building of the related actors

and/or stakeholders. The reasons are that existing barrier might be as a result of low use of available field schools, lack of available certified seed, and low knowledge owning by farmers. In the past, many field schools were built to educate the farmers in improving their rice production. Now, these schools are not used anymore for that purpose and therefore they need to be refunctioned to their original tasks and functions. The availability of certified seed near the farmers is hardly ever found and it therefore causes the crop production of small farming is not optimal. This is further declined with the low education or knowledge of the farmers.

Intellectual Property Rights (IPR) aspect

In regard to IPR, technology rice breeding and cultivation of flood and drought resistant plants can be done solely by researchers and farmers in the country. However, environment and weather conditions to support such growth still need the help of foreign technology, such as weather measurement equipment and early weather prediction software. Therefore, IPR issues that are addressed in the weather prediction software to determine the planting time associated with flood or drought conditions might be needed. The benefit of this type of IPR has not commonly been understood by the farmers therefore it is considered to be one of the constraints faced. In addition, farmers also do not understand that the IPR cost will be part of their agricultural production costs.

Social and cultural aspect

From social and cultural aspects, the tradition and habit are considered to be important barrier for the implementation of this crop farming. For example, farmers just commonly do the agricultural practices the ways their parents did. They are not really aware of whether or not the rice seed is resistant to drought and flood. It is because they do not understand what is the effect of the climate change to their daily work on crop cultivation. Moreover, they do not really understand what the relationship among crop cultivation, food security and climate change impact.

2.1.2.2. Barrier identification and analysis for the transfer and diffusion of milkfish mariculture technology through floating net cage

The identification of barriers and analysis for the transfer and diffusion of milkfish mariculture technology through floating net cage has been done and its result is summarized in Table 2-2. Its barrier causal relation is also presented in Figure 2-2.

Regulatory aspect

Regulation of spatial zone use for mariculture in the small islands have not been regulated yet in the Regional Spatial Plan (RTRW). There is sometime overlapping regulations regarding spatial planning on seawater zone issued by local government with those issued by Central Government.

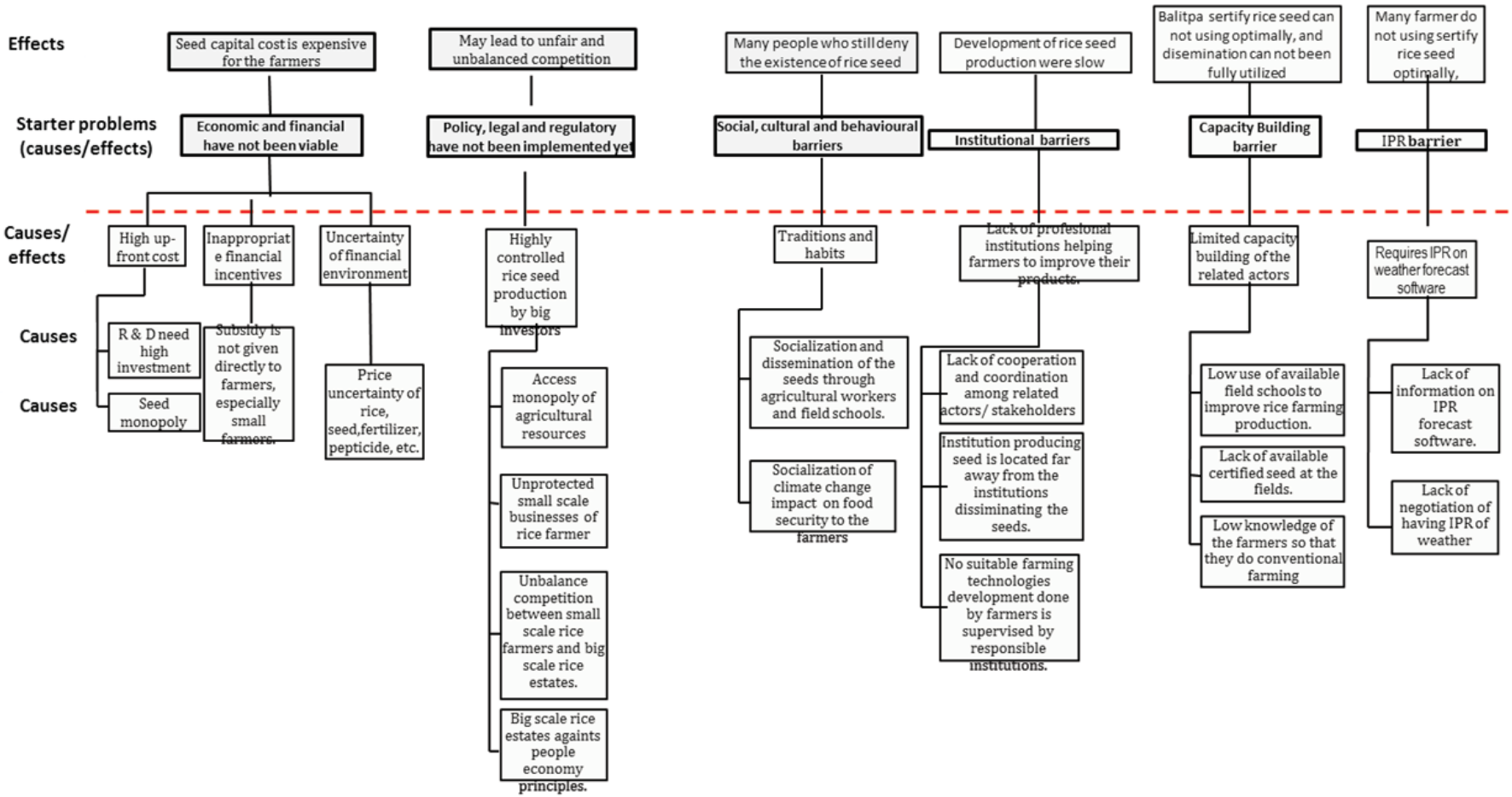


Figure 2- 1 Causal tree of technology transfer for drought and inundated rice varieties

Table 2- 2 Barrier identification and analysis for development of technology transfer and diffusion of milkfish cultivation in floating net cage

Aspect	Barrier	Barrier Element	Overcoming Barrier
Policy and regulatory	Overlapping regulations on zone use of mariculture on small island	Mostly zone use for mariculture in the small island has to been regulated yet	Needs local regulations (Perda) for regional spatial planning (RTRW) in the seawater zone
Economic and financing	High Capital Cost Credit access to financial institutions is difficult	■ High-interest loans as commercials ■ High cost of production facilities ■ Product marketing system tends to monopoly ■ Access to borrow money for farmers is difficult ■ Revolving funds from the Government (e.g. from KKP) is limited	■ Needs incentive for interest rates ■ Needs incentive for production facilities ■ Requires product marketing unit establishment from upstream to downstream ■ Requires socialization to the financial institutions in providing soft loan facilities to fish farmers ■ Provide additional revolving funds from the Government

Institutional	Lack of professional institutions and coordination	■ The difficulty of integrated inter-agencies coordination related to exports
		■ Lost or less assistance from relevant governmental agencies to develop supply chain (such as logistical problems)
		■ Lack of institutions or agencies that are ready to provide information and promote and enhance market
			■ Coordination among relevant agencies need to be improved such as:
			  ■ Licensing and taxation of the product governed by customs
			  ■ Exporters or firms over sighted by Chamber of Commerce.
			  ■ Security and order by the Army and the Police associated with the conflict of interest and looting of mariculture product
			  ■ Supervision, mentoring and training by the Ministry of Marine Affair and Fisheries (Directorate General of Aquaculture) by performing quality control and other biosecurity surveillance.
			  ■ Establishment of program implementors of Minapolitan

Table 2- 2 (Continued)

Aspect	Barrier	Barrier Element	Overcoming Barrier
Capacity Building	Limited institutional capacity and human recourses	■ Lack of Training Center for the enhancement of human resource capabilities ■ No agencies to control product quality	■ Establishment of training centers in the potential areas ■ Establishment of quality control Institutions
Social and cultural	Common practices from older generation in fish cultivation	■ Common practice of community resulting lack of good and proper practice of fish cultivation (CBIB) ■ Common practice of community to borrow money from informal lender with high interest rate	Relevant agencies should conduct socialization of CBIB and revolving funds to fish farmers

Economic and financial aspect

Since the initial capital cost for milkfish farming is high, fish farmers have to borrow money from non banking financial institutions although at higher rates. The other barriers are the high cost of production facilities and product marketing systems that tend to be monopolized. Moreover, fish farmers' access to financial institutions to borrow money is still difficult and the amount of revolving funds from the Government such as from Ministry of Marine Affair and Fisheries (KKP) is very limited.

Institutional aspect

Lack of professional institutions and their coordination and cooperation has been found to be one of the barriers in the implementation of milkfish mariculture in the small islands. For example, it is very difficult for related agencies to work integrately and coordinately in helping fish farmers to export their products. Also, the assistance done by the governmental agencies in helping fish farmers to develop supply chain such as for logistic needs is very weak. Moreover, most institutions are lack of capability and courage to readily provide information as well as promote and enhance the fish market.

Capacity building aspect

Limited institutional capacity and human resource capability are considered to be the barriers of the capacity building aspect. The capacity of the relevant institution to do product quality control is very limited so that the product does not meet the market standard which results in its low price. This also includes the lack of human resource capability due to lack of training for available human resources. As a result, institutional capacity and human resource capability is very limited.

Social and cultural aspect

Previously common practices in fish cultivation done by older generation that has still been followed by current fish farmers result lack of good and proper practices in fish cultivation (CBIB). Also, farmers still prefer to borrow money from informal lenders with high interest rate. They do not use or get access to revolving funds provided by the government.

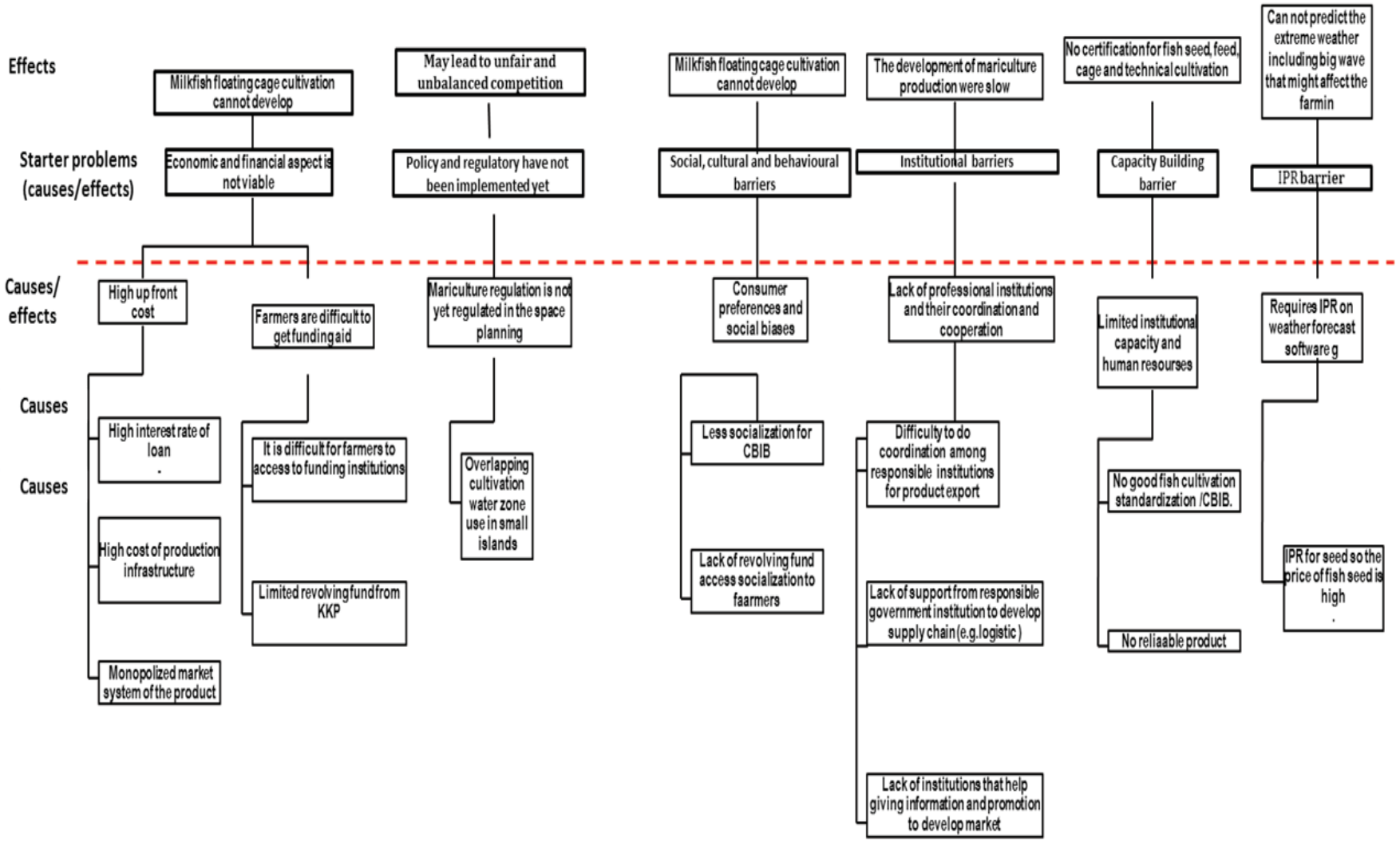


Figure 2- 2 Causal tree of technology transfer for milkfish cultivation in floating net cage

2.1.2.3. Barrier identification and analysis for the transfer and diffusion of technology engineering application of beef cattle

The identification of barriers and analysis for the transfer and diffusion of technology engineering application of beef cattle has been done and its result is summarized in Table 2-3. Its barrier causal relation is also presented in Figure 2-3.

Table 2- 3 Barrier identification and analysis for the transfer and diffusion of technology engineering application of beef cattle

Aspects	Barrier	Barrier Element	Overcoming Barrier
Policy and regulatory	Insufficient technical implementation of the available regulations	■ Complex procedures to import calves ■ Legislation may favour incumbent cattle farmers	■ Make simple and transparant technical procedures to import calves
	Ineffective enforcement	■ Ineffective enforcement of regulations causing many illegal importers.	■ Realize the self-sufficiency of beef catle program in accordance with MoA Regulation No.19/2010 regarding 2014 PSDS guidelines.
Economic and Financing	High capital cost and inconsistent financial climate	■ Expensive capital for calves (young feedlot cattle) import ■ Commercial fare and import tax is imposed	■ Provide venture capital ■ Provide incentives to small-scale rearing practices.
	Inappropriate financial incentives and disincentives	■ Favourable treatment to large-scale farmings ■ Lack of direct incentive	■ Revitalize the allocation of livestock breeds and beef cattle in the country. ■ Direct incentive to rearing practitioners
Institutional	Lack of coordination and cooperation among actors.	■ Lack of institutional role in promoting and marketing the product ■ Lack of governmental aids to develop distribution chain (logistical aspects) ■ Lack of institutions to enforce technical standards ■ Lack of dedication from institution or association to convey information (market information)	■ Governments focus as regulator, facilitator and motivator. ■ Set distribution and marketing of beef and beef products through domestic stock according to the needs of public consumption. ■ Develop institutional instrument to support technical standards: (i) scientists, experts and trainers, (ii) the business institutions for small, medium and large scale business units. ■ Apply good governance principle that uphold law enforcement, rewards and punishment.

Capacity Building	Weak connectivity among actors	■ Dispersed and poorly organized practitioners ■ Lack of market information for farmers ■ Poor education and low revenue of cattle farmers ■ Conventional management and technology application	■ Develop area mapping of meat sources ■ Apply low external input of sustainable agriculture principle (to produce food, feed, fertilizer and fuel, abbreviated as 4F). ■ Do training for cattle farmers to increase the productivity of beef cattles. ■ Improve farmers management in pressing and holding calf mortality - as well as preventing slaughtering productive cows -
IPR	Lack of IPR on feed technology and cattle disease medicine	■ Lack of information on registration and benefit of IPR ■ No help from government to negotiate for IPR	■ Socialize about IPR of breeding technology and its benefit to farmers. ■ Produce superior males for IB by the Government. ■ Government intervention in the form of special incentives to farmers in the form of feed and medications that require IPR from outside
Social and cultural	Consumer preferences and social biases	■ Only few percentages of Indonesian people consume meat and mostly prefer local meat. ■ Consumers prefer to buy cheaper meat whether it is healthy or not.	■ Socialization and campaign of eating beef as well as implementation of PSDS-2014 -guidelines ■ Public guidance concerning veterinary to prevent Zoonoses diseases

Regulatory aspect

The barrier in beef cattle cultivation is due to the limited number of local cattles that can be raised for meat production. Therefore, the rate of cattle import tends to keep growing, which could amount to Indonesian currency of Rp 4,8 - 5 Trillions (USD 505 – 526 Million for exchange rate of Rp. 9,500/ USD 1). The function of importing cattle, which is used to cover the lack of local cattle, grows to threaten the rearing of local cattle. The foreign exchanges that go to the other countries can and shall be used to develop the cultivation of local beef cattle and production of meat, which would increase the industry's independence and competitiveness. Apparently in term of regulatory aspect, the technical implementation of the availble regulation is not yet sufficient resulting the difficulty and complicated procedures to import calves. Moreover, the regulation is not effective enough to encourage the rearing of local cattle. The current regulation is more favorable toward importers rather than the stakeholders and practitioners of the local cattle rearing industry. This situation is possibly caused by ineffective enforcement of regulations on importing activity. If this problem persists, the import of foreign cattle can kill the local cattle rearing industries and also cause many illegal importers.

Economic and financial aspect

The investment opportunity for beef cattle is very high. The industry requires massive funding, which would be used to purchase the beef cattle, feedlot and barn, work force, and other

necessary resources. The inconsistent financial climate will also result in the price fluctuation of beef cattle and meat. Besides, the lack of direct incentive given to rearing practitioners would be a problem in the development of beef cattle rearing. The process of raising beef cattle is considered to be commercial activity, thus the fare and import tax are applied in commercial sense. Practitioners of local cattle rearing would have difficulty in obtaining venture capital due to the distorted capital market and the lack of incentive given to small-scale rearing practices. In addition, poor market infrastructures such as missing or underdeveloped supply channels are other problems faced by cattle farmers.

Institutional aspect

The main barrier in the institutional aspect is the difficulty of integrated cooperation between related institutions, such as Financing Ministry, Ministry of Research and Technology, Ministry of Trade, and Ministry of Industry. There is a lack of governmental aid to the development of distribution chain (the logistical aspect in particular), resulting in a poor distribution of cattles to farmers and from farmers to consumers. The institutions' role in promoting and marketing the products are far from satisfactory, whether in terms of quality, quantity, or supply. That condition reduced the capacity of beef cattle rearing and in turn reduced the production output as well. In regards of this development project, there is still a lack of effort from related institutions in the farming field to effectively enforce the technical standards required. Furthermore, stakeholders are not sufficiently involved in the project, which also influence the product optimization. Just as importantly, there is a lack of institutions or associations dedicated to convey information related to this development project, specifically the market information.

Capacity building aspect

Practitioners of beef cattle rearing are sporadic and very hard to organize. Their livestock placement is being spread far apart, relatively small scale of operation, season-dependent feed, family operation, and limited control of feedlot. The farmers also barely have any knowledge about the market condition and information. Most of the farming industry's structures are classified as 'civilian venture', which is characterized with poor educational background and low revenue. They do conventional application of management and technology. Besides, the farmers' management is very conventional, making it hard to obtain developmental data that can be used to solve any rising problems.

Intelectual Property Rights (IPR) aspect

In regards of IPR, beef cattle rearing technology can already be practiced with local human resource. However, there is still a need for feed technology and handling of cattle disease in order to preserve the quality of the meat. Therefore, there is probably still a necessity for an IPR negotiation related to feed technology and medicine. Besides, the practitioners also do not possess sufficient understanding yet on how IPR cost will affect their cultivation production cost.

Social and cultural aspect

The problem in this aspect is related to research and development (R&D), in which there is a lack of R&D facilities, capacity, and appreciation toward its role in technological adaptation. Farmers who live in villages do not possess the necessary knowledge about how climate changes can affect their cattle cultivation. Socially, there are very few people who consume meat, and they tend to prefer local meat. They also prioritize inexpensive price over high quality. Finally, most cattle farmers are villagers with low income.

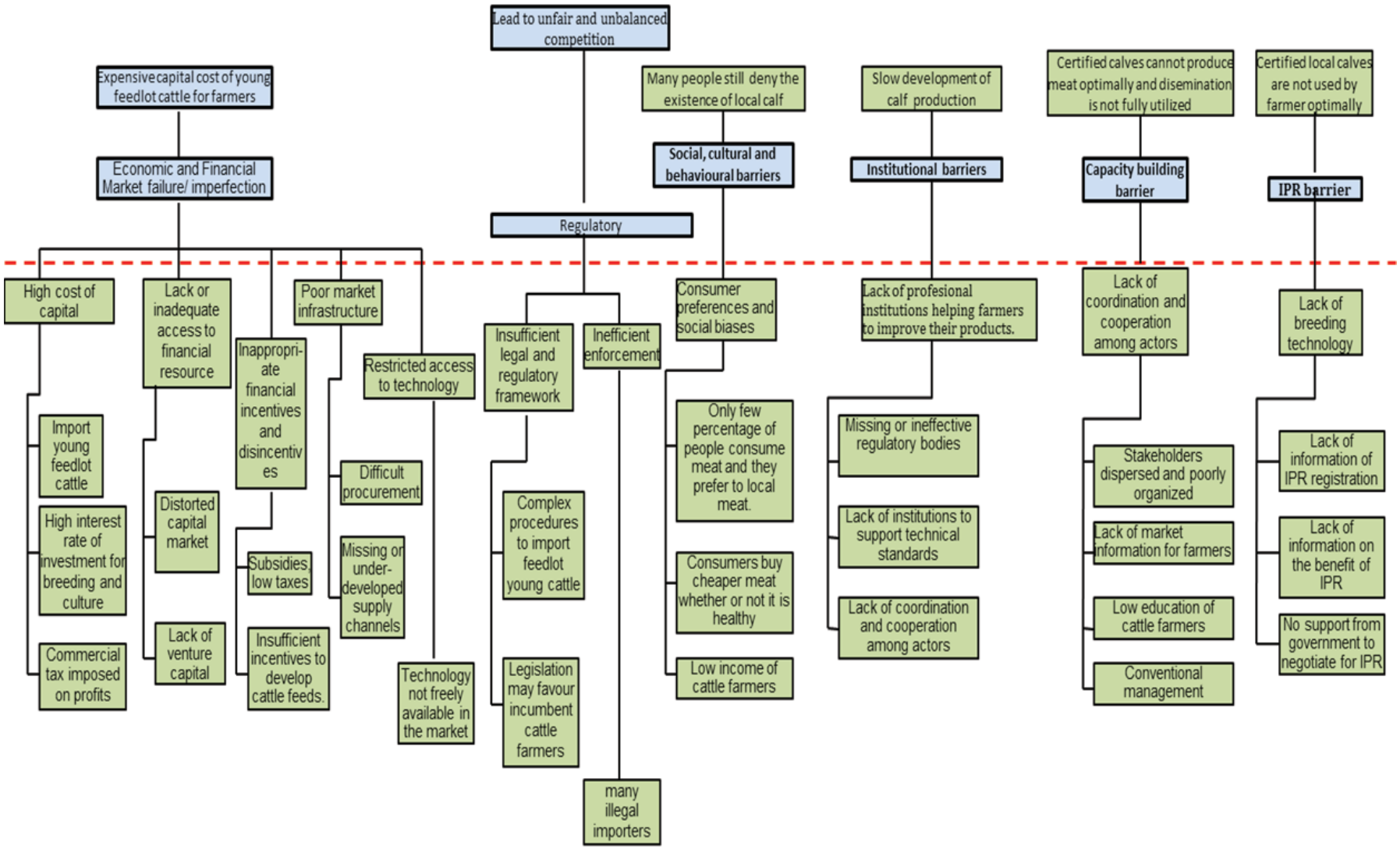


Figure 2- 3 Causal tree of technology transfer of technology engineering application for beef cattle

2.1.2.4. Linkages of the barriers identified

All selected technologies on food security sector own similar obstacle that is a difficulty for the government to form organizational structure to implement food security in facing climate change impact that are operational, independent, tiered, and coordinated. Thus the organization needs to have an operational power of implementation, self help, tiered, and coordinated from the Central level, Provincial, District/City to Sub-District (Kecamatan) in synergistically overcoming the barriers.

2.1.3. Enabling framework for overcoming the barriers

2.1.3.1. Possible solutions to address the barriers for the transfer and diffusion for farming technology of drought and flood tolerance rice varieties

Regulatory aspect

If rice cultivation is controlled by a single big investor, there would be an unbalanced and unfair competition in the market. An improper implementation of Law No. 25/ 2007, Law on investment and Presidential Regulation No. 77/2007, regulation on closed-door and opened-door agricultural industry could result in such an unhealthy competition. For instance, there would be a monopoly of the access to agricultural resources, unprotected practitioners of small-scale business, and unbalance between big and small businesses, all of which would result in a capitalism economic system, not socialism economic one as regulated by the nation's constitution. Therefore, the following solutions need to be addressed. First is to create a balance competition between big and small-scale businesses by fairly implementing Law No. 25/2007 and Presidential Regulation No. 77/ 2007. Protecting small-scale farmers are sometime neccessary such as by giving compensation for failed harvest, as mandated by Presidential Instruction No. 5/ 2011. Another overcoming barrier is to increase both quantity and quality of rice seeds in order to achieve the targeted rice production surplus, 10 million tons, in 2014.

Actually, activities to support that goal would be done in the form of land intensification with water irrigation, field school, and balanced use of fertilizer, as well as land extensification for outside Java. Therefore, the key to achieve the rice production surplus target of 10 million tons lies on the hands of the Local Government, and there would need regulations in both State and Provincial Government levels in order for the supporting factors to work.

Economic and financial aspect

Investment needed for R&D may be lowered by giving incentive for that R&D investment so that the total capital cost could also reduce. Furthermore, possible access monopoly practices of rice seed must be controlled by the government through issuance of government regulation that allows many other seed breeders to do businesses. Inappropriate financial incentives which are not given directly to small farmers must be stopped. Subsidies of fertilizer and pesticipe for example, have to be given directly to the small farmers instead of to the manufacurers. Price uncertainty of rice, seed, fertilizer, pesticide and others must be stabilized by the government in order to reduce price fluctuation. In addition to help rice farmers to get capital for their farming is to restructured previous microfinance institutions, such as cooperative union of Village Cooperation Unit (KUD) dedicated only for the good of the farmers. They could help farmers finding the planting capital in the central rice production area.

Capacity building aspect

Historically, increasing capacity of Indonesian farmers relies heavily on the field workers as well as farmer working groups. To build the farm it needs a quality human resource in agriculture field because the availability of the qualified human resource is the major contributor for the region to speed up its agriculture development. Also, disseminating new varieties must also be improved through understanding of the agricultural field workers on the advantages and disadvantages of these varieties. This knowledge adoption of new varieties can be done by improving the capacity building of the field workers and the farmers through education and training in the available agricultural field schools. This training process can also increase their knowledge on planting calendar and information technology utilization for agricultural purposes. In addition, it needs to empower Agricultural Technology Assessment Agency (BPTP) to always develop high quality seed, so that the availability of certified seeds can be resolved.

Institutional aspect

Indonesian government via Ministry of Agriculture, in particular Agricultural Technology Assessment Agency (BPTP) and Agricultural Research Agency, needs to bridge the gap between farmers who need technology for their farming and applied research results conducted by researchers of Agricultural Research & Development Body. BPTP establishes land agricultural schools located in central rice production areas. It also makes a guidance on planting cycle. Besides, BPTP also develop a new socialization channel in regards of new rice varieties..

Intelectual Property Rights (IPR) aspect

Agricultural Technology Assessment Agency (BPTP) with its new paradigm, that is "research for development", has highly committed to implement Act Number 18 of 2002 concerning the National System of Science and Technology that is outlined in Government Regulation (PP) Number 20 of 2005 regarding the obligations on technology transfer of R&D results. Real evidence of that commitment among others is the the signing MoU between the BPTP as a technology producer (plant varieties) and the Center for the Protection of Plant Varieties (Pusat PVT) concerning the utilization acceleration of the registration and protection of plant varieties glorification produced by BPTP. In term of intellectual property issues it could sometime be perceived negatively, for example it will only add to the burden to the stakeholders especially the farmers. Indeed, with the protection of intellectual property rights of R&D products it precisely will protect the related parties, such as researchers and stakeholders.

Social and cultural aspect

Increasing the land fertility (Adiningsih, S., 1984) is essential, due to the conventional cultivation method done by farmers and their lack of innovation. They tend to use chemical fertilizer and inefficient water irrigation. Farmers commonly neglect to do plant rotation that can result the land fertility reduction over time. Post-harvest techniques used by farmers could cause significant production loss between 15 and 20%. The low productivity and weaak food commodity's competitiveness lead to the loss of farmers' interest in developing food cultivation, which in larger scale would affect national production. Therefore, dissemination through land agricultural schools becomes a strategic step to educate the farmers to implement planting calendar on their own so that they can predict weather condition with better result.

2.1.3.2. Possible solutions to address the barriers for the transfer and diffusion of the sustainable technology development of milkfish cultivation in floating net cage.

Regulatory aspect

The barrier of the regulatory aspect in mariculture is the overlapping regulations on zone use of mariculture on small islands, where mostly zone use for mariculture in the small islands has not been regulated yet. To overcome this barrier, it is needed to set up Regional Spatial Plan (RTRW) which is prepared by the local government through the local regulations (Perda).

Economic and financial aspect

To alleviate the problem of capital cost in the business of milkfish cultivation, incentives for interest rates and incentive for production facilities need to be given. In addition, it needs to establish product marketing unit from upstream to downstream, socialization to the financial institution to provide soft loan facilities to fish farmers and also need to provide additional revolving funds in the National Budget for marine fish farmers.

Institutional aspect

Lack of professional institutions and coordination among relevant agencies which are the main barriers of institutional aspect of mariculture in Indonesia can be improved by several policies, such as:

a) Licensing and taxation of the mariculture product governed by customs;
b) Sales done by exporters or firms with oversight Chamber of Commerce;
c) Maintaining security and order associated with the conflict of interest;
d) Task of supervision, mentoring and training by the Ministry of Marine Affair and Fisheries through the Directorate General of Aquaculture by performing quality control of products, and other biosecurity surveillance; and
e) Establishing program implementers of Minneapolitan.

Capacity building aspect

Need to be established mariculture training centers particularly in areas that have potential for mariculture development so that the needs of skilled human resources in the field of mariculture will be fulfilled.

Social and cultural aspect

To alleviate common practices from older generation in fish cultivation such as less application of good and proper practice of fish cultivation (CBIB) and common practice of community to borrow money from informal lender with high interest rate, relevant institutions should conduct socialization of CBIB and revolving funds to fish farmers.

2.1.3.3. Possible solutions to address the barriers for the transfer and diffusion for beef cattle cultivation through engineering technology

Regulatory aspect

It needs to have a regulation that could conductively and optimally execute TTD for beef cultivation. The regulation may contain the following objectives:

- Assist the Business Credit of Cattle Breeding (KUPS).
- Develop a system of easy credit for cattle cultivation so that the cutting process can be done smoothly.
- Manage export feeds, such as Oil Palm Core (BIS), drops, wafer (cane tip), and many others. They could even be limited or even prohibited from being exported if the local needs are yet to be fulfilled.
- Manage on farm cultivation that could provide business assurance, related to space management, plant-livestock integration pattern, etc.
- Regulate pricing and trade to ensure that the price of high quality meat will always be reasonable for business practitioners.
- Preventing monopoly or cartel, damaged goods import by dumping politic, illegal entrance of meat, etc.
- Protect small farmers and business practitioners in general with international trade context, by utilizing the fare or non-fare instruments.

Economic and Financial Aspect

There has to be a local stock regulation that governs cattle and beef distribution related to the society's needs and their consumption level. Local supply and livestock demand of imported cattle and meat have to be examined. It is then followed by yearly livestock allocation in the country in order to improve the quality of local cattle and their prospect cultivation so that the supply of high quality meat for restaurants, hotels and others can be met.

Government has to fully realize the plan to form Indonesian Cattle Farmers Consortium (KPSI) to ensure that cattle producers will not have any difficulty to distribute their commodities to the area with highest demand level. Also, in order to correctly estimate the cattle production and consumption data, government needs to revise the blueprint of meat and potential cattle import policy. The number of the imported cattle and meat must be adjusted to census data accordingly, in order to prevent excessive import and distortion of local cattle price.

Institutional Aspect

The activity to realize meat self-sustenance must be given proper institutional support, which are from: (i) scientists, experts, and educators, (ii) business practicioners, whether small, medium, or large-scaled, and (iii) government in state and local levels as regulator, provider, motivator, and dynamisator. The existence of farmer groups or cooperative union is a must, and cooperation between related parties must be extended.

Capacity Building Aspect

Breeding

It needs to increase the mapping capacity of potential livestock source areas in order to get the knowledge about a certain area's availabity of potential livestock and to develop a breeding system. Also, an increase of cattle breeding of capacity is required in order to produce a genetically superior male for artificial insemination (IB) or natural mating intensification (INKA).

Feed

Extensive development of cow calf operation (CCO) or integration of grazing into other agribusiness concept (crop livestock system/CLS) is needed. This activity must apply the principle of low external input sustainable agriculture (LEISA), or through the approach of zero waste, and if possible, zero cost; so as to generate a product that fulfills the 4-F criterias (food, feed, fertilizer & fuel). There is a need to optimize rearing capacity through agribusiness, efficiency, with high or medium external input, and based on local feed with ideal composition of fiber, energy, and protein.

Cultivation

During the cultivation process, delay of the local cattle's cutting time or IB result is optimized in order to achieve maximum possible weight on cutting time, according to its genetic and economic potential to produce meat. In addition it needs to increase the capacity of local cattle and IB result in order to have the maximum numbers of productive female cattle, suppressing the service per conception (S/C) figures, shorten calving interval, accelerate the firstborn timing, and extend the longevity of productive period, which overall could improve the calves. Moreover, optimizing the trade management of livestock and meat related to the cultivation process are also equally important so that the benefits for farmers and traders would be fairer, more balanced, and more proportional.

Animal Health

The target on animal health programs in general can be carried out via suppressing the death rate of calves from 20 - 40% to 5 - 10% and the death rate of the parents from 10 - 20% to 2 - 5%. For certain potential livestock source areas, the death rate of calves can be reduced to less than 5 - 10 % and the death rate of the parents can be reduced to less than 2-5 %.

Intelectual Property Rights (IPR) aspect

There has to be prevention on Indonesian cattle germ plasm from being cultivated outside, in order to preserve the originality of Indonesian local cattle. Therefore, if Indonesian farmers can cultivate local cattle, they would not be charged with property rights fee from outside parties.

Social and Cultural Aspect

The low level of meat consumption for Indonesian people is assumed to be one of the constraints for increasing productivity of the national farm. Threfore it still needs to enlarge farm market and to increase campaign on meat consumption of the people. This has been guided with the beef meat self-sufficiency program (PSDS) 2014. In addition, another constraint in the social aspect is the development of zoonotic diseases. For that it it needs socialization the the common people on the animal health of the animal breeders and the slaughter houses.

