INTERNATIONAL SEMINAR ON UNIVERSITY-BASED RESEARCH FOR WETLAND DEVELOPMENT
JOINT PROGRAM BETWEEN LAMBUNG MANGKURAT UNIVERSITY
AND GOVERNMENT OF SOUTH KALIMANTAN PROVINCE

26-27th November 2012
Banjarmasin, INDONESIA

PROCEEDING

Collaboration between:
INTERNATIONAL SEMINAR ON UNIVERSITY-BASED RESEARCH FOR WETLAND DEVELOPMENT

Theme:
“Wetland development in frame of empowering universities in education, research, and public services”

Swiss-Belt Hotel, Banjarmasin, South Kalimantan
26-27th November 2012


Editors:
Prof.Dr.Ir.H. Abdul Hadi, M.Agr
Dr. Arief Budiman, SE, M.Mark
Dr.Eng. Rodiansono, S.Si, M.Si
Dr.rer.nat. Ir.H. Wahyuni Ilham, MP
Dr.Ir.H. Aberani Sulaiman, M.Sc
Dr. Laila Zuhro, M.Eng
Dr. Rony Riduan, ST, MT
Hasrul Satria Nur, S.Si, M.Si
Dewi Anggraini, S.Si, M.Appl.Sci

Layout:
Dr.Ir. Iset Setya Budi, MP

Published by:
Research Institution of Lambung Mangkurat University in Cooperation with Government of South Kalimantan Province
Preface

University is expected as center of excellence as it has numbers of students, faculties and supporting staffs and facilities. Located in swamp-dominated South Kalimantan, Lambung Mangkurat University (UNLAM) has choice swampland study as its main core of excellence (Pola Ilmiah Pokok). This Pola Ilmiah Pokok has been translated into Strategic Plan (RENSTRA) of UNLAM, and detailed in Research Implementation Plan (RIP).

The implementation of RIP in research activity is coordinated by Research Institution (LEMLIT). During this last five years LEMLIT UNLAM has coordinate 922 titles with nearly IDR 30 billion. This then allowed the researcher in UNLAM to carry out more research, including research for constructing swamp environment knowledge. The number of researches carried out in UNLAM during this last five years is above national average. For example, in year 2012 UNLAM has 146 research titles including those funded by the Government of South Kalimantan Province for faculty strengthening research (11 titles) and study program strengthening research (17 titles).

An International Seminar and Workshop was held on 26-27 November, 2012 in Swiss-belt Hotel, Banjarmasin, aiming at (1) evaluating state of the art of researches on wetland development, and (2) designing researches and public service relevance to wetland development. The theme of this seminar is “Wetland development in frame of empowering universities in education, research, and public services”. Fifty nine papers have been presented at the seminar, including four key not papers, 20 oral papers and 35 posters. Current prosidings contains twenty four papers, including four key not paper, oral papers and poster.
papers. The rest of the papers are planned to be published in Proceedings Book II in the near future.

The success of publishing these proceeding is determined by the Government of South Kalimantan Province through its partial financial support for which we very much appreciate. We are extremely grateful to Ministry of Science and Technology, Republic of Indonesia, for their support. I extend my sincere thanks to invited speakers, who, by short notice, could prepare their paper and present here. I would like to express our thanks to the PEMDA Grantee and all speakers, for submitting and revising their papers in time. Last, but not the least, I would like to thank all editors, layout and Research Institution staffs for their continuous effort in publishing this proceedings. May the readers find Proceedings Book 1 useful. Wassalamu’alaikum wr. Wb.

Lambung Mangkurat University, June 2013
Head of Research Institution

Dr. Ahmad Alim Bachri, SE, M.Si
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PREFACE</strong></td>
<td>i</td>
</tr>
<tr>
<td><strong>CONTENTS</strong></td>
<td>iii</td>
</tr>
<tr>
<td><strong>SPEECHS</strong> :</td>
<td></td>
</tr>
<tr>
<td>Welcome speech at international seminar on</td>
<td></td>
</tr>
<tr>
<td>wetland development</td>
<td></td>
</tr>
<tr>
<td><em>Rector of Lambung Mangkurat University</em></td>
<td>v</td>
</tr>
<tr>
<td>Summary of international seminar on</td>
<td></td>
</tr>
<tr>
<td>university – based research for wetland</td>
<td></td>
</tr>
<tr>
<td>development</td>
<td>viii</td>
</tr>
<tr>
<td><em>Chairman of Organizing Committee</em></td>
<td></td>
</tr>
<tr>
<td><strong>PRIME PAPERS</strong> :</td>
<td></td>
</tr>
<tr>
<td>World trade hot issues in wetland development</td>
<td></td>
</tr>
<tr>
<td><em>Towa Tachibana</em></td>
<td>1</td>
</tr>
<tr>
<td>A river basin-based cooperative effort on</td>
<td></td>
</tr>
<tr>
<td>wetland research and conservation trainings</td>
<td></td>
</tr>
<tr>
<td><em>Duong Van Ni, Tran Triet, Sansanee Choowaew, and Jeb Barzen</em></td>
<td>12</td>
</tr>
<tr>
<td>Development of swamp land for rice based</td>
<td></td>
</tr>
<tr>
<td>farming system</td>
<td></td>
</tr>
<tr>
<td><em>E. Eko Ananto and Kasdi Subagyono</em></td>
<td>22</td>
</tr>
<tr>
<td>Environmental hot issue on wetland development</td>
<td></td>
</tr>
<tr>
<td><em>Nyoman Suryadiputra</em></td>
<td>38</td>
</tr>
<tr>
<td><strong>SUPPORTING PAPERS</strong> :</td>
<td></td>
</tr>
<tr>
<td>Vegetation structure and herbivory in</td>
<td></td>
</tr>
<tr>
<td><em>Rhizophora</em> sp.*</td>
<td></td>
</tr>
<tr>
<td>Mangrove stands of varying planting ages</td>
<td></td>
</tr>
<tr>
<td><em>Anang Kadarsah and D.N. Choesin</em></td>
<td>44</td>
</tr>
<tr>
<td>Sustainable tilapia (<em>Oreochromoris niloticus</em>) culture on swamps water</td>
<td>54</td>
</tr>
<tr>
<td><em>Fatmawati, Noor Arida Fauzana, and Pahmi Ansyari</em></td>
<td></td>
</tr>
<tr>
<td>Storage efficiency of N, P, K on degraded</td>
<td></td>
</tr>
<tr>
<td>peatland by giving some formula ameliorant</td>
<td></td>
</tr>
<tr>
<td><em>Eni Maftuah, A. Ma’as, and B.H. Purwanto</em></td>
<td>62</td>
</tr>
<tr>
<td>Risk factors of dengue hemorrhagic fever in</td>
<td></td>
</tr>
<tr>
<td>the working area of guntung payung public</td>
<td></td>
</tr>
<tr>
<td>health center, Banjarbaru city</td>
<td></td>
</tr>
<tr>
<td>*Ratna Setyaningrum, Rudi Fakhriadi, and</td>
<td></td>
</tr>
<tr>
<td><em>Fahini Yulidasari</em></td>
<td>73</td>
</tr>
<tr>
<td>Converting wetlands to oil palm plantation in</td>
<td></td>
</tr>
<tr>
<td>South Kalimantan</td>
<td></td>
</tr>
<tr>
<td><em>Abdul Halim Barkatullah, Ifrani, Lies Ariany, and Lena</em></td>
<td>80</td>
</tr>
</tbody>
</table>

---

International Seminar on University-Based Research for Wetland Development
Joint Program Between Lambung Mangkurat University and Government of South Kalimantan Province
Banjarmasin, Indonesia, 26-27th November 2012
Hanifah
Analysis of Barito channel tidal harmonic pattern and water level rise effects to Banjarmasin city hydrotopography

Fathurrazie Shadiq, Rony Riduan, and M. Azhari Noor
Effect of plantonic microalgae growing on reduction of ammonia concentration in waste water used by holding of giant fresh water prawn caught

Djasmani Hisbi
Study of technical and non technical aspects of Tambak Hanyar polder management

Novitasari and Reza Adhi Fajar
Hearing function conservation by ear plug and traditional sarong method : Obsevational study among “Saijaan” fisherman Pulau Laut Utara Sub District, Kotabaru

Qomariyatus S, Ratna S, Leni M, M. Trisetya HS
Physical and numerical modelling of the mitigation of settlements due to footing interaction in clay

Rustam Effendi
Design of paddy field on the wetland area in Rakumpit District Central Kalimantan

Maya Amalia, Petrisly Perkasa, Muhammad Noor, and Agus Sulistio
Tabunganen unit after 30 years of reclamation

Ulfy Fitriati and Muhammad Afief Ma’ruf
Antidiarrheal activity of tanjung leaf leaf infusa

Khoeirul Anwar, Nashrul Wathan, and Nani Kartinah
Biology of nonpathogenic Fusarium specific location of tidal swampland

Ismed Setya Budi and Mariana
The raffinose, glucose, and fructose in extract of sweet potato nagara white from South Borneo

Rini Hustiany
Welcome Speech at International Seminar on Wetland Development by Rector of Lambung Mangkurat University

His Excellency the Minister of Science and Technology, Republic of Indonesia
His Excellency the Governor of South Kalimantan Province
Dear invited speakers from Japan, Vietnam and Malaysia
Dear invited speakers from Indonesia
Dear colleagues from Indonesian government offices, Lambung Mangkurat University’s lecturer and post graduate students
Distinguish ladies and gentlemen

Good morning, Assalamu’alaikum warahmatullahi wabarakatuh

First of all let us regard the Almighty Allah, the Lord of the Universe, the Beneficent, the Merciful, the Sustainer, the Omnipotent

Secondly, on behalf of civitas academica I would like welcome you all to our university, Lambung Mangkurat University. Lambung Mangkurat University (LMU) was established preliminary 1957 year by the independence heroes of Republic Indonesia in South Kalimantan. At a reunion of the heroes in Kandangan, Hulu Sungai Selatan district they form a board named “Dewan Lambung Mangkurat”. One of Dewan Lambung Mangkurat work plan was to established a university in Kalimantan. The plan was started by setting up a committee for preparing the establishment of LMU. In mid of 1958 year, the committee could established LMU as private university with four faculties including Faculty of Economics, Faculty of Low, Faculty of Social and Political Science, and Faculty of Islamic Studies. After two years as private university, LMU became in a government university based on the government regulation Number 41, the year of 1960. It also had four faculties, that is Faculty of Economics, Faculty of Low, Faculty of Social and Political Science, and Faculty of Agriculture. The faculty of Islamic Studies was transferred to National Institute of Islam Religion of Yogyakarta and finally became Antasari National Institute of Islam Religion, Banjarmasin. In its development, LMU today has ten faculties. They are Faculty of Teacher Training and Education, Faculty of Low, Faculty of Economics, Faculty of Social and Political Sciences, Faculty of Agriculture, Faculty of Forestry, Faculty of Fishery, Faculty of Faculty of Engineering, Faculty of Medecine, and
Faculty of Mathematic and Natural Sciences. These ten faculties have 13 study programs of diploma, 54 study programs of regular bachelor, 6 study programs of extensive bachelor, fourteen study programs of master and one doctorate study program. Number of students of LMU per September, 2012 is ... students.

His Excellency the Minister of Science and Technology, Republic of Indonesia, His Excellency the Governor of South Kalimantan Province, invited speakers, distinguish ladies and gentlemen.

The wetland issue has entered LMU since about six teen years ago when the Ministry of Education and Culture set a scientific main excellence of every university in Indonesia. Realizing that LMU is located in a province with huge area of wetlands, LMU has then choice wetlands environment as its scientific main excellence. After six teen years, LMU keeps maintaining it focus on wetland environment though it has not been easy. At the beginning, not all Deans moreover faculties accept the “wetland environment” as LMU’s center of excellence. Long discussion has been occurring disputing the issue, though some faculties have been implementing this scientific main excellence in their teaching, research and public services activities. Today International Seminar is one of our effort to give understanding to who has not accepted the “wetland environment” as LMU’s scientific main excellence. In my opinion, wetland environment includes low land as well as upper land those affect the lowland. We strongly accept the Ramsar convention on wetland as a basic definition of wetland as the international also does. Apart from Ramsar’s definition, we also include up-lands those have changed or have been changed by human to wetlands. These include post mining pond at mining plan, waste water treatment at oil palm mill or coal mining areas, as well as irrigated up-land for paddy field cultivation.