2.1.3.4 Recommended solutions for food security sector

The main barrier is the capacity of related institutions coordination for ensuring the beef cattle rearing cultivation can work as expected. Therefore, the existing laws and regulations need to be executed in complete faithfulness, while cooperation between institutions has to be improved. Besides, there is a need for an executive organization with operational capability, independence, tiers, and coordination from State, Provincial, Regency/City, and Sub-District levels to overcome the existing barriers.

In accordance with the analysis of barriers and attempt to handle it, there are several recommendations the following solutions:

- Increasing budget for food security program as priority of development.
- Assistance food security program budget of local government from the central government.
- Policy on subsidies for food security program development.
- Increasing awareness through campaign, socialization, and demonstration plant.
- Completing the implementing regulations.
- Increasing cross sectoral coordination in food security program.
- Increasing public private partnership.

2.1.4. Concrete actions plans and ideas

2.1.4.1. Plans for domestic actions and measures

Since the adaptation to climate changes on food security sector is an effort to overcome the failure of providing feed material due to climate anomaly, there needs to be a coordinating forum to assist the Feed Preservation Agency in responding more effectively to the problem of feed shortage.

Meanwhile, the activity that has to be included in the plan of coordinating forum is:

- Monitoring and evaluating problems that occured on the field.
- Finding solutions to the food shortage.
- Giving considerations on planning for the next years target and aim, workforce, funding, and other factors related to local needs for food.

The coordinating forum on the state level will be in the form of technical team consisting of structural elements headed by General Director of the Ministry of Agriculture and Ministry of Marine Affairs & Fisheries. The coordinating forum on the provincial level will be in the form of technical team consisting of elements from the related provincial Agencies. The coordinating forum on the regency level will be in the form of technical team consisting of stuructural elements headed by an Agency that handle agricultural, farming, and fisheries development aspects. Each coordinating forums on each level will give instructions toward their respective management units based on regular meetings held every other months.

a. Disemination of farming technology of drought and flood tolerance rice varieties

Description

In general the domestic action plan is to disseminate a cultivation method of drought and flood tolerance rice plant and an implementation program of dynamic planting calendar. Cultivation technology dissemination of drought and flood tolerance rice plant is an attempt to socialize those varieties in order to be known by the farmers. Besides, the farmers need to be skillfull in implementing planting calendars and overcoming harvest failure due to climate change. For seed mass reproduction of these varieties it needs cooperation among related parties. Seed production cooperation is part of the programs of the Agency for Research and Development of Agriculture. This collaboration involves several parties such as BPTP, seed developers (seed farmers) and nationally private companies. The purpose of cooperation is to facilitate the access to drought and flood tolerance rice plant at rice farming locations. In the implementation of the program it will also need to set up the forum coordination at village

levels pioneered by the Agricultural Field School and tutored by field farm workers through demonstration plant.

Timeline

Plan for demonstration development activities will be carried out in three years. The stages of the activities are as follows.

First year:

- Coordination with the Rice Research Unit (BALITPA) of Sukamandi as a provider of drought and flood tolerance rice seed technology.
- Coordination with all related stakeholders (Ministry of agriculture, Ministry of Public Works, Indonesian Agency for Meterology, Climatology and Geophysics, Agricultural Field Workers, Local Farmer Groups, and others) in the implementation of dynamic croping calendar.
- Development of the tasks and authority distribution carried out by all stakeholders together.
- Financial sharing decision.
- Establishment of demonstration plant management.
- Determination of prospective location and its socialization to surrounding community.
- Preparation of basic design and feasibility study.
- Preparation of the Detailed Engineering Design (DED) of Demonstration Plant together with technology inventor.

Second year:

- Delivery (import) equipment that cannot be procured domestically in the country particularly for monitoring and measurement of weather equipment of the agricultural field school.
- Manufacture of supporting materials, such as seed, fertilizer and organic pesticides in conjunction with CBPBB.
- Preparation of location and land for the establishment of demonstration plant in the experimental garden of BPTP.
- Development of rice fields required for demonstration plant.
- Transportation and assembly (construction) of weather monitoring machine and equipment at the demonstration plant.
- Training on demonstration plant operation.
- Socialization to local farming community on planting calendar operation.
- Do trial or initial test of demonstration plant.

Third year:

- Perform trial test of demonstration plant.
- Evaluation of the test results
- System improvement based on the test results.
- Demonstration plant operation.
- Evaluation of demonstration plant operation.

Geographic scope

Preferred location of demoplant is a location where there is BPTP. As a consideration, Karawang which is as the national granary and as a food production laboratory can also be prioritized as the demoplant location giving its proximity to BALITPA, Sukamandi. Other locations are Papua as a territory that experiencing accelerated development programs and Donggala (Central Sulawesi) that its human resources in particular Combined Farmers Group (GAPOKTAN) has been prepared and have adequate facilities.

Resources needed

- Professional institution or a private company that manages demoplant and can cooperate with BPTP and local farmers.
- Qualified expert who can transfer the technology and system of demoplant as well as its operation.
- Professional workers who have been trained and have the discipline and commitment to be field agricultural supervisors.
- Agricultural field supervisors that fully support and continuously disseminate cultivation technology of rice resistant to drought and flood variety, in their working area.
- Central and local governments that fully support the development and operation of demoplant.
- Sharing adequate funding from both donor and local government.
- Good community participation in the production of rice seed at the source.
- Local workshops that support the provision of weather monitoring equipment for the agricultural field school in implementing the planting calendar, which was launched by Agency for Research and Development, Ministry of Agriculture.
- Facilities and infrastructures that support program implementation of planting calendar in agricultural field schools.

Regulatory change

In order to guarantee the dissemination of drought and flood tolerance varieties of rice, it is necessary to hold legal protection and in this case it is Law No. 5/ 2007 regarding capital investment. Government needs to enforce this law appropriately to achieve the goal. In addition it has been issued Law No. 61/ 2011 regarding genetically modified products, however in the future it is necessary to prepare lower level regulations as operational ones.

Coordinating or Implementing Agency

Implementation of dissemination and development of demoplant requires coordination as well as implementing agency. In this case the implementing agency is the Ministry of Agriculture through the Agency for Agricultural Research and Development while the supporting institutions are the Agency for the Meteorology, Climatology and Geophysics (BMKG) and others. In addition it is also necessary to do coordination with the Ministry of Home Affair, Agency for the Assessment and Application of Technology (BPPT), and Local Government.

B. Development of sustainable milkfish cultivation technology in floating net cage

Description

The development of sustainable technology of milkfish cultivation in floating net cages is one way in implementation of minapolitan area development program. In the regulation of the Minister of Marine Affairs and Fisheries stated that the development of Minapolitan area is the efforts consisting of (a) national campaign; (b) running the production, processing, and/or marketing in leading production centers pro-small business; (c) integrating production centers, processing, and / or marketing of the leading economy areas into the Minapolitan areas; (d) business mentoring and technical assistance in the centers of production, processing, and / or marketing in the form of counseling, training and technical assistance; and (e) developing marine and fishery areas based economic systems.

The objective of this program is to develop and disseminate mariculture technology, especially the environmentally friendly cultivation of milkfish (*Chanos chanos*) in floating net cage (KJA) to support food security programs in order to anticipate the negative impact of global climate change.

Timeline

In accordance with the targets, this activity is a multiyear project which will be implemented over three years.

First year

1) Site selection and feasibility study.
2) Design of production units, economic estimation and evaluation of marketing.
3) Setting up a small scale pilot unit of environmentally friendly milkfish cultivation technology in floating net cage for production and training purposes with the method of "Integrated Multitrophic Aquaculture (IMTA)" to the group of fish farmers.

Second year:

Expand the medium-scale pilot unit by involving groups of fish farmers, through training for a skilled group of fish farmers.

Third year:

Establishment of several milkfish production centers as well as establishment of industrialization of environmentally friendly milkfish cultivation technology in floating net cage in several areas of Indonesia including the Thousand Islands (Kepulauan Seribu), the Riau Islands (Riau Kepulauan) and South Sulawesi.

Geographic scope

- Kepulauan Seribu
- Batam (Riau Kepulauan)
- South Sulawesi

Resources needed

- Expert coordination with stakeholders (KKP, local Fisheries Department, Fish farmer group/ Fishermen, Entrepreneurs, Institutions of funding sources,etc.).
- Technical expert for detail planning, financing and implementation of project activities.
- Manpower availability and equipment (cage) locations to be used as training and production facilities.
- Milkfish fish floating cage system.
- Energy for supporting facilities, training and socialization of milkfish cultivating techniques with floating net cage system must be environmentally friendly.
- Application of facilities and infrastructures in various regions of Indonesia such as survey equipment of the location for environmental impact assessment study.
- Pilot unit of milkfish cultivation technology in floating net cage and its facilities for training and monitoring activities.
- Facilities and infrastructures of mariculture aquaculture monitoring and evaluation.

Regulatory change

1) Law Number 16 Year 2006, on Extension System for Agriculture, Fisheries and Forestry
2) Act No.17 2007, on Long-Term Development Plan of 2005 to 2025
3) Law Number 26 Year 2007 regarding Spatial Planning
4) Law Number 27 Year 2007 on the Management of Coastal Areas and Small Island.

Coordinating or Implementing Agency

Coordination with stakeholders from the central to district level, such as KKP, especially Marine and Coastal Research and Technology (P3TKP)-KKP and the Center for Marine and Coastal Resources (P3SLP)-KKP, Center for Agricultural Production Technology - BPPT, Kepulauan Seribu Fisheries Office, Fisheries Office of City of Batam, other Local Government Fishery Offices, Fish Farmers/ Fishermen groups, Private Companies, particularly the owners of milkfish hatchery feed producers, Institutions of funding sources, and others in the trade sector and downstream industries, NGOs accompanying the application of milkfish cultivation technology.

c. Cultivation Engineering of Beef Cattle Technology

Description

The main program of cultivation engineering of beef cattle technology is the development of the cattle breeding technology to fulfill the sertification standard. The purpose of this certification is to maintain and increase the price of seed produced by the breeder. The calf quality standard is determined to implement the method of the parent's breeding to produce good calves.

Timeline

First year:

Formulation of village breeding center (VBC) criteria based on the scientific references.

Second year:
Increase the number of good quality calves for the cattle ranchers who have intensive experiences in cattle breeding.

Third year:
Training and assisstance to groups of breeders in order to implement good breeding practices.

Geographic scope

Areas that become a choice location of cow breeding is Blora (Central Java), Nganjuk (East Java), South Sulawesi and East Nusa Tenggara. The reason for selecting those locations is because people there have good skill for cattle breeding for longtime. Table 2-4 shows the potential locations of the local cattle breedings in Indonesia.

Table 2- 4 Source of local cattle breeding in Indonesia

No.	Types of local cattle	Breeding locations
1.	Bali	Bali, West Nusa Tenggara, South Kalimantan, West Sulawesi, South Sulawesi, South East Sulawesi, Gorontalo
2.	PO	North Sumatera, West Java, Midlle Java, East Java, North Sulawesi
3.	Madura	Madura
4.	Aceh	Aceh
5.	Coastal	West Sumatera
6.	Bali and PO	South Sumatera, Lampung and South East Sulawesi
7.	PO and SO	East of Nusa Tenggara

Source: Directorate of Breeding, Directorate General of Animal Husbandry

Resources needed

Facilities and infrastructures such as business district location, land, water resources, buildings and barn equipment and calves availability must meet the requirements of the guidelines of Good Breeding Practices.

Regulatory change

Judging from the current regulations, there is no need to change them. However, they need to be transparently socialized particularly for import mechanism regulation of calves. Some existing rules that support this program are as follows.

- Agriculture Ministrial Regulation No. 19/ 2010, on Program guidelines of beef self-sufficiency, 2014.
- Agriculture Ministrial Regulation No. 54/Permentan/Ot.140/10/2006, on Guidelines of good cattle breeding (Good Breeding Practices).
- Agriculture Ministrial Regulation No. 40/Permentan/Pd.400/9/2009, regarding Regulation on guidelines of business credit for cattle breeding.

Coordinating or implementing agency

Executor of this program at the central level is the Directorate General of Animal Husbandry and Agency for Research and Development of Livestock, Ministry of Agriculture (BPTP), and Universities. At the local level, the program is guided by the Regional Office of Animal Husbandry and at the village level, the program is conducted by Cooperation of the Group of Farmers (GAPOKTAN)/ Farmers (POKTAN).

2.1.4.2 Project ideas for international support

a. Dissemination of technology of drought and flood tolerance rice cultivation

Judging from the positive response toward the farm paddy integration system (SIPT) by the establishment of agricultural groups, dissemination of technology on drought and flood tolerance rice cultivation will be made based on dissemination effort by forming agricultural groups through agricultural field schools. Dissemination will be practiced by the agricultural group approach, and is a socialization strategy developed together with the utilization of third-wave technology, which are telecommunication and data processing by using information technology related to new varieties. Therefore, the socialization will enable agricultural groups to comprehend, try out, and inform the farmers about beneficial varieties on their work areas. The farmers' competitiveness will also be increased by utilization of this telecommunication technology.

This strategy would be the dissemination model expected to be utilized by national rice program to increase the effectiveness in increasing rice production.

Type of technology transfer

Types of technology that require international support, among others are technology that can support the plan of rice seed development activities and information technology in the form of software of dynamic planting calendar.

Capacity building

To train human resources' skill and seed breeding institutions, a training on technology transfer must be conducted for example on the method of paddy seed cultivation training for and also the application of information technology of dynamic planting calendar both for individuals and for institutions (legal entities).

Financing

Source of financial can be grant from international institutions with low interest rate and national budget (APBN) for co-financing. The use of fund is classified as:

- Pre-installment cost: planning, Feasibility Study (FS) and Detailed Engineering Design (DED).
- Capital cost: construction and laboratory equipment installation.
- Operation and maintenance cost: salaries, utility bills, tools and supplies, maintenance of laboratorium equipment, etc.

Resources requirement

The components in the success of seed certification program involve the following resources:

- Manufacturers and dealer' groups including seed breeding farmers.

- Laboratory analysts / selection experts / plant breeders.
- An official agency from the Ministry of Agriculture that is reponsible for seed certification.
- Institution that is responsible for supervision.
- Distribution system.

Time line

The implementation of transfer and diffusion of technology of drought and inundated rice paddy seed, particularly for seed nursery that meets Indonesian national standards might take a period of three years with the following stages:

First year:

- Planning and coordination
- Feasibility Study
- DED

Second year :

- Construction and installation of paddy seed breeding laboratory
- Provision of certified land for cultivation of seed
- Running the test
- Evaluation and improvement

Third year :

- Full operation of rice seed production

Indicators of success

- Good cooperation and networking between stakeholders (foreign partner/donors, Ministry of Public Work (for Irrigation), Ministry of Agriculture, community based organization such as Gabungan Kelompok Tani (GAPOKTAN) atau Kelompok Tani.
- Community participation for the project.
- Running well continuously of demoplant and laboratory of rice seed.
- Certification of rice seed.

Domestic partners

The principal domestic partner is the Agency for Seed Research under the Ministry of Agriculture. It needs to be supported by Agency for National Atomic Energy (BATAN), Agency for the Assessment and Application of Technology (BPPT) and Indonesia Science Institute (LIPI).

c. Development of milkfish mariculture cultivation technology in floating net cage

Development of sustainable technology of milkfish cultivation in floating net cage including business mentoring and technical assistance in the centers of its production, processing, and/ or marketing in the form of counseling, training and technical assistance is the program activity of the adaptation to climate change for food security sector. The purpose is to produce the source of protein for the people from cultured marine fish.

In order to support the success of this program, it is necessary to build milkfish hatcheries and training centers in the areas that have potential development of milkfish cultivation.

Type of technology transfer

Floating net cage (KJA) technology with the application of IMTA (Integrated Multitrophic Aquaculture) and milkfish seed certification.

Capacity building

Capacity building to develop milkfish hatchery as the representative of Institute Research on Marine and Fisheries in local areas in order to facilitate access to seed of milkfish of those areas.

Financing

Source of financing can be grant from foreign donors with low interest rate and national budget (APBN) for co-financing.

- Pre-installment cost: planning, Feasibility Study (FS) and Detailed Engineering Design (DED).
- Capital cost: construction and laboratory equipment installation.
- Operation and maintenance cost: salaries, utility bills, tools and supplies, maintenance of laboratory equipment, etc.

Resources requirement

Development agencies of milkfish hatchery, individuals and legal entities, need to meet several requirements, such as milkfish seed certification from Administering Agencies. Suitable land allocation must be inline with regional and spatial planning (RTRW). The local government has to do examination of documents, field inspection, inspection of cultivation/harvesting equipment, fish storage, milkfish seed rearing floating net cages, seed sampling and laboratory test, granting certificate, and labeling.

Time line

Implementation of the development of milkfish hatchery must meet Indonesia National Standard (SNI) that will take approximately 3 years:

First year:

- Planning and coordination
- Feasibility Study
- DED

Second year:

- Construction and installation of milkfish hatchery and laboratory.
- Installation of Milkfish Floating Net Cages (IMTA) certified for mariculture.
- Running the test.
- Evaluation and improvement.

Third year:

- Full operation of milk fish production.

Indicators of success

- Good cooperation and networking between stakeholders (foreign partners/donors, Ministry of Marine Affairs and Fisheries, community-based organization such as Reliable Group of Farmers and Fishermen (Kelompok Tani Nelayan Andalan/KTNA).
- Establishment of Minapolitan region with production unit from upstream to downstream.
- Demoplant of floating net cages (KJA) and laboratories that runs well in accordance to Good and Proper Fish Culture Practices (CBIBB) and it is continuously operated.
- Meeting quality standards for industrial products of soft thorn milkfish commodities for domestic and export market such as clean and shiny scales, no smelly sludge, relatively high fatty acid Omega-3 content compared with pond milkfish, chewy flavor meat, and a 600 - 800 gram fish size as requested by market demand.

Domestic Partners

Stakeholders involved in the development of sea cage milkfish cultivation are Research and Development Center for Marine and Fisheries Technology (P3TKP)-Minstry of Fisheries and Marine Affairs (KKP), Research and Development Center for Marine and Coastal Resources, (P3SLP)-KKP, Fisheries Office of Kepulauan Seribu, Fisheries Office of Batam, other Fisheries Officies, Milkfish fish farmer groups, NGOs, Center for Agricultural Production Technology - BPPT, Environmental Technology Center - BPPT, milkfish feed producers, milkfish private farmers, and traders of seeds including seed-grower groups, milkfish fishermen, and marine fisheries extension workers.

c. Cultivation Engineering of Beef Cattle Technology

To support one of the operational programs in PSDS-2014, which is development of beef cattle breeding through VBC, the project cultivation engineering of beef cattle technology is recommended to be developed. This operational activity is meant to increase the amount of potential beef cattle, which will fulfill the national needs in accumulation.

Type of TechnologyTransfer

Embryo Transfer (ET) is the type of technology in courses of action of engineering technology application of livestock farming. ET is the most appropriate technology to accelerate breeding production program, with an effort to produce superior seedlings of local and imported cows by using the local productive female with low genetic quality. This cow serves as a recipient for embryo stem from superior of both local and imported cow seeds.

Support for embryo transfer technology is the design and construction of Village Breeding Centre (VBC) in areas' resources of the productive female parents, completed with a quality management system that follows the guidelines of Good Breeding Practices (GBP). This is important because BET Cipelang can only be a cooperation partner of VBC that has already applied the GBP.

Capacity Building

Capacity development needs to be conducted in the form of human resources training in the area where VBC is available so that BET Cipelang may have many strategic partners to accelerate the production of cow seed.

Financing

Source of financing can be grant from foreign donors with low interest rate and national budget (APBN) for co-financing.

- Pre-installment cost: planning, Feasibility Study (FS) and Detailed Engineering Design (DED).
- Capital cost: construction and laboratory equipment installation.
- Operation and maintenance cost: salaries, utility bills, tools and supplies, maintenance of laboratory equipment, etc.

Resources requirement

Facilities and infrastructure needed in the VBC is the construction of infrastructure. Development of infrastructure such as complete cowshed with sewage treatment systems and the procurement of forage and concentrate feed for the raising of the recipient cow, calf birth through weaning off (about 6 months age), and the donor parent.

Time line

Implementation of VBC development that meets the Indonesian national standard takes about three years with the following steps:

First year:

- Planning and coordination
- Feasibility Study
- DED

Second year:

- Construction and installation of the stable parent and calf
- Certification for cattle and the cultivation of prospective parent
- Running the test
- Evaluation and improvement

Third year:

- Full operation production of VBC

Indicators of Success

Success indicators of the program are that VBC is able to be a BET Cipelang partner in delivering recipient cattles which meet the BET standard, i.e.:

- Female or parents' cattles with a maximum age of 7 years.
- Good performances and healthy with a body condition score (BCS) of 2.9 to 3.4
- Having a good history of reproduction with normal estrous cycles.
- Not affected by infectious diseases.
- The corpus luteum (CL) function on ovarian function is 6-8 days after the lust.
- Being in the Village Breeding Center (VBC) with an intensive monitoring system.

Domestic Partners

Domestic partners to support the program of PSDS Breeding 2014 are as follows:

- Local governments (Provinces, District) via related offices.

- The private sector (Farming Corporation, Cooperative, NGOs).
- BET Cipelang can also do the application on an individual farmer if the farmer has been extensively trained by local governments, corporations, cooperatives or NGOs that have attention to the development of livestock breeding.

2.1.5. Summary

TNA study results for food security set three adaptation methods, namely: (a) the dissemination of drought and flood-resistant rice varieties, (b) milkfish farming techniques in floating net cages, and (c) technology engineering in the cultivation of cattle. Application of the three technologies is facing obstacles in terms of regulatory, financial, institutional, capacity building, IPR and social and cultural problems. Regulatory barriers might be viewed from either an unavailable appropriate regulations, unimplemented existing regulations or no regulation in the operational level. In terms of economic and financing aspect for agricultural sector, especially rice cultivation sector, it still needs strengthening for small investors because some of the production chain is still monopolized by large investors. Overall, the government is still facing difficulties in coordinating all activities related to food security in the climate change context. Some recommendations from the results of this study include the need for government to run existing regulations consistently or to change the regulations according to national needs and interests, the need to increase the budget in the sectors of food security and the need for subsidies policy in food security R & D, improvement in coordination between agencies and public-private partnership.

Through this study by identifying barriers and solutions, it is necessary to conduct pilot project on climate change adaptation in the field of food security, if possible with international support. This plan sets forth in both domestic action plans and international support ideas. For the dissemination of drought and flood tolerance varieties, collaboration with BPTP and field agriculture school will be conducted in order to empower the farmers. Location of demonstration plot for trials can be conducted in Karawang, Papua and Donggala. For international support it can be utilized to increase the trainer's skill (training for trainers) to master the information technology or software applications of planting calendar. Milkfish aquaculture technology development with a floating net cage is basically a part of Minapolitan area development program with an alternate location chosen is Kepulauan Seribu, Batam Island and South Sulawesi. International support for this program may include training for enhancing production techniques, feed, disease prevention (vaccines) and the application of information systems or early warning system for the aquatic environmental quality.

Meanwhile, the national action in the development of technologies is focused on cattle farming and cattle breeding and standards setting of calf quality through certification. The purpose of certification is to maintain/increase the price of seed produced by the breeder. Determination of the seed quality standards of cow is established to implement breeding method of right cow farming to produce good cow seed. Type of technology in the action program on engineering of application technology of cattle breeding is embryo transfer (ET). ET is the most appropriate technology to accelerate seed production program, with an effort to produce superior seedlings of local and imported cattle by using the local productive female having low genetic quality. The key word is the formation of Village Breeding Center and the implementation of Good Breeding Practices. Areas of selected locations of cattle breeding are Blora (Central Java), Nganjuk (East Java), South Sulawesi, and East Nusa Tenggara. International support can be in the form of training and capacity building of farmers or farmer groups.

The action plan of the domestic and international sides are organized into 3 (three) years timeline and involve collaboration between institutions like the Ministry of Agriculture, Ministry of Maritime Affairs and Fisheries, National Development Planning Agency, Ministry of Home Affairs, Provincial Government, Local Government, BPPT, BATAN, Universities and Groups of farmers and fishermen.

2.2. TAPs for water resouce sector

2.2.1. Preliminary targets for technology transfer and diffusion

Water is the crucial basic needs for human activities. The problem currently faced in terms of water resources in Indonesia is its scarcity both the quantity and the quality. For several locations, the amount of water resource availability is much less than that needed for people activities. One cause of water resource problems in Indonesia as a tropical country is believed to be due to the impact of climate change. Therefore, we need to do adaptation measures in order to manage limited water resources. Adaptation to water resource vulnerability has to be done in line the long-term as well as short-term measures. It must need a responsible institution to coordinate these measures. The institution that holds major task in water resources management in Indonesia has already existed that is the Ministry of Public Works (MoPW). This Ministry has already made the formulation of the short-term and long-term national programs on water resources management in the country. The adaptation measures of water resources vulnerability presented here is basically produced through an intensive discussion by related stakeholders and experts, and is in-line with the national program set up by the MoPW. The conclusion of the prioritized technologies for water resource sector as described in Section I are rain harvesting technology using "*embung*" or a small reservoir, water recycle technology from wastewater and water resources projection model.

These all technologies are mainly prioritized for the purpose of adaptation measures for water resources vulnerability in anticipating climate change impact.

2.2.2. Barrier identification and analysis

Basically, barrier analysis has been done according to six criteria: regulatory, economic and financial, institutional, capacity building, intelectual property rights (IPR) and social and cultural aspects. The regulatory aspect includes the rules and laws prevailing in Indonesia related to these projects. Economic and financial aspect includes cost of capital, operating and maintenance costs and incentives associated with the project. The institutional aspect is the task of institution in doing coordination, research and development of the project. Capacity building is directed to improve the potential resources particularly human resources (skilled people) such as through training. Intelectual property rights (IPR) includes possible right of the technology to be used and transferred. The social aspects associated with projects are habits of society, public perception, consumer desires and so forth. However, not all six barriers could be found for technology transfer of water resource sector. They are different from one technology to the other in terms of barrier analysis.

2.2.2.1. Barrier identification and analysis for the transfer and diffusion of water harvesting technology

Table 2-5 presents barriers identification of rain harvesting technology. It consists of four criteria: regulatory, economic and financial, institutional, and social and cultural aspects.

Regulatory aspect

The first regulatory barrier component is the insufficient regulation and legal ground for the installation of reservoir. There are some frequent rejections from the people in using local cultural land for the installation of reservoir. Although the reservoir installation program has been stipulated in the Regulation of Minister of Public Works No 6 of Year 2011, the installation of reservoir has not been optimally promoted and most of them have not been well targeted.

The second barrier component is the frequent conflict of interests in using the reservoir water. It is caused by the absence of any specific regulation concerning the management of reservoir water. The reservoir is often misused for the purposes which are not in accordance to the initial agreement made at the time the reservoir was built. For instance, a reservoir whose initial function is to provide drinking water is also used to irrigate the fields, and to supply water for cattle ranch and fishery purposes. Hence, the water quality and quantity in the reservoir decreases rapidly.

Economic and financial aspect

The first barrier component in the economic and financial aspect is the lack of accessible low-interest financing source, such as the absence of any soft loan for the reservoir installation project. Most of the time, banks cannot provide any credit for the project due to the difficulty in assessing the economy feasibility. The second barrier component is that the capital required for reservoir installations is quite large such as for the preparation stage, land clearance and reservoirs construction. The capital cost for reservoir construction borrowed from the bank uses the commercial system, i.e. using collateral and commercial interest.

The third barrier component from the economic and financial aspect is that the government does not give any special incentives to the community who build the reservoir by themselves. Meanwhile, the exact sums of investment costs for reservoir are often unpredictable. Most of the time, there are some high compensation demand from the people whose lands are used for the installation of reservoir.

Table 2- 5 Barriers identification of rain harvesting technology

Aspects	Barrier	Barrier Element	Overcoming Barrier
Policy and regulatory	The existing regulation on embung development is not yet complete	Lack of implementation of the regulations Need regulation on technical design and land use criteria.	Need regulations on land use of reservoir, technical criteria for the location of reservoir and so forth. Need intensive socialization.
	Lack of rules about utilization and management of reservoir water.	Water use conflicts occur	Make regulation on reservoir water use

Economic and financial aspect	Lack of access to financial resources for the construction of ponds	■ Construction fund from the government budget is limited ■ Bank is reluctant to give loans for the construction of reservoir	Need foreign aid in the form of grants and domestic funds from companies through CSR programs
	High up-front capital	■ Uncertain price of acquisition land from society ■ Capital cost of reservoir construction is difficult to predict	Need banking regulations for soft loans Ease of getting funds from other sources.
Economic and financial aspect	Claims of unfair compensation of land acquisition from public	■ Problem of land use and its compensation.	■ Continuously do the campaign and socialization to make public understand the benefit of reservoir for them. ■ Select reservoir location where non productive land exists
	Lack of rules about utilization and management of reservoir water.	■ Water use conflicts occur	■ Make regulation on reservoir water use
Institutional aspect	Lack of information and coordination regarding reservoir development from local to central government who is in charge with water resources.	■ Many communities who require reservoir do not know where to submit funding	■ There should be a network between central and local government to disseminate reservoir development program ■ Existing regulations need to emphasize on the role of each institution involved in the construction of reservoir. ■ Existing regulations need socializing more intensively to all relevant institutions.
	Constructed reservoir is commonly found at unsustainable condition	■ Less maintenance done for constructed reservoir	■ Need a good spatial planning from local institution. ■ Need planning on budget allocation from Central Government for the operation and maintenance of the reservoir
Social and cultural aspect	Water use between community groups is not balanced and the overlap	■ The use of much water by a group of people can cause a sense of envy for those who use little water. ■ Inappropriate utilization of reservoir water in the community such as used for fish cages, bathing cattle and toilets	■ Created rules of reservoir water use. ■ Formed organization of reservoir water users ■ Created clear rules in the use of reservoir water. ■ Need a good reservoir pilot project dedicated for agricultural purposes and meeting the needs of clean water

Institutional aspect

The first institutional barrier component is the lack of information supply on the need of reservoir from the local institution to the central governmental institution dealing with water resources issue. The community who needs many reservoirs does not have any idea on where to submit the financial proposal.

Second, there is a lack of coordination among the institutions in conducting the installation of reservoir. This is caused by the lack of publication on the role of each institution responsible for the installation and maintenance of the reservoir. Consequently, many installed reservoirs are unmaintained.

Capacity building aspect

In the capacity sector, no barrier is identified. The support from the workers, natural and human resources facility as well as the capacity of the research institution in the installation of reservoir are already sufficient.

Intelectual Property Right (IPR) aspect

"Embung" reservoir making technology is actually common technology that has been mastered in the country. It only needs technology transfer from one location to others domestically. Therefore, it has not required the transfer of technology from abroad.

Social and cultural aspect

The first barrier component from the social aspect is the unbalanced usage of the reservoir water by the different community groups. The community owns various kinds of business with different level of water needs. The groups that use less water may resent the groups that use more water out of envy. This may lead to the disputes among the different community groups.

The second barrier component is the overlapping utilization of the reservoir water by the people. It is not unusual to see the reservoir water is being utilized inappropriately. For example, the reservoir water is used for floating fish cage, washing cattle, bathing, toilet use etc. Such use will decrease the quality of the reservoir water.

2.2.2.2. Barrier identification and analysis for the transfer and diffusion of wastewater recycle technology

Table 2-6 presents barriers identification of water recycling technology. It consists of six criteria: regulatory, economic and financial, institutional, capacity building, IPR, and social and cultural aspects.

Regulatory aspect

The barrier from the regulatory aspect is the lack of regulation to support the wastewater recycles activity. The Regulation of Minister of Public Works Number 6 of Year 2011 requires all activities that produce wastewater to conduct recycle process. Nevertheless, the regulation does not mention the quantity of water that has to be recycled, the technology to be used, the form of awards for those who have implemented and the sanction for those who have not.

Economic and Financial aspect

The barrier from the economy aspect is the high costs for the development of wastewater recycle technology system. It is due to the large number of the processing unit equipment required to recycle wastewater into clean water. Second, there is no sufficient financial incentive. Currently, the business community in the field of wastewater recycle does not

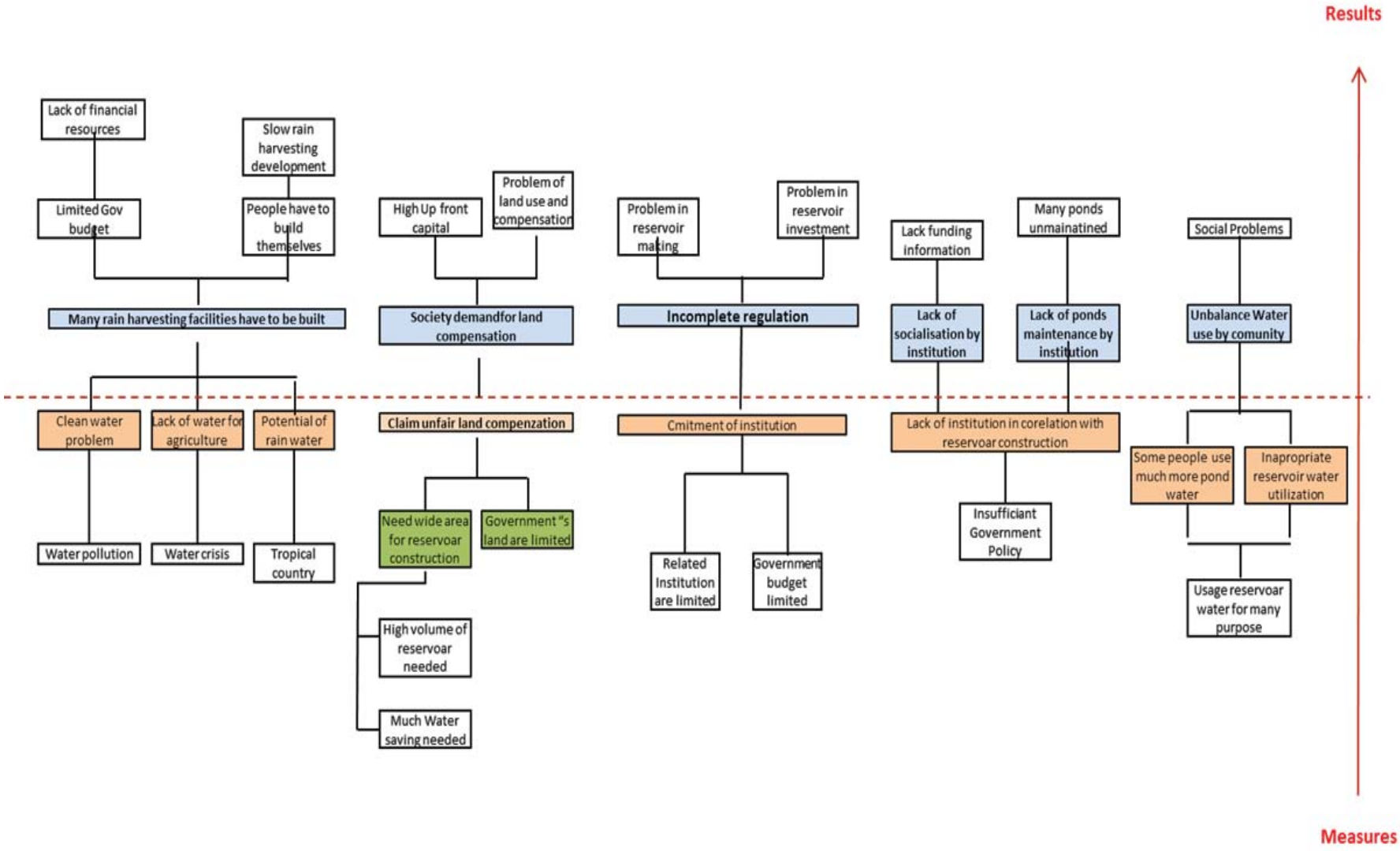


Figure 2- 4 Causal tree of technology transfer for rain harvesting technology

get any financial incentive, such as the reduction of tax and interest rates. This fact makes the wastewater recycle business to be difficult to develop. The third is the high cost for the operation and maintenance of the wastewater recycle equipment due to the initial treatment process, the number of processingunits required and the low quality of raw water used. At the municipal water treatment plant where the raw water used comes from rivers, the required treatment cost is USD 0.12 per m^3. Menawhile, the installation of domestic waste water recycle requires higher treatment cost that is amounting to USD 0.5 per m^3.