Distinguish ladies and gentlemen

Kalimantan island, universities and companies. Kalimantan is a big island with huge un-renewable resources such as coal, earth gas, iron ore as well as renewable resources like forest product, fishes and oil palm. LMU with all of its potentials including its human resources, intellectual wealth and facilities will keep on participating in managing these resources through educational, research and public service activities. The educational activities are main task of each of ten faculties and one post graduate we have. The research activities are coordinated by Research Institution (Lemlit), while the public service activities are coordinated by the Institution of Public Service, LMU. The tasks, off course, will not be effective and powerful if they are carried out only by LMU itself. Therefore, in this prestigious occasion I would vi
like to call your collaboration on empowering the education, research and public service in LMU. So far, at regional level we have partnership with Chiba University (Japan), Sang Ji University (South Korea) and University Utara Malaysia. I do hope there will be a collaborative activities between LMU and Chanto University (Vietnam). I would also call collaboration of local governments at district levels, corporate and research center to empowering educational, research and public service activities though wetland development.

Distinguish ladies and gentlemen

**Finally,** I would like to thank the Ministry of Science and Technology, Republic of Indonesia for his coming and we look forward for his keynote speech. We also thanks the Governor of South Kalimantan for coming and continuous support to LMU though a harmonist relationship, providing research funds, and serving us dinner for tonight at his guest house. I would also express my appreciation to all invited speaker, Prof Dr Towa Tachibana, Dr. Doung Van Ni, Prof. Dr Nordin Kudri from abroad and Mr. I Nyoman Suryadiputra, Dr. Eko Ananto and Dr. Alim Bachri of Indonesia. We do hope your presentations will give contribution to the comprehensive understanding on the wetland issues. The presence of district government representative, colleagues from other universities and research institutes is also highly acknowledged. The last but not the least, I would like to thank all the organizing committee of this seminar due to their hard works, solid cooperation and charity during the preparation of this seminar. Let’s pray Allah to the success of this International Seminar on “University-based Researches for Wetland Development”.

Thank you very much for your attention.

_Assalamu’alaikum Wr Wb._

Muhammad Ruslan, Prof. Dr.
Summary of International Seminar and Workshop on Wetland Development

An International Seminar and Workshop was organized to (1) evaluate state of the art of researches on wetland development, and (2) design researches and public service relevance to wetland development. The International Seminar and Workshop was held in Swiss-belt Hotel, Banjarmasin from 26 November through 27 November, 2012. The theme of this seminar and workshop is “University-based research for wetland development”. The International Seminar and Workshop is attended by representative of District Governments, representative of Research Institute, Academia, Businessman, Post graduate student, totaled 234 attendees.

The International Seminar and Workshop have presented Dr Towa Tachibana from Japan, Dr. Doung Van Ni from Vietnam, Prof Dr Rosenani from Malaysia, Mr. I Nyoman Suryadiputra from Wetlands International Indonesia Program and Dr. Eko Ananto from Indonesia, as plenary speakers. Apart from these, 20 papers has been presented orally and 42 papers were presented by poster. The International Seminar and Workshop was officially opened by Ministry of Science and Technology who was represented by Dr. Agus Suyana Hotman, the Special Expert of the Minister.

The summary of the presentation is as follow:

1. Wetlands cover about 3% of globe surface, among which 33-55 mill ha occur in Indonesia. The wetlands consist of various types and have a range of values and benefits. Broadly speaking, these wetlands can be grouped into coastal wetlands, marshes (peat and mangrove), rivers, floodplains, estuaries/river estuaries, lakes and artificial wetlands. The values and benefits of the various types of wetlands include: flood and drought control, coastal belt, transportation, recreation, research and education, sediment traps and water purification, nutrient retention and provision, dilution of pollutants, stabilization of microclimate, global climate control, provision of water to the community, recharging of groundwater, water supply for other wetlands, provision of forest products, wildlife and other food resources, fisheries resources, support for agriculture, energy resources, habitat for biodiversity, unique traditional values /culture, habitat for part or the entire lifecycle of flora and fauna.
2. Wetlands are known as one of the most important terrestrial ecosystems for global environment management. Anthropogenic wetlands such as rice paddies with seasonally alternative flooding and drainage are potentially main source for nitrous oxide (N$_2$O) emission. In wetland soils, the major biological reaction-involving nitrate is denitrification which account to about 50% of applied N are common in rice paddies. Nitrous oxide (N$_2$O) gas is presently the greatest threat to the ozone layer and also contributing to climate change as a greenhouse gas, which has heat absorbance capacity that is greater than carbon dioxide (CO$_2$) and methane (CH$_4$).

3. Apart from paddy, oil palm (Elaeis guineensis) is the crops that can be harvested in tropical wetlands and has gained its importance rapidly. There are two hot issues related to oil palm development. First, oil palm is a relatively new international commercial crop that rapidly expanded its area in the second half of the 20th century. In 2010, the world export value of palm oil (the main product from oil palm) amounted to 29.9 billion US dollars, which is the 3rd largest export among the agricultural produce behind soybeans (39.7 billion USD) and wheat (32.6 billion USD). In 1961, the export value of palm oil is the 44th from the top. Second, production of oil palm surged in South East Asia, in particular, in Malaysia and Indonesia. In 2010, Indonesia and Malaysia accounted for 82% of world production of palm oil fruits and 61% of the harvested area. One can refer to the current international palm-oil market as the duopoly market of Indonesia and Malaysia.

4. Indonesia and Malaysia are the most producers of palm oil production in addition to rubber, coffee, and sago. There are three major international arguments about the trade of palm oil. First is the alleged impact on deforestation. The big fire in 1997 stimulated the international concern about the expansion of oil palm plantation into forest areas, which led to the establishment of Round Table on Sustainable Palm Oil (RSPO) in 2004. The principles and the guidelines of RSPO are well organized, but may be too idealistic which many small producers find difficult to follow. Second is the rising concern about TFA: trans-unsaturated fatty acids. Up to now, this concern gives a boost to palm oil consumption. The last is the concern about the export restriction on palm oil by the two dominant producers: Indonesia and Malaysia. To response these arguments, Indonesia palm oil producers should employ sustainable program for palm cultivation in
order to comply with European Union and United State regulation, especially with regards with greenhouse gas emission savings, deforestation and land clearing.

5. About 9.53 million ha of tidal land in Indonesia were potential for agriculture, but only about 4.18 million ha has been reclaimed for agricultural production. Meanwhile, from the non-tidal swamps land area, only 730 000 ha were already cultivated. However, due to biophysical and socio-economic constraints the utilization is not optimum yet as indicated by lower level of productivity. On the other hand, specific packages of technology developed from research are available which may change the marginal status of tidal swamps land into prospective agricultural producing areas. Agricultural development in swamps land has to be initiated by improvement of land and water management both at macro and micro level, followed by proper cultural practices supported by effective rural institution and farmers participation. Crops management techniques involve the use of improved variety, location specific fertilization, soil ameliorations, effective pests/diseases control and use of farm machineries.

6. University-based research for wetlands development has a success story in Mekong River and can be scale-up further. The activity was a cooperative effort on wetland research and conservation trainings by 18 universities of 7 countries within the Mekong River basin and Malaysia. The background, concept, goals, agreement on academic cooperation, capacity building and training programs carried out so far can be adopted as a model. The implementation of this model at other wetlands will enhance and strengthen the capacity of educators, researchers, technical staffs, facilitators and discussion makers who are willing and able to work in the field of wetland conservation. In the long-term, the network should aim at contributing to management and sustainable development of wetlands.

7. Example of research that can be followed-up for wetland development is Integrating Oil Palm with Rice on Acid Sulfate Soil. The application of integrated oil palm with rice though to keep the crop lands sustainable, while supporting the estate crops like oil palm developed. This notion is in line with the Indonesia Government Regulation No 41/2009 about Sustainable Food Crop, being implemented by the Government of South Kalimantan Province. The manufacturing of waste by producing biochar is another
multiplier effect of integrated farming system. Biochar application in the rice paddies and soil amendment also has the potential to enhance soil C stock and N retention as well as improving soil fertility.

8. State of the art of wetlands knowledge was believed to be sufficient at this moment, though need to be empowered in the future. Intentions to establish a center and/or a forum on wetlands development were strongly expressed by the attendees.

9. UNLAM has the strategic location for wetlands research centers and such centers can be focused on man-made wetlands from like the ex-mining areas. For initiating the center, it was suggested that UNLAM needs to establish an integrated field laboratory focusing on empowering people surrounding ex-mining areas with the existing technologies UNLAM has. These laboratories can later be promoted to national and international levels.

Banjarmasin, 27 November 2012
Organizing Committee
PRIME PAPERS
World Trade Hot Issues in Wetland Development

Towa Tachibana
Faculty of Law and Economics,
Chiba University, 1-33 Yayoi-cho, Inage, Chiba 263-8522, Japan;
E-mail: ttachi@chiba-u.jp

1. Introduction

This paper overviews 1) the changes in world demand for the major ‘environmental commodities’ that are, or can be, produced on the tropical wetland, and 2) international trade issues related to such environmental commodities. Environmental commodities here indicate primary agricultural products, primary forestry products, and carbon credits, all of which are currently traded in the international markets. We do not discuss important but not yet widely traded environmental services of tropical wetlands such as eco-tourism and preservation of biodiversity. Most data about harvested area of agricultural produce and production are taken from FAOSTAT (FAO various years). Unless specified otherwise, the data were downloaded in November, 2011.

A major soil in tropical wetland, in particular in coastal wetlands, is Histosols, or in plain English, woody peat soil. Woody peat soils are characterized by a) acid underlying sediments, and b) poor mineral nutrients. These two characteristics naturally render agriculture on woody peat soils difficult. For more details about tropical peat soils, refer to Furukawa (1994).

Due to the little official statistics on crop distribution over the soil types in tropics, the author listed the agricultural products on tropical wetland based either on the literature review or on the results of the own surveys on 108 transmigrant households in the 2005-2006 and the 2009-2010 cropping season in Central Kalimantan, Indonesia. The author’s own survey includes the detailed information on the changes in cropping patterns on the 102 plots over the four transmigration sites. All of these 102 plots are on woody peat soil: with the average peat depth of 42.7 centimeter (with the standard deviation of 30.0 centimeter) and the average surface C-organic of 42.5%.

Table 1 summarizes the changes in cropping patterns found in the author’s own survey. These changes reflect the differences between the first cultivation of the plot after in-migration and the crops harvested in the 2005-2006 season. Consistent with the original idea of the transmigration program, in the first cultivation, rice was planted on 87 plots (85% of the 102 plots).

---

1Note that 1) irrespective of the ethnicity, all the sample households cultivated the plots in the former transmigration areas, not in the indigenous Dayak villages, and 2) these 102 plots were not house gardens.
Table 1: Cropping Patterns and Its Changes up to the 2005-2006 Season

<table>
<thead>
<tr>
<th></th>
<th>Rice</th>
<th>Rice + Vegetables and/or Fruits</th>
<th>Rice + Rubber</th>
<th>Rice + Other Crop Combination</th>
<th>Vegetables</th>
<th>Fruits</th>
<th>Rubber</th>
<th>Rubber + Other</th>
<th>Commercial Crops and/or Trees</th>
<th>Cassava + Other</th>
<th>Fallow</th>
<th>Total (First Pattern)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>11</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>6</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Rice + Vegetables and/or Fruits</td>
<td>3</td>
<td>9</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>Rice + Rubber</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Rice + Other Crop Combination</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>14</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>Vegetables</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Fruits</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rubber</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rubber + Other Commercial Crops and/or Trees</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Commercial Crops and/or Trees</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Cassava + Other</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Fallow</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total (2006 Crop Season)</td>
<td>15</td>
<td>15</td>
<td>2</td>
<td>21</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>14</td>
<td>2</td>
<td>6</td>
<td>14</td>
<td>102</td>
</tr>
</tbody>
</table>

Table 2: Sale of Agricultural Products: Valid Sample 95 HHs (unit: rupiah)

<table>
<thead>
<tr>
<th></th>
<th>Number of HHs Sold</th>
<th>Average Sale per HH (over 95 HHs)</th>
<th>Max Sale Unit : Rupiah</th>
<th>Ratio to Total Agricultural Sale (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>83</td>
<td>2,253,116</td>
<td>20,510,000</td>
<td>100</td>
</tr>
<tr>
<td>Rise</td>
<td>11</td>
<td>158,474</td>
<td>6,000,000</td>
<td>7.0</td>
</tr>
<tr>
<td>Cassava</td>
<td>12</td>
<td>37,063</td>
<td>1,300,000</td>
<td>1.6</td>
</tr>
<tr>
<td>Vegetables</td>
<td>41</td>
<td>695,734</td>
<td>13,810,000</td>
<td>30.9</td>
</tr>
<tr>
<td>Fruit</td>
<td>64</td>
<td>986,645</td>
<td>16,010,000</td>
<td>43.8</td>
</tr>
<tr>
<td>Rubber</td>
<td>5</td>
<td>181,579</td>
<td>9,000,000</td>
<td>8.1</td>
</tr>
<tr>
<td>Coffee</td>
<td>22</td>
<td>100,611</td>
<td>2,250,000</td>
<td>4.5</td>
</tr>
<tr>
<td>Tree</td>
<td>2</td>
<td>7,895</td>
<td>500,000</td>
<td>0.4</td>
</tr>
</tbody>
</table>
As of the 2006 rainy season, rice was still planted on 51 (50% of 102) plots. However, the number of plots under mono-cropping of rice became less than half: to 15 from 34 plots. In contrast, plots with rubber trees increased from 6 plots in the first cultivation to 29 in the 2006 season. Note here that the classification of ‘Rice + Other Crop Combinations’ includes the cases of rubber plantation, which are added to mono ‘Rubber’ plots (6 plots), ‘Rubber + Others (14)’ and ’Rice + Rubber (2)’.