Institutional aspect

The first institutional barrier is the lack of institutions that implement the water recycle program. Currently, the institution which implements wastewater recycle program is still limited to the Ministry of Public Works. Consequently, the recycled water has not been used optimally. The second barrier is the absence of institution that is responsible to certify the feasibility of the recycled water products. This makes the society becomes reluctant in using such water.

Table 2- 6 Barriers identification of water recycling technology

Aspects	Barrier	Barrier Element	Overcoming Barrier
Policy and regulatory	Lack of regulations that support the implementation of wastewater recycling program		Need to issue a regulation which states that the actors who discharge domestic watewater must perform recycling of the wastewater at least 50% of its.
Economic and financial	High capital cost for the construction of waste water recycling systems	High capital cost due to many processing units of equipment needed to treat domestic wastewater into clean water	Banking rules need to be made for the low interest loan for wastewater recycling projects
	Absence of appropriate financial incentives	Business actors of waste water recycling do not receive financial incentives or tax relief or low interest rates	Need regulation about the reduction or elimination of entry tax (tariff) of water recycling equipment
	High operational and maintenance cost for wastewater recycling system	Need complicated equipment of processing unit required for wastewater recycling due to low quality of raw water.	Need to issue a regulation to regulate recycled water prices to make sustainable operation and maintenance of the water recycling system
Institutional	Lack of institutions that carry out programs of water recycling activities	Wastewater recycling program is done currently limited by the ministry of Public Works	It needs to make recycling programs more widely in other related institutions such as the Ministry of Industry, Ministry of Agriculture and Ministry of Research and technology
	Absence of institutions that is eligible to provide certification for recycled water treatment plant and its products	No assignment by the government of Indonesia to certify technology and recycled water product	It should be assigned by the government to certain institutions such as the Ministry of Industry or the Ministry of Public Works or the National Standardization Agency to certify the installation of water recycling and its product.

Capacity building	Lack of mastery of the latest water recycling technology	Insufficient transfer of technology and the absence of a pilot wastewater recycling technology in the region	Need training of recycled water treatment technology both in and outside the country.
Intelectual Property Right	There is no available high quality materials and installation of recycled water in domestically	Membranes and activated carbon of high quality still is not yet be produced domestically.	Need technology transfer of making high quality materials for installation of wastewater recycle system
Social and cultural	Water use habits by community and lack of information about the recycled water	Comunity commonly use well water or tap water for garden watering and others which do not need high quality water	Need socialization water recycling and campaign movements on the use recycled water
	The existence of negative perception in society that recycled water harmful to health	The absence of adequate information of water treatment technology and water recycling products to the public	Need early learning through formal education in schools about water quality and water treatment technologies. Needs to construct a pilot scale of recycling water treatment technology in a certain region.
	Some moslems have assumption that recycled water cannot be used for ablution	The absence of sufficient information about water quality and water treatment and technology to society	Need to socialization that recycled water has been well processed and its quality is clean enough for ablution water

Capacity building aspect

The barrier from capacity aspect comes from the lack of skilled workers that can support the success of wastewater recycling activity. The second barrier is the lack of supporting infrastructure, in the form of a process laboratory, to develop the research on wastewater recycles. The third is that not all equipments and materials for the installation of wastewater recycle can be produced in Indonesia. Some of them, such as the reverse osmosis and ultra filtration membrane, as well as high quality active carbon, are still imported from foreign countries. The fourth barrier is that there has not been any samples on the domestic wastewater recycle installation in the regional scale which can persuade society to approve the use of wastewater.

Intellectual Property Rights (IPR) aspect

The barrier from the intellectual property rights is caused by the fact that the some materials and spareparts for good wastewater installation cannot yet be produced in the country. For examples of those materials are mebranes for water filtration as well as high quality of activated carbon for pollutant adsorbance. This might need IPR if they are manufactured in the country.

Social and cultural aspect

The first social barrier is the society's custom in using water and the lack of information concerning the products of recycled water. People have not been able to accept the use of recycled water products since they have not been accustomed yet. This is due to the lack

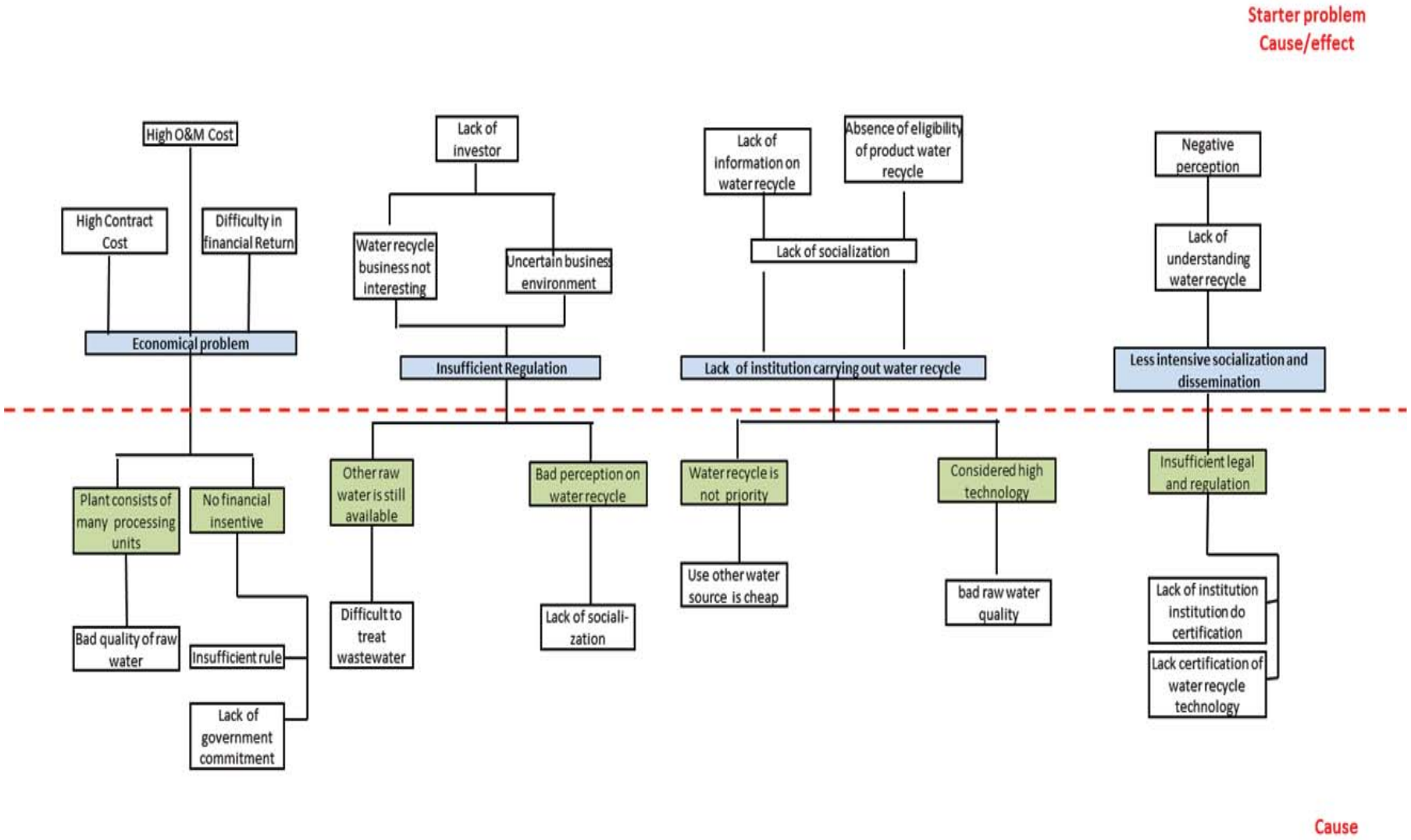


Figure 2- 5 Causal tree of technology transfer for wastewater recycling technology

of information on the water treatment technology among the society. In advanced countries such as Japan and Singapore, such social barrier is no more. Hence, the recycled water from domestic wastewater has been commonly used there.

The second barrier is the negative perception that the recycled water product is unhygienic and may be harmful to health. People worry that the use of recycled water will result in diseases. Religion factor is the third social barrier. Many Moslems consider that recycled water may not be used for *wudhu* (ritual ablution before prayers).

The second barrier is the negative perception that the recycled water product is unhygienic and may be harmful to health. People worry that the use of recycled water will result in diseases. Religion factor is the third social barrier. Many Moslems consider that recycled water may not be used for *wudhu* (ritual ablution before prayers).

2.2.2.3. Barrier identification and analysis for the transfer and diffusion of water resources projection model

Table 2-7 presents barriers identification of water recycling technology. It consists of five criteria: economic and financial, institutional, capacity building, IPR, and social and cultural aspects. Its causal tree of this technology is also presented as shown in Figure 2-6.

Regulatory

In the aspect of regulation, no barrier is identified. Any parties conducting modelling activities, either from certain institutions or the community, may freely use any software as they wish.

Economic and financial aspect

The first economic barrier is the absence of import custom incentives for hardware and software for the development of water resource modelling. This makes the costs of them become relatively high. The second barrier is the limited duration of the software for the

Table 2- 7 Identified barriers of water resources projection technology

Aspects	Barrier	Barrier Element	Overcoming Barrier
Economic and financial	The absence of duty incentives on hardware and software for developing water resources modeling	The price of modeling tools relatively expensive	■ Necessary to ease the process of customs regulations
	The limited lifetime of the modelling software of water resources	Modeling software must be upgraded after certain time	■ Need software with free lifetime
	Lack of marketing infrastructure, such as networking among the modeling users	Modelling product is difficult to obtain in the absence of networking support	■ Set up networking association water resources modeling
	Modeling product market competition does not develop	Lack of modeling user	■ Need socialization water resources modeling to the wider community

Table 2- 7 (Continued)

Aspects	Barrier	Barrier Element	Overcoming Barrier
Institutional	Lack of coordination in the use of software among institutions and research institutes	Currently there is no institution responsible for the use of software	■ Need coordination among (research) institutions for informatin changes about software of appropriate water resource modeling
Capacity building	Many government employees do not understand the importance of water resources modeling	Modeling systems are generally complex and complicated and also require input much data	■ Training in the use of water resources modeling to various government institutions
	Insufficient infrastructure that supports water resource modeling systems	To perform complex modeling requires reliable supporting software and computer with high capacity.	■ Need aid of realiable software and hardware
Intelectual Property Right	The high cost of IPR which leads to high cost, including price for updating the software to a higher version		■ Need transfer of technology for water resources modeling software from developed countries. ■ ■ Need support to put the water resources modeling software into the public domain, therefore making it accessible to developing countries with cheaper prices
Social and cultural	Modeling is rarely used directly by the public	Ordinary people do not consider modeling as something important	Need socialization or intense workshops to introduce the benefits of modeling of water resources to the community
	Habits of users who are reluctant to change and accept a new modeling software product	Users are comfortable with software products that have been owned	Intensive training is required to introduce the new modeling software

water resources modelling. The users have to update the software into the latest version and to renew the license which incurs relatively high expenses. The third is the lack of marketing infrastructure, such as networking among the modelling users. Currently, the users of the modelling are from industrial, mining, governmental institutions and academicians. The modelling products are difficult to find due to the lack of facilitating networking support. Furthermore, the users of such modelling are still limited. The fourth barrier is the stagnant market competition for the modelling due to the limited number of the users.

Institutional aspect

The barrier from institutional aspect is the absence of the institution responsible for the reliability and certification of modelling software. The certification is needed in order to protect the users of the modelling software. The second barrier is the lack of commitment from the

head of a certain institution in utilizing and developing water resource modelling. This causes the modelling activity cannot be developed optimally.

Capacity building aspect

The first barrier from capacity aspect is that most of the human resources are still uninformed about the importance of water resources modelling. The modelling systems are generally complex and complicated. Moreover, despite the fact that they need a lot of data input, the data which supported them is not sufficient. The insufficient information on the water resources degradation in the future becomes the reason to accept the modelling. The second barrier comes from the infrastructure that supports the water resource modelling. Operating a complex and complicated model requires support from facilitating infrastructure, such as software computers with high capability and communication networks to connect the region and the central area.

Intellectual Property Right (IPR) aspect

The barrier from the Intellectual Property Rights (IPR) is high cost of IPR that causes the high price of the modelling software including also the price to update the software into the latest version.

Social and cultural aspect

The first social barrier is that most people are not familiar with modelling software. At present, promotions are carried out in the form of workshops or scientific conference that discuss the softwares or products of water resource model prediction modelling. The second barrier is the habit of the users who are often reluctant to change or renew the softwares. Many users are already settled with the softwares they own. New softwares will require the users to learn further on how to use the softwares.

2.2.2.4. Linkages of the barriers identified

Linkages of barriers identified in the rain harvesting technology can be observed from the economic and social aspects. Social upheaval that occurs in connection with the reservoir water usage by various community groups has a significant impact to the flow of financial resource for the installation of reservoir. In the event any social upheaval occurs, the capital provider will likely feel reluctant in giving any loan or grant to the community groups which can be used for the installation of reservoir. Thus, one of the ways in countering the economic barrier is to minimize the risk of the occurrence of the possible social problems arising from the establishment of reservoir.

The linkage of the barriers in the wastewater recycle technology can be explained from the high cost of capital and capacity building aspects. The high initial cost is caused by the technology capacity and the treatment system of domestic wastewater into consumable water which requires a complex process as mentioned before. Therefore, the technology that will be used is more complicated compared to the one used in the conventional process for river water or groundwater, for example. The complexity and the quantity of the technology used contribute to the high cost of capital.

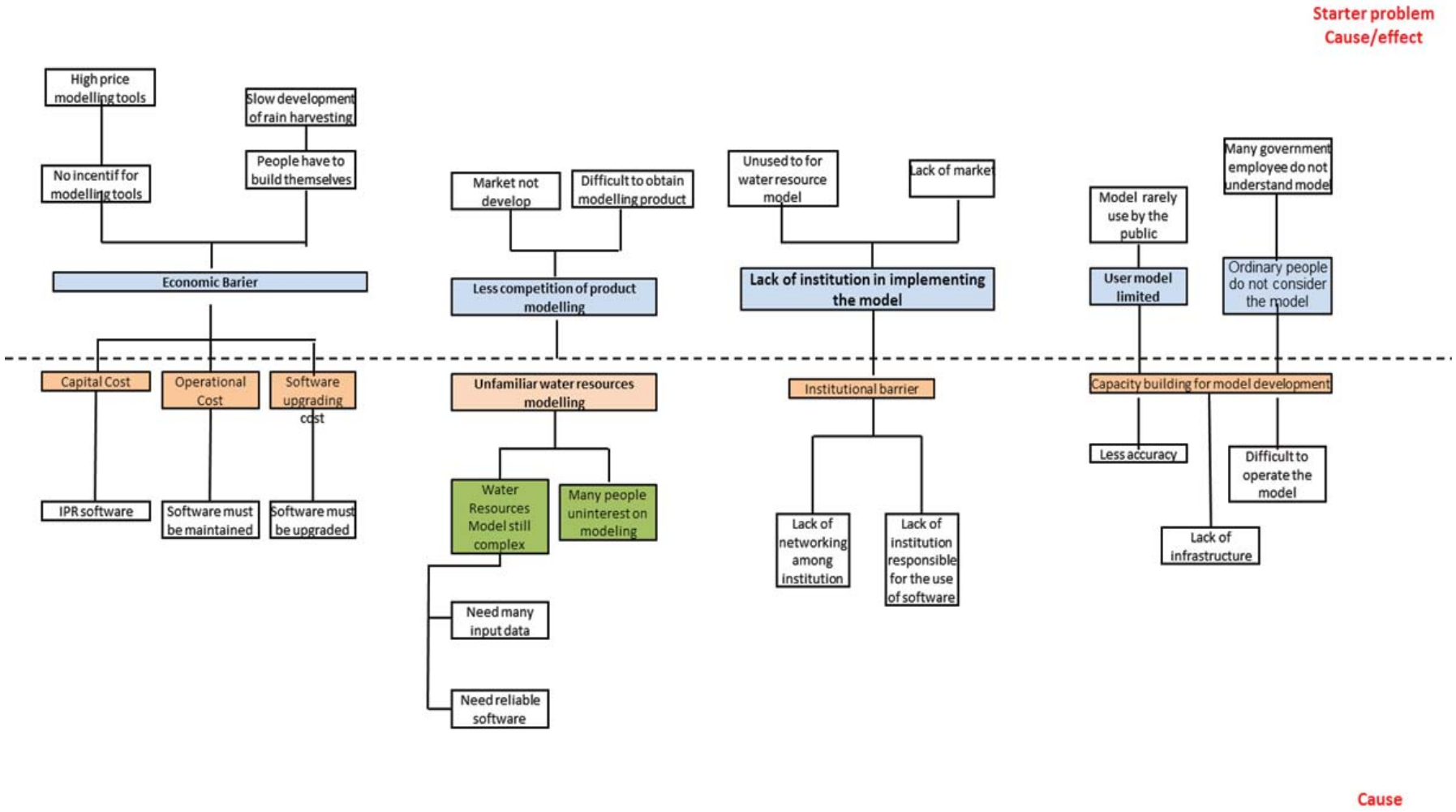


Figure 2- 6 Causal tree of technology transfer for water resource modelling software

The linkage of the barriers can also be explained from the institutional and social aspects. People are reluctant and not yet accustomed to use domestic wastewater recycle products. One of the causes may come from the lack of the capacity from the institution responsible to disseminate the information on the water treatment technology and recycled water products. The linkage between the barriers in the sectors of water resources modeling technology can be seen in the social and economic aspect. From the social side, product and infrastructure of water resource modeling is not widely known and understood by the general public. Therefore, there is a very little demand of water resource modeling by the community. With a little demand of water resource modelling, market competition of the water resource modeling does not develop that leads economically unattractive to its business.

2.2.3. Enabling framework for overcoming the barriers

2.2.3.1. Possible solutions to address the barriers for the transfer and diffusion of rainwater harvesting technology

Regulatory aspect

Barrier arises from the aspect of regulation is the lack of laws and legal framework regulating the installation of rainwater reservoirs. Therefore, it is necessary to produce a complete set of regulation on these points: land used for building the reservoirs, technical criteria for determining the location of reservoirs, and other technical regulations.

Actually, regulations on the utilization of water resources through the installation of rainwater reservoirs has already been set up, which are the Minister of Public Works' Regulation and specific spatial planning in each region. However, the regulations are still not sufficiently understood by the public, making them difficult to implement. Therefore, to successfully implement these regulations, more ardent and frequent campaigns and propagation, as well as strong law enforcement, are necessary.

The second barrier is the fact that the utilization of rainwater accumulated and harvested in the rainwater reservoirs often triggers conflicts of interest amongst members of society due to lack of specific regulations on management and exploitation of the new water resource. In order to eliminate these conflicts, a special regulation has to be made on the utilization of harvested rainwater.

Economic and financial aspect

The barrier that arises from economic aspect involves lack of access to financial resources, such as the absence of soft loans for funding the rainwater reservoir installation project. The current condition is that installing rainwater reservoir is almost entirely funded by the state budget (DIPA). Only local people independently fund a small part of the installation of storage reservoirs. Consequently, the effectiveness of the reservoir installation process depends almost entirely on the government budget.

The second barrier to the rainwater reservoir installation project comes from the considerably large sum of capital required for disseminating the project to the public, acquiring lands, and ultimately starting the installation of the reservoirs. As is the case today, applying for bank loans to accumulate the capital, which will be used to make the reservoirs, requires certain

collaterals and subjects to regular interest rate. The cost for the reservoir installation project is generally unpredictable because the landowners sometimes demand unreasonably high amount of money as the compensation for their lands acquired for building the reservoirs. To overcome these barriers in constructing the rainwater reservoirs, in addition to using the already allocated funds from the state budget, it is also crucial to obtain foreign aid in the form of grants and funds from domestic companies through corporate social responsibility (CSR) programs. Moreover, standardized rules of soft banking loans and easy access to funds from other sources are necessary.

To lower the unreasonable cost imposed by the landowners for their lands, it has become increasingly necessary to give regular and earnest campaigns and propagations so that the community can have broader understanding of the great future benefits offered by the reservoirs, including the fact that the lands selected for the reservoir installation is the least productive ones.

Institutional aspect

Institutionally, the most significant barrier is lack of information and coordination regarding the need for developing rainwater-harvesting project between regional stakeholders and the central government in charge for managing water resources. Local residents who are in need of rainwater reservoirs and want to take part in this enterprise often do not know where to channel their funds. In order to address this need, excellent networking has to be built between the central and regional government, as well as through dissemination of government's rainwater reservoir installation program across provinces. Although basic regulations on rainwater reservoirs have already been set up, the fact that we are still relying on the central government for publicizing the regulations is clearly an imminent sign that the development of rainwater harvesting will be slow.

The second barrier is lack of coordination amongst institutions in implementing the rainwater reservoir installation plan. To overcome this problem, existing regulations on role of each institution in the rainwater reservoir enterprise must be clearly defined and reaffirmed. In addition to that, a more intensive dissemination of the available regulations to all relevant stakeholders and institutions is required. The dissemination involves reaffirmation of the role of each institution responsible for the installation and maintenance of the rainwater reservoirs, so that after the reservoirs have been built, there will never be any serious obstacles to their operation and maintenance.

In the operation of rainwater reservoirs, a problem that will often be encountered is their sustainability. In order to maintain high sustainability, there is a need for a definite spatial planning set up by each regional government. Furthermore, there must also be a special planning by the central government to allocate some funds for the reservoirs' operational and maintenance costs, especially before the regions are ready to directly take charge for the operation of the rainwater reservoirs.

Social and cultural aspect

Social barriers arise from problems triggered by inequality of water supply amongst neighboring community groups. In order not to arouse envy between consumers who get larger water share and those who get smaller share, clear regulations need to be set up regarding the usage

and allocation of harvested water. Furthermore, an organization of local harvested rainwater consumers needs to be established in order to regulate fair and reasonable usage of rainwater so that conflicts on water use can be avoided.

Another obstacle is overlapping and conflicting interests regarding the use of harvested rainwater by different members of the community. There are many community members who apparently do not have complete understanding of the appropriate usage of harvested rainwater; consequently, it is possible to find harvested rainwater used for purposes that are not in line with the agreement made following the installation of the reservoir. To prevent against any violation to the appropriate uses of harvested rainwater, clear and definite rules need to be composed regarding the use of harvested rainwater. Equally important, those rules also need to be extensively publicized amongst the community members. For example, certain notices on the agreed allotment of harvested rainwater and on the imposed bans should be distinctly installed around the rainwater reservoir area. Operators of the rainwater harvesting facility are also expected to always supervise the use of the reservoir.

The society clearly needs a model on how to carefully manage rainwater reservoirs; such information will prove very beneficial to them. In order to achieve this end, an excellent pilot rainwater harvesting facility should be constructed so that it can immediately serve agricultural purposes and meet the society's need of clean water supply.

2.2.3.2. Possible solutions to address the barriers to the transfer and diffusion of water recycle technology.

Regulatory aspect

Barrier arising from the aspect of regulation is lack of laws and regulations which uphold the implementation of wastewater recycling system. To overcome this barrier, government should produce regulations which impose any enterprises generating domestic wastes to recycle at least 50% of their wastes. The regulation must also prescribe severe penalties for those who do not comply with the rules. It is also advisable to include tokens of appreciation for those who faithfully obey the regulations.

Economic and financial aspect

The first barrier is the considerably high cost for the installation of wastewater-to-clean water recycling systems. To overcome this financial barrier, we need to have banking rules that allow low interest loan for wastewater recycling projects. The second barrier is lack of appropriate financial incentives. To overcome this, the Ministry of Finance needs to make a special regulation on the reduction or elimination of tax on the import of water recycling equipments. The third obstacle is the high cost of operation and maintenance of wastewater-to-clean water recycling facilities. To address this problem, a clear regulation on suitable price for recycled water has to be made so that the operation and maintenance of wastewater recycling system can sustain.

Institutional aspect

Institutional barrier comes from lack of governmental bodies that are authorized to carry out the wastewater recycling programs. Because of this situation, we need to extend the wastewater recycling programs to cover extensive areas, such as for government buildings of Ministry of Industry, Ministry of Agriculture, the Agency for Assessment and Application of Technology, and the Jakarta City Hall.

The second institutional barrier is the absence of institutions which is authorized to conduct eligibility certification of recycled water treatment plants and recycled water products. The government can solve this problem by appointing certain institutions to deal with the job, such as the Ministry of Industry or Public Works, together with the National Standards Board to issue certificate of installation, as well as certificate of recycled water product.

Intellectual Property Right aspect

Another barrier comes from the aspect of intellectual property rights, which is our country's inability to self-produce good quality materials and equipments for the recycled water installation. Therefore, quick transfer of technology is essential for Indonesia to produce high quality materials for recycled water installation.

Social and cultural aspect

The first social barrier to the recycled water program is people's habitual ways of using water (many of which may not fit to the appropriate usages of recycled water) and lack of information about the recycled water products. Therefore, dissemination of water recycling program and campaign for recycled water use movement need to be extensively encouraged. People who are already very accustomed to using tap water or ground water for watering their gardens should be persuaded into replacing the tap water with the recycled water.

The second barrier is the emergence of negative perception that recycled water is harmful to health. To contest this rumor, proper education about water quality and water treatment technologies must be given to children since early ages through formal education at schools. By doing so, it is expected that people will fully understand that the recycled water, which has been processed with right technology, can be safely used as clean water.

The third obstacle is religion factor. Many Muslims think that recycled water is not acceptable for being used as ablution water. Therefore, Islamic authorities in Indonesia should issue a *fatwa* (official religious opinion) pronouncing that recycled water can now be considered acceptable for being used as ablution water, provided that the water has been appropriately and qualifiedly processed.

2.2.3.3. Possible solutions to address the barriers for the transfer and diffusion of water resources projection model

Economic and financial aspect

The first barrier from the aspect of economy is lack of duty incentive on imported hardware and software which will be used for the development of water resources modeling. Thus, it is not surprising that their prices are still relatively expensive. To overcome this, special policy need to be issued to ease the formal process and decrease the entry tariff.

The second obstacle is the limited applicability of the software for water resources modeling. Users are obliged to update the software to the latest versions at a high cost. To overcome this, the users must be supported by software with unlimited applicability or time-limitation free.
The third obstacle is lack of infrastructure for marketing, such as networks amongst model users from various areas, including industrial, mining, government, and academic circles. To overcome this problem, extensive networking must be built amongst them, such as network of water resource modeling associations.

The fourth barrier is fierce market competition, which may hinder the development of less-sophisticated model products due to their limited users. This can be overcome by actively publicizing the benefits of water resources modeling to the wider community. This effort is expected to convince the community user that modeling can really be a useful tool to make decision-making process more efficient and economical.

Institutional aspect

One institutional barrier is the absence of coordination amongst government bodies and research institutes regarding the use of software. Currently there is no institution claiming responsibility for the use of the software. All of the institutions are conducting their own modeling project using their respective software application they are already used to, without checking the software's reliability. This problem must be solved by building mutual coordination amongst government bodies and research institutions which also includes universities. By doing so, it is expected that they can share information with each other regarding what software is appropriate to make a particular water resource modeling.

Capacity building aspect

Another barrier concerning human resources capacity is the fact that many workers do not have good understanding of the importance of water resources modeling. Generally, modeling systems are considered very complex and so complicated that it requires an overwhelming input of data. To address this problem, users from the community/institutions need to undergo sufficient trainings in a variety of software for water resources modeling. The second barrier is lack of infrastructure that supports the water resources modeling system. The solution is to provide infrastructure in the mediums of reliable hardware and software.

Intellectual Property Right (IPR) aspect

One barrier regarding Intellectual Property Rights is the high cost of IPR, which in turn led to high price of modeling software, including the cost of updating the software to the latest version. To overcome this problem, quick transfer of the most sophisticated water resources modeling technology from developed to developing countries is clearly important. In addition to that, the developed countries should give their support in transferring the water resources modeling software to the public domain, thus making it accessible to developing countries at lower price.

Social and cultural aspect

One social barrier is that the model is generally not known by the public, so that general people may simply disregard the importance of water resources modeling. It can be said that modeling is only circulated amongst scientific communities, such as governmental research and development institutions and certain universities, while workshops or academic conventions discussing modeling is still relatively uncommon. Therefore, more vigorous public exposure or workshops are necessary for introducing the system of water resources modeling to the wider scientific community.

The second barrier is the tendency of scientific community to be reluctant to embrace change and accept any brand new modeling software products. This barrier can be lifted by conducting intensive trainings to introduce the latest modeling software products and how to use them.

2.2.3.4. Recommended solutions for water resource sector

a. Rain water harvesting technology

Solutions recommended for rainwater harvesting technology using reservoir system are as follows:

- Improvement of networking system between central and regional governments in terms of information about the needs for rainwater reservoir in respective areas.
- Reformation of regulations on the role of stakeholders in preparing, installing, and operating of the reservoir.
- Provision of incentives (e.g. supporting facilities for the reservoir) and easy access to financing (funding subsidized by, for instance, the government and private sectors) for the community which will install the reservoir independently.
- Campaigns and dissemination of the importance of rainwater harvesting with reservoir system for conservation of water resources.
- Composition of regulations on management and utilization of rainwater reservoirs in various communities and establishment of a reservoir operators organization.
- Installation of a pilot reservoir which will be equipped with a simple water treatment plant, so that the reservoir can serve the community as a reliable source of clean water.
- Installation of infrastructure for controlling sediments in the upstream reservoir; this is to prevent against the threat of sedimentation which can decrease the effectiveness of the reservoir.

b. Wastewater recycling technology

Based on the analysis of barriers and enabling framework that has been discussed above, there are some points advisable for the application of domestic wastewater recycling technology. The points are listed as follows:

- Campaign for promoting water recycling technology and recycled water products.
- Formulation of a policy simplifying import procedures for goods related to wastewater recycling technology.
- Formulation of a policy reducing taxes on imported equipment and material for wastewater recycling technology.
- Reduction in taxes on purchase of goods which will be used for the purpose of domestic wastewater recycling.
- Tokens of appreciation or incentive for stakeholders who are devotedly applying domestic wastewater recycling technology.
- Installation of a pilot domestic wastewater recycling installation for the purpose of providing clean water for the community living in a particular region.

b. Water resources projection model

In terms of the modeling of water resources, there are some recommendations that need to be offered to ensure smooth operation of the modeling processes. The points are listed as follows:

- Formulation of regulations ensuring easy procedure and lower cost for imported goods needed for the modeling.
- International aid in the form of software with unlimited applicability or time-limitation free.
- Network building, such as association of water resources modeling, which involves government institutions and private sectors.

- Dissemination of the benefits of water resources modeling to the wider community.
- Intensive trainings in how to use the modeling software.
- Trainings in a variety of water resources modeling software for general public/ institutional users.
- Infrastructural assistance in the form of reliable hardware and software from abroad which can be easily accessed for long period of time at a relatively low cost.

2.2.4. Concrete actions plans and ideas

2.2.4.1. Plans for domestic actions and measures

a. Rainwater harvesting technology

Description

The ready-to-implement concrete plan for adaptation to climate change on rainwater harvesting technology is to make a pilot rainwater harvesting reservoir which will be equipped with water treatment facilities. Rainwater harvested in the reservoirs is expected to serve the needs of the local community. The pilot plants will be built in the area that have major problem of water such as *Gunung Kidul* and *Nusa Tenggara Timur*.

The main objective of the project is to provide a pilot rainwater harvesting project which employs a rainwater reservoir with the capacity of 100,000 m^3. This reservoir is equipped with a moderate water treatment facility. It is hoped that this pilot rainwater reservoir project can serve as a model for rainwater harvesting projects in other regions.

Time line

Time line of the pilot rainwater reservoir installation project is predicted as follows.

First year

- Identification of total number of rainwater reservoirs required throughout regions in Indonesia.
- Prioritization of regions in dire need of rainwater reservoirs.
- Determining a region which has a great potential for becoming the site where the pilot rainwater reservoir installation project will be taking place (remote island or barren land would be favorable), such as the Province of East Nusa Tenggara.
- Preparation of the location of the rainwater reservoir installation.
    - Hydrological/geohydrological examination
    - Geological examination
    - Examination of soil structure / sustaining capacity
    - Examination of usage
    - Examination of capacity determination
    - Examination of rainwater harvesting technology implementation
    - Examination of environmental impact
    - Technical examination of rainwater reservoir installation planning
    - Financial examination of the rainwater reservoir installation

- Dissemination of the rainwater reservoir installation plan
  - Urgency of rainwater reservoir installation
  - Benefits of the rainwater reservoir for the future
  - Land requirement
  - Sustainable rainwater reservoir maintenance

Second year

- The rainwater reservoir installation
  - Land acquisition
  - Preparation of the location and field workers
  - Supply of materials and equipments
  - Rainwater reservoir installation
- Initial operation of the rainwater reservoir
  - Water filling
  - Leakage test
  - Training for the rainwater reservoir operators

Third year

- Monitoring and mentoring during the initial operation of the rainwater reservoir.
- Official opening ceremony and handing of the rainwater harvesting facility to the regional government.

Geographic scope

The area for the construction of pond pilot project will be located in the Province of East Nusa Tenggara (NTT). Until the end of 2010, six of 21 regencies of the NTT province have been a trouble for having clean water for daily needs. Those six regencies are Ende (Ende island), Sikka (at Palue village), East Flores (at Solor island), Belu (at Atapupu), Kupang (at Sulamu) and East Sumba (at Aha village).

They are considered to be water-prone areas because their people cannot have drinking water at a standard quantity , i.e around 30 liters per person per day. The amount of water in the province reaches around 354 million m^3 per month or equivalent to 136 m^3 per second however this area always experiences water defisit. These conditions are accompanied by the watershed (DAS) damage so that water debit declines. For solving water problem in this area, a good pilot pond (*embung*) is needed so it can store water for long period for public needs. This type of *embung* pilot plant is expected to be used as a reference for the government in constructing a good *embung* for other areas.

Resources needed

- A professional institution or a private company that manages pilot plant.
- Qualified expert who can transfer the technology and system of rain water reservoir pilot plant to the community.
- Skilled workers who have been trained and have discipline and commitment in supervising rainwater reservoir maintenance and operation at the field.