Table 2 shows the components of annual crop income, from the year of 2006 to 2007, of the 95 household samples with valid information. Vegetables and fruits accounted for more than 70% of the sale of agricultural produce, while rice accounted for merely 7%. Among fruits, pineapple was a popular crop, in particular, in the site close to Kuala Kapuas, an urban area. From Table 2, cassava and coffee also stand out as a popular crop. As of 2007, rubber trees were still young in our study area. In one survey site, however, rubber accounted for more than 20% of the agricultural sale.

Our follow-up surveys in 2009 and 2010 revealed that under the several local government sponsored projects, rubber cultivation gained further importance. More drastic change was the expansion of oil-palm planting. There were no farmers who planted oil palm in their first cropping. As of the baseline survey in 2006, there was merely one plot, out of 102 plots, with oil palm trees. In a site resurveyed in 2010, most of the respondents leased out all of their fields to a transnational palm oil company. These respondents became casual wage workers of that company, and were mainly engaged in oil palm planting. These respondents told the author that they decided to lease out their plots because they could earn stable wage income from hired oil-palm works across the seasons.

This paper proceeds as follows. The next section is entirely devoted to oil palm, due to the internationally widespread debate about its expansion. Refer to, for example, an article in Nature in 2012 (Gilbert 2012), or New York Times on January 1, 2007. Section 3 examines the agricultural crops which are often observed on the tropical peat soils, or were recommended for the woody peat soils by the soil-science literature. Section 4 examines the carbon market. The last section provides the issues we need to explore in the future research on tropical wetland development. From the economics point of view, the key concept is ‘profit’. It may sound almost obvious. But the point here is that the key variable is not yield.

2. Oil Palm

2.1 Biology and Main Uses

Oil palm, *Elaeis guineensis*, is a tree crop originated in humid tropics of West Africa. It performs best under high temperature between 22 and 32 Celsius and under much

---

2In fact, most of the rice cultivators initially planted rice varieties for irrigated fields. Within a few years, however, they often adopted the local rice varieties for upland.
rainfall (2,500 - 3,500 mm per year). Oil palm is adapted to a wide range of soil including tropical peat soils. For a more detailed overview of oil palm plants and its cultivation history, refer to, e.g., summaries in Sheil et al. (2009) and Teoh (2010). Although oil palm provide various raw materials including timber, its main use has been extracting palm oil from the fruits. The purified palm oil is a popular cooking oil in the various areas of the world, in particular, in tropics. Palm oil is also a basic ingredient in a vast array of products such as margarine, soap, shampoo, and cookies. It is also a major candidate for biofuel material. Currently, palm oil is one of the major agricultural commodities that are internationally traded.

2.2 Production and Trade

Figure 1 shows the transition of harvested area and fruit production since 1961, with the share of top 3 countries in 2010.

Two major characteristics of oil palm production stand out from Figure 1. First, oil palm is a relatively new international commercial crop in tropics that rapidly expanded its area in the second half of the 20th century. Second, production of oil palm surged in South East Asia, in particular, in Malaysia and Indonesia.

The harvested area of oil palm increased from 3.6 million hectares in 1961 to 15.4 million hectares in 2010: more than four folds with the annual growth rate of 3%. Correspondingly, the world production of oil palm increased from 13.6 million tonnes in 1961 to 217.9 million tonnes in 2010: remarkable sixteen folds with the annual growth rate of 5.7%. During the same period, rubber, another major tropical commercial crop, expanded its harvested area 2.5 folds and increased its production five folds. Coffee provides a much clearer contrast: during 1961 and 2010, the harvested area stagnated around 10 million hectares while production increased less than two folds. These numbers reconfirm the conventional wisdom that palm oil is a rising star among the tropical commercial crops.

As of 2010, the top five countries in terms of the harvested areas of oil palm are Indonesia (5.4 million hectares), Malaysia (4.0), Nigeria (3.2), Thailand (0.6), and Ghana (0.4). But the increase in the harvested area since 1961 is widely different between the three South Asian.

---

3 Oil-palm fruits quickly deteriorate after they are cut out from trees, so that the palm oil extraction should be done within a few hours after the harvest. The major producers of palm oil is, therefore, the same as the major cultivators of oil palm.

4
countries and the two African countries: Indonesia (77 fold), Malaysia (93 fold), Nigeria (1.2 fold), Thailand (598 fold), and Ghana (6 fold). In the 20th century, the world production of palm oil surged mainly in South East Asia, mostly in Malaysia and Indonesia. In 2010, Indonesia and Malaysia accounted for 82% of world production of palm-oil fruits and 61% of the harvested area.

Figure 2 (1) shows the changes in export of palm oil, the major product from oil palm since 1961, with the share of top 3 countries in 2010. Figure 2 (2) depicts the average prices of major cooking oils including palm oil. The average export prices are obtained by dividing total export value of the product by its total exported amount. In 2010, the world export value of palm oil amounted to 29.9 billion US dollars, which is the 3rd largest among the agricultural produce following soybeans.
In 1961, in contrast, the export value of palm oil is the 44th from the top. These numbers indicate how rapidly palm oil gained its importance in the world agricultural commodities market.

Figure 2 (1) looks similar to Figure 1, in particular after the mid 1980s. Along with the growing production, Indonesia at first regained and then rapidly increased its share in the world export market since the mid 1980s. As of 2010, the dominant exporters of palm oil are Indonesia and Malaysia. These two countries accounted for 88% of the world palm oil exports in amount. We can argue that the current world palm oil market is under the duopoly by Indonesia and Malaysia.

As were mentioned above, palm oil is produced in tropical emerging countries and its export market is the 3rd largest among the agricultural produce. These two observations may tempt us into regarding palm oil as another primary product that is produced in South and purchased and consumed mainly in North. It is not. Figure 3 shows the major importers of palm oil. China and India, the giant emerging countries, have been the top two importers of palm oil since the late 1990s. As of 2010, China, India, and Pakistan absorbed one third of the world total export.

Figure 2: Palm Oil: Export and Its World Export Price

(1) Palm Oil Export and Share of Top 3 Countries in 2010

---

4Netherlands, the third largest exporter, has not produced raw palm oil. Its export is by triangular trade.

5Due to the biology of oil palm trees, almost all significant producer of oil palm are located in humid tropics. An exception is China, which produced 0.67 million tonnes of oil palm fruits in 2010, and ranked 17th largest producer.
of palm oil. This is mainly due to the rising demand for oil and fats in the burgeoning middle class in emerging countries. Palm oil is a popular cooking oil in tropical areas because, first, it is usually cheaper than the other cooking oils (Figure 2 (2)), reflecting its higher oil productivity per hectare (Sheil et al. 2009, p. 11). In addition, consumers in tropical areas do not suffer from coagulation of palm oil that often happens under lower temperature. In sum, the palm-oil trade among the emerging countries, as well as between Indonesia plus Malaysia and industrialized economies,
is already significant, and will gain further importance as emerging countries keep growing.

2.3 ‘Hot Issues’ in International Trade

As was emphasized above, oil palm can be commercially grown only in humid tropical areas. Unlike the cereals and diary products, therefore, export subsidies by the US and the EU countries, the biggest challenge in the current WTO negotiation, are not an issue about oil palm. The sole trouble about oil palm, however, also comes from the fact that the suitable areas for oil palm plantation is humid tropics. The area overlaps with the remaining tropical rain forests, many of which are on woody peat soils. Oil palm, with its rapid expansion and with its biology adept to woody peat soils, is a major suspect of a driver of deforestation.

The evidence seems to be accumulated. Carlson et al. (2012), for instance, found that in Ketapang District in West Kalimantan, oil palm planting directly caused 40% of peatland deforestation. Dennis et al. (2005) identified that use of fire for clearing land for oil palm plantation was a major cause of wild fire in the three out of eight locations of their study. In August 2008, the growing complaints led the World Bank Groups to the announcement that it would not approve any new investments in palm oil until a new strategy would be in place (Teoh 2010, p. 20), which was published in march 2011. The international responses to the debate over the environmental impacts of oil palm expansion can be summarized as follows.6

2. 2001: WWF Forest Conversion Initiative. It requires the reduction in forest conversion for development of oil palm plantation.
3. 2004: Establishment of Round Table on Sustainable Palm Oil (RSPO).
4. 2008: A Directive by the European Parliament, which set criteria for acceptable biofuels (“land with high carbon stocks should not be converted for biofuel production”).
6. 2009: Unilever suspended future purchase of palm oil from PT SMART (an Indonesian supplier).

A currently insignificant but a latent problem related to palm oil trade is export restriction. We have reviewed in the previous subsection that the emerging markets are large importers of palm oil. Indonesia and Malaysia, the virtual duopolists of international palm oil export, are also big emerging economies. Since 1973, the world average of the export ratio of palm oil (in quantity) has been above 60%. In 2010, the export ratio of the world average was 81%, while that of Indonesia and

---

6For more details, refer to Sheil et al. (2009), Teoh (2010), and the documents listed on the web site of Round Table on Sustainable Palm Oil (http://www.rspo.org/).
Malaysia was 82% and 87%, respectively. In these two exporters, the growing domestic demand may retard palm oil export in future.

3. Suitable Plants for Tropical swampland

3.1 Permanent Crops

3.1.1 Rubber

3.1.2 Coffee

The international price is stagnating.

3.1.3 Sago palm *Metroxylon sagu*

The can grow on acid peat soil (can survive even waterlogged environment). [http://www.palms.org/](http://www.palms.org/)

3.2 Annual Crops

3.2.1 Pineapple

3.2.2 Cassava

Figure 4 shows the transition of harvested area and crop production of cassava since 1961, with the share of top 3 countries as of 2010.

The export market of cassava (in flour, starch or dried) is easy to overview. In short, Thailand has been the virtually sole exporter.

Figure 4: Cassava: Harvested Area and Crop Production

(1) Harvested Area and Share of Top 3 Countries in 2010
3.2.3 Algae Bio-energy

3.3 Timber Trees

The original flora of swampland was, obviously, forests. Logging activities have put damages on swampland ecology. In other words, timber trees have significant potential for commercial products in swamplands. ea albida Any market distortions in Europe and the USA? What we should grow.

4. Profit

The trouble is the obsession to the yield. If the more output requires much more inputs, it soes not make much sense.

References


A River Basin-based Cooperative Effort on Wetland Research and Conservation Trainings

Duong Van Ni\textsuperscript{1)}, Tran Triet\textsuperscript{2)}, Sansanee Choowaew\textsuperscript{3)}, Jeb Barzen\textsuperscript{4)}

\textsuperscript{1}Environmental College, Can Tho University (CTU), Viet Nam
\textsuperscript{2}Faculty of Biology, University of Natural Sciences (UNS)--Ho Chi Minh City, Viet Nam
\textsuperscript{3}Faculty of Environment and Resource Studies, Mahidol University (MU), Thailand
\textsuperscript{4}International Crane Foundation (ICF), Wisconsin Baraboo, USA

Abstract

This paper describes a cooperative effort on wetland research and conservation trainings by 18 universities of 7 countries within the Mekong River basin and Malaysia. Background, concept, goals, agreement on academic cooperation, capacity building and training programmes carried out so far, as well as future planned activities of this university network are presented. It is expected that this established network and its continuous activities will enhance and strengthen the capacity of educators, researchers, technical staffs, facilitators and decision makers of the Mekong region who are willing and able to work in the field of wetland conservation. In the long-term, the network aims at contributing to the wetlands and natural resource management and sustainable development of the Mekong region.

Keywords: Wetland trainings, University network, Mekong River Basin

1. Introduction

The Mekong River is one of the great rivers of the world. Wetlands of the Mekong basin are intimately linked with the ecological balance and socioeconomic well-being, nourishing a population of more than 60 million people of 6 countries: China, Myanmar, Lao PDR, Thailand, Cambodia and Viet Nam. Wetland ecosystems maintain and support vital ecological functions, as well as provide valuable products and services for human activities. The biodiversity of the Mekong wetlands is of international significance, including many unique ecosystems and a wide range of globally threatened species such as Giant catfish, Siamese crocodile, Eastern sarus crane, Giant ibis, and Irrawaddy dolphin. Despite their importance, wetlands in the Mekong River Basin have suffered from widespread destruction due to misuses and abuses. Wetlands are threatened by population growth, increased exploitation of biological resources, timber harvest, pollutions of various forms, development activities and mis-management (Mekong River Commission, 1977). Conserving wetland ecosystems and their resources through a better understanding of wetland ecology and the application of ecologically-sound management is urgently needed.