- Supervisors who fully support and continuously disseminate rain water reservoir technology to other areas.
- Central and local governments that fully support the implementation and development of rainwater reservoir plant.
- Sharing adequate fund from both donor and local government.
- Good community participation in the construction, operation and maintenance of the rainwater reservoir.
- Other facilities and infrastructure that support implementation program of *embung* contstruction.

Regulatory change

In order to guarantee the rainwater reservoir can be built and operated sustainably, it is necessary to hold legal protection. In this case is Law No. 7/ 2004 regarding water resources. Government needs to enforce this law appropriately to achieve the goal of *embung* development and operation. Also, Government Regulations No. 42/ 2008 regarding water resources management, No. 43/2008 regarding ground water, No. 37 regarding Dam, and No. 38/2011 regarding river can be used for guidances or references in developing *embung*.

Coordinating or implementing agency

Implementation of rainwater reservoir (*embung*) pilot plant requires coordination as well as implementing agency. In this case the implementing agency is the Ministry of Agriculture and Ministry of Public Works, while the supporting institutions are the Agency for the Meteorology, Climatology and Geophysics (BMKG) and others. In addition it is also necessary to do coordination with the Agency for the Assessment and Application of Technology (BPPT), and related local government.

b. Wastewater Recycling technology

Description

The concrete action plan designed for recycling domestic wastewater is to create a pilot domestic wastewater plant in an urban area. The area chosen is the Yogyakarta City, based on the consideration that it already has an integrated domestic wastewater treatment plant in a densely populated urban area.

Objectives

- To serve the local community as a model for domestic wastewater recycling technology with membrane system.
- To gain local people's trust and interest in using the recycled water.

Time line

First year:

- Survey on public perception regarding the recycling of wastewater with a sample of 10 major cities in Java Island.
- Planning of wastewater recycling process fro wastewater treatment plant (WWTP), Sewon.

Second year:

- Construction of the recycling wastewater at the wastewater treatment plant (WWTP), Sewon, Yogyakarta.
- Monitoring and evaluation of the wastewater recycling process of WWTP, Sewon, Yogyakarta.

Third year:

- Dissemination of wastewater recycling process in Yogyakarta Province.
- Dissemination of wastewater recycling in 10 big cities of Java, through mass media as well as seminars and/ or elucidations.

Geographic scope

Yogyakarta is one of the provinces in Java Island. One of the most important needs for the people of Yogyakarta is immediate access to clean water. Until this present day, people who have already had access to clean water from the provincial tap water company (PDAM) are only 67% of the total population. (Proceedings of Dialogue of Policy Planning and Management of Water Supply for Small Communities in Yogyakarta, CIDA-AIT, May 20, 2006). The most reliable sources of water are shallow wells and deep wells of Sleman regency but the public water service reduces to 40% in dry seasons. One important issue for Yogyakarta in the next five years is the availability of clean water. In 2010 the need for clean water in Yogyakarta reached 1,544 liters per second and, by 2020, it is predicted to increase to 2,899 liters per second. Considering this dire situation, reasonable solution needs to be made. One of possible strategies offered in this TAP proposal is to supply clean water derived from recycled domestic wastewater.

Resources needed

- Professional institution or a private company that built and manages pilot plant of water recycle.
- Qualified expert who can transfer the technology and system of water recycle pilot plant to the operator or community.
- Professional workers who have been trained and have the discipline and commitment to supervise field water recycle operation and maintenance.
- Supervisor who fully supports and continuously disseminates water recycle product and technology.
- Central and local governments that fully support the development and operation of water recycle pilot plant.
- Sharing adequate fund from both donor and local government.
- Good community participation in the construction, operation and maintenance of the water recycling pilot plant.
- Raw materials such as membrane filter and good quality of carbon filter media.
- Other facilities and infrastructure that support construction of water recycling program.

Regulatory change

In order to guarantee the water recycling pilot plant can be built and operated sustainably, it is necessary to hold legal protection and in this case is through Law No. 7/ 2004 regarding water resources. Government needs to enforce this law appropriately in order achieve the goal. In

addition it has been issued Government Regulatory No. 42/ 2008 regarding water resources management, Ministry of Public Works Regulatory No. 6/2011 regarding water resources usage guidance, and President Instruction No 2/2008 regarding energy and water efficiency that need to be followed in implementing wastewater recycling program.

Coordinating or implementating agency

Implementation of water recycling pilot plant requires coordinating and implementing agency. The implementing agency is the Ministry of Public Works while the supporting institutions are , Ministry of Environmental,the Agency for the Assessment and Application of Technology (BPPT), and Local Government.

c. Water resources projection model

Description

Flood and drought disasters that occurred in Indonesia was allegedly caused by global warming, unsuitable land use with the physical condition, and spatial planning which does not take into account the condition of natural resources and existing water system. Evaluation of the water system balance can describe the circumstances and needs of potential future water resources and can be used as data in conducting adaptive steps to anticipate the vulnerability of water resources due to the climate change.

The main objective of the water resource projection model is to develop the potential of Indonesia's water resources that consist of database of water resources, the use of geographic information systems, the quantity and quality of various types of water resources in one watershed of Indonesia. Also, inventory of the software will be carried out for modeling water resources in Indonesia as well as modeling and simulation of water balance.

The goal is to know the water resources potential projection of selected watershed as a base for the drafting of adaptation measures on long-term and short-term in facing water resource vulnerability due to global climate change.

Time line

Time line of the water resources projection model is predicted as follows.

First year:

- Determine a watershed location of the project activity. It will be selected one watershed whose condition is critical and needs immediate treatment, for example Citarum watershed.
- Collect secondary data from all institutions related to water resource management of that selected watershed area.
- Survey and collect primary data regarding the condition of the selected watershed area such as data of rainfall for a certain period, hydrogeology, water quantity and quality, and social economy of the society.

Second year:

- Do inventory of the software that can be used for modeling of water resource projections in Indonesian conditions.

- Establish a expert networking on water resources modelling.
- Perform simulation of water resources projection modelling that can provide input to the government for water resource protection, efficiently use of water resources and control of water resource degradation.

Third year:

- To disseminate the results of modeling to the public through seminars, workshops and trainings
- Formulate policies of short-term and long-term water resource management with reference from the results of the simulation model projections of water resources
- Conduct strategic planning in anticipation of water resource degradation and unsustainable utilization of water resources.
- Create a master plan of management, control and utilization of water resources in the selected watershed (Citarum).

Fourth year:

Develop water resource management scenario until the year 2025, 2050 or 2100.

Geographic scope

Citarum watershed (DAS Citarum) is the largest and longest river basin in West Java. DAS Citarum covers an area of 718,268 hectares and length of 269 kilometers. There are 12 sub-watersheds and three great basins (Saguling, Cirata and Jatiluhur). Citarum water is also used for rice field irrigation and drinking water for the people of Bandung, Cimahi, Cianjur, Purwakarta and Jakarta.

With such a big role of Citarum watershed and involving multi-stakeholders, it is necessary to have Citarum watershed water source to be projected through application of advanced modeling software. This modelling product will be a usefull information in decision making processes done by the government.

Resources needed

- Professional institution or a private company that operates and manages programming of water resources projection model.
- Qualified expert who can transfer the software usage and system water resources projection model.
- Professional workers who have been trained and have the discipline and commitment to be supervisor forrunning the water resources projection model.
- Supervisor that fully supports and continuously disseminates the water resources projection models and software.
- Central and local governments that fully support the development of water resources projection models.
- Sharing adequate fund from both donors and local government.
- Good community participation in the usage, operation and maintenance of the water resources projection model.
- Other facilities and infrastructures such us software and hardware that support implementation of water resources projection modelling program.

Regulatory change

In order to guarantee the water projection modelling application for the Citarum watershed water resources sustainably, it is necessary to hold legal protection and in this case is Law No. 7/2004 regarding Water Resources Management, Law No. 26/2007 regarding Master Plant of Local Government, and Government Regulation No. 76/2008 regarding Forest reclamation and rehabilitation.

Coordinating or implementating agency

Implementation, operation and usage of water resource modelling software require coordinating and/or implementing agency. In this case the implementing agency is the Ministry of Public Works and Ministry of Environmental while the supporting institutions are the Agency for the Assessment and Application of Technology (BPPT), and Local Government.

2.2.4.2. Project ideas for international support

a. Rain water harvesting technology

Type of technology transferred

One of the efforts used to lessen the *embung* water's absorption through soil is by coating it with geomembrane. Geomembrane is the waterproof layer usually used on artificial pond/ *embung,* sanitary landfill, final disposal, and irigation pond.

The advantages of geomembrane are its ability to endure from chemical solution, weather changes, high temperatures, elongation caused by ground soil deformation, fissures, and ultraviolet light. Geomembrane also has a relatively high melting index, and can be combined with different structure designs. The type of geomembrane applied for water structure is *Ethylena Propylene Diene Monomer* or usually called EPDM. The qualities EPDM possess are its endurance from sun ray, ozone, and other weather elements. Meanwhile, EPDM weakness is its low adhesive force.

At present, geomembrane from EPDM material is not yet produced in Indonesia. The producers of this material are Germany, Brazil, Thailand, and China. Therefore, in order to overspread EPDM utilization on *embung* construction in Indonesia requires a proposal on International project to assist producing EPDM.

Capacity Building

The objective of this project is for Indonesia to be able to produce our own *embung* geomembrane layer, one of which produces EPDM membrane type. The next step is the *embung* sampling production that uses geomembrane with financial support from foreign countries. Therefore, technology transfer for geomembrane production is necessary as well as its training.

Source of financing

Financial support from foreign countries in the form of grant in producing geomembrane factory and *embung* pilot plant construction is estimated to be USD 10,000,000

Resources Requirement

Specialist, patent, raw materials

Time line

First year:

- Geomembrane products inventory for *embung* layer.
- Geomembrane production training.

Second year:

- Indonesian geomembrane Industrial's detail planning

Third year:

- Geomembrane production in Indonesia and *embung* pilot plant construction with geomembrane layer.

Indicators of success

- The establishment of a rainwater reservoir with a capacity of 100.000 m^3 in a designated region.
- Excellent and sustainable operation of the pilot rainwater harvesting facilities.
- Improvement of the living condition of the people benefiting from the rainwater harvesting system.

Domestic partners

- Minstry of Public Works
- Ministry of Industry
- Agency for the assessment and Application of Technology (BPPT)

b. Wastewater recycling technology

Type of technology transferred

Currently Indonesian clean water supply is met through PDAM which is very low in numbers around 18% nationally. One of the problems is the continual decrease of raw water quantity and quality. It is beleived to be partly caused by the impact of global climate change. Therefore, domestic wastewater has a potential use for community clean water source.

Waster water recycle can be done through various technologies. It depends upon the target of intended water quality. To produce clean water used by the community it usually uses technology of coagulation, flocculation and sedimentation followed by conventioanl filtration method employing sand filter. This technology has already well-known in Indonesia and has many been used by PDAM. However, it has disadvantages those are requiring high amount of chemical materials and large land area so that it can have constraint if it is applied in the urban area with a high land price.

In order to efficiently treat domestic wastewater to produce clean water with a concise plant design is by employing advanced technology of ultrafiltration and reverse osmosis systems. One of these systems is so called membrane bioreactor (MBR). This system is very compact one that in a waste treating bioreactor is placed ultrafiltration membrane for directly filtering wastewater. This system only requires relatively small land area and produces better quality

of clean water. However, it has advantages those are more complicated in its operation and therefore needs high skilled operators.

MBR technology has been developed by Mitsubushi, Japan and some of them have been implemented in Indonesia but it still relies on imported spare parts and foreign operators/ experts. Thus, the transfer and diffusion of MBR technology to Indonesia to have more widely spread out need to be proposed through this document.

Capacity building

- Do technology transfer of MBR technology from foreign conutries to Indonsia so it could enhance the knowledge and expertise of Indonesians
- This technology transfer is in the form of planning, constructing, and operating water waste recycling technology with MBR system.
- MBR technology training for domestic water waste recycling

Source of financing

Financial support from foreign countries in building pilot plant of domestic water waste recycling installment with MBR technology is estimated to be U$ 2,000,000.

Resources requirement

Fund, experts and probably patent.

Time line

First year:

- Training on planning, constructing, and operating of domestic water waste installment with MBR.

Second year:

- Detail planning and construction as well as sampling of domestic water waste recycling with MBR.

Third year:

- Initial operation, monitoring and evaluation of MBR instalation and operation.

Indicators of Succes

- Construction of the Domestic Wastewater Recycling Plant at a city scale.
- Publics could receive recycled wastewater as their source of clean water.
- Clean water need in Yogyakarta Province is met.

Domestic partners

- Ministry of Public works
- Local Government
- Ministry of Industry
- Minstry of Environment
- Agency for the Assessment and Application of technology (BPPT)

c. Water resources projection model

Type of technology

Type of technology to be transferred is modelling software called "groundwater flow modeling with MODFLOW" and related programs. Flow Model module of finite-difference (MODFLOW) was developed by the U.S. Geological Survey (USGS). MODFLOW is a computer program to simulate the general features of the groundwater system (McDonald and Harbaugh, 1988; Harbaugh and McDonald, 1996). MODFLOW program is built in the early 1980s, the current model continues to evolve which is equipped with a new package and program development related to ground water used in the study. MODFLOW progam popularity as a computer program that can be used to simulate ground water is the most widely used program in the world for the simulation of groundwater flow.

Capacity building

The ability of researchers in Indonesia to master the modeling technology is very possible to be enhanced through the implementation of this computer model both hardware and software. If the hardware and software is available on the market in Indonesia the modeling technology for water resource will increase the capacity building of people who work on the projection water resources and finally colud be used for better decision making process.

Source of financing

Substantial funds are allocated to the cost of procurement of hardware (computers and their supporters) and software (software licenses), the cost for the procurement of data (through surveys and the purchase of secondary data, and salaries and wages for researchers and skilled persons.

Financial support from foreign countries in the form of grant in having the hardware and software for this modelling is required. Estimated fund for purchasing of the modelling system (hardware and software), installation, training and operation including data analyzing, interpreting and reporting as well as operation, maintenance and upgrading is around USD 2,000,000.

Resources requirement

Resources requirement includes specialist, skilled persons, building (office), equipment (hardware) and software as well as supporting equipment and materials.

Time line

First year:

- Iventory of hardware and software as well as all related supporting equipment and materilas to be used.
- Select personnels who are intended to work on the modelling software.
- Select location of the hardwares to be placed and networking for the purpose of software operation.
- Select location to be predicted of its water resource and find data of the location conditions.

Second year:

- Procure hardware and software of the model.
- Establish experts networking on water resources modelling.
- Do training by the vendor to personnel who will work on it.
- Do installation of the modelling system.
- Try out (commisioning) of the equipment and its system.

Third year:

- Operate the system.
- Analyze and validate data for its prediction of water resource in the future in designated location.
- Evaluate the operation of the system
- disseminate the results of modeling to the public through seminars, workshops and trainings

Fourth year:

- Improvement of the situation in the future, by using a design scenario,
- Do more extensive use for its prediction and research.

Indicator of success

- Obtained complete data of water resources in one particular watershed in Indonesia (e.g. Citarum watershed)
- Identified various water resources modeling software.
- Formed networking of modeling actors of water resource.
- Availability of water resources modeling data that can be used to input the model so that it can answer how to protect, utilize and control water resource degradation in that particular watershed.
- Implemented training in the use of new modeling software of water resources.
- Arranged water resource management scenarios in a particular watershed in the long run.

Domestic partners

- Minstry of Public Works
- Ministry of Industry
- Agency for the Assessment and Application of Technology (BPPT)
- Related local government

2.2.5. Summary

Water resource is one of the crucial sectors in Indonesia affected by global climate change. The occurrence of floods and prolonged droughts are problems that need to be anticipated in both long and short-term period. This document discusses the technology action plans to anticipate the impact of climate change on water resources sector.

The selected technologies are obtained through technology prioritization process involving various stakeholders and experts as reported in the TNA document of Section I. Those prioritized technologies are technologies for rainwater harvesting, recycling of domestic waste water and water resource modeling projections.

Rainwater harvesting technology is carried out through development of small-scale reservoir ("embung") in a certain area. Reservoir volume is no more than 100.000 m^3. Reservoir water is used by people for agricultural purposes and the provision of community water sources. These reservoirs are equipped with simple water treatment facilities such as slow sand filter to improve water quality so it can be more safely utilized by the community.

Wastewater recycling technology is made to recycle domestic wastewater. Domestic wastewater is a relatively large number compared with industrial wastewater. The quality of wastewater is relatively safer for reuse so that domestic wastewater is an alternative source of raw water to address the water crisis in the future. This type of water recycling technology depends on the desired water quality. The target of this technology is to produce recycled water that is equal to or better than tap water. Therefore the applied technology must employ a membrane filtration technology.

To be able to define more accurately what adaptation measures are necessary to anticipate the vulnerability of water resources, it is needed indispensable data projections of future water resource conditions. These data can be obtained from the results of a modeling of water resources in a particular region. This requires modeling tools in the form of hardware and software that can be obtained from within or outside the country. With reference to the results of modeling of water resources, it will be able to devise utilization, protection and control of the damaging effects of water resources.

All three prioritized technologies can be applied in the country, when the arising barriers can be minimized. These barriers include economic, regulatory, institutional, social, and intellectual capacity aspects of the technology. In this document it is reviewed on an analysis of the barriers and how to minimize them. It is also performed market mapping, and describes what proposed activities for the scope of domestically and international aids.

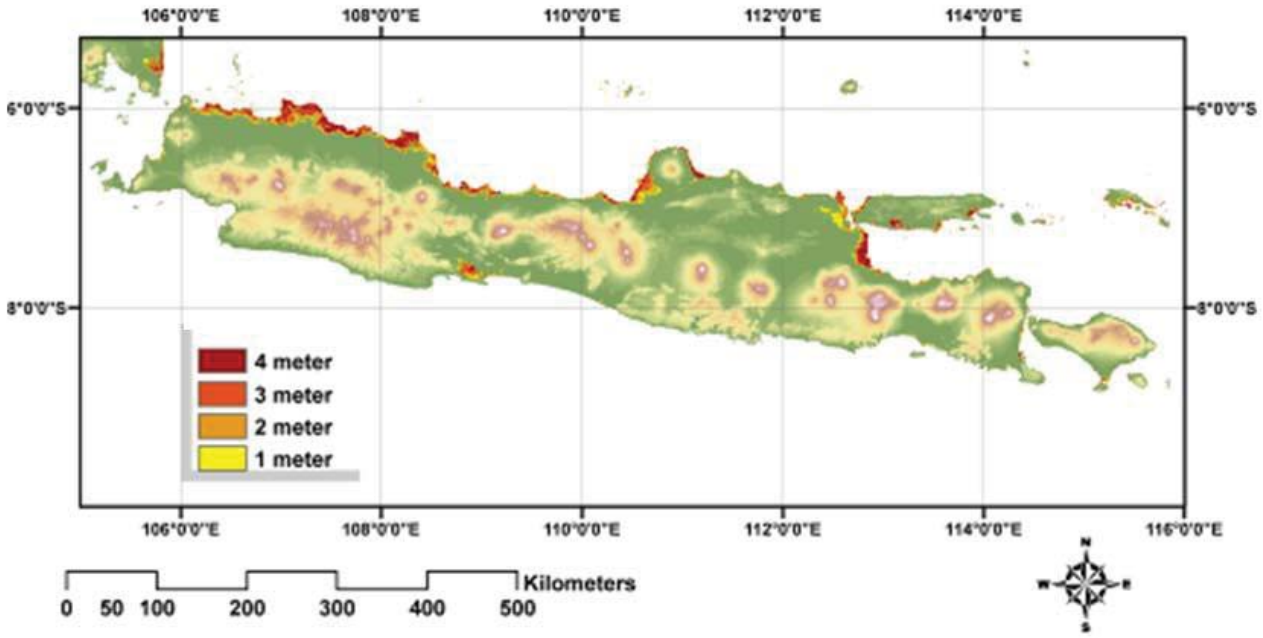
2.3. TAPs for coastal vulnerability sector

2.3.1. Preliminary targets for technology transfer and diffusion

Most of big cities in Indonesia are located in coastal area, such as Jakarta, Surabaya, Semarang, Denpasar, Makassar, Manado, Banda Aceh, Padang, Medan, Lampung, Mataram, and Ambon. About 140 million or 60% of Indonesian population live within radius 50 kilometers from the coastline in 42 cities and 182 districts (kabupaten); and about 48 million or 23% of that population live below the poverty line (RAN PI, 2007). In fact, many coastal areas have become the hub for various activities such as recreation/tourism, transportation, industry, residency, harbor, business, environmental service, and others. Global warming will raise the surface of seawater due to the added volume of seawater and the melted of the polar ice sheath. The rising of sea-level may result in the flooding of some land area. This will affect economics activities in coastal cities affected; thus may influence the national economic's stability. Indonesia has dozens of thousands small islands. Sea level rise (SLR) may also cause some of small islands to submerge, especially small islands with low-lying topography. The estimated average rate of SLR in Indonesia is around 0.6 cm/year (ICCSR, 2009). Based on available SLR scenarios, maps of inundated area have been developed as exemplified for Java Island below and the projection of the size of inundated areas in each region in Indonesia in 2030 is illustrated in Figure 2-7.

Coastal vulnerability toward coastal flooding due to global sea-level-rise and due to storm surge and La Nina climate variability shown in Figure 2-8, which shows the level of vulnerability within Indonesia's coasts. In General, the level of vulnerability of the region is divided into: (1) high to very high for some parts of Java's north coast, parts of southern coast of Central Java and Bali, especially around the major cities; (2) medium for most of the east coast of Sumatra, north coasts of Java, small part of the coasts in East Nusa Tenggara, Sulawesi and Maluku, as well as the southern coast of Borneo/Kalimantan and Papua; and (3) low to not prone for most of the west coasts of Sumatra and southern coasts of Java, most of the coasts in Nusa Tenggara, Sulawesi, the Moluccas and the north of Papua.

Figure 2- 7 Simulation of coastal inundation in Java-Madura-Bali (ICCSR, 2009)



Given the magnitude of potential impacts due to sea-level-rise, and to minimize the impacts, thus efforts of climate change adaptation through development of coastal protection structures and coastal reclamation, become important to be implemented. Materials for construction of coastal protection structures should be attempted to the greatest extent possible tailored to the availability of local materials found in the area or areas where the development is taken place. Seawall/revetment may be constructed from a variety of materials, most commonly: reinforced concrete, boulders, steel, or gabions. Additional seawall/revetment construction materials may include: vinyl, wood, aluminium, fibreglass composite, and with large biodegradable sandbags made of jute and coir. In coastal reclamation project, there are many aspects that must be considered, i.e. before, during and after the reclamation. These aspects include: physical, ecological, social-economic, culture, environment, legal aspects, feasibility, planning, and construction methods.

Figure 2- 8 Vulnerability maps of sea level-rise hazards in Indonesia (ICCSR marine and fisheries sector, 2010)

Examples of seawall, revetment and coastal reclamation are given in Figure 2-9. It is an example of a modern seawall and revetment in Ventnor on the Isle of Weight in the United Kingdom, as well as coastal reclamation at Losari beach, Makassar, South Sulawesi of Indonesia.

An example of a modern seawall in Ventnor on the Isle of Wight in the UK. (Source: http://en.wikipedia.org/wiki/Seawall)

An example of revetment (Source: http://www.snh.org.uk/publications/on-line/heritagemanagement/erosion/appendix_1.16.shtml)

An example of Losari-Makassar coastal reclamation (Source: Subandono, 2009)

Figure 2- 9 Examples of seawall, revetment and coastal reclamation

2.3.2. Barrier identification and analysis

Barrier analysis has been done according to five criteria: regulatory, economic and financial, institutional, capacity building, and social and cultural aspects. The two selected adaptation technologies for coastal vulnerability sector are similar and therefore the identified barriers for coastal protection technology (seawall/revetment) and coastal reclamation technologies are presented in one Table 2-8. Similarly, the causal tree relation of identified barriers of those two technologies is put in one Figure 2-10.

2.3.2.1. Barrier identification and analysis for technology transfer of coastal protection technology (Seawall/Revetment)

Regulatory aspect

Regulation and Technical Guidelines related to coastal protection issue do exist. Among other are: a). Minister of Public Works Regulation No. 09/PRT/M/2010 on Coastal Protection Guideline (*Peraturan Menteri Pekerjaan Umum* No. 09/PRT/M/2010: *Pedoman Pengamanan Pantai*); b) Guideline on Construction of Coastal Protection Structures (*Surat Edaran No.07/ SE/M/ 2010*); c) Guideline on Valuation of Coastal Damage and Its Management Priority (*Penilaian Kerusakan Pantai dan Prioritas Penanganannya, Surat Edaran* No.08/SE/M/2010); both published by Ministry of Public Works. The main problem is that those regulation and guidelines are relatively new, thus not much people understand and implement them.

Economic and financial aspect

High cost of capital for materials and equipments in the construction of seawall/revetment may exist as barrier element in implementing these coastal protection structures as adaptation measures for climate change effects, especially, if the length of coastal to be protected is tremendously long and the location is considered difficult (i.e. rough seas, access to location is not easy and costly, scarcity of materials, etc).

Table 2- 8 Identified barriers of seawall/revetment and beach reclamation technology

Aspect	Barrier	Barrier element	Overcoming barrier
Policy, legal and regulatory	Insufficient legal and regulatory framework	Existing regulations and guidelines have not been implemented properly yet	Need policy for implementing the existing regulations and guidelines properly
Economic and financial	High cost of capital	High construction costs (material, construction works, equipments, and/or environmental costs)	Need policy for financial support
			Consider the availability of local materials
	Financially not viable for places not having high economic value		Need policy for financial support to make financially viable places
	Uncertain financial condition	The ambiguity of energy tariff (fuel cost)	Need maintenance economic stability
	Uncertain macro-economic condition	Volatile inflation rate and high price fluctuations	Need stability in political and social conditions
		Unstable currency and exchange rates	Need stability in political and social conditions
Institutional and organizational capacity	Limited institutional capacity	Lack of interest or capacity in existing institutions to audit construction planning	Need policy to push the interest or capacity of existing institutions to audit construction planning
		Limited R&D culture (R&D facilities missing, lack of capacity for R&D, lack of appreciation of R&D role in technology adaptation)	Increase the R&D culture, such as R&D facilities and funding, capacity for R&D, appreciation of R&D role in technology adaptation
	Weak connectivity between actors favouring the seawall/ revetment and coastal reclamation technologies	Insufficient cooperation between industries and R&D institutions	Need policy to support and increase joint research collaboration between private sectors (industries) and R&D institutions

Table 2- 8 (Continued)

Aspect	Barrier	Barrier element	Overcoming barrier
Social, cultural and behavioural	Consumer preferences and social biases	For seawall/revetment: Aesthetic considerations, product lacks appeal; For reclamation: New reclamation area is potential for conflict of interest among stakeholders	Conduct socialization and dissemnination of positive impact of coastal protection structures and reclamation to the stakeholders (planner, contractor, community)
	Inadequate information	Poor dissemination of information to technology users (on product, benefits, costs, financing sources, potential project developers etc.)	Need dissemination of information to technology users in various ways, such as develop handbooks, website, etc.
	Lack of media interest in promoting technologies		Need policy to increase the media interest in promoting technologies
	Lack of awareness about issues related to seawall/revetment and coastal reclamation technologies solutions		Good awareness about issues related to seawall/revetment and coastal reclamation technologies solutions by conducting Public Consultation Meeting
Capacity	Poor O&M facilities	Lack of O&M periodically	Need to conduct O&M periodically
	Lack of standards, codes and certification	Lack of initiatives to set standards	Need standardization for seawall/ revetment and coastal reclamation technologies
	Environmental impacts, such as local pollution (only at construction stage) and ecological aspects		Need policy to implement the suitable regulations and guidelines to decrease environmental impacts, such as local pollution (only at construction stage) and ecological aspects

Seawalls/revetments are not financially feasible for places not having high economic value. Uncertain financial condition, such as the ambiguity of energy tariff (fuel cost) would influent the cost of materials and construction works that will add-up the construction cost. Uncertain macro-economic condition, like volatile inflation rate and high fluctuations, as well as unstable currency and exchange rates, will also contribute to economic and financial barrier. The construction of coastal protection structures in a certain location takes time and resources. Unstable economic condition during construction phase may alter materials and equipment cost, which consecutively differ the quality and the quantity (length) of the structure being build.

Institutional aspect

Limited institutional capacity may become barrier, such as: lack of interest or capacity in existing institutions to audit construction planning. Moreover, limited R&D culture (especially in private developer/contractor) may be considered as barrier; this includes missing of R&D

facilities, lack of capacity for R&D, and lack of appreciation of R&D role in technology adaptation. Weak connectivity between actors favoring coastal protection technology, such as insufficient cooperation between industries and R&D institutions is considered as a barrier as well.

Capacity building aspect

Poor Operation & Maintenance (O&M)

The resulting seawalls/revetments should be maintained periodically. Extreme wave may occur and disturb the stability of coastal protection structures. To maintain and to sustain the usefulness of coastal protection structures definitely requires funds.

Lack of standards, codes and certification

National standards, code and certification are still deficient in addressing some factors as mean of adaptation to climate change, such as increasing extreme wave, wind speed, air temperature, precipitation, etc. Moreover, the implementation of standards/codes/ certification in coastal construction is still poor. To some extends, specific standards/ certifications in coastal structures are not obligatory.

Environmental Impacts

Environmental issues mainly arise during the construction stage; such as local pollution at construction site and during transportation of materials, increasing water turbidity, noise, ecological aspects, etc.

Social and cultural aspect

Consumer/community preferences and social biases may alter the construction of seawall/ revetment in some locations, due to aesthetic considerations or product lacks appeal. Recreational sandy beaches might look 'bad' or unnatural in the presence of this 'hard structures'. Lack of awareness about issues related to climate change and technological solution may become a barrier as well. Inadequate information, such as poor dissemination of information to technology users (on product, benefits, costs, financing sources, potential project developers etc.) and lack of media interest in promoting the technologies may become a barrier as well, since the condition may lead to the community resistance on the planning to build expensive seawall/revetment.

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2.3.2.2. Barrier identification and analysis for transfer and diffusion of coastal reclamation technology

Regulatory aspect

Currently, numbers of relevant rules and regulations for reclamation activity are in act in Indonesia. Regulatory issue should not be considered as a barrier as long as all related rules and regulations are abided by stake holders. In 2004, a Guideline for Reclamation in Coastal Area published by the Ministry of Marine Affairs and Fisheries. Act No. 27/2007 on Coastal and Small Islands Management (*UU No. 27/2007 tentang Pengelolaan Wilayah Pesisir dan Pulau-Pulau Kecil*) set that reclamation should be able to guarantee the sustainability of the lives and livelihoods, ensuring a balance between the interests of the utilization and conservation of coastal environment and the interests of small islands, as well as ensuring that technical quarrying, dredging and stockpiling of material carried out in accordance with the requirements is a mandatory. Earlier, the Ministry of Marine Affairs and Fisheries issued a Guideline in Coastal Reclamation (SK.64D/P3K/IX/2004). The problem is the regulation that has been around not yet been implemented properly.

Economic and financial aspect

Coastal reclamation requires large capital. High cost of capital for implementing these technologies mainly due to high construction costs which include the cost of materials (landfills, concretes, etc), construction works, equipments and environmental cost. Table 2-9 illustrates the cost of several reclamation projects experienced in several locations of Indonesia and other countries.

Table 2- 9 Examples of cost for several reclamation projects

Name/Location	Reclamation area	Reclamation Cost, USD
Pantai Losari Makassar (Indonesia)	150 Ha	47 Million
Pulau Nipah (Indonesia)	63 Ha	30 Million
Cordova Metro Cebu (Philippine)[2)]	3,000 Ha	460 Million
Palm Jumeirah (Dubai)	2,500 Ha	12.3 billion

Consideration of environmental costs in the project's cost-benefit analysis will increase the capital cost. Environmental costs mainly arise from the loss of coastal resources (and the ecosystem goods and services they provide) as well as from the adverse impacts of landfill quarrying. In places with high marine diversity, the environmental cost of reclamation project is most likely become large. Environmental costs is estimated from the value of major environmental impacts, such as: (1) the loss of on-site fisheries; (2) the loss of reef gleaning; (3) the loss of potential recreational benefits from the affected coral reef; and (4) the environmental damage from landfill quarrying (Montenegro, et.al., 2006).

Coastal reclamation is considered as one of the proven technology that can be used as coastal adaptation measure to rising sea level as consequences of global warming. However, coastal reclamation is financially not viable for places without high economic values or vital usage.

Uncertain financial condition such as the uncertainty of the energy price in the country could also become a barrier in implementing the technology for adaptation. Moreover, uncertain

macro-economic condition such as volatile inflation rate, high price fluctuation, and unstable currency and exchange rate, might also contribute as barrier since those non-conducive situations may affect the material and construction cost.

Institutional aspect

Limited institutional capacity may become barrier, such as: lack of interest or capacity in existing institutions to audit construction planning. Moreover, limited R&D culture (especially in private developer/contractor) may be considered as barrier; this includes missing of R&D facilities, lack of capacity for R&D, and lack of appreciation of R&D role in technology adaptation. Moreover, weak connectivity between actors favoring coastal reclamation technology, such as insufficient cooperation between industries and R&D institutions is also considered as barrier.

Capacity building aspect

Poor Operation & Maintenance (O&M)

The resulting coastal reclamation area needs to be maintained in regular basis. Scoring and extreme wave may occur and disturb the stability of reclamation structures/parts. Ideally, O&M is conducted every 6 (six) months up to 1 (one) year period. Poor O&M commonly is due to the lack of funds to maintain and sustain the existing coastal reclamation project.

Lack of standards, codes and certification

Climate change may bring increased storm activity, flooding, or sea level rise, which in turn will increase wind and wave forces on structures/buildings, including in those areas not currently vulnerable. The International Standards Organization (ISO), for instance, has incorporated a significant level of technological aspects as adaptation to climate change effects. On the contrary, national standards, code and certification are still deficient in addressing such kind of factors as mean of climate change adaptation. Moreover, the willingness to implementing standards/codes/certification in practice is still poor.

Environmental Impacts

It is common that a reclamation project opposed by the community due to environmental issues. In terms of material supply, reclamation project has the potential to cause new environmental problems, especially in the quarry location as well as during transportation of materials. This is due to the huge amount of material needs for a reclamation project. As an example of environmental damage resulting from sand mining for material reclamation, such as increasing turbidity of the waters which decline the fishery resources and destruction of the existing biota (ecological aspects) and, the worst, sinking of small islands around the quarry site.

Social and cultural aspect

The potential existence of consumer preferences and social biases are because new reclamation area has a potential to generate conflict of interest among stakeholders. Therefore, the City Planning Agency must play a significant role to regulate and plan the land usage. Inadequate information such as poor dissemination of information to technology users (on product, benefits, costs, financing sources, potential project developers etc.) can also cause the social and cultural conflict. In addition to that is also lack of media interest in promoting technologies as well as lack of awareness about issues related to climate change and technological solutions.

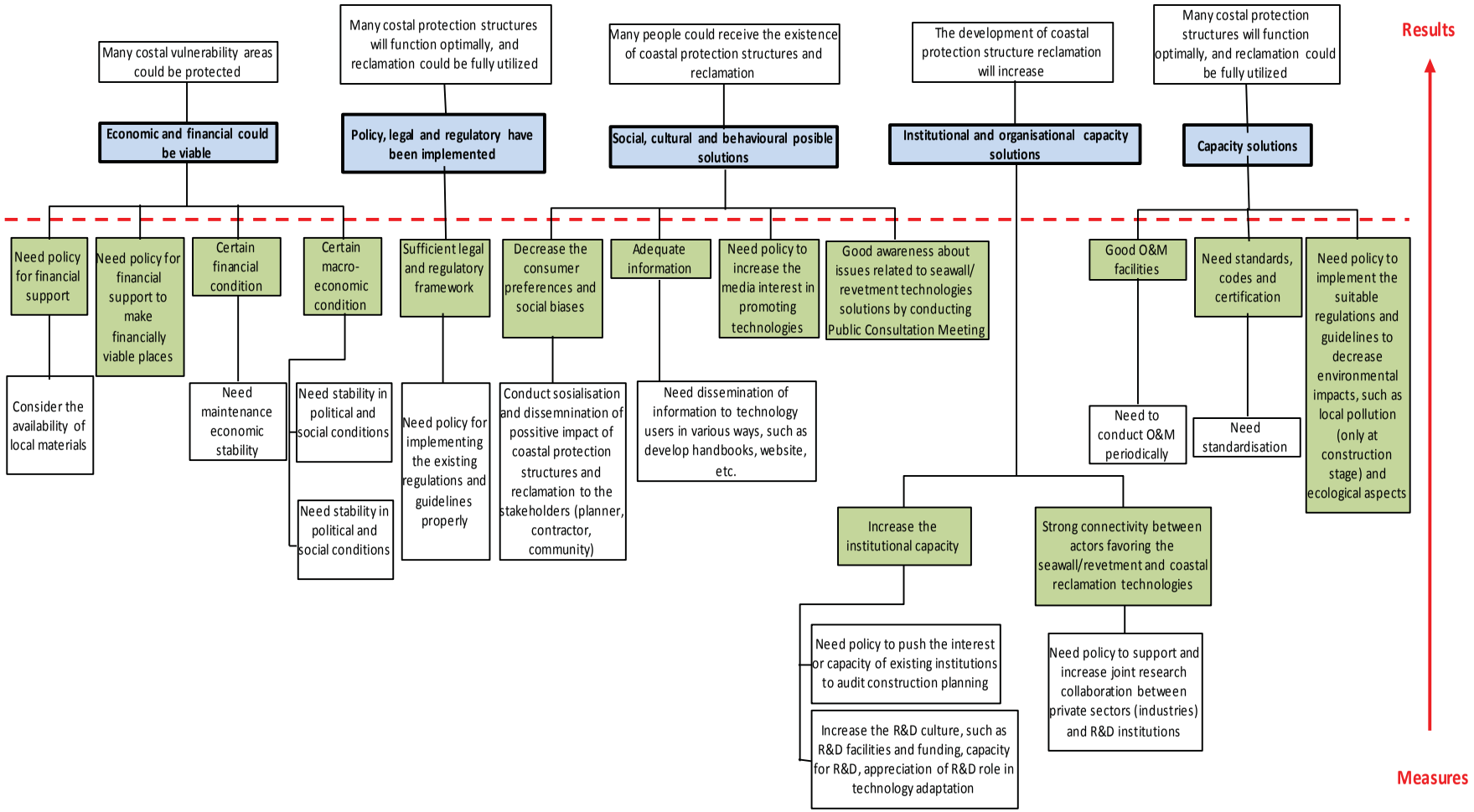

Figure 2- 10 Causal tree relation of barriers for seawall/revetment and coastal reclamation technology

2.3.2.3. Linkages of the barriers identified

Based on discussions and input from various experts and resource persons, it was decided that in principle, the barriers and barrier elements of this two technology priorities in coastal vulnerability are the same. Thus, the enabling framework in overcoming the barrier can also be said to be the same. The most crucial barrier is the amount of initial capital to be secured for the development of reliable coastal protection structures as well as for coastal reclamation project. From financial point of view, the expensive initial capital to be allocated for shore protection and coastal reclamation project is not viable if applied to areas without high economical value, nor even have the potential of tourism, even though shore protection and coastal reclamation is implemented.

In general, the distinctions between the two technologies are in substance of 1) element barrier insufficient legal and regulatory framework; 2) element barrier consumer preferences and social biases.

2.3.3. Enabling framework for overcoming the barriers

2.3.3.1. Possible solutions to address the barriers for the transfer and diffusion of coastal protection technology (seawall/ revetment) and coastal reclamation technology

Policy and regulatory aspect

To address the regulation issues, it is necessary to set up a policy so that the existing rules and regulations in coastal reclamation were implemented properly. So that, sustainable coastal management community-based can be achieved.

Environmental issues in reclamation project should be taking care seriously. The implementation of Act No. 32 (PPLH) could minimize this barrier. In addition, Guidelines for Reclamation in Coastal Areas (MMAF, 2004) should be enhanced and used as a guideline in every coastal reclamation project in Indonesia.

Economic and financial aspect

The issue of high construction-cost should be resolved by creating a policy to provide a full support of funds, so that the creation of coastal protection and development of coastal reclamation can be conducted. Specifically for coastal protection, there are two options, namely seawall and revetment; where the cost for construction of seawall is more expensive than the construction cost of revetment, considering the availability of local materials.

Uncertain financial condition and macro-economic condition which potentially increases coastal reclamation cost, it could be overcome by maintaining economic stability in the country. Stability in political and social conditions may also lead to favorable economic condition.

Institutional aspect

Operation and maintenance (O&M) require the existence of an agency (or agencies) responsible for maintaining the condition of flood protection system in the reclamation area. Its main tasks are:

- Develop, implement, manage and adjust the monitoring programs
- Review and assess of monitoring data
- Administration of the data monitoring and reporting
- Periodic reports on the status of flood protection structures
- Preparation of the decision to do the repairing activity
- Operation and maintenance

The organizational structure of this O&M system depends strongly on the local social, political, and financial conditions. Certain budget should be allocated and secured for O&M activities. Monitoring program as part of O&M activities can be distinguished as monitoring *during* the construction phase and monitoring *after* the project completed. Monitoring is essential to ascertain whether in its implementation in accordance with predetermined design standards.

Capacity building aspect

Limited capacity in R&D culture should be enhanced by optimizing the existing government institutions/research agencies, such as conducting joint research and research collaboration with private sectors. Funding for R&D activities should be allocated properly. In addition, the government should issue policies/regulations to support and enhance cooperation between the industry and R&D institutions.

Standards and codes should be adapted to climate change effects, and implemented on coastal reclamation project. Furthermore, this practice should become a basis of establishing a permitting program that requires municipal or state inspection officials to ensure structural integrity and maintain quality control in building practices. For seawall/ revetment, the common practice in the construction of coastal structures is by adding the structure elevation with +0.5 meters as a safety factor to sea level rise.

Information limitations and capacity issues can be addressed in various ways, such as: develop handbooks, websites and other educational materials to clarify each agency's legal jurisdiction and authority in coastal reclamation.

Particular attention should be given to monitor the functions of existing system after new construction is completed and during treatment in the construction contract. In this phase contractors play the role. Monitoring process should be followed by developers / users with the following activities:

- In the first 3-years after completion, the protective seawall should be inspected every three months. After this period, the inspection interval was gradually extended to every six months then every one year. In addition to regular monitoring, the assessment is also required immediately after extreme storm events occur.
- Scours should be carefully monitored in the first year after completion. Monitoring of scour immediately carried along with the start of the manufacturing operations embankment. The largest part of scours was evident in the first 2 years.
- Condition of flood protection structures above the lowest water level should be tested at regular intervals through visual observation.

Social and cultural aspect

In order to anticipate some barrier in community awareness and miss-leading information on reclamation project, socialization and dissemination of positive impact from reclamation project should be highlighted and enhanced. Public consultation meeting (PCM) should be conducted prior to the construction stage and should involve all stakeholders. Furthermore, since those Regulation and Guidelines regarding to coastal protection are relatively new (less than 2 years), their dissemination and socialization to the stakeholders (planner, contractors, and community) is necessary. So that, resistant from the community on the planning to build expensive coastal protection and reclamation could be minimized.

2.3.3.2. Recommended solutions for coastal vulnerability sector

In order to transfer the technologies, the recommended solutions for coastal vulnerability sector are: 1) conduct dissemination/socialization of these two technologies to stakeholders in priority areas; 2) build and implement those two technologies in areas most potentially affected. Following are some other proposed recommendation solutions for utmost implementation of the two priority technologies:

a. Coordinated databases—on coastal resources, uses (e.g. farming, fishery, and industry), geo-spatial data, including property lines, and demographic data on coastal residents—are needed both for more effective coastal adaptation planning and can inform the improved allocation of resources in a post-hazard situation.
b. Building capacity of government and private sector professionals to incorporating climate change adaptation. For instance, conducting training for land use professionals in hazard risk assessment and the physical identification of hazard areas.
c. Adopting Integrated Coastal Zone Management in Local Government Level as a mean in managing their coastal and marine resources.

2.3.4. Concrete actions plans and ideas for coastal vunerability sector

2.3.4.1 Plan for domestic actions and measures for coastal vunerability sector

Description

The real action plan that will be implemented in the framework of the climate change adaptation efforts in coastal vulnerability sector is by developing coastal protection structures and/or beach reclamation. For coastal protection structures, there are two options as priority: seawall and revetment. The implementation of coastal protection structures and/or beach reclamations should be based on priority levels. Therefore, areas with higher vulnerability is become more priority than the less vulnerable coasts. It is considered that shore protection structures will be built on the coasts of Tegal and/or Pemalang Regency (Central Java). As for coastal reclamation, it will be focused on the areas of Jakarta, Tangerang and Bekasi. Period for the implementation of the development is expected to complete within three years. Some other aspects into consideration in the construction of coastal protection structures and coastal reclamation are the resource requirements, regulations, and authorities.

Timeline

First year:

- Identify vulnerable coasts/beaches all over the country
- Determine priority/rank; locations having high susceptibility and high economical value or vital object should be prioritized
- Assess which technology is more suitable for each location

Second year:

- Funding and economic analysis
- Create Master plan
- Conduct Feasibility study
- Conduct Detail Engineering Design
- Third year:
- Constructions
- Monitoring and Evaluation

Geographic scope

For the construction of coastal protection, the selected regions are the town of Tegal and/ or Pemalang Regency (Central Java). For reclamation, the focus coastal areas include Jakarta, Tangerang and Bekasi. Consideration in choosing Tegal and Pemalang as the priority location is because the area located in the north coast of Java that considered having very high level of vulnerability to hazards. Figure 2-11 shows the extend line of coastal flooding in Pemalang based on Quick Bird imagery data, October 12, 2007 (left), and the city of Tegal based on Quick Bird imagery data, 30 June 2004 (right).

Figure 2- 11 The extend of coastal flooding in Kabupaten Pemalang (left) and Kota Tegal (right)
(Source: Final Report – Drafting the Strategy Document for Adaptation and Disaster Mitigation in Coastal and Small Islands due to Climate Change, 2008)

In the case of Jakarta, Tangerang and Bekasi, based on the results of simulation, particularly to the North Jakarta, it is estimated that by 2050, about 25 percent of the North Jakarta will drown. The area such as such as Ancol, Pantai Indah Kapuk, Koja, and Tanjung Priok will disappear from the map of Indonesia (final report of Drafting Strategy Document for Adaptation and Disaster mitigation in Coastal and small islands due to climate change, 2008). The predicted sea-level condition of Jakarta in 2050 is presented in Figure 2-12.

Resources needed

Resource requirement for the construction of coastal protection and reclamation includes human resources, equipment, materials and costs. Materials for the construction will be tailored to the availability of local materials in order to reduce the costs. The needs for human resources involved which includes experts in the field of structure modelling, civil engineering, oceanography, and coastal ecology. In addition, the construction works also need heavy equipments. Funds for the construction will be allocated from or funded by grant from donor countries.

Regulatory change

From the regulation point of view, rules and regulations related to coastal protection and reclamation already exist. Currently, the existing regulations related to coastal protection are in the form of Minister's Regulation and Circulars; issued in 2010, these relatively new regulations still need intensive socialisation and disemination, so that the parties concerned become aware and put the regulations into practice. The current status for regulation in coastal reclamation is that the draft of the President of the Republic of Indonesia's Decree on Reclamation in Coastal area and Small islands, just waiting to be signed.

Figure 2- 12 Predicted sea-level condition of Jakarta in 2050
(Source: ITB, 2007; in Final Report of Strategy Document for Adaptation and Disaster Mitigation in Coastal and Small Islands due to Climate Change, 2008)

Coordinating/ implementing agency

Coordination for the implementation of coastal protection and coastal reclamation constructions, from preparation stage to completion, is carried out by the implementing agencies, in this case is the Ministry of Public Work and the Ministry of Marine Affairs and Fisheries. The agency carries out will be adapted to the location or existence of which the coastal protection or in the territory of which the reclamation was built. If it is in the borders region, which includes more than one province, then it will be the responsibility of the Central Government, but if it is in a province or district/city, became the responsibility of the Local Government.

2.3.4.2 Project ideas for international support

Type of technology transferred

From technological point of view, Indonesia is capable to conduct coastal protection as well as coastal reclamation project. But, given the large number of coastal regions which their level of vulnerability are high to very high, then transfer of technology and dissemination from one area to another area is needed to be immediately carried out. In addition, improvements are still needed, including the current technology (for example, interm of structure and design) and the possibility of innovation in materials from abroad / developed countries (transfer of knowledge).

Capacity building

In line with the process of technology transfer, capacity building should be covered as well. Capacity building activities should be targeting three aspects: local community, local contractor, and project manager/administrator.

Economic and financing

To accelerate the implementation and development of coastal protection structure and coastal reclamation, assistance from internationals in the form of grant and experts are still needed, as complement to the available domestic funding.

Resources requirement

Requirements for development of coastal protection structures had been arranged in the Ministry of Public Work's Circular No. 07/SE/M/2010 on Guidelines for Construction of Coastal Protection Structures. For coastal reclamation, it is set in SK issued by the Directorat General of Marine, Coastal and Small Island SK.64D/P3K/IX/2004 on Guideline for Reclamation in Coastal Area.

Time line

Timeline of the project ideas for international support is similar to the timeline of domestic actions and measures plans.

Indicators of success

The success of coastal protection / coastal reclamation development can be seen from the resulted coastal protection / reclamation, whether it can give the feeling of security to the public and the community can get the benefit of it.

Domestic partners

Domestic partners for the development of coastal protection and coastal reclamation projects may consist of local government/institution, community in the project location and local contractor.

2.3.5. Summary

The most crucial barrier is the amount of initial capital to be secured for the development of reliable coastal protection structures as well as for coastal reclamation project. From financial point of view, the expensive initial capital to be allocated for shore protection and coastal reclamation project is not viable if applied to areas without high economical value, nor even have the potential of tourism, even though shore protection and coastal reclamation is implemented. In order to transfer the technologies, the recommended solutions for coastal vulnerability sector are: 1) conduct dissemination/socialization of these two technologies to stakeholders in priority areas; 2) build and implement those two technologies in areas most potentially affected by climate change. The real action plan that will be implemented in the framework of the climate change adaptation efforts in coastal vulnerability sector is by developing coastal protection structures and/or beach reclamation. For coastal protection structures, there are two options of priority: seawall and revetment. For the construction of coastal protection, the selected regions are the town of Tegal and/or Pemalang Regency (Central Java). For reclamation, the focus coastal areas include Jakarta, Tangerang and Bekasi. Consideration of choosing Tegal and Pemalang as the priority locations because these areas are located in the north coast of Java that is considered to have very high level of vulnerability to hazards.

Section 3

Cross-Cutting Issues for the National TNA and TAPs

3.1. Cross-cutting technologies for the TNAs in the three sectors

Basically, application of adaptation technology can be done in a single sector or in multiple sectors. Although using a sectoral approach, but if an adaptation technology can be applied to several sectors at once, then the result of the implementation will be more effective and efficient. The barriers of the implementation of multiple technologies from different sectors, among others, are different geographic scopes. In addition, some barriers that are considered to be major cross cutting issues for some sectors relate to financial and social aspect.

By changing a particular policy and/or financial incentive, it can sometime remove barriers in one or more sectors. The result of prioritization technologies in each sector of TNA for climate change adaptation is as follows. It was concluded that prioritized technologies for the food security sector are (a) dissemination of farming technology of drought and flood tolerance rice varieties (b) technology development of milkfish cultivation in floating net cage, (c) transfer and diffusion for beef cattle cultivation through engineering technology. While for the water resource sector comprises of (a) rainwater harvesting technology (b) domestic waste water recycling technology (c) water resources modelling. For the coastal vulnerability sector the prioritized technologies were concluded to be (a) coastal protection technology (sea wall/ revetment) and (b) coastal reclamation technology.

From the results of technologies prioritization in each sector, it is difficult to encounter cross-cutting adaptation technologies in more than one sector at once. However, it might be possible to have cross cutting technologies of the water resource sector to the food security sector. For example, prediction modeling for water resource is useful for the cultivation of drought and flood tolerance rice varieties. Similarly, recycle water treatment will strongly support the provision of drinking water that means adapting in food safety. Water recycling technology, can be put to beef cattle farming to maintain environmental sanitation and health of livestock farms.

3.2. Cross-cutting issues for the TAPs in the three sectors

All three selected technologies in the food security sector are essentially to meet food needs, especially of agriculture, fisheries and livestock. Thus, the selected adaptation technology cannot be applied to different domain areas. But in terms of policy, there are things that can be considered as a cross-cutting issue that is the need for regulation that favor the majority of small farmers or rancher. The regulation's aim to avoid monopoly both on the crop seeds supply and marketing of product. Apart from the financial side it is also encountered the same barriers in terms of initial capital for the offender and the need for incentives. While for the social aspect is the need for socialization and training for farmers intensively. Almost the majority of the farmers still applied the tradition or heredity for cultivation.

The three selected technologies in the water resources sector is essentially to fulfill clear water needs of the community are included in order to meet the target of MDGs. Rainwater harvesting technology can be followed with water recycling techniques or a combination of those two. While modeling for the prediction of water resources will be very supportive to the development of rainwater harvesting technology and water recycling technology. The major

issue of the three selected technology is policy need in the distribution system as well as overlapping in utilization of water resources.

Coastal protection and reclamation technology is basically to protect coastal areas from sea levels rise. From the aspect of regulation, sea wall/revetment or reclamation construction is the responsibility of Ministry of Public Works. While the Ministry of Marine and Fisheries task is to issue the technical guidelines. The cross-cuttingissues in two technologies is more to social aspects such as the disruption of the fish catching area of fishermen. Construction of sea protection (sea wall/ revetment) and beach reclamation requires intensive socialization with a persuasive approach.

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Annex 1: Technology Factsheets

Annex 1.1. Technology factsheets for food security

a. Technology transfer of drought and flood tolerance rice technology.

Rice is the most important staple food crop of the world's as well as Indonesia's population. The immediate impacts of climate change on rice production systems and food security will be felt in the form of adverse effects of extreme weather events on rice production. Floods also cause indirect damage to rice production by destroying the properties and production means of farmers, and infrastructures supporting rice production such as dams, dikes, roads, etc.

Less immediate but possibly even more significant impacts are anticipated due to changes in mean temperatures, increasing weather variability, and sea level rising. Rice cultivation is both an important *sequester of carbon dioxide from the atmosphere* and an important *source of greenhouse gases* (e.g. methane and nitrite oxide) *emission*. In 2004, for example, the global paddy rice output was 607.3 million tonnes at 14% moisture content. At the grain/straw ratio of 0.9 for most currently planted rice varieties, the global rice straw output in 2004 was about 676 million tonnes at 14% moisture content. This means that in 2004, rice *sequestered about 1.74 billion tonnes of CO2 from the atmosphere* to produce about 1.16 billion tonnes of biomass at 0% moisture content.

In Indonesia, rice for drought and flood tolerance has been developed by Center of Rice Research (BaLitPa), Ministry of Agriculture, Sukamandi, West Java. The drought tolerance type rice is developed from local type of *gogo rancah* that grows in a dry land whereas the flood tolerance type is developed from one that grows in swamp land.

Varieties developed are as a result of local exploration capability which the seed has been taken from the germ plasm in its origin media, i.e. swamp and dry field soil. Variety of rice that is tolerance to drought and flood is flexible towards climate change because by the implementation of cropping calendar made by Ministry of Agriculture, it can be planted the a year long. Because of its varieties the rice seed can adapt both dry and flood conditions.

Biotechnology that is applied to produce drought and flood tolerance rice can be employed as a technology of priority. The rice produced has to fulfill important criteria, such as environmental, social and economic aspects. From the environmental criteria, the rice that is drought and flood tolerance can be grown in related types of soil, such as in the dry land for the drought tolerance or in a swamp condition for the flood tolerance. Dissemination of these varieties of rice has to involve agricultural instructors into groups of farmers so that most of the farmers who is currently only knowing local rice seed will easily use the new drought and flood tolerance of rice varieties.

There is quite significant difference in term of cost needed in treating the rice field. The cost for low mechanical intensity is US$ 10,000 – 20,000 TPD, while using high mechanical intensity is about US$ 25,000 – 50,000 TPD. Operational and maintenance cost is around US$ 30-50/ ton. Example of technical criteria on disemination of drought and flood tolerance rice cultivation is summarized in Table A-1.

b. Development of milkfish farming technology

Cultivation in sea fishery that is known as marine culture is an effort to farm fishes in a controlled floating cage under human interference. This technology can be applied in the fisherman location because it does not need a wide field. Therefore, this marine culture technology can be prioritized to anticipate the decrease of fishery due to climate change. Marine culture must meet the following important criteria, such as:

- Seedling should be done by the farmers in order to have the seed supply not dependence on the season and natural seed;
- The cultivation technique of pond or floating net must be mastered and it is technically easy to apply and profitable;
- The farming is tolerable to the salinity changes from 0 – 158 ppt, therefore the cultivation area is significantly wide from the non-salinity to the salinity/sea water;
- It is able to survive in a crowded floating net (100-300 fishes/m^3);
- It is fast growing fishes (1,6% / day);
- It is efficient on feed used (FCR: 1.7 - 2.,2);
- Commercial feed for fish is suficiently provided up to the rural area/ villages; and
- The potential market is still available domestically or internationally.

Table A- 1 Criteria of disemination of drought and flood tolerance rice varieties

Technical Criteria	Description
Technology Maturity	• It is already applied
Local Availability	• Seed variety has been created from the germ plasm in its origin media taken fromswamp and dry field land of Indonesia
Operational flexibility	• It is done with planting calendar so it can be created rice production in whole year
Climate Suitability	• It is able to adapt to dry season or wet season (flooded time)
Technology to be included in prioritization	• Biotechnology is used for selection and nurturing of drought and inundatated resistant rice varieties
Environmental Criteria	
Resource Conservation	• The rice varieties are automatically conserved because they are planted in their suitable habitats
Land	• Dry and wet land
Social Criteria	
Employment	• Farmers and rice field supervisors
Public perception	• Farmers are not yet aware for drought and inundatated resistant rice varieties instead of local rice varieties
Community Involvement	• Farmer group
Economic Criteria	
Capital Cost	• US$ 10,000 – 20,000 TPD (low mechanical intensity) • US$ 25,000 – 50,000 TPD (high mechanical intensity)
Operational & maintenance costs	• S$ 30-50 /ton
Market availability	• It is already available

Technical criteria of disemination of milkfish mariculture is summarized in Table A-2.

Table A- 2 Technical criteria of disemination of milkfish mariculture

Technical criteria	Description
Technology maturity	Has already implemented
Local availability	Can be farmed at fishermen's water zone
Operational flexibility	Is easy to be carried out with unlimited water zone
Climate suitability	Is able to adapt at any weather conditions (strong wind) because its location is at coatal bay with low wave
Technology to be included in prioritization	Milkfish mariculture
Environmental Criteria	
Resource conservation	Milkfish
Area	non-salinity to the salinity/sea water
Social Criteria	
Employment	Fishermen and fish farming supervisors
Public Perception	Not yet known by ordinary fishermen
Community Involvement	Fishermen group and coastal communities
Economic Criteria	
Capital Cost	-
Operational & maintenance costs	-
Market Availability	Domestic and export needs

c. Development of cultivation engineering of beef cattle

Cultivation of engineering technology of beef cattle is also as part of the development of a community based cattle seedling. The traditional breeders are the ones follow a Village Breeding Center (VBC). To produce superior calves, there are several ways could be conducted such the implementation of embryo transfer (ET) technology, artificial insemination (IB) or natural insemination (INKA) of both imported, and local female cows with genetically low quality.

This technology has been in the implementation phase and in the exploration of local product because the ability of local calf will be one that is being developed. Those local cattle are from Bali, Madura, Ongole cross-bred, Sumbawa Ongole, and Aceh. The common feed of the cow such as corn has the ability to adapt dry condition because it can be stored or kept for months. This type of cow feed can be prioritized as a local consideration.

From environmental point of view, this will meet the resource conservation because the local cattle seedling is innovated through an embryo transfer using VBC implementation in the location with vulnerable area due to climate change, and the integrated location of palm and crop fields. Dissemination of this technology is involving a number of groups of breeders and instructors of rice or palm agriculture, which is known as VBC (Village Breeding Center) and CLS (Crops Livestock System).

The costs for operational and maintenance of this technology is approximately US$ 600,000 in the first year up to US$ 3,000,000 in the third year, with the price of Indonesian Rupiah 6,000,000 or around USD 600 per head of calf. Seedling can be carried out with step by step processes from 1000 female cows in the first year up to 5000 female cows in the third year. Therefore, the operational and maintenance costs are about US$ 100.000 per 1000 heads of calves. The market availability of the cattle seed is ready to be fattened.

Table A- 3 Technical criteria of beef cattle engineering development

Facts	Description
Short Description	Development of beef cattle engineering technology is the cow seedling of community based. The breeders are traditional farmers who implement "Village Breeding Center" pattern. This is a pattern of breeding that is specially located in designated area not in indvidual house of breeder. The superior calves must be used first local cattle seed that has employed embrio transfer (ET) technology or artificial insemination and natural insemination (INKA) with the use of imported female cows or productively local cattle but genetically low.
Technical Criteria	
Technology Maturity	Has been applied
Local Availability	Local beef cattle can be as seedling that can be developed. Those are cows of Bali, Madura, genetically Ongole cow (PO) and Sumbawa Ongole (SO), Aceh
Operational Flexibility	Adaptation technology of cow green feed and concentrate production as well as adaptation technology for reproduction of cow with one calf per head of cow parent per year.
Climate suitability	Ha ability to adapt on dry season condition by utilizing preserved greenish cattle feed (HMT).
Technology to be included in prioritization	Production of HMT and concentrate uses local wisdom of technology Embrio Transfer (ET) technology
Environmental criteria	
Resource Conservation	Seedling of local calf with its local parent through ET
Land	VBC at location of vulnerable to climate change impact and intergated with food plant or oil palm
Social Criteria	
Employment	Beef cattle farmers and field supervisors of rice farming and oil palm estate
Public perception	Public perception will be good because the farmers use VBC and CLS (Crops Livestok system)
Community Involvement	Beef cattle farming communities
Economic Criteria	
Capital Cost	USD 600 per head with capacity of 1000 heads in the first year up to 5000 heads in the third year and it costs US$ 600.000 up to US$3.000.000; respectively
Operational & maintenance costs	US$ 100.000 / 1000 heads
Market Availability	Domestic and export needs

Annex 1.2. Technology Factsheets for Water Resources

a. Technology fact sheet for rain water harvesting technology

Introduction

Rainwater harvesting (RWH) is now back after having been ignored for decades. For arid and semi-arid regions, domestic rainwater harvesting has a proven track-record of providing water next to the house. That water has both domestic and economic uses. This fact sheet gives an overview of systems, component technology, planning and management and the potential effects and impacts.

In many families need water for animals, vegetables, crops and trees. Where groundwater and surface water sources are in short supply, rainwater may be a sustainable alternative or supplement. Roof harvesting of rain is the most common, but also other hard surface areas are used.

Rainwater harvesting can be categorized according to the type of catchment surface used, and by implication the scale of activity (Figure A-1).

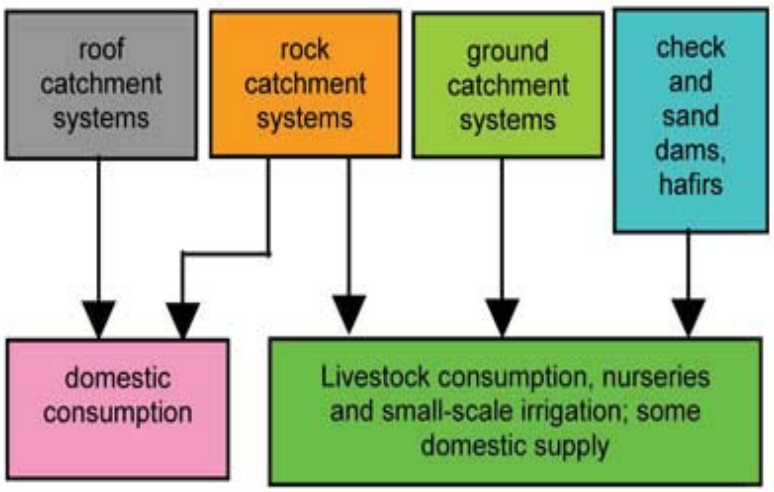

Figure A- 1 Small-scale rainwater harvesting systems and uses

Technical requirements

Rainfall data is required, preferably for a period of at least 10 years. The more reliable and specific the data is for the location the better the design will be. Domestic water consumption and demand varies substantially by country. Socio-economic conditions and different uses of domestic water are among the influencing factors. Where water is very scarce, people may use as little as a few litres per day. An estimate of the amount of water required for economic and productive uses should be added. In general, roof rainwater harvesting is only able to provide sufficient water for a small vegetable plot.

Status of technology and its future market potential

Rainwater systems can be classified according to their reliability, yielding four types of user regimes:

- Occasional - water is stored for only a few days in a small container. This is suitable when there is a uniform rainfall pattern with very few days without rain and when a reliable alternative water source is available.
    - Intermittent - in situations with one long rainy season when all water demands are met by rainwater. During the dry season, water is collected from other sources.
    - Partial - rainwater is used throughout the year but the 'harvest' is not sufficient for all domestic demands. For example, rainwater is used for drinking and cooking, while for other domestic uses (e.g. bathing and laundry) water from other sources is used.
- Full - for the whole year, all water for all domestic purposes comes from rainwater. In such cases, there is usually no alternative water source other than rainwater, and the available water should be well managed, with enough storage to bridge the dry period.

User regimes to be followed depends on many variables including rainfall quantity and pattern, available surface area and storage capacity, daily consumption rate, number of users, cost and affordability, and the presence of alternative water sources. The storage reservoir is usually the most expensive part of the rainwater harvesting system such that a careful design and construction is needed. The reservoir must be constructed in such a way that it is durable and watertight and the collected water does not become contaminated.

All rainwater tank designs should include as a minimum requirement:

- a solid secure cover
- a coarse inlet filter
- an overflow pipe - a manhole, sump, and drain to facilitate cleaning
- an extraction system that does not contaminate the water, e.g. a tap or pump.

Storage reservoirs for domestic rainwater harvesting are classified in two categories:

- surface or above-ground tanks, most common for roof collection, and
- sub-surface or underground tanks, common for ground catchments systems.

Materials and design for the walls of sub-surface tanks or cisterns must be able to resist the soil and soil water pressures from outside when the tank is empty. Tree roots can also damage the structure below ground. The size of the storage tank needed for a particular application is mainly determined by the amount of water available for storage (a function of roof size and local average rainfall), the amount of water likely to be used (a function of occupancy and use purpose) and the projected length of time without rain (drought period).

Rainwater harvesting is an accepted freshwater augmentation technology in many parts of the world. While the bacteriological quality of rainwater collected from ground catchments is poor, rainwater from properly maintained rooftop catchment systems, which are equipped with tight storage tanks and taps, is generally suitable for drinking and often meets the WHO drinking water standards. This water is generally of higher quality than most traditional water sources found in the developing world. Rooftop catchment of rainwater can provide a good quality water which is clean enough for drinking, as long as the rooftop is clean, impervious and made from non-toxic materials and located away from over-hanging trees.

Contribution of the technology to protection of the environment

Rainwater harvesting is one of the most promising alternatives for supplying water in the face of increasing water scarcity and escalating demand. The pressure on water supplies, increased environmental impact from large projects and deteriorating water quality, constrain the ability to meet the demand for freshwater from traditional sources. Rainwater harvesting presents an opportunity for the augmentation of water supplies allowing t the same time for self-reliance and sustainability.

Rainwater harvesting in urban and rural areas offers several benefits including provision of supplemental water, increasing soil moisture levels for urban greenery, increasing the groundwater table via artificial recharge, mitigating urban flooding and improving the quality of groundwater. In homes and buildings, collected rainwater can be used for irrigation, toilet flushing and laundry. With proper filtration and treatment, harvested rainwater can also be used for showering, bathing, or drinking. The major benefits of rainwater harvesting are summarised below:

- rainwater is a relatively clean and free source of water
- rainwater harvesting provides a source of water at the point where it is needed
- it is owner-operated and managed
- it is socially acceptable and environmentally responsible
- it promotes self-sufficiency and conserves water resources
- rainwater is friendly to landscape plants and gardens
- it reduces stormwater runoff and non-point source pollution
- it uses simple, flexible technologies that are easy to maintain
- offers potential cost savings especially with rising water costs
- provides safe water for human consumption after proper treatment
- is low running costs
- Its construction, operation and maintenance are not labour-intensive.

Climate

The rain water harvesting technologies are suitable for all climates. In many regions of the world, clean drinking water is not always available and this is only possible with tremendous investment costs and expenditure. Rainwater is a free source and relatively clean and with proper treatment it can be even used as a potable water source. Rainwater harvesting saves high-quality drinking water sources and relieves the pressure on sewers and the environment by mitigating floods, soil erosions and replenishing groundwater levels. In addition, rainwater harvesting reduces the potable water consumption and consequently, the volume of generated wastewater.

Financial requirements and cost

Valid data on the economic efficiency of rainwater harvesting systems is not possible. Dependent on the regional conditions (water and wastewater prices, available subsidies), the amortisation period may vary between 10 and 20 years. However, it should be taken into consideration that for the major investment (storage and pipework) a period of use of several decades is expected.

The associated costs of a rainwater harvesting system are for installation, operation and maintenance. Of the costs for installation, the reservoir as well as storage tank represents the largest investment which can vary between 30 and 45% of the total cost of the system dependent on system size. A pump, a pressure controller and fittings in addition to plumber's labour represent other major costs of the investment.

In general, a rainwater harvesting system designed as an integrated element of a new construction project is more cost-effective than retrofitting a system. This can be explained by the fact that many of the shared costs can be designed to optimise system performance and the investment can be spread over time.