To implement this task, the 6 riparian countries within the Mekong River basin need a sufficient number of experts and technical staff who are willing and able to work in
the field of wetland conservation. It has been a challenge for Cambodia, Myanmar, Lao PDR, Thailand and Viet Nam to find enough competent native professionals to work on wetlands and on natural resource management in general. It is worthwhile to raise awareness and foster interests in wetland conservation among undergraduate and graduate students of these countries in hopes that those students will get involved in wetland research and conservation practices as they develop their career. There is also a great demand in providing practical trainings in wetland ecology and management for protected areas staff, government officials and other interested parties.

The collaboration among universities of China, Myanmar, Cambodia, Lao PDR, Thailand and Viet Nam is essential, both in effectively providing regional trainings and in improving understanding and cooperation among researchers and educators of the region. The establishment of a network of universities of the region is proposed, discussed and established. The network will facilitate the construction and implementation of regional training courses focusing on fieldbiology aspects of wetland ecology and conservation.

This paper describes the background, ongoing and future planned activities of the “University Network for Wetland Ecology and Conservation Trainings in the Mekong Region” (the Network) and discusses its potential contribution to education for sustainable development of the Region.


2.1 Background

The idea of establishing a formal network of universities within the Mekong region to address the issues of wetland education, research and training has occurred for a long time and has been informally discussed among individual academic staff from different universities in various occasions when their academic paths crossed.

Until 2000, more concrete discussions for the establishment of the network were carried out. And on November 2002 the network was formally created with initial 8 university members. On 2009 the university network expanded to 13 members and to date was 18 members.

1. Royal University of Agriculture (RUA), Phnom Penh, Cambodia
2. Royal University of Phnom Penh (RUPP), Phnom Penh, Cambodia
3. National University of Laos (NUOL), Vientiane, Lao PDR
4. Champasak University (CPU), Champasak, Lao PDR
5. Universiti Sains Malaysia (USM), Penang, Malaysia
6. Chulalongkorn University (CU), Bangkok, Thailand
7. Khon Kaen University (KKU), Khon Kaen, Thailand
8. Mahasarakham University (MSU), Mahasarakham, Thailand
9. Mahidol University (MU), Nakhon Pathom, Thailand
10. An Giang University (AGU), Long Xuyen, Vietnam
11. Can Tho University (CTU), Can Tho, Vietnam
12. Nong Lam University (NLU), Ho Chi Minh City, Vietnam
Representatives of the Rectors and Presidents of member universities attended the 1st executive meeting on 2002, 2nd on 2008 and the 3rd will be on 2013. The main objectives of these meeting were to gather opinions of participating universities about the Network; Network’s activities such as kinds of trainings, curriculums, academic credit exchange, fund raising, joint research, workshops, conferences and to sign a Memorandum of Understanding (MoU).

2.2 Agreement on Academic Cooperation

The Network facilitated academic cooperation in wetland education, and communication, wetland research, regional wetland conferences and consultations, construction and implementation of regional training courses focusing on field-biology aspects of wetland ecology and conservation. The longer-term goal of the Network will be to strengthen the capacity of member universities in establishing complete academic MSc and PhD programmes in wetland ecology and conservation.

2.3 Goals

Overall Purposes

- To build and enhance the capacity of university lecturers and researchers of the Mekong region in teaching wetland-related courses, conducting scientific research in wetland-related fields, and assisting wetland conservation practices;
- To enhance the understanding in wetland’s values and threats to the sustainable socioeconomic development of the whole Mekong river basin;
- To enhance the knowledge and understanding in wetland ecology and management of protected areas staff, junior staff of GOs, NGOs and CBOs, grassroots and community leaders and facilitators of the Mekong riparian countries and to improve their capacity in wetland conservation and management practices.

Specific Objectives

- To introduce the concepts and principles of wetland ecology and management;
- To provide intensive academic and practical training on wetland ecosystem management, focusing on wetland biodiversity conservation and it’s threats in the Mekong Basin;
- To provide in-situ training and hands-on experience in designing and conducting wetland surveys, inventory, studies, threat analysis and research
in wetland conservation and management by means of field projects carried out by course participants;

- To introduce education and training methodology for the design and implementation of wetland academic courses and special training for communities in wetland-related subjects.

### 2.4 Potential long term benefits

The Network has full confidence that all participants of this training course will be an important task force in wetland education, research, trainings, and wetland biodiversity conservation and management in the Mekong Region. Therefore, it is possible and considerable for the Network to provide annual trainings, joint research to researchers and practitioners who would have a holistic experience and expertise of wetlands of the Mekong Region.

The Network has several unique characteristics. Its activities can contribute to education for sustainable development due to the following reasons:

(a) The Network provides education and trainings on wetland ecology and conservation. Wetland ecosystems and their resources are contributing to subsistent livelihoods, food and water security, poverty alleviation, and sustainable development of rural economy of the Mekong region.

(b) The establishment and operation of the Network takes into account the ecosystem approach and a river basin-based approach i.e. the Mekong River Basin. A river basin is an appropriate unit for addressing the wetland management issues and integrating wise use of wetlands into the basin development plan and sustainable development of the whole river basin. A river basin is also an appropriate unit for wetland education, research and trainings as well as communication and public awareness.

(c) Among the prioritized target trainees of the Network’s training activities are junior lecturers and researchers of member universities. In the future, they will be an important task force in wetland education, research and trainings region-wide. Each member university benefits in the long term through capacity building of its academic staff. In addition, the prioritized target trainees of the Network also include protected areas staff, government officials, staff of NGOs and CBOs, local facilitators, field coordinators, and grassroots leaders. They, too, will be an important task force in wetland biodiversity conservation and management.

(d) The Network’s training activities require minimal expertise from outside. Trainers are selected and drawn from member universities within the region. Trainings are provided using available expertise, experience, as well as teaching facilities of member universities.

(e) The Network operates regional training activities, using key wetland ecosystems of the Mekong region as natural laboratories for the trainings. Course contents are field-oriented and emphasize on in-situ trainings and hands-on exercises. Trainees have a holistic view and insight of wetland ecosystems within the Mekong region. They also have opportunities to share their knowledge and experience with colleagues from other riparian countries and learn from each other.
(f) The Network enhances partnerships among individual academics as well as between institutions, therefore strengthens the capacity and enhances cooperative efforts in wetland research, communication, education, and public awareness within the Mekong region.