Refference:
1) DIN 1989-1. 2002. Rainwater Harvesting Systems – Part 1: Planning, Installation, Operation and Maintenance. German Institute for Standardisation, Berlin, 2002.
2) Gould, J. and Nissen-Petersen, E. (1999) Rainwater Catchment Systems for Domestic Supply: Design, construction and implementation. IT Publications, London.
3) Rainwater Harvesting Project at the Development Technology Unit of School of Engineering, University of Warwick, UK http://www.eng.warwick.ac.uk/DTU

b. Wastewater recycle using membrane bioreactor

Introduction

The technologies commonly used for water recycle that are performed at secondary treatment of municipal wastewater rely on the microorganisms suspended in the wastewater. Although these technologies work well in many situations, they have several drawbacks, including the difficulty of growing the right types of microorganisms and the physical requirement of a large site. The use of microfiltration membrane bioreactors (MBRs), a technology that has become increasingly used in the past 10 years, overcomes many of the limitations of conventional systems. These systems have the advantage of combining a suspended growth biological biomass with solids removal via filtration. The membranes can be designed for and operated in small spaces and with high removal efficiency of contaminants such as nitrogen, phosphorus, bacteria, biochemical oxygen demand, and total suspended solids. The membrane filtration system in effect can replace the secondary clarifier and sand filters in a typical activated sludge treatment system. Membrane filtration allows a higher biomass concentration to be maintained, thereby allowing smaller bioreactors to be used.

The advantages of MBR systems over conventional biological systems include better effluent quality, smaller space requirements, and ease of automation. Specifically, MBRs operate at higher volumetric loading rates which result in lower hydraulic retention times. The low reten-tion times mean that less space is required compared to a conventional system. MBRs have often been operated with longer solids residence times (SRTs), which results in lower sludge production; but this is not a requirement, and more conventional SRTs have been used (Crawford et al. 2000). The effluent from MBRs contains low concentrations of bacteria, total suspended solids (TSS), biochemical oxygen demand (BOD), and phosphorus. This facilitates high-level disinfec-tion. Effluents are readily discharged to surface streams or can be sold for reuse, such as irrigation.

The primary disadvantage of MBR systems is the typically higher capital and operating costs than conventional systems for the same throughput. O&M costs include membrane cleaning and fouling control, and eventual membrane replacement. Energy costs are also higher because of the need for air scouring to control bacterial growth on the membranes. In addition, the waste sludge from such a system might have a low settling rate, resulting in the need for chemicals to produce biosolids acceptable for disposal (Hermanowicz et al. 2006). Fleischer et al. 2005 have demonstrated that waste sludges from MBRs can be processed using standard technologies used for activated sludge processes.

Technical requirements

Designers of MBR systems require only basic information about the wastewater characteristics, (e.g., influent characteristics, effluent requirements, flow data) to design an MBR system. Depending on effluent requirements, certain supplementary options can be included with the MBR system. For example, chemical addition (at various places in the treatment chain, including: before the primary settling tank; before the secondary settling tank [clarifier]; and before the MBR or final filters) for phosphorus removal can be included in an MBR system if needed to achieve low phosphorus concentrations in the effluent.

MBR systems historically have been used for small-scale treatment applications when portions of the treatment system were shut down and the wastewater routed around (or bypassed) during maintenance periods. However, MBR systems are now often used in full-treatment applications. MBR systems provide operational flexibility with respect to flow rates, as well as the ability to readily add or subtract units but that flexibility has limits. Membranes typically require that the water surface be maintained above a minimum elevation so that the membranes remain wet during operation. Throughput limitations are dictated by the physical properties of the membrane, and the result is that peak design flows should be no more than 1.5 to 2 times the average design flow. If peak flows exceed that limit, either additional membrane is needed simply to process the peak flow, or equalization should be included in the overall design. The equalization is done by including a separate basin (external equalization) or by maintaining water in the aeration and membrane tanks at depths higher than those required and then removing that water to accommodate higher flows when necessary (internal equalization).

Design Feature

To reduce the chances of membrane damage, wastewater should undergo a high level of debris removal prior to the MBR. Primary treatment is often provided in larger installations, although not in most small to medium sized installations, and is not a requirement.

MBR systems are configured with the membranes actually immersed in the biological reactor or, as an alternative, in a separate vessel through which mixed liquor from the biological reactor is circulated. The former configuration is shown in Figure A-2; the latter, in Figure A-3.

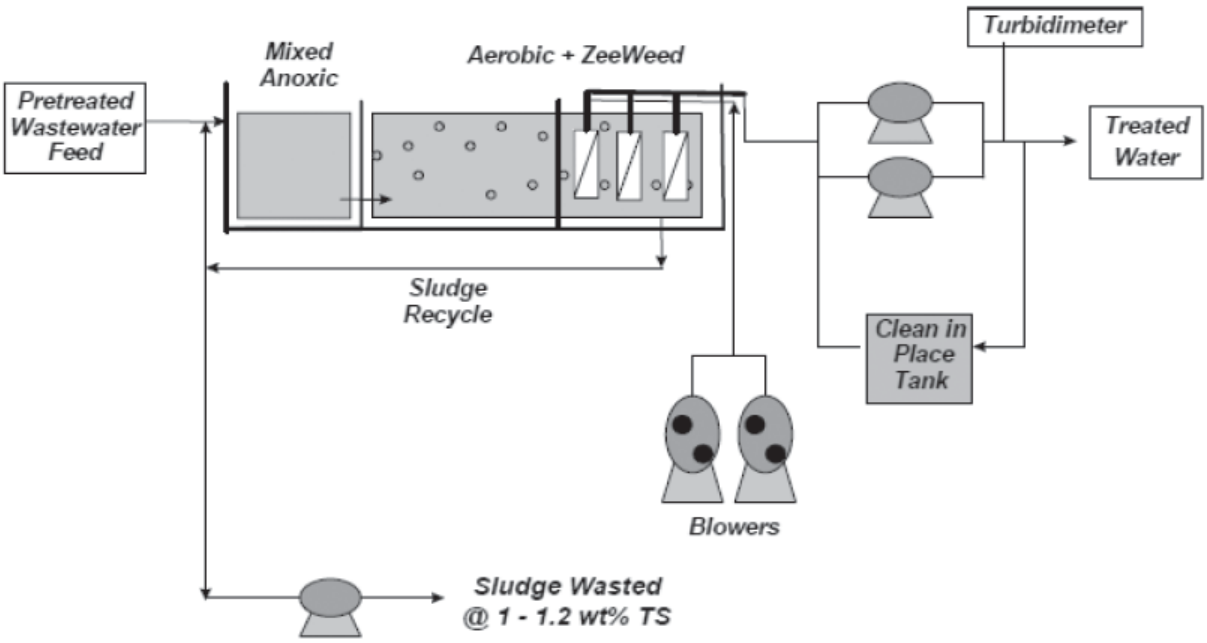

Figure A- 2 Immersed membrane system configuration (Image from GE/Zenon)

MBR manufacturers employ membranes in two basic configurations: hollow fiber bundles and plate membranes. Siemens/U.S.Filter's Memjet and Memcor systems, GE/Zenon's ZeeWeed and ZenoGem systems, and GE/Ionics' system use hollow-fiber, tubular membranes configured in bundles. A number of bundles are connected by manifolds into units that can be readily changed for maintenance or replacement. The other configuration, such as those provided by Kubota/Enviroquip, employ membranes in a flat-plate configuration, and again with manifolds to al-low a number of membranes to be connected in readily changed units. Screening requirements for both systems differ: hollow-fiber membranes typically require 1- to 2-mm screening, while plate membranes require 2- to 3-mm screening (Wallis-Lage et al. 2006).

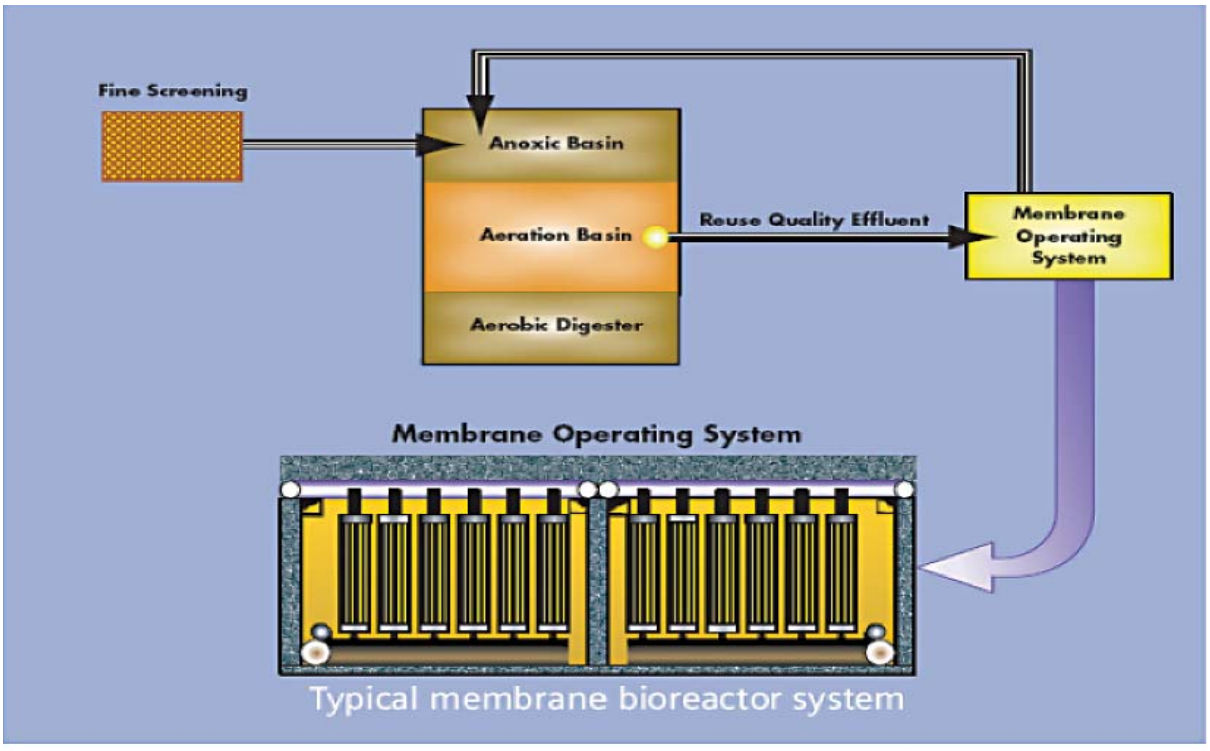

Figure A- 3 External membrane system configuration (Image from Siemens/U.S. Filter)

System Operation

All MBR systems require some degree of pumping to force the water flowing through the membrane. While other membrane systems use a pressurized system to push the water through the membranes, the major systems used in MBRs draw a vacuum through the membranes so that the water outside is at ambient pressure. The advantage of the vacuum is that it is gentler to the membranes; the advantage of the pressure is that throughput can be controlled. All systems also include techniques for continually cleaning the system to maintain membrane life and keep the system operational for as long as possible. All the principal membrane systems used in MBRs use an air scour technique to reduce buildup of material on the membranes. This is done by blowing air around the membranes out of the manifolds. The GE/Zenon systems use air scour, as well as a back-pulsing technique, in which permeate is occasionally pumped back into the membranes to keep the pores cleared out. Back-pulsing is typically done on a timer, with the time of pulsing accounting for 1 to 5 percent of the total operating time.

Downstream Treatment

The permeate from an MBR has low levels of suspended solids, meaning the levels of bacteria, BOD, nitrogen, and phosphorus are also low. Disinfection is easy and might not be required, depending on permit requirements.

The solids retained by the membrane are recycled to the biological reactor and build up in the system. As in conventional biological systems, periodic sludge wasting eliminates sludge buildup and controls the SRT within the MBR system. The waste sludge from MBRs goes through standard solids-handling technologies for thickening, dewatering, and ultimate disposal. Hermanowicz et al. (2006) reported a decreased ability to settle in waste MBR sludges due to increased amounts of colloidal-size particles and filamentous bacteria. Chemical addition increased the ability of the sludges to settle. As more MBR facilities are built and operated, a more definitive understanding of the characteristics of the resulting biosolids will be achieved. However, experience to date indicates that conventional biosolids processing unit operations are also applicable to the waste sludge from MBRs.

Status technology and its future market

The MBR process was introduced by the late 1960s, as soon as commercial scale ultrafiltration (UF) and microfiltration (MF) membranes were available. The original process was introduced by Dorr-Olivier Inc. and combined the use of an activated sludge bioreactor with a crossflow membrane filtration loop. The flat sheet membranes used in this process were polymeric and featured pore sizes ranging from 0.003 to 0.01 µm. Although the idea of replacing the settling tank of the conventional activated sludge process was attractive, it was difficult to justify the use of such a process because of the high cost of membranes, low economic value of the product (tertiary effluent) and the potential rapid loss of performance due to membrane fouling. As a result, the focus was on the attainment of high fluxes, and it was therefore necessary to pump the mixed liquor suspended solids (MLSS) at high crossflow velocity at significant energy penalty (of the order 10 kWh/m3 product) to reduce fouling. Due to the poor economics of the first generation MBRs, they only found applications in niche areas with special needs like isolated trailer parks or ski resorts for example.

The breakthrough for the MBR came in 1989 with the idea of Yamamoto and co-workers to submerge the membranes in the bioreactor. Until then, MBRs were designed with the

separation device located external to the reactor (sidestream MBR) and relied on high transmembrane pressure (TMP) to maintain filtration. With the membrane directly immersed into the bioreactor, submerged MBR systems are usually preferred to sidestream configuration, especially for domestic wastewater treatment. The submerged configuration relies on coarse bubble aeration to produce mixing and limit fouling. The energy demand of the submerged system can be up to 2 orders of magnitude lower than that of the sidestream systems and submerged systems operate at a lower flux, demanding more membrane area. In submerged configurations, aeration is considered as one of the major parameter on process performances both hydraulic and biological. Aeration maintains solids in suspension, scours the membrane surface and provides oxygen to the biomass, leading to a better biodegradability and cell synthesis.

Contribution of the technology to the protection of environment

The MBR technology can be applied to treat Municipal wastewater, industrial wastewater as well as for water reclamation (water re use). Simply due to the high number of microorganism in MBRs, the pollutants uptake rate can be increased. This leads to better degradation in a given time span or to smaller required reactor volumes. In comparison to the conventional activated sludge process (ASP) which typically achieves 95%, COD removal can be increased to 96-99% in MBRs. COD and BOD5 removal are found to increase with MLSS concentration. Above 15g/L COD removal becomes almost independent of biomass concentration at >96%. Arbitrary high MLSS concentrations are not employed, however, as oxygen transfer is impeded due to higher and Non-Newtonian fluid viscosity. Kinetics may also differ due to easier substrate access. In ASP, flocs may reach several 100 µm in size. This means that the substrate can reach the active sites only by diffusion which causes an additional resistance and limits the overall reaction rate (diffusion controlled). Hydrodynamic stress in MBRs reduces floc size (to 3.5 µm in sidestream MBRs) and thereby increases the apparent reaction rate. Like in the conventional ASP, sludge yield is decreased at higher SRT or biomass concentration. Little or no sludge is produced at sludge loading rates of 0.01 kgCOD/(kgMLSS d). Due to the biomass concentration limit imposed, such low loading rates would result in enormous tank sizes or long HRTs in conventional ASP. Due to the high pollutans removal, the MBR technology can reduce environmental pollution significantly.

The MBR technology can also remove nutrient from wastewater. Nutrient removal is one of the main concerns in modern wastewater treatment especially in areas that are sensitive to eutrophication. Like in the conventional ASP, currently, the most widely applied technology for N-removal from municipal wastewater is nitrification combined with denitrification. Besides phosphorus precipitation, enhanced biological phosphorus removal (EBPR) can be implemented which requires an additional anaerobic process step. Some characteristics of MBR technology render EBPR in combination with post-denitrification an attractive alternative that achieves very low nutrient effluent concentrations.[7]

Due to the high pollutans removal, the MBR technology can reduce environmental pollution significantly.

Climate

The Membrane Bioreactor technology is suitable for warm climates such as in sub or in tropical country. For operation in the winter season, the pollutant removal can decrease severely. The

MBR is a combination of pollutants degradation by microbe and filtration using a membrane. Microbes work is strongly influenced by temperature. In the temperature range between 30-40C, microbial will works very effectively. So the MBR technology is suitable for warm climates.

Financial requirements and costs

Capital Costs

Capital costs for MBR systems historically have tended to be higher than those for conventional systems with comparable throughput because of the initial costs of the membranes. In certain situations, however, including retrofits, MBR systems can have lower or competitive capital costs compared with alternatives because MBRs have lower land requirements and use smaller tanks, which can reduce the costs for concrete. U.S. Filter/Siemen's Memcor package plants have installed costs of $7–$20/gallon treated.

Fleischer et al. (2005) reported on a cost comparison of technologies for a 12-MGD design in Loudoun County, Virginia. Because of a chemical oxygen demand limit, activated carbon adsorption was included with the MBR system. It was found that the capital cost for MBR plus granular activated carbon at $12/gallon treated was on the same order of magnitude as alterna-tive processes, including multiple-point alum addition, high lime treatment, and post-secondary membrane filtration.

Operating cost

Operating costs for MBR systems are typically higher than those for comparable conventional systems. This is because of the higher energy costs if air scouring is used to reduce membrane fouling. The amount of air needed for the scouring has been reported to be twice that needed to maintain aeration in a conventional activated sludge system (Scott Blair, personal communica-tion, 2006). These higher operating costs are often partially offset by the lower costs for sludge disposal associated with running at longer sludge residence times and with membrane thickening/dewatering of wasted sludge.

Fleischer et al. (2005) compared operating costs. They estimated the operating costs of an MBR system including activated carbon adsorption at $1.77 per 1,000 gallons treated. These costs were of the same order of magnitude as those of alternative processes, and they compared favorably to those of processes that are chemical-intensive, such as lime treatment.

c. Water resources model - Groundwater flow modeling with MODFLOW and related programs

Introduction

Computer model that can simulate groundwater flow in the aquifer system continues growing significantly, not only in the two-dimensional but three dimensional scale. The computer model can now be run using a personal computer, so the user model is easier to operate for research. One of the most popular computer models used by researchers is the MODFLOW ground water problems. Groundwater Flow Model module of finite-difference (MODFLOW) was developed by the U.S. Geological Survey (USGS). MODFLOW is a computer program to simulate the general features of the groundwater system (McDonald and Harbaugh, 1988; Harbaugh and McDonald, 1996).

MODFLOW program is built in the early 1980s; the current model continues to evolve which is equipped with a new package and program development related to ground water used in the study. MODFLOW prongam popularity as a computer program that can be used to simulate ground water is the most widely used program in the world for the simulation of groundwater flow.

Technical requirement

MODFLOW is designed to simulate aquifer systems in which (1) saturated-flow conditions exist, (2) Darcy's Law applies, (3) the density of ground water is constant, and (4) the principal directions of horizontal hydraulic conductivity or transmissivity do not vary within the system. These conditions are met for many aquifer systems for which there is an interest in analysis of ground-water flow and contaminant movement. For these systems, MODFLOW can simulate a wide variety of hydrologic features and processes. Steady-state and transient flow can be simulated in unconfined aquifers, confined aquifers, and confining units. A variety of features and processes such as rivers, streams, drains, springs, reservoirs, wells, evapotranspiration, and recharge from precipitation and irrigation also can be simulated. At least four different solution methods have been implemented for solving the finite-difference equations that MODFLOW constructs. The availability of different solution approaches allows model users to select the most efficient method for their problem.

Application of MODFLOW

MODFLOW simulates ground-water flow in aquifer systems using the finite-difference method. In this method, an aquifer system is divided into rectangular blocks by a grid. The grid of blocks is organized by rows, columns, and layers, and each block is commonly called a "cell." The output of this MODFLOW model can be realized in addition to numerical data, the image can also be visualized. Visual display output from MODFLOW model in the computer, as if to give an overview of the real conditions. Visual appearance of natural objects imitated in the computer model can bring all parties to take appropriate action.

Model Input

For each cell within the volume of the aquifer system, the user must specify aquifer properties. Also, the user specifies information relating to wells, rivers, and other inflow and outflow features for cells corresponding to the location of the features. For example, if the interaction between a river and an aquifer system is simulated, then for each cell traversed by the river, input information includes layer, row, and column indices; river stage; and hydraulic properties of the river bed.

Status of technology and its future market potential

Modeling technology has become a very important tool in the study. As a tool in research, technology has many advantages: 1). Provide quick and efficient results. 2). As a tool to predict groundwater flow conditions in the aquifer system in the future. 3). Can be used to improve the situation in the future, by using a design scenario. 4). Inspire more extensive research in the future.

The ability of researchers in Indonesia to master the modeling technology is very possible that needs to be supported by hardware and software. If the hardware and software is available on the market in Indonesia is the modeling technology will be more interesting to learn.

The market potential associated with the modeling technology widely opens, considering that Indonesia is an archipelago, so that each region has different hydrological characteristics as well. This condition causes the computer modeling market primarily related to groundwater flow in the aquifer system is promising potency in the future.

Contribution of the technology to protection of the environment

Simulation modeling technology of water resource is intended to have better knowledge about the potential water in the storage of the ground and then to optimize its usage. By optimizing the use of available water it is automatically the water resource is protected meaning the protection of environment. The output of the model is for planning purposes in optimizing the usage of stored water hence it is maintaining the environment.

Climate

Groundwater modeling technology application is actually derived from existing water scarcity as a result of climate change impact. Therefore it is very important to have this projection model on water resource in order to better manage the available water. The climate parameters such as rainfall and temperature are basic inputs to the program of groundwater modelling. The results of groundwater flow predictions obtained with the computer model is a very important sources of information for administrator for making development plan. Thus, stakeholders are benefitted from the outputs generated by this computer model.

Financial requirements and cost

To be able to develop and apply computer models of groundwater flow, it requires substantial funds. Substantial funds are allocated to: 1). the cost of procurement of hardware (computers and their supporters) and software (software licenses). 2) The cost for the procurement of data (through surveys and the purchase of secondary data). 3). Salaries and wages for researchers.

Annex 1.3. Technology factsheets for coastal vulnerability

a. Seawall and revetment technology

Introduction

In every coastal area and beach in Indonesia, integrated coastal management will be applied. This is a process of coastal natural resource management and environmental services that integrate the activities of government, business and society covering horizontal and vertical planning, preserving land and marine ecosystems, application of science and management, so that this resource management will improve and be sustainable for the surrounding community welfare.

Lack of understanding of coastal dynamics will lead the efforts to harness the economic potential even bring up new problems such as erosion and abrasion as well as accretion. Besides, the incidence of sea level rise and tropical storms will also lead to coastal erosion. Various efforts to solve the problems through the development of Seawall and revetment have been and some are being done by government, business and the society. Because the incidence of abrasion and erosion of beaches are scattered throughout Indonesia, the location that has a significant

impact will be followed up in advance. Development of Seawall and revetment is one of the appropriate adapt technology in dealing with further damage of coastal and beaches.

Feasibility of technology and operational necessities
Seawall and revetment are structures that were built on coastline as a barrier of the mainland on one side and waters on the other. The function of this structure is to protect and keep the coastline from waves and to hold the soil behind the seawall. The seawall is expected to cease erosion process.

On the north coast of Java, many cities are experiencing abrasion and erosion resulting from a decrease of land and sea-level rise. Actually those areas are potential as economic and tourism area. Land use in coastal areas is widely utilized as shrimp and fish ponds. With the incidence of abrasion and sea level rise, the damage of aquaculture infrastructure is very costly. Construction of seawall and revetment is needed in these areas.

The raw material to build Seawall and revetment is plentiful, as well as the field workers. However, the structure and strength of Seawall is still a problem, the existing building is not strong enough to hold the waves and movement of land, so that the lifetime of the building is not as initially expected.

Benefits of the seawall and revetment
Coastal protection strategy emphasizes on the complex variation of protecting the national assets in the coastal area covering from residential, commercial areas, agriculture to fisheries fields. The goals that are set for the coast should pay attention on the life, natural and artificial environment including land for a variety of prime activities.

Some of the functions of Seawall and revetment construction include:
- As the flood wall that serves as a protection / barrier from waves.
- Protection of wall of beaches from erosion
- Protecting the settlements, aquaculture and road infrastructure

Technical requirements
Good management of the coastline using one of its technologies, i.e. seawall and revetment will enhance the economic and environmental potencies along the coast, so it can be maximally utilized for the public interest. Diagram of the technical development to build seawall can be seen in the Figure A-4.

Status of the technology and its future market potential
Seawall and revetment technology has been widely applied in coastal areas in Indonesia, but its existence is still lacking, because the damage process is faster than predicted while the need of many Seawalls and revetments is considerably urgent throughout Indonesia. The budget required should be planned on a regular basis and should be covered in the road map of the application of adaptive technology, especially coastal security with sustainable development policies and strategies.

The need for the appropriate Seawall and revetment technology suitable for a coastal area is of a huge potential market. In the presence of sea level rise and increasing the amount of

waves in the waters, local government would anticipate from the incident. There have been many areas in Indonesia which suffered from damage due to the rising of sea levels, but until now there has been no initiative from local or central government in reducing disaster with Seawall and revetment construction.

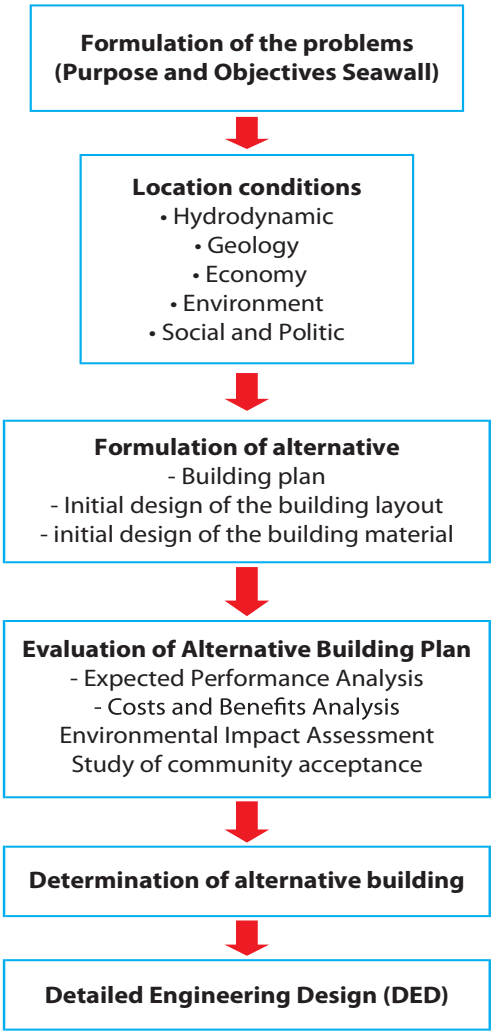

Figure A- 4 Diagram of the determination process of the seawall or revetment to control the coastal damage.

Contribution of the technology to protection of the environment

The availability of a seawall and revetment will reduce the environmental damage, such as damage to road infrastructure, aquaculture and even residential areas. Indeed, on one side seawall and revetment will reduce the damage from rising water level, but on the other side it will result in erosion of shore-line or in increasing sedimentation where there is no such construction especially at the end of the building. It necessitates a thorough and comprehensive solution with respect to coastal cells approach that is an approach where the beach is characterized as a system of a sediments input, transfer, storage and reduction. Seawall and revetment construction concept is using coastal cell by dividing the shore-lines into parts where its changes has no affects to adjacent section or who has a different character to the next sections.

Climate

Seawall and revetment technology is potentially used as a technological adaptation to coastal communities. It is not directly reduce the presence of carbon dioxide (CO2), but the immediate benefit is felt by the surrounding community, such as reducing the damage of fish or shrimp ponds, holding a deeper intrusion of sea water into the mainland so that the road infrastructure and housing are safer.

Financial requirements and costs

Construction of buildings on the coastal areas requires a substantial cost depending on the design, size and strength of the building. In the construction of Seawall or revetment, it requires a minimal of budget of about 3-5 billion Indonesian Dollars (ID) for a less extensive scale. The example is in the centre of Indonesia, at the Losari, Makassar, it takes a fund of 19 billion ID for the construction of such seawall.

Reclamation Technology

Introduction

Most of big cities in Indonesia are located in coastal areas, having large populations and rapid growth economic activities. Often, available land is not able to support growth and development of the city, i.e. level of need and growth of such settlements, industrial sites, offices and shopping centers and tourisms.

In order to obtain the needed lands, the big cities see the area that had been forgotten, i.e. the coast (coastal zone), which generally has a low environmental quality. This phenomenon is not only experienced by Indonesia, but also experienced by developed countries, so that the coastal area will be a concern and a beacon of hope in solving the supply of urban residential population.

Considering these conditions, reclamation activities is one of the activities which are unavoidable at this point. Reclamation can provide both positive and negative effects for society and the coastal and marine ecosystems. The positive impact of reclamation activities include the improvement of quality and economic value of coastal areas, reducing the land that is considered less productive, the addition of territory, protection of coastal erosion, improvement of aquatic habitat, improved hydraulic regime of coastal areas, absorbing employment. etc.

While the negative impact of the reclamation activities on the environment include physical effects such as changes in hydro-oceanographic, coastal erosion, sedimentation, increased turbidity, marine pollution, changes in groundwater regime, increasing the potential for flooding and inundation in coastal areas. Induced biological effects such as disruption of mangrove ecosystems, coral reefs and sea-grass beds and the decline in biodiversity, as well as some social impacts such as community activities in the region is largely coastal fish farmers, fishermen and laborers, so that the reclamation will affect the catch and impact on decline in their income.

In carrying out reclamation, it should follow the procedures and guidelines have been prepared by several institutions like the local government, so as to minimize any negative impact.

Currently, the site that has been developed into the reclamation area includes Losari beach in Makassar, the beach of Semarang and part of Jakarta bay area.

Technical Requirements

In the implementation of the reclamation work, the things to note are:

1) Study of the impact of reclamation, such as:
   - Changes in the coastal hydrodynamic as a result of changes on flow and wave patterns during reclamation construction which will cause turbidity of waters.
   - Changes in the sediment transport that occurs due to the disruption of littoral transport which lead to erosion on one side and sedimentation on the other.
   - Changes in the ground water that occurs when the accumulation of wet material reclaimed from the sea, the sea water is trapped and will contaminate the coastal ground water aquifers.
   - Changes in the water system in the hinterland resulting from the reclamation. The disturbance is lengthening the water drainage path or decreasing the existing gradients of water flow hydraulic that can reduce drainage capacity. This condition is vulnerable to flood.
2) In the muddy areas, attentions should be made on:
   - Mud wave or explosion that is an area that has a low carrying capacity because its type of soil is mud.
   - Lowering the non-flat surface land resulting from the uneven mud thickness.
   - Liquefaction; it is a sandy soil that lost its carrying capacity due to imperfect compaction, so that when vibration/shock take place such as that caused by the earthquake, the reclamation land can be buried. Liquefaction is a process of reducing drastically ground pressure on soft sand with uniform particle size which is soaked water, due to instantaneous load (e.g. an earthquake or vibration). The instantaneous load causes increasing water pressure in the soil pores, so that effective soil pressure will be dropped (if it reaches zero, the grains will float). This will decrease soil bearing capacity and makes it could no longer able to support the load on it.
   - Parameters that influence the occurrence of liquefaction process are: the type of land and sand particle size distribution (fine sand, medium and uniform), low density particle (not solid), environmental conditions (submerge in water), shocked load (seismic / vibration).

Status of the technology and its future market potential

Reclamation provides many advantages to developing some regions. This practice gives alternative land selection for expansion of areas, the arrangement of the coast, creating alternative activities and the development of marine tourism. The reclamation of an island can withstand tidal waves that erode beaches. Instead, they can also become a sort of dam to hold the intrusion and land floods. But keep in mind also that reclamation is also as human intervention on nature and all of these activities may also bring adverse effects.

In order to minimize the adverse impact, it needs a deep assessment of the reclamation project by involving many parties with interdisciplinary science and technology support. A careful and comprehensive study of the reclamation will certainly result in an reclamation area which is secure and environmentally preserved.

Coastal areas reclamation and revitalization projects developed by the local government of Jakarta is intended to build and provide those areas to be a business and economic activity as well as elite settlements. With this initiative, the government of Jakarta and their several corporate partners intend to change the title of Jakarta to be a Water Front City.

Contribution of the technology to protection of the environment
Healthy ecological and ecosystem conditions will ensure the sustainability of economic activities. For that reason, reclamation activities must be planned with as much as avoiding possible problems.

- Disturbance to the presence endemic and protected aquatic biota (endangered species).
- Significant reduction of the diversity, abundance and biomass of benthic organisms due to an increase in suspended solids.
- Damaged and the loss of plants that became a place to live for aquatic biota.
- Changes in animal migration patterns, the death of biota, the extinction of biota, disruption in the form of expulsion and noise to wildlife.
- Damage to the function of the protected habitat/ecosystem (mangroves, coral reefs, sea-grass beds, wetlands) located in the coastal waters and estuaries.
- Disturbance to the protected areas, so it should be considered whether the region should be preserved, revitalized or diverted its designation.

Climate

Reclamation development does not directly reduce the impact of global warming, population adaptation technology through land reclamation will improve people quality of life and of course on improving the quality and economic value of coastal region. Instead reclamation will bring benefits it can also lead to various negative impacts on social and environmental areas. Therefore, prior to reclamation activities, it absolutely needs extensive support for the study of various aspects, such as socio-cultural, economic, environmental, technical, transportation and so forth. Reclamation plan should be included in the spatial planning document having the force of a strong legal binding (Local Government Regulation, Presidential Regulation or Government regulation).

Financial requirements and costs

In 2012 for example, the budget allocated for reclamation of Painan area is about Rp 300 billion. As for reclamation in the outer islands of Pulau Nipah only implemented for the purposes of economy, defense and security. Likewise, the beach called on Losari, Makassar in the Center of Indonesia, with amount of fund as much as Rp 19 billion for the construction of the embankment. The total budget needed for reclamation of Losari reachs of about Rp 500 billion and the land will be used for businesses, country palace, public and green open spaces. Losari beach reclamation will be provided to invest.