3. Network Activities

3.1 Training activities

Member universities take turn in hosting the training courses on Wetland Ecology and Management on a yearly basis, using important wetland sites of each countries as natural training classes and laboratories. Till 2012, the Network have organized ten regional training courses. The first training course was held in Viet Nam 2003, the second was in Thailand 2004, the third was in Lao PDR 2005, the fourth was in Cambodia 2006, the fifth was in Vietnam 2007, the sixth was in Thailand 2008, the seventh was in Thailand and Lao PDR 2009, the eighth was in Cambodia 2010, the night was in Malaysia 2011, and the tenth was just finished at Vietnam 2012. During these training programs, more than 30 specific wetlands were surveyed (Figure 1).

Specific Outcomes:

- Understand the concepts and principles of wetland ecology;
- Have knowledge on major wetland ecosystems of the Mekong region and their biodiversity;
- Have knowledge on approaches and methods, techniques and equipments commonly used in wetland biodiversity surveys and research and wetland management;
- Understand major issues, threats related to wetland management in the Mekong basin;
- Exchange knowledge and experiences on the wetland management and adaptation;
- Have experience in designing and conducting wetland studies and research;
- Understand methods and have necessary materials to transfer knowledge on wetland ecosystems to communities and wider public, and to develop and teach wetland courses at university level.

Specific Outputs:

- At least 24 wetlanders of Myanmar, China, Lao PDR, Cambodia, Malaysia, Vietnam, Thailand who are well-equipped with knowledge, expertise, educational materials, and ready to join a task force in conservation and management of wetlands and their biodiversity in the Mekong Region;
- Curriculum and course materials for use in future courses;
- Course report;
- Field project reports, including field data collected during course implementation;
- Identified potential wetland research topics and conceptual ideas.

Main Activities and Location(s) for the Training Course:

- Lecture course was conducted at lecture rooms;
• Laboratory practices was conducted at laboratories of host university;
• Geology and soil formation, Hydrology, Biodiversity, Socio-economics field surveys and practices was conducted at some specific wetland sites;
• Threats to climate change analysis, data analysis and writing group reports, final training course report;
• Open workshop at the end of each training.

Accommodations and other facilities: Host universities will facilitate a proper accommodation for the trainees during lecture session and field study.

Sites for Field Work: Determined by the host universities

Lead Trainers/Instructors:

• Dr. Sansanee Choowaew: Mahidol University (Thailand), PhD in Environmental Planning (University of Melbourne, Australia, 1987);
• Dr. Tran Triet: University of Natural Sciences (Vietnam), PhD in Land Resources (University of Wisconsin – Madison, USA, 1999);
• Dr. Duong Van Ni: Can Tho University (Vietnam), PhD in Geography (Royal Holloway Institute, University of London, U.K. 2001).

International expert:

• Mr. Jeb Barzen, International Crane Foundation (ICF), expert in birds, waterfowls, wetland hydrology, wetland restoration;
• Dr. Mashhor Mansor: USM–University Sains Malaysia, Malaysia, expert in biology;
• Dr. Richard Keim: LSU–Louisiana State University, USA, expert in hydraulic wetlands;
• Dr. Scott Wilson: USGS–National Wetland Research Center, USA, expert in wetland restoration;
• Dr. Cindy Thatcher: USGS-National Wetland Research Center, USA, expert in GIS and Remote Sensing.

Local experts: Determined by host universities

Number of Participants: varies between 20-25

• Employment/Occupation: Junior lecturers, teaching assistants, researchers and postgraduate students from appropriate departments of 18 member universities of the Network; protected areas staff; junior staff of wetland-related programmes/units/agencies of GOs, NGOs and CBOs of the Mekong riparian countries; grassroots and community leaders and facilitators; media.

• Minimum Qualification: BSc degree or equivalent;

• Essential Skills, Experience, and Attributes: Being able to listen, speak, read and write in English; being able to work in the field; having worked relating to wetland ecosystems; being interested in wetland ecosystems; willing to work on wetlands management issues, e.g. teach wetland-related courses, conduct research on wetlands, assist wetland biodiversity conservation and management practices, wetland education, communication and public awareness;
• **Recruitment procedure:** The Trainees Selection Committee of each member university within the Network selects and nominates number of participants.

**Training methods**

- In-class lectures, key concepts;
- In-situ training, hands-on observations and exercises;
- Developing essential technical skills such as field survey, measurement, inventory, assessment, monitoring, participatory rural appraisal (PRA), interview, facilitating techniques, team work, group discussion, oral presentation, report writing, conceptualizing research concept;
- Encouraging active participation from trainees and sharing experience through activities such as brain-storming, group discussion, presentation, workshop.

**Evaluation**

- **Evaluation of Participants** : Trainees performance will be evaluated based on a combination of in-class participation, field performance, field reports, group work and individual work, presentation materials, and oral presentation;
- **Course Evaluation** : At the end of the course, each participant will anonymously fill in a course evaluation form.
3.2 Joint research activities

- Participants from all six of the countries within the Mekong Basin as well as from Japan, Malaysia, New Zealand and the USA have participated in different research. Since 2003 to date, four joint research investigations have evolved:
  - Asialink’s project on urban wetland ecosystem management, involved University of Salzburg and University of Helsinki, Finland;
  - Bamboo of Cambodia, Lao PDR and Vietnam, involved Museum of Natural History Paris, France; Botanical study of the family Zingiberaceae, involved Royal Botanic Garden-Edinburgh, Singapore Botanic Garden; and
  - Persistent Organic Pollutants (POP), a survey of 531 wetlands in the whole Mekong Basin, involved scientists of US Geological Survey (USGS), International Crane Foundation (ICF), examined a landscape never before studied in the region (Figure 2).

These research projects exemplified the potential of the Network.
Figure 2 A survey of 531 wetlands in the whole Mekong basin by the Network

4. Future of The Network

Since 2003 the website of the Network was developed and maintained by the Faculty of Environment and Resource Studies, Mahidol University (http://www.en.mahidol.ac.th). But from 2013 onwards, the Network will have its own website.

With a grant from the US Department of State, the Network is seeking to establish a permanent independent organization to expand the network on a sustainable basis. The organization will be responsible for fund raising for various Network’s activities, communication among Network’s member universities and its partners, planning and implementing annual activities (regional meeting, training courses, conferences), creating and coordinating joint research programs in the region.

A permanent office for the Network was established at Cantho University, Vietnam and a full-time manager was hired to manage Network’s activities.

A permanent organization of the Network, when fully developed by the member universities and in partnership with local governments throughout the Mekong region, will provide a valuable institution for education, research