Annex 2. Market mapping

Annex 2.1. Market Mapping for Food Security

a. Dissemination of rice varieties for drought and flood tolerance

Table A- 4 Dissemination of rice varieties for drought and flood tolerance

KEY INFRASTRUCTURE AND MARKET SUPPORT SERVICES:				
Module of cultivation dissemination	Planting calendar, cultivtion techniques for rice varieties for drought and flood tolerance by BPTP and rice seed farmers			
Actor	BPTP, Rice filed supervisor, farmers of rice seed for drought and flood tolerance			
The Market Chain :	Networking activity of the actors including farmers			
Market environment :	Factors causing the barriers of the market mapping actors			
Enabling Barrier	Actor	Supplier factor / Supporter	Dissemination of cultivated rice product Produk Diseminasi Budidaya padi	Intended data from the rice field supervisors
Six government steps to solve food security due to climate change impact Rice field supervisor makes map of village needs in conjunction with those six steps. The supervisor passes through data to related institutions	Center for Agriculture Technology Development (BPTP) Rice field supervisor Rice farmers 4. Rice seed farmers	Demonstration to use planting calender Production of rice seed for drought and flood tolerance at the pilot garden of local BPTP Demonstration plant of cultivation drought and flood tolerance rice varieties	Confidant supervisor in his or her role in guiding farmers to adapt to dry or flooded land condition due to climate change impact Farmers who plant these rice varieties need to have incentive from the government	Rice field locations of dry and inundation Food stock condition Potency of making artifial rain Potency of pumpin water from the available sources Other commodities that must need to be planted to have food reserve Location of Red Cross (PMI) office if clean water is shortage Do food diversification program

b. Cultivation of milkfish in floating net cage

Table A- 5 Cultivation of milkfish in floating net cage

KEY INFRASTRUCTURE AND MARKET SUPPORT SERVICES:			
Module of milk fish farming	Disain Karamba Jaring Apung (KJA) Tahan Gelombang, Benih Bandeng, Pembesaran Bandeng, Teknis penerapan Budidaya IMTA (Integrated Multi Trophic Aquacultur)		
Actor	Finance, R&D, Legal and security,and other institutions that support the farming of milk fish in floating net cage		
The Market Chain :	Sea fish farming centers of small islands		
Market environment :	Factors causing the barriers of the market mapping actors		
Enabling Barrier	Actor	Supplier factor / Supporter	Product of milk fish farming
Regulation of Marine and Fisheries Minister No. Per.12/ Men/2010 al. cocerning "Minapolitan". Minister of Marine and Fisheries Decree No. 41/2000 concerning General Guidelines of Small islands sustainable and community based management, e.g. sea farming zone	■ Funding institutions (Bank dan Venture Capital) ■ Institutions for research and development (BRKP KKP) ■ Institutions of Legal and Security (Army & Police) ■ Trade Agency (KADIN) ■ Supervising , tutoring and training institutions (BRKP KKP) ■ Downstream industries (Frozen fish, canned fish industries,etc)	■ Training of milk fish farming in floating nnet cage ■ R&D on milk fish seed by BRKP ■ Guidance on production center and marketing by KADIN ■ Regulation prefering to milk fish farmers prepared by KKP ■ Stop monopoly practices by businessmen ■ Chanelling to venture capital and subsidy for the farmers ■ Clear job descriptions among institutions/ agencies ■ Need implementation of innovated technologies to farmers by BRKP KKP. ■ Invite development of down stream industries of milk fish to operate with larger scale ■ Need a role of Trade Ministry in helping find the market for milk fish ■ Make pilot plany of milk fish in floating net cage for training on the good and right marine fish farming (CBIBB).	Zoning of milk fish in floating net cage with CBIBB

c. Implementation of beef cattle farming engineering

Table A- 6 Implementation of beef cattle farming engineering

KEY INFRASTRUCTURE AND MARKET SUPPORT SERVICES:			
Module of beef cattle farming	Implementation of beef cattle farming engineering from up till down stream with village breeding center (VBC) pattern		
Actor	Cattle farming supervisors from central government down to Sub-District levels, Coordination Forum of beef meat self sufficiency program 2014 (PSDS 2014), beef cattle farmers, beef cattle traders, cow slaughter houses (RPH), Directorate General Animal Husbandary, Ministry of Agriculture		
The Market Chain :	As network activity for supporters of market mapping		
Market environment :	Factors causing the barriers of the market mapping actors		
Enabling Barrier	Actor	Factors of supplier/ supporters	Cattle beef farming product (meat)
■ Policy on meat import ■ Insentive policy for public breeders ■ Development of public livestock farming patern ■ Integrated system rice paddy, livestock and other crops ■ Microfinance and cooperation ■ Development policy of livestock farming in east Indonesia (KTI) ■ Planned Indonesian Livestock Farmers Forum	■ Livestock fattenned Association ■ Greenish feed industries ■ Slaughter houses ■ Certification Institutions ■ Upgrading Standard ■ Animal Health Center ■ Microfinance Institution ■ Concentrate feed industry	■ Feed indusrty ■ Public Cattle Farm Industry ■ Beef cattle traders	■ Calves ■ Cow parent ■ Cow ■ Cow seed ■ Cattle beef

Annex 2.2. Market mapping for water resources

a. Market mapping rain harvesting technology

Market mapping of rainwater harvesting technology using reservoir can be seen in Figure A-5. The development of a reservoir is initiated by the need from community and government program. The program must be supported with legislations, networking between communities as the parties who need it as well as its dissemination to the public.

The next stage is installing the reservoir. At this stage, contractor service providers and material suppliers are the actors at play. Contractors must be provided with an easy access to finance and a guarantee of material availability from the material providers. These materials must also be guaranteed to reach the reservoir project site, thus requires a proper transportation system.

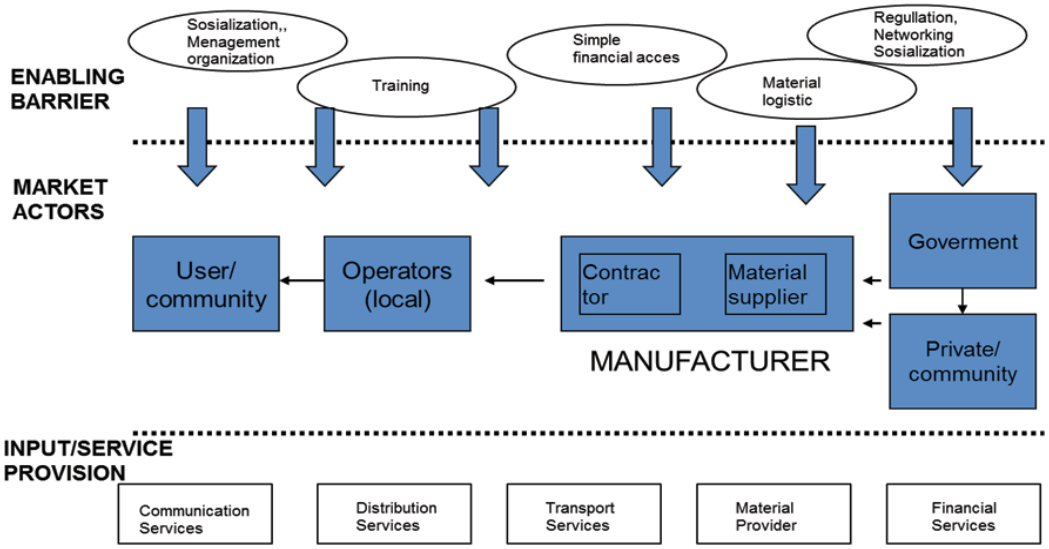

Figure A- 5 Market mapping of rainwater harvesting technology using reservoir method

Once the reservoir has been installed and tested for proper operation, the contractors would hand it over to project manager who would then assign the operation and maintenance to trained operators. The operation of reservoir requires the availability of a water distribution facility, either to farm or to certain communities.

The end user of the reservoir will be the community members. Therefore, dissemination on the rules of utilizing reservoir water is necessary in order to maintain efficiency.

b. Market mapping for water recycle technology

Figure A-6 below explains the market mapping diagram of water recycle technology. The technology is a government program which should be implemented by industries and society. For the program to be successful, the government should formulate clear rules to be disseminated by network of industries and society. In developing wastewater recycling technology, industries should be well supported financially.

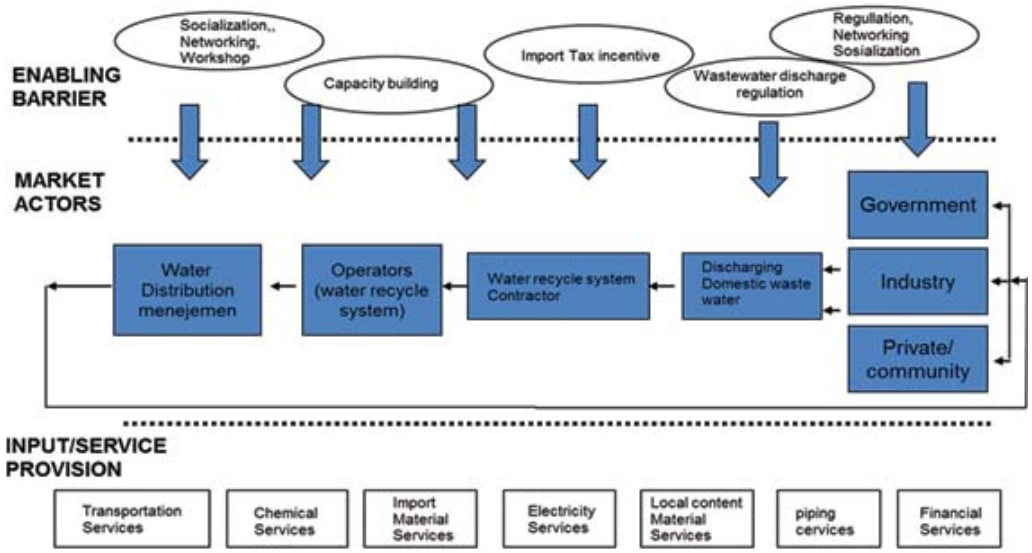

Figure A- 6 Market mapping of domestic wastewater recycling technology

Both industries and society must obey government regulations in the case of disposing their domestic wastewater. Accordingly, they need to be supported with good piping system so that all wastewater produced can be processed in one place.

Contractors play the biggest role in developing wastewater recycling plant. In order to attract these contractors, financial incentive in the form of a tax relief should be given. While developing the domestic wastewater recycling installation, contractors need strong supports from various suppliers, such as power supplies, and the supply of local and imported materials. In addition, the ease to commodity import services will further help contractors to develop wastewater recycling technology.

Once the wastewater recycling system is developed, the operation, care and maintenance are handed over to operator. Trained operators are needed to operate the wastewater recycling system. The operation of wastewater recycling process requires certain chemicals in order to attain perfect processing result. Therefore, the chemical supplier support is indispensable in the operation and maintenance of the installations.

The distribution of recycled water products needs to be conducted and managed by certain parties, such as PDAM, and requires tanks as a transportation system and also a piping system. Intense dissemination about water management technologies and the use of recycled water is a must in order to attract the public to use these recycled water products. Furthermore, it will minimize the barrier of people reluctant to use recycled water.

c. Market mapping for water resources modeling technology

Figure A-7 below explains one of market mappings of water resources modeling. Modeling technology of water resources is a government program to encourage industries and the society together to support the conservation of water resources and to predict the supply and demand of future water needs. It needs to be supported by formulating certain rules and disseminating them in networking to all parties.One of the stages in making a model of water resources is to conduct an analysis of needs and use of water (water supply and demand) both for the present and future. It needs trained, specific, and fully capable of modeling human resources and also a good coordination between the human resources that are involved in this modeling to make this activity succeeds. In making a modeling, the support of reliable and valid data from competent sources is necessary.

The next step is to create predictive models of demand and availability of water. Creating and conducting the model must be supported by adequate software and hardware which will be procured with low import cost. One of the ways to decrease the import cost is to lower the import tax.

The completed models of water resources will be much beneficial when operated by trained operators. In order to employ such operators, both domestic and overseas trainings on the application of modeling software are necessary. To run the model, they need to be provided with valid data of the water resources conditions. The modeling results will be used by the government, industries and society to frame policies in water resources management.

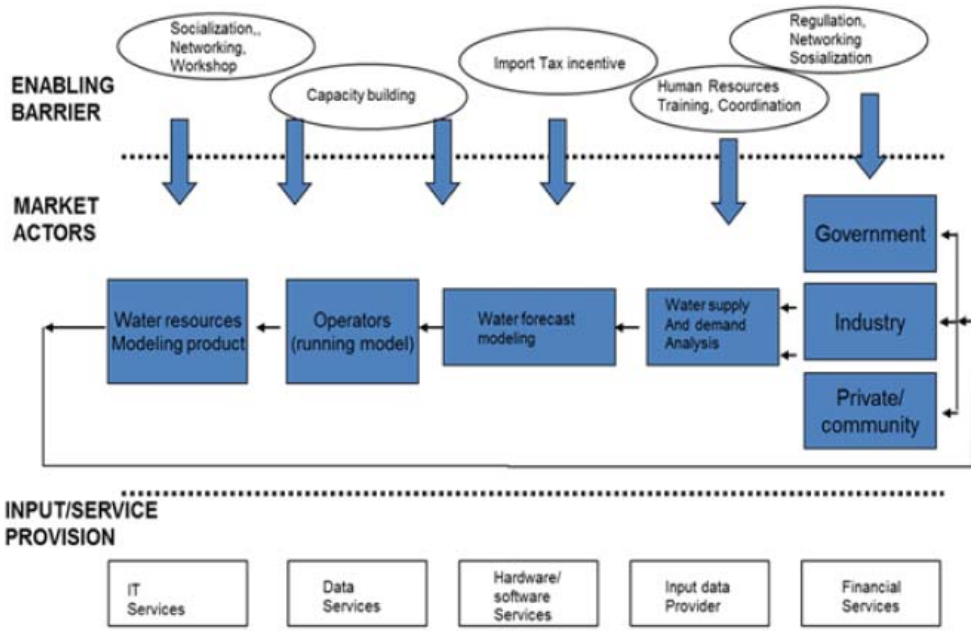

Figure A- 7 Market mapping of water resources modeling

Annex 2.3. Market mapping for coastal vulnerability

a. Market mapping for sewall/revetment

Market mapping for coastal protection and beach reclamation technology is shown in figure A-8. From the figure it is known that initiation to carry out a coastal protection or beach reclamation project, can be proposed either by the government or private companies. The propose project should be based on the results of the study of R&D related institutions on the vulnerability/risk assessment of the region. Regions with higher levels of hazard vulnerability will be more prioritized to implement the climate change adaptation efforts rather than other area with less vulnerablility.

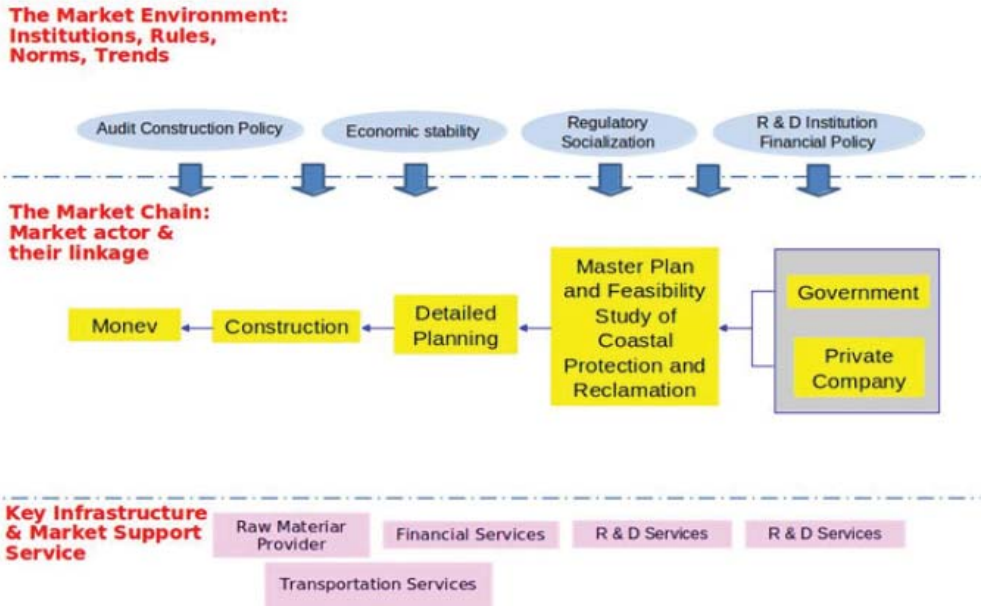

Figure A- 8 Market maps for coastal protection and reclamation technologies

The proposed project should be supported with adequate amount of funding, bearing in mind the huge amount of funds needed for the development of coastal protection structures and/or coastal reclamation. Subsequently, a master plan should become available and feasibility study has to be conducted. At this stage, supporting regulations and socialization are indispensable and should be implemented. So that, the parties concerned can understand the benefits of coastal protection / reclamation projects. In this stage, the results from R & D study should also be considered.

The next stage is to make detail planning. At this stage, economic stability is essential, so that the implementation will not differ much from the initial planning, especially in terms of finance.

Then come to the construction stage. At this stage, the availability of local material and its provider become the important thing, supported by adequate transport. More over, audit construction policy will be supporting the construction phase as well as the last stage of the implementation, i.e. monitoring and evaluation (M&E).

Annex 3. Project ideas

Annex 3.1. Project ideas for food security

a. The agricultural calendar determination for the cultivation of the flood and drought resistant rice varieties

Objective: to upgrade the climate forecasts capability and to apply a dynamic and integrated planting calendar for selected rice varieties that tolerant toward flood and drought

Introduction

Rice is the staple/main food of the majority people in Indonesia therefore rice has a strategic function in food security. The consumption of rice according to current information from the Central Bureau of Statistics of Indonesia is about 25-27 million tons per year, while the national production is around 40 million tons per year, based on the 2011 data. This information indicates that the national target of 10 million tons per year rice surplus by 2015 set by the government has been achieved.

The success in the achievement of the national rice production itself has not necessarily success for the whole program, sinve there are several issues need to be addressed, such as the lack ability of Bulog to maintain at least 3 million tons of storage for the year of 2010, and this is causing the price of rice increased.

A study conducted by research and development institutions in Indonesia and the International Rice Research Institute (IRRI) for the ACIAR-SADI, found that the cause of low yields have links to: technical limitations that restricted access to knowledge about cultivation practices of intensive crops which has been successfully implemented in other parts of Indonesia.

Goals of the Project

- To increase the role of the agriculture instructors in technology transfer of climate change adaptation focused on the increasing sustainable productivity and profitable of farmers toward drought and flood tolerance rice varieties, which the experiments have been piloted and done by the Ministry of Agriculture.
- To assist in re-setting up the main tasks and functions of experimental gardens of Centre for the Development of Agriculture Technology (BPTP) that spread over 118 experimental gardens, in order to achieve the ability to produce drought and flood tolerance rice seeds in the experimental locations.

Methods

The agriculture instructors provides a variety of appropriate technology transfer modules to increase local rice production through a focusing on increasing sustainable productivity which profitable in irrigated rice farming systems, lands, and wetland depending on the weather. The aim is for farmers to identify, adapt and implement the proper practices crop cultivation.

This activity must also involve the Centre of Rice Research (BB Padi) and Center for Assessment and Development of Agricultural Technology. The R & D institutions will be working with Centre for Development of Agricultural Technology (BPTP), Extension agencies at provincial and local/ district governments, universities, non governmental organizations, and farmers in some target villages in the Province areas that have agricultural land expansion program. Improved crop cultivation practices have the potential to increase productivity because these practices have been examined and adapted to local conditions by farmers.

Phase of Activity

The project activity will need to be done in 3 phases with the total time needed is 3 years, which can be broken down as follows:

- Year/phase I: Training of weather monitoring and test of planting calendar
- Year/phase II: Determination of planting calendar of drought and flood tolerance rice
- Year/phase III: Production

Phase I activities of the farmers are the stage of looking for partners

Research partnerships of agriculture instructors in targeted villages with the land area of 100-200 hectares of paddy fields per village. The research team hopes that within three years at least as many as 240 farmers in these villages will shift from just a test to apply practices rice cultivation sustainably introduced by planting calendar.

Phase II activities are the expansion activity

Tests are planned to be implemented as an effort to expand the program implementation in the nearby villages. The next goal is to expand the economic benefits impact to reach at least 6,000 farmers through the extension of these changes by various research institutes and instructors.

Phase III activities are all the more advanced stages of dissemination of new practices

It is expected that farmers are supported by a program of adaptation to climate change which is a subprogram of Food Security will use the funds of local governments to improving food security in increasing productivity of their rice cultivation system in accordance with their own planting calendar.

Expected Results

- Crop cultivation practices that are most successful will be combined into the integrated platform of Crop cultivation technology, and into the Prima Tani Program (business model for agriculture) which is currently being promoted by the Government of Indonesia, especially the Ministry of Agriculture.
- Strategies and line instruction developed will be a model that can be utilized by the national rice program to facilitate the implementation of increasing rice production practices in the farmer community.
- Indonesia marketing of rice is influenced by the government rice market (BULOG) and the free market price. If farmers have started to implement improved practices of rice cultivation, they will be able to benefit from a very low price margin even for better-quality rice.

Partner institutions in this Project

- The International Rice Research Institute, (IRRI), Philippines
- Institute for Agricultural Technology, Indonesia Provinces that are being the center of the rice or the rice farm expansion planned by the Local Government.
- Center for Rice Research, Indonesia in Sukamandi.
- Balitklimat, Center for Research and Development of Agricultural Land Resources, Ministry of Agriculture.
- The joint research team of the provincial education staff to develop expertise and knowledge of agriculture instructors on natural resource management in the rice production system.

Budget

- First year's budget: Rp. 1.75 billion
  - For pilot-plant of 200 Ha Rp 750 million
    (Calculation based on the assumption of Rp. 3.7 million/Ha for land preparation)
  - Financial counseling for 4 (four) villages Rp. 1 billion.
- Second year's budget: Rp. 2.2 billion for the expansion of the 240 farmers to 6000 farmers
- Third year's budget: Rp. 1 billion to fund agricultural instructor's assistance.

Total budget for this project will be Rp 4.95 billion

b. Floating Net Cage (KJA) Milkfish Cultivation

Objective: to increase the fish production by the utilization of floating net cage method fish cultivation

Introduction

The consumption of fish, as one of the protein sources, has rapidly increased along with the increasing of population in Indonesia.

In the fishery is commonly known 2 kind of cultivation, wich are Capture and Aquaculture cultivations. Capture fishery is heavily depened on weather, which now days effecting by climate change, therefore aquaculture need to be boosed up by implementing innovative approaches or technologies.

Eventhough Indonesia has the second longest coastline in the world (81,000 km) after Canada, which mean Indonesia has a great potential in fisheries, particularly in mariculture, but the fish production is declining from time to time. As of present day Indonesia has sea cultivation area of 2.5 million Ha, and it is being utilized approximately 0.67 million Ha only.

As an illustration, mariculture in China proved to significantly contribute to the food security, provide employment and global climate change, i.e. the reduction of carbon gas (CO2) and eutrophication (Fang, 2009). In food security, mariculture in China has contributed 15 million tons of seafood to human and provided 1 million jobs. In addition mariculture have also been able to reduce 1.37 million tons of carbon and 96 000 tons of nitrogen which are absorbed by the oyster and seaweed cultivation. Hence the concept of IMTA (Integrated Multi Tropic Aquaculture) introduced by Chopin in Fang (2009) by performing the oyster and seaweed cultivation around floating net cages for fish farming is an environmentally friendly fish farming concept that needs to be adopted.

Fish cultivation has long been recognized by the fish farmers and has grown in almost all Indonesian waters, namely by using brackish water and tidal

Cultivation of fish found not only thrive in brackish water only but currently was also developing in freshwater or marine using Floating Net Cage (KJA) systems. Cultured fish as a commodity has several advantages compared to other aquaculture commodities, among others are:

- Breeding technology has been well mastered so that the supply of seeds is no longer dependent on the seasons and the seeds from the wild.
- Cultivation technology in both the ponds and in cages has been well controlled, technically easy to apply and be economically advantageous.
- Able to tolerate salinity changes ranging from 0-158 ppt so that the area of cultivation is quite extensive ranging from freshwater to the ocean waters.
- Able to live in crowded floating net cages (100-300 fish/m3).
- Rapid growth (1.6% / day).
- Efficient in utilizing feed FCR from 1.7 to 2.2.
- Commercial feed for this fish is available in sufficient quantities even on the countryside.
- Market for the fish is still wide open for both in Indonesia and overseas.

The use of floating net cages for milkfish farming in the sea has several advantages including:

- Efficient use of land
- Easily in both selective and total
- Easily monitored and does not require special water management as in ponds
- High productivity (350-400 kg/cage 6m3/planting period of 6 months)
- Scale can be adjusted to capital by utilizing locally available materials

Furthermore milkfishes produced by using floating net cage would have export quality because of its:

- Clean and shiny scales
- No smell of mud
- The content of Omega-3 fatty acids is relatively high compared to milkfish produced in farms/ponds
- Chewy meat with a distinctive smell.
- The fish size can reach 600-800 g/fish in accordance with the market demand

Fishery including mariculture is believed to be one important solution to improve food security in many countries including Indonesia. Therefore, increased productivity in fisheries sector can also keep the world from the food vulnerable situation. However, in order to reduce the negative impacts of mariculture development in this case milkfish farming in the floating net cages against environmental degradation, the concept of IMTA has been widely practiced in various countries urgently need to be applied.

Goals of the Project

The purpose of this project is to develop and promote aquaculture technology, milkfish farming in particular (Chanos) in an environmentally friendly floating net cages (KJA) to support food security program in order to anticipate the negative impact of global climate change.

Methods

The methods used in the project include:

- Coordination with stakeholders (KKP, Related Service Institutions, The Fish Breeders/ Fishermen, entrepreneurs, funding sources, etc.).
- Planning of technical detail, financing and implementation of project activities.
- Survey for location to place KJA to be used as a means of training and production.
- Establishment of fish farmers' group KJA system.
- Training and socialization of milkfish cultivation techniques in the environmentally friendly KJA Application of technology in various regions in Indonesia.
- Evaluation
- Materials or facilities needed in the implementation of this project include:
- Tools to survey the location of the environmental impact assessment.
- Pilot cultivation unit of milkfish in KJA.
- Support for training and monitoring activities.

Phase of activity

First year

- Create a pilot unit of KJA as production facilities and training on fish farming technology in the KJA.

Second year:

- Create a pilot unit of KJA as production facilities and training on milkfish farming technology in KJA using environmentally friendly Multi Tropic Integrated Aquaculture (IMTA) method to a group of fish breeders.
- Establishment of skilled groups of fish farmers.

Third year:

- Establishment of several milkfish production centers in environmentally friendly KJA technologies in several areas in Indonesia including Jakarta, Riau Islands and South Sulawesi.

Expected results

Technology development of Mariculture of milkfish in Floating Net Cage (KJA) in Indonesia is implemented in the format Cooperative Management that is the government together with

the community to carry out the planning, implementation and evaluation of development programs together.

Budget

The total budget for this project, which will be implemented in 3 years is US$ 7.5 billion, which can be broken down as follows:

First year : Approximately US$ 2.6 billion
Second year : Approximately US$ 1.4 billion
Third year : Approximately US$ 3.5 billion

c. Cattle farming using integrated breeding center village pattern and crops-livestock system

Objective: to develop a system toward the production of free deases livestock

Introduction

Farm development is a part of an important national development. The objective of livestock development is to improve of the excellence human resource quality, increase farmers income and welfare, environmental protection and increase state revenues. An ecologically, economically and sustainably sound farming system is developed for food security and poverty alleviation, especially for the facility limited farmers and community, with the development opportunity given to large-scale farming industry as well. The challenge of livestock development is more because of an economy globalization, which will become a threat if Indonesia continually importing farm products and technologies. At the same time globalization is also an opportunity for the livestock industry if we can producehigh quality, clean and healthy livestock products and free from diseases.

Based on Livestock Statistics in 2005, Indonesia's exports grew by 17% per year. The Islamic world also expects Indonesia as a livestock exporter in accordance with the Islamic rules. Dependency on imports will be a threat if the independent productive effort, move the production process to meet the needs, can not be met domestically.

Factor in the country which have obstructed the growth of the livestock sector, among others are:

- The structure of the livestock industry that largely remains in the form of community business which are characterized by low education and income levels of farmers, management practices and technologies that are still conventional, widespread farm location, business size is relatively small, and procurement of main inputs namely HMT Forage Livestock Foods (HMT) are still dependent on season, availability of family labor, as well as a limited tenure for HMT.
- Availability of good quality seeds that are not accessible by farmers because the research on livestock breeding that have been carried out on a large scale have not been socialized. This was due to communication failure of the R & D with the rancher, and also with both Research Agency of the Ministry of Agriculture and Higher Education. In addition, farmers also have no incentive to adopt new technologies that will be accompanied by an increase in costs

- Agro-farms have not been able to move the livestock sector, for example the dairy processing industry that most are still use the input from the origin country, like the hospitality industry that still requires imported meat.
- Heavy imports of illegal farm products
- Catastrophic diseases (anthrax outbreaks)
- High dependency on feed raw material

Goals of the Project

- Establishment of cattle breeding communities that implement good and correct cultivation technology in the Village Breeding Centre (VBC) pattern to keep the local cattle seed.
- Support and join the Program of Beef Self fulfillment 2014 (PSDS 2014)
- Save the seeds of local cattle
- Improve the farmers ability to manage cattle fattening and breeding both in terms of feed managing and reproductive health of cows and health of seeds

Methods

Livestock development is a shared responsibility among government, public and private sectors. All those three managerial components is necessarily synergize each other to build a structured institutional. A good structure body is aimed to optimize the utilization of various owned resources in the development of expected farming systems. Therefore, livestock restructuring should focus on institutional that are able to:

1. Provide adequate and continuous seeds
2. Achieve adequate and ease of feed acquisition and medicines
3. Profitable marketing for actors.

Institutional that each component will synergize very well will generate the development of the livestock industrial area from upstream to downstream industry that are able to make the people prosperous and supports PSDS-2014.

Distribution of institutional tasks in each synergy work is as follows:

- Government organized setting, guidance, control and supervision to the availability of adequate farm products, both quantity and quality, safe, nutritious, varied and uneven.
- Private and the public have the opportunity to take part in realizing the adequacy of farm products; can be by doing production, trade and distribution of livestock products.

On the other hand, Indonesia with a population reaching 223 million people with population growth rate of 1.01 percent per year (Ditjenak, 2006), is a potential market that want to be targeted by world's food producer from several countries including livestock feed products. It needs to search for a model development and the appropriate institutional and economically advantageous in the application of the model (Ilham, 2006) to build a system capable wisely to accommodate various interests and beneficial for the actors in its operation. Thus the institutional development model can improve the welfare of the community and developing the Human Resources (HR) quality through food security program in providing foodstuffs of animal protein that Safe, Healthy, Whole and allowed in accordance with islamic rules/ halal (ASUH).

Welfare of the community can improve the ability of purchasing power and ability to provide and distribute farm products throughout the archipelago throughout the year. Ministry of Agriculture will perform the update data of cattle population held in the 33 provinces, 471 districts/municipalities, 6548 sub-districts, and 78,732 villages. The Work has been carried out in collaboration with the BPS (Central Bureau of Statistics). Although there are still many farms in Indonesia supported by traditional breeding, but they were one of the important role of the sustainability of farm holders Indonesia, therefore it is needed a special attention to the traditional farmers to improve the quality of their livestock by government and farm experts intervention via operational of Village Breeding Center (VBC).

One of the government programs that is a collaboration between the Directorate General of Livestock, Ministry of Agriculture, with the Directorate of Higher Education, Ministry of Education to promote small-holder livestock is a "Livestock Bachelor Degree Enters Villages (SMD)" program. Undergraduate candidates are attempted to raise livestock farms in Indonesia by contributing in promoting livestock, one of which through the program of SMD which has been running since 2008.

Phase of Activity

VBC development stage that meets national standards take three years project with the following stages:

First Year:

- Planning and coordination
- Feasibility Study
- Detailed Engineering Design

Second Year:

- Construction and installation of cages cattle and the calves
- Certification beef for cultivation and the prospective parent (heifers).
- Running test
- Evaluation and improvement

Third Year:

- Full Operation/production of VBC

Expected results

The most often found in people's farm in Indonesia is the low-income farmers contrary with the expensive price of meat. Therefore, VBC program is expected to be a program that is able to realize the local cattle breeding center based on traditional livestock. This traditional livestock plays an important role to hold the sustainability farms in Indonesia, with good quality cattle as a result of the Cattle Farming Method implementation following the guidelines of Good Breeding Practices (GBP). It is mentioned in the Agriculture Ministerial Regulation No. 54/ Permentan/Ot.140/10/2006 about the GBP and must have been achieved at the latest by 2014 according to PSDS 2014.

Budget

The cost can access needed costs by the NTB provincial government in launching the concept of "earth with a million cattle" that is considered to help fulfilling cattle need in Indonesia and support to meet the national self-sufficient program in 2014. Earth with a million cattle is a flagship program of NTB Governor, Muhammad Zainul Majdi, and his Deputy, Badrul Munir. Data from the Office of Animal Husbandry and Health said that cattle population is about 546,114 by 2008 with the percentage of parent cow of about 37.36% from the population. The birth rate reaches 66.7% of the total parents with the calf mortality of about 20% of all born calf. The recent population of calf is 101,239 with the total slaughter of productive female cattle is not more than 20% of all cattle slaughtered. In NTB, the total slaughtered cattle is of about 41,575 and cattle that are sent out of NTB reaches 28,500.

In accordance to the PSDS 2014, the Directorate General of Animal Husbandry in collaboration with the Central Bureau of Statistics will record over centers of cattle breeding in Indonesia to update the data. Cattle that will be recorded is that afforded by households and legal entities, whose purpose is for business, trade, and transportation. Data collection conducted in this year (2012) is not the first time data collection. Previously, the government has had a cattle population data obtained from cattle census in the past years. Updating the cow data only renew the PTS (cattle keepers) database by visiting the owner of livestock.

NTB provincial government which is as one of cow breeding centers as seen in the national map of local cattle seeds source of in Indonesia (Table A-4) has also launched a concept of Earth With a Million Cattle that was approved by the President of Indonesia. However, this concept will be a cooperation work between Australian Government with local government of NTB province.

Table A- 7 Sources of local cattle breeders in Indonesia

No.	Type of Local Cattle	Breeding Location
1.	Bali	Bali, NTB,Kalsel,Sulbar, Sulsel,Sultra,Gorontalo
2.	Cattle of PO	Sumut, Jabar, Jateng, Jatim,Sulut
3.	Cattle of Madura	Madura
4.	Cattle of Aceh	Aceh
5.	Cattle of Coasal area	Sumbar
6.	Cattle of Bali dan PO	Sumsel , Lampung dan Sulteng
7.	Cattle of PO dan SO	NTT

Sources: Directorate of Breeding, Directorate General of Animal Husbandry

Annex 3.2. Project Ideas for Water Resources

a. Project idea for rain harvesting technology via reservoir

Objective:

To extend water availability for agricultural needs at the dry area by implementing rain harvesting system

Introduction

The occurrence of droughts and floods that are becoming more frequent nowadays causes an impact as well as difficulties in predicting the agricultural season and clean water supply. Meanwhile, the tremendous pressure by population growth to global climate change causes the destruction of forests and uncertainty of hydrological cycle. An indicator of that is the water discharge of the river had decreased sharply in the dry season, while in the rainy season the it sharply increases. The low absorption and storage capacity of water in the watershed cause the supply of water for agriculture mostly is uncertain. This condition is exacerbated by the drought due to selection of commodities that do not correspond to the ability of the water supply. To cope with the drought, one of the least expensive, fast and effective strategies and immediate visible results is to harvest the rain water runoff during the rainy season through water harvesting pond. This technology has been growing very rapidly and widely not only in developed countries such as Europe, America and Australia, but also in countries such as China where densely populated and widespread ownership of land is very limited. Water harvesting efforts accompanied by increasing ground water in rivers, reservoirs and lakes will be able to maintain the supply of water resources for agricultural, domestic, municipal and industrial demand. One effort is to take an advantage of rainwater overflow through building ponds (onfarm reservoirs).

Theoritically, with an annual rainfall average of 2,779 mm (Las et al,1997) logically Indonesia will not be short of water during the dry season. With a population of 206,264,595 people (BPS, 1997), per capita of Indonesian people obtains the water by 71 million liters per day, but it can only be used 0.28% of the existing rainwater. This shows that Indonesia is still lack of water storage technologies. For example, the USA is able to utilize rain water by 8.1% of the existing rain water. Indonesia needs to work hard to create a rain water harvesting technology to fulfill water demand for its people.

The concrete action plan for adaptation to climate change of water resource sector with rain water harvesting technology is to make a pilot plant of rainwater harvesting reservoir which will be equipped with water treatment facilities. Water harvested in the reservoirs is expected to serve the needs of the local community. The pilot plant will be built in the area that has major problem of water supply such as in Gunung Kidul and Nusa Tenggara Timur.

Goals of the Project

The main objective of the project is to

- Provide a rainwater harvesting pilot project which employs a rainwater reservoir with the capacity of 100,000 m3. This reservoir is equipped with a moderate water treatment facility. It is hoped that this pilot rainwater reservoir project can serve as a model for rainwater harvesting projects in other regions.
- Achievement of excellent and sustainable operation of the pilot rainwater harvesting facility.
- Improvement of the living condition of the people benefiting from the rainwater harvesting system.

Methods

The construction method of pond pilot plant involves site selection, coordination measurement, design, construction, and training for ponds operation. The criteria of ponds location is dry land farming, horticulture or animal husbandry which require a supply of water from the ponds as irrigation water. The area is also very deep soil water. There are sources of water that can be accommodated either in the form of rain, surface runoff and spring water or ditches or streams. Its upper region has a catchment area or areas that have water sources to be incorporated into the ponds, such as springs, streams or ditches, and so forth.

The data collected includes the geographic coordinates of latitude and longitude altitude locations using Global Positioning System (GPS) or by extrapolation of available topographic maps. These wells coordinate data that are needed to compile the database system of land management and water as well as monitoring the performance of the implementation of activities that have been run. As preparation for the construction of ponds, its design needs to be made. Designs can be simple in order to be read by the executor in the field. In preparing the design the following steps must be done.

- Conduct field observations to determine the construction of ponds that will best suit local site conditions. For example, in porous soil conditions, the wall of the pond must be stronger and waterproof.
- Determine the geographical location of ponds. In determining the location of ponds should be considered the position and area of cropping land, water source location, height and slope of the land. Location of ponds should be higher than that of farm land and the drainage of water into the distribution of agricultural land/ farm can be done with a gravity system.
- The candidate area of ponds should be rain water catchment areas, the surface flow can be directed into ponds.

Construction of ponds made by the appointed executors has to be carried out intensively. Monitoring and evaluation activities conducted on the overall development of ponds include planning, implementation and control, namely:

- Planning activities include, among others, site selection, socialization, financial plan, support from local government and others.
- The implementation of activities include preparation, planning activities, organization, duties and functions of executive, procurement and use of materials/ equipment, implementation of physical activity, productivity and other work.
- To the control and supervision of the role includes supervision, technical implementation and deodorized physical work.

Operation and maintenance of ponds that have been developed by the farmer / farmer group management ponds. Use of water ponds is done by making Network / Channels Water to farm land or to the public.

To maintain the sustainability of ponds, there are several components that need attention for maintenance that include:

- Reduce water loss through evaporation.
- Maintain/ protect ponds with fencing, removal of silt, repairing a leaking dike and do not throw garbage into the ponds.

Expected results

The expected results of the pilot development of these ponds is obtained 'embung' model that can operate in a sustainable and managable by the community. Demonstration ponds are equipped with a simple water treatment facility that can improve water quality of ponds. By increasing water quality, people can use water ponds as raw water for their water supply in times of crisis. 'Embung' pilot will use a more robust technology that can hold not much water to seep into the ground. This pilot is expected to be disseminated to other areas that have clean water crisis.

Phase of Activity

First year

- Identification of total number of rainwater reservoirs required throughout regions in Indonesia.
- Prioritization of regions in dire need of rainwater reservoirs.
- Determining a region which has a great potential for becoming the site where the pilot rainwater reservoir installation project will be taking place (remote island or barren land would be favorable), such as the Province of East Nusa Tenggara.
- Preparation of the location of the rainwater reservoir installation.
  - Hydrological/geohydrological examination
  - Geological examination
  - Examination of soil structure/ sustaining capacity
  - Examination of usage
  - Examination of capacity determination
  - Examination of rainwater harvesting technology implementation
  - Examination of environmental impact
  - Technical examination of rainwater reservoir installation planning
  - Financial examination of the rainwater reservoir installation

Dissemination of the rainwater reservoir installation plan

- Urgency of rainwater reservoir installation
- Benefits of the rainwater reservoir for the future
- Land requirement
- Sustainable rainwater reservoir maintenance

Second year

1) The rainwater reservoir installation
   - Land acquisition
   - Preparation of the location and field workers
   - Supply of materials and equipments
   - Rainwater reservoir installation

2) Initial operation of the rainwater reservoir
   - Water filling
   - Leakage test
   - Training for the rainwater reservoir operators

Third year

1) Monitoring and mentoring during the initial operation of the rainwater reservoir.
2) Official opening ceremony and handling of the rainwater harvesting facility to the regional government.

Budget

In the construction phase of ponds need for socialization, land replacement, the construction itself, the initial operation until the handover to the people who will manage the ponds. The proposed pilot ponds here have 100.000 m3 volum per day. If the average depth is 8 m, then the area required for the manufacture of ponds is around 15.000 m2.

Total cost of the starting phase of socialization required for managing ponds is estimated at USD 8 billion. The cost of construction of the ponds pilot is obtained by grant assistance of foreign aid.

b. Project ideas for waste water recycling technology

Objective: to increase the availability of clean water through a recycling process of the domestic wastewater by applying of ultrafiltration and reverse osmosis membranes processes

Introduction

Reuse of domestic wastewater has been occurring for a long time. However, planned wastewater reuse has being gained importance for only the last couple decades, as the demands for water has dramatically increased due to technological advancement, population growth, and urbanization, which impact on the natural water cycle. Reuse of wastewater, which consumes limited fresh water, will actually imitate the natural water cycle via engineered processes. This treatment has been done confidently for the safe reuse of reclaimed water for beneficial uses. The main reuse is commonly for agricultural and non-potable reuses. There are also many projects that have proved to be successful for indirect or direct potable reuse. Thus, the potential wastewater has to serve as a viable alternative source of water, in future.

Historically, water management has focused on building dams, reservoirs, and diversion canals etc., to make available water wherever needed, and in whatever amount desired. Soaring demands due to rapidly expanding population, industrial expansion, and the need to expand irrigated agriculture, were met by ever larger dams and diversion projects. Dams, river diversions, and irrigation schemes affected both water quality and quantity. Demands on water resources for household, commercial, industrial, and agricultural purposes are increasing greatly. In Indonesia, the populations are growing while water availability is getting scarcity. More than half of the populations have low to very low water availability, and quality of water has also been the key issue for this low water availability. In addition, the rapid spread of water pollution, the links between quantity and quality of water supplies have become more

apparent. In many parts of Indonesia particularly in urban areas, there is already a widespread scarcity, gradual destruction and increased pollution of freshwater resources.

Widespread shortage of water is caused due to contamination of ground and surface water by industrial effluents, and agricultural chemicals. They are severe near large urban centers lika Jakarta, Surabaya, Medan, Bandung, etc. Untreated sewage poses acute water pollution problems that causes low water availability. Development of city is heavily dependent upon availability of water with suitable quality and in adequate quantities. It is used for a varirous purposes ranging from domestic to industrial supplies. It is estimated that every year, the wastewater discharges from domestic, industrial and agricultural practices pollute environment more and more, thereby, what can be called a "man-made water shortages." Thus, water scarcity is endemic in most parts of Indonesia.

One concept of urban waste water treatment for clean water uses can be carried out using a combination between primary and secondary treatment of biological processes proceeded with further processing such as physic-chemical coagulation-flocculation process including sedimentation, filtration, adsorption with activated carbon, ion exchange process, as well as the process of demineralized and chlorinated reverse osmosis. With the combination of these processes the wastewater can be treated to become a agricultural and non-potable water reuses or even drinking or potable water.

Goals of the Project

The main goal of the project is to provide a pilot plant of water recycling technology for recycling domestic wastewater to become clean water uses. The main processing part is ultrafiltration and reverse osmosis membranes. The TTD of this membrane technology is estimated to be done through aid from donor countries. Transferred technologies include knowhow of microbial reactor (MBR) design system as well as the operation of the system.

The target of this project will be:

- Construction of a waste water recycling plant with a capacity of 50 liter per second in a designated location.
- Sustainable operation of the waterwater recycling pilot plant in Indonesia.
- Improvement of wastewater recycling plant and its produced clean water.
- Awareness and acceptance of this technology by communities.

Methods

Methodology for the implementation of wastewater recycling demoplant includes:

Public perception survey. It is intended to know what communities who will utilize this produced clean water respond to this technology. The survey will be conducted through the distribution of questionnaires to determine the extent of public understanding and willingness to recycled domestic wastewater. It is planned to conduct the survey in 10 major cities of Indonesia.

Planning process for wastewater recycling. Wastewater recycling plant is planned to be built in communal domestic WWTP Yogyakarta. This area was chosen because it has already owned a wastewater treatment system that is good enough in quality of the processed water. In addition, in the next few years Yogyakarta will potentially be impacted with clean water crisis.

The main equipment of the system that might need supporting from the donors is bioreactor and Reverse osmosis membranes.

Pilot development of wastewater recycling technology. The system construction and installation will be carried out by local contractors with the help of experts from abroad who have already experienced in this technology.

Running test. The trial test operation (commisioning test) is carried out when the system is installed completely. The modification or allignment of the system might be done if it is required depending on the results during trial test.

Monitoring and Evaluation. During the installation, trial test and operation, it will be carried out monitoring of the system performance as well as the quality of the processed water. Processed water will be sampled regularly and analyzed it at the laboratory for its quality parameters. The knowledge transfer from expets to Indonesian experts or operators will occur during whole activities.

Socialization. Socialization of the system and its processed water must be carried to communities that this product of water is safe to be utilized. Socialization in other major cities in Indonesia might be necessary in order to spread out this technology to other areas. To have communities accepting the technology it is better to get processed water checked and certified. The role of local government is pivotal in this regard. It is expeted that the government will improve the existing regulations in order to better support the movement of wastewater recycling program in Indonesia.

Expected Results

The expected results of the domestic wastewater recycling technology development is the utilization of domestic wastewater to become clean water and can operate in a sustainable way and socially acceptable. The water products are constantly monitored to make sure the quality is met with the clean water standard.

With the implementation of wastewater recycling pilot plant and socialization to the public, it is expected that the increased public's perception on using recycled water to address the water crisis in the future will be widely spread out to other areas of Indonesia.

Phase of Activity

First Year

- Survey on public perception regarding the recycling of wastewater with a sample of 10 major cities in Java Island.
- Planning of wastewater recycling process fro wastewater treatment plant (WWTP).

Second Year

- Construction of the recycling wastewater at the WWTP.
- Monitoring and evaluation of the wastewater recycling process of WWTP.

Third Year

- Dissemination of wastewater recycling process in Yogyakarta Province.
- Dissemination of wastewater recycle in 10 Big Cities of Java, through mass media as well as seminars and/ or elucidations.

Budget

Installation of a wastewater recycling plant with about 50 liters per second product capacity will cost USD 6 Million, covering from the survey until the complete installation of the system. The cost of the system construction and installation is expected coming from international support in the form of grant with government fund of APBN.

The operating and maintenance costs of wastwater recycling system that includes cost for power, labor, equipment replacement and chemicals is estimated to be USD 0.5 - 0.8 per m3 of product water.

c. Project Ideas for water resource model

Objective: to develop the potential of Indonesia's water resources along with its model, and the simulation of water balance.

Description

Flood and drought disasters that occurred in Indonesia was allegedly caused by global warming, unsuitable land use with the physical condition, and spatial planning which does not take into account the condition of natural resources and existing water system. Evaluation of the water system balance can describe the circumstances and needs of potential future water resources and can be used as data in conducting adaptive steps to anticipate the vulnerability of water resources due to the climate change.

Water resources modeling is an important tool to plan the use of resources for public water supply ensuring that the water environment is protected from over-abstraction.The modeling will be conducted by simulation model at Citarum Watershed. Watershed (DAS) Citarum is the largest and longest river basin in West Java, geographically from 106 ° 51'36 "- 107 ° ° 51 'E and 7 ° 19' - 6 ° 24 'latitude. Watershed wide Citarum: 718,268.53 Ha, Long DAS Citarum: 269 Km (Main River), 14346.24 km (including tributaries), derived from the Fountain of Mount Wayang through 8th District (Bandung, Bandung, City Cimahi, Sumedang, Cianjur, Purwakarta, Bogor and Kerawang) as Citarum River estuary.

There are 12 sub-watersheds and three the Great Basin (Saguling, Cirata and Jatiluhur). These basins are as a source of 300 000 ha of agricultural irrigation water and also as a source of drinking water to Bandung, Cimahi, Cianjur, Purwakarta, Jakarta, Karachi, Jakarta. Land Critical Frequency = 125,692.20 ha with flood events every year there and Sedimentation mean = 25.52 tons / ha / yr.

***Goals of the Project*:**

- To get better understanding of the water resources potential projection of selected watershed as a base for the drafting of adaptation measures on long-term and short-term in facing water resource vulnerability due to global climate change

- Establishment of water resources potential projections of Citarum watershed.
- Obtain data projected conditions of water resources in the watershed Citarum up to the year 2100 and thereafter.
- Determine the vulnerability of adaptation measures in the watershed Citarum water resources based on data obtained from modeling.
- Create a pilot water management and water resource vulnerability adaptation measures that can be applied to other watersheds.

Methods

The method carried out in this proposal consist of survey to collect database of water resources, inventory of water resources modeling software, modeling with a particular software and development scenarios water resources management. Preparation of water resource potential of Indonesia includes a database of water resources, the use of geographic information systems, the quantity and quality of various types of water resources in one watershed in Indonesia for example is at the watershed Citarum. There are many varieties Software modeling of water resources such as Modflow, Powersim, ArcView GIS, FJ.Mock, NRECA and others. This software utility is evaluated and then selected which one is the best to be used to project future water resource potential in a watershed. Selection is made through discussions between the user and test software modeling. With a data base obtained from the survey data directly or secondary data, modeling test is then performed with specific software which may be used as a basis for determining the policy of water management in the future until the year 2100.

These modeling results will be disseminated to the academic community, relevant institutions and the public as an information resource condition and management of water in the future. By knowing these conditions, it will make people more careful in the use of existing water resources.

Expected Results

The expected result of this activity is a concept of water resource management in the watershed that can be used as the basis for spatial development of an area. This model can be used to determine the steps in the future management of water resources including water resources vulnerability adaptation measures due to global climate change. The results of this model should be able to reflect the relationship between the components of the hydrological, agronomic, and economic importance and to explore economic and environmental consequences of alternative policy options. Model can be used also as a decision support tool to assist water management authorities and policy makers

Phase of Activity

First year

- Determine a watershed location of the project activity. It will be selected one watershed whose condition is critical and needs immediate treatment, for example Citarum watershed.
- Collect secondary data from all institutions related to water resource management of that selected watershed area.
- Survey and collect primary data regarding the condition of the selected watershed area such as data of rainfall for a certain period, hydrogeology, water quantity and quality, and social economy of the society.

Second year

- Do inventory of the software that can be used for modeling of water resource projections in Indonesian conditions.
- Establish an expert networking on water resources modeling.
- Perform simulation of water resources projection modeling that can provide input to the government for water resource protection, efficiently use of water resources and control of water resource degradation.

Third year

- To disseminate the results of modeling to the public through seminars, workshops and trainings
- Formulate policies of short-term and long-term water resource management with reference from the results of the simulation model projections of water resources
- Conduct strategic planning in anticipation of water resource degradation and unsustainable utilization of water resources.
- Create a master plan of management, control and utilization of water resources in the selected watershed (Citarum).

Fourth year

- Develop water resource management scenario until the year 2025, 2050 or 2100.

Resources needed

- Professional institution or a private company that built and manages programming of water resources projection model.
- Qualified expert who can transfer the software usage and system water resources projection model.
- Professional workers who have been trained and have the discipline and commitment which should be a supervisor of how to run the water resources projection model.
- Supervisor that fully supports and continuously disseminates the water resources projection models and software.
- Central and local governments that fully support the development wusage of water resources projection models.
- Sharing adequate funding from both donor and local government.
- Good community participation in the construction, operational and maintenance of the water resources projection model.
- Other facilities and infrastructure such us software and hardware that support implementation program of water resources projection model.

Budget

The cost for water resource modeling activities include the cost of mapping surveys, secondary data collection costs, the cost of purchasing software, the establishment of networking, hardware purchase costs, preparation of data base, the cost of software testing, the cost of the formulation and dissemination of results of modeling. To the overall modeling activities in the watershed of Citarum is about 20,000 USD. The cost is expected of foreign aid in the form of grants, and funds the government of Indonesia

Annex 3.3. Project ideas for coastal vulnerability

Coastal protection and coastal reclamation technologies

Technology Transfer

Sanur Beach, Kuta Beach and the beach of Padang city, are examples of areas where coastal protection stuctures have been implemented. As for coastal reclamation, some coastal areas that have been reclamated are: the Losari Beach (Makassar), Boulevard Beach (Manado), Sangkapura Beach (Bawean Island) and the Nipah Island. But given the large number of coastal regions which their level of vulnerability are high to very high, then the transfer of technology and dissemination from one area to another area is needed to be immediately carried out. In addition, improvements are still needed, including the current technology (for example, interm of structure and design) and the possibility of innovation in materials from abroad / developed country (transfer of knowledge).

Capacity building

Capacity building includes three aspects: local community, local contractors and project managers. Some things can be done in capacity building are:

- Providing the local community a complete understanding on the benefits and what to do to get the maximum benefits of shore protection / coastal reclamation in their area.
- Involving local community (as local workers) during the construction stage of coastal protection / reclamation project.
- Providing knowledge to local contractors, on how to make the structures/reclamation in accordance with the standards and rules that apply
- Providing knowledge and strengthening the capacity of the project managers (government/ privates) in managing the project based on the project's goals and purposes.

Economic and financing

Currently, the funds used in climate change adaptation efforts on coastal vulnerability sectors, especially in the construction of coastal protection and reclamation, derived from the domestic budget. However, considering the number of priority locations need to be protected base on the length of coasts with high to very high vulnerability level, as well as the expensive cost especially for reclamation, then assistance from external/international funding in the form of grant and experts are still needed.

Resources requirement

Requirements for development of coastal protection strucures had been arranged in the Ministry of Public Work's Circular No. 07/SE/M/2010 on Guidelines for Construction of Coastal Protection Structures. For coastal reclamation, it is set in SK issued by the Directorat General of Marine, Coastal and Small Island SK.64D/P3K/IX/2004 on Guideline for Reclamation in Coastal Area. In general, domestic resources are available in Indonesia, unless there is new material for structure developments.

Timeline

The implementation for the development of coastal protection and reclamation project, from preparation to completion, is divided into three years, i.e.:

First year

- Identify vulnerable coasts/beaches all over the country

  In this first year, the first thing to do is identify the coasts all over Indonesia's territory that are prone to climate change impacts. Identification can be done through a number of ways, including through literature study of various research that had been done before, and/or ground-checking to beaches which conditions/status had been known; as well as doing a simulation or modeling to estimate the impacts of climate change in the future, mainly caused by the sea-level-rise.
- Determine priority/rank; location which is very susceptible and having high economical value or vital object should be prioritized

  After the results from identification activity obtained, it should be followed by determination of priorities or rankings. Determination of priority or ranking is based on the status of the location or vulnerable coastline. Beach or locations that are particularly vulnerable and having high economic value or a vital object had to be protected and more prioritized than beaches or locations with low economic value.
- Assess which technology is more suitable for specific location

  The last thing to be done in the first year is to assess which technology is more suitable for a particular location. For example, based on the analysis it is known that coastal protection is estimated to be better for a specific beach or location, while other beaches or other locations may be more appropriate if reclamation is carried out.

Second year

- Funding and economic analysis

  Economic analysis and financing is started to be conducted in the second year. The economic analysis is based on the technology assessment of which technology is more appropriate for a given location/beach. Economic analysis and funding should also consider the following matters: economic feasibility, foreign exchange and cost calculations.

- Preparation of Masterplan

  In general, the preparation of master plan for coastal protection project can be started from the project pre-preparation, preparation, construction/ implementation, contract delivery I, maintenance period, and contract delivery II. As for Coastal Reclamation Technology, Masterplan is the key factor in the overall planning of the implementation activities, thus it must accommodate the complexity of the systems in coastal areas by using the Integrated Coastal Zone Management (ICZM) approach as a management tool for sustainable coastal resources utilization. In managing the coasts, we should integrate several things, such as: a variety of planning, either sectoral or levels of government; terrestrial and marine ecosystems; as well as science and management. Before making the masterplan, first thing to do is to draw up a Strategic Plan for Integrated Management of Coastal Areas and Planning Zones around the project location. Masterplan should cover and accommodate the following things: 1) ecological balance, 2) the physical condition of the site; 3) legal aspects; 4) socio-economic-cultural aspects; 5) utilization aspects; and 6) damage prevention (mitigation) aspects.

- Conduct feasibility study

  Feasibility studies need to be done for the implementation of coastal reclamation technology should include feasibility of technical aspects, economic-financial aspects,

and the Environmental Impact Assessment (EIA). EIA is conducted in order to assess and to determine whether an activity can be done and feasible in terms of technical, economic and environmental aspects. The results of feasibility study needs to be consulted with all stakeholders. EIA studies consist of Environmental Impact Assessment (EIA), Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL); and its implementation should be based on existing regulations. The same feasibility studies also apply for the implementation of coastal protection technology.

- Preparation of Detailed Engineering Design

The plans for detailed engineering design of coastal protection technologies include:

- land preparation work;
- mobilization of equipment, field facilities for service providers, laboratory equipment and personnels;
- design review which cover all technical specifications and methods of work implementation, the volume of works and availability of time, as well as eligibility requirements functions and operational construction;
- measurement includes measurement of topography and bathymetry, as well as observation and collection of tidal data;
- setting up base camp and its equipment;
- material, which involves quarying and stocking of materials, collection of ground water for employment purposes, the provision and installation of fuel;
- regulation of of heavy equipment traffic; and
- Health and safety (HSE) supplies.
- While the detailed engineering design plans for coastal reclamation technology includes the following:
- planning land preparation and manufacturing infrastructure;
- planning for land clearing from vegetation or other debris, and leveling of the base land;
- planning for dredging/pumping of reclamation materials from the quarry location i.e. land and/or sea;
- planning the construction of of retaining wall (if any) and breakwaters;
- planning the transportation of materials from the quarry location (in land and / or sea);
- planning for soil mprovement (if any);
- the planning of material handling and stocking of the reclamation materials from land or from the sea;
- planning for land reclamation draining;
- planning of land reclamation alignment with heavy equipment;
- planning of land reclamation maturation/compaction;
- planning of drainage systems;
- planning of developmen after the land reclamation.

Third year

Construction

Coastal protection technology (Seawall / revetment)
Seawall construction implementation consists of two kinds, namely masive seawall and permeable sea wall.

a) Masive seawall

The construction of masive structure of seawall is strongly influenced by the waves height and tide level as well as the wave periods. Implementation method using concrete blocks sea wall are as follows:

- installation of the profile;
- excavation of foundation using the excavator / backhoe;
- installation of filter layers on the foundation up to the slope behind the wall using geotextile;
- installation of toe protection, the core layer, filter layers and armor layer;
- installation of concrete blocks in accordance with the form specified in the design, filling in the concrete cyclops;
- excavation of foundation masonry;
- installation of coneblock.

b) Permeable seawall

The method of construction of permeable seawall is as follows:

- Stones placement is carried out by dumping the stones and trimmed by human/labor or heavy equipment; armor layer is then arranged individually using excavators;
- Stones are placed on the foundation, and should not affect by the tide.
- Placement of rip-rap revetment (stones or precast concretes with various forms) can be done from the main land or from the sea if the depth and draft is sufficient. Revetment construction method is as follows:
- Installation of profiles;
- Excavation of foundation using excavator
- Installation of geotextile over the top to the bottom of the foundation, geotextile at the slope should be tied with peg / iron clamp to prevent folding;
- Core materials are placed over the geotextile, then armors are put on top of the core (up to the design level) using excavators at the offshore side;
- Installation of the core layer and the upper armor using excavators on the onshore side.

Coastal reclamation technology

The execution of coastal reclamation construction phase should consider several things as follows:

- dredging activities (quarrying), both on land and / or at sea, starting from:
- setting up semi-permanent buildings and other infrastructures as a temporary residence for construction's workers;
- the dredging/pumping of sands/ muds (reclamation materials);
- transportation of mud or sand dredged to the disposal sites using dredger ship or other conveyances.
- Reclamation activities and flattening of basement:

- land preparation and setting up semi-permanent buildings and other infrastructures as a temporary residence for construction's workers;
- Flattening of basement for reclamation, taking into account the construction methods applied and the type of materials used;
- cleaning of vegetation and other debris and leveling the basement;
- Retaining wall construction activities (if any) and breakwaters;
- installation of silt screens around potential land reclamation to avoid the spread of fine sediment particles into the waters around the reclamation site;
- Soil improvement activities (if required);
- handling and stocking of reclaimation materials from main land or from the sea;
- draining of land reclamation activities;
- leveling and compacting the land reclamation with heavy equipments;
- Maturation of land reclamation activities;
- Drainage system development activities;
- Developing and building the land reclamation areas

Monitoring and evaluation

Coastal protection technology

Monitoring activities include:

- Initial mutual check, made and agreed between the service provider (consultant) and the board of directors, stated in the job and work of drawings (soft drawing) which then approved by the technical directors, as a temporary or permanent guidelines for the implementation of the works;
- Monthly mutual check, intended to monitor the monthly progress of works that have been carried out/ completed and are entitled for payment;
- Final mutual check, performed in order to know the volume of work already carried out until the end of the work, including the calculation of the work progress for addendum contract or other kinds of works, as a reference for determining the total amount of payment;
- The results of a joint final check is executed and agreed between the service provider (consultant) with the users, then the "as built drawing" is made, which draws the complete project, which describes all the changes and additions as well as job reductions to the detail design, approved by the board of directors for technical implementation.
- The evaluation consists of maintenance and repairs, and performed for a minimum of six months. Activities conducted during the evaluation are:
- Service providers must constantly monitor the damage that occurred during the maintenance period;
- The damage that occurs due to incomplete implementation of the work or the usage of bad quality/unqualified materials, should be improved and become the responsibility of service providers;
- The damage that occurred outside of the stated above, such as design errors, natural disasters and extraordinary events, becomes the responsibility of the users (project owners).

Coastal Reclamation Technology

Monitoring and evaluation activities are conducted during the pre-construction phase, construction and post construction. This M & E covers the method of implementation, the type of material used and the impact of activities. Aspects being monitor include physical, ecological, social, economic, law and institutional aspects. M & E activities executed by local governments that issue the reclamation permit. To carry out the reclamation activities from planning to monitoring and evaluation, a Management Board of Coastal Reclamation needs to be set by the government or local government, in accordance with their authorities. In the implementation of monitoring and evaluation of reclamation work, several things need to be considered:

- to be conducted periodically and sustainable,
- must be in accordance with the EIA documents,
- should be conducted scientifically, and can be accounted for.

Indicators of success

Some indicators of success on assessing how the implementation of the making of coastal protection and reclamation works are:

- Coastal protection structures or coastal reclamation do exist.
- The existence of coastal protection / reclamation can give a sense of security to the community and the public can also make use and get the benefit of them.
- The existence of coastal protection and reclamation not lowering the level of the economy and the lives of local people.

Domestic partners

Domestic partners for the creation of coastal protection and reclamation should fit with the location where they will be built. Domestic partners may consist of the Government or the local institutions, related communities live in the area, and local contractors (local government, local community, local contractor).

Annex 4: List of stakeholders involved and their contacts

National Consultant:
Program Coordinator : Kardono
Chief Engineer : Agung Riyadi
Group Leader : M. Sidik Boedoyo

Supporting Team: Feddy Suryanto and Saraswati Diah

Table A- 8 List of stakeholders involved and their contacts for food security sector

Sector Leader : Diah Asri Erowati (Centre for Environmental Technology – BPPT)

No	Name	Institution	Sector selection and technologies	Identification of barriers and development of enabling framework	Technology Action Plans (TAPs), IPR issues	Project Ideas
1	Dr. Haryono	Head of Agricultural Research, Ministry of Agriculture		✓		
2	Dr. Ir. Muhrizal Sarwani, Msc.	Head of Research and Development Center for Agricultural Land Resources (BB SDLP), Agency for Agricultural Research, Ministry of Agriculture	✓			
3	Dr. Ir. Prihasto Setyanto, M.Sc	Head of Agro-climate and Hydrology, Central Research and Development of Agricultural Land Resources, National Agricultural Research, Ministry of Agriculture	✓			✓
4	Iwan F Malonda	BKP Ministry of Agriculture		✓	✓	
5	Dr. Ir. Kasdi Subagyono, Msc	Head of Research and Development Center for Agricultural Technology, agricultural Research and Development Agency, Ministry of Agriculture.	✓	✓		
6	Ir. Erma Budiyanto, MS.	Directorate of Food Crop Protection, Directorate General of Food Crops, Ministry of Agriculture	✓	✓		
7	Dr. S. Gatot Irianto	Director General of Infrastructure, Ministry of Agriculture	✓	✓		
8	Ninik	BKP Ministry of Agriculture	✓			
9	Joni Haryadi	Research and development center PB	✓	✓	✓	✓
10	Gatut Sumbogojati	Directorate of Food Crop Protection, Directorate General of Food Crops, Ministry of Agriculture				
11	Prof. Dr. Win Nugroho	Livestock Research Center Ciawi Bogor		✓	✓	✓

12	Prasetyo Nugroho	BBP Agricultural Mechanization, Agency for Agricultural Research	✓	✓		
13	Andriarti Kusumawardani	Dit. Crop Protection Directorate General of Food Crops, Ministry of Agriculture	✓			
14	Dr. Dodi Irawan	Center for Agricultural Technology, TAB - BPPT		✓	✓	✓
15	Dr. Budi Sulistyo, M.Sc	Center for Marine and Coastal Resources , Ministry of Maritime Affairs and Fisheries			✓	✓
16	Sachoemar			✓	✓	✓
17	Dr. Ir. Aryo Hanggono, DEA	Marine and Coastal Research and Technology, Balitbang KP, Ministry of Maritime Affairs and Fisheries	✓	✓	✓	✓
18	L.P.A. Savitri Ch. Kusuma, M.Sc	Marine and Coastal Research and Technology, Balitbang KP, Ministry of Maritime Affairs and Fisheries	✓	✓	✓	✓

Table A- 9 List of stakeholders involved and their contacts for water resources sector

Sector Leader : Rudi Nugroho (Centre for Environmental Technology – BPPT)

No	Name	Institution	Sector selection and technologies	Identification of barriers and development of enabling framework	Technology Action Plans (TAPs), IPR issues	Project Ideas
1	Jaya Murni WD	Dit. Central Management of Water Resources Ministry of Public Works			✓	
2	Pradah Dwiatmanta	Sudit Hydrology and Water Quality. Directorate General of Water Resources Ministry of Public Work			✓	✓
3	Gatut Bayuadji	Dit. Central Management of Water Resources Ministry of Public Works			✓	✓
4	Hendra Ramdhani	Dit. River and Coastal			✓	✓
5	Hendra Utama	Dit Sungai dan Pantai			✓	✓
6	Pandu Yuri P	Central Management of Water Resources Ministry of Public Works	✓	✓		
7	Dwi Agus K	Subdit EK Dit. Development Program, Dijten Water Resources		✓	✓	
8	Dr. Ir. Gadis Sriharyani,	Limnology researcher LIPI	✓	✓	✓	✓
9	Djaenal,	Kasubdit Water sanitation	✓	✓	✓	
10	M.Doni Asdan,	Director of Lake and River Bappenas		✓	✓	
11	Peny Susanti	Head of the Regional Agency for Environmental Management DKI Jakarta	✓	✓		

Table A- 9 (Continued)

No	Name	Institution	Sector selection and technologies	Identification of barriers and development of enabling framework	Technology Action Plans (TAPs), IPR issues	Project Ideas
12	Dr. Ir. Wanny Adidarma	Water Resources Research and Development Center, Bandung.	✓	✓	✓	✓
13		Head of the Central River Region, Ciliwung -Cisadane		✓	✓	
14	Andri Sewoko	Perum Jasa Tirta II	✓	✓		
15	Ann Natalia Umar	Environmental Health Directorate of the Ministry of Health	✓	✓		
16	Tutut Indra W	Environmental Health Directorate of the Ministry of Health	✓	✓		
17	Suci Wulandari	Ministry of Research and Technology	✓		✓	
18	Ferdinanto	Central River Region Ciliwung-Cisadane	✓	✓		
19	E.P. Fitratonnisa	Regional Agency for Environmental Management - DKI	✓	✓		
20	Job Supangkat	PT Premanet	✓	✓	✓	✓
21	Efni	Regional Agency for Environmental Management – DKI	✓	✓		
22	Tati Hermaningsih	Centre for Environmental Technology - BPPT			✓	✓
23	Haryoto	Centre for Environmental Technology - BPPT			✓	✓
24	Andono Warih		✓	✓		
25	Eko Gumelar		✓	✓		
26	Samsuhadi	Centre for Environmental Technology - BPPT	✓	✓		

Table A- 10 List of Stakeholders involved and their contacts for coastal vulnerability sector

Sector Leader : Ressy Octivia (Centre for Environmental Technology – BPPT)

No	Name	Institution	Sector selection and technologies	Identification of barriers and development of enabling framework	Technology Action Plans (TAPs), IPR issues	Project Ideas
1	Dr. Ir. Subandono Diposaptono, M.Eng	Director of the Directorate of Coastal and Small Islands Ministry of Marine Affairs and Fisheries	✓	✓	✓	✓
2	Dr. Budi Sulistyo, M.Sc	Director, Marine and Coastal Research and Technology, Balitbang KP, Ministry of Maritime Affairs and Fisheries	✓	✓	✓	✓
3	Dr. Ir. Aryo Hanggono, DEA	Marine and Coastal Research and Technology, Balitbang KP, Ministry of Maritime Affairs and Fisheries	✓	✓	✓	✓
4	Ir. Berny A. Subki, Dipl. OC	Marine and Coastal Research and Technology, Balitbang KP, Ministry of Maritime Affairs and Fisheries	✓	✓		
5	L.P.A. Savitri Ch. Kusuma, M.Sc	Marine and Coastal Research and Technology, Balitbang KP, Ministry of Maritime Affairs and Fisheries	✓	✓	✓	
6	Dr. Ing. Widodo S. Pranowo	P3SLP Balitbang KP – KKP	✓	✓	✓	
7	Fajar Kurniawan	Marine and Coastal Research and Technology, Ministry of Maritime Affairs and Fisheries			✓	✓
8	Enggar S, MT	Marine and Coastal Research and Technology, Ministry of Maritime Affairs and Fisheries			✓	✓
9	Ir. Velly Asvaliantina M.Eng.Sc	Center for the Coastal Dynamics – BPPT	✓	✓	✓	✓
10	P.Pitoyo Subandrio	River and Coastal Director, Directorate General of Water Resources, Ministry of Public Works			✓	
11	Dr. Ir. Suprapto, M.Eng	River and Coastal Directorate, Head of Sub Directorate of Technical Planning in the Ministry of Public Works			✓	
12	Anggia Satrini	River and Coastal Directorate Ministry of Public Works			✓	

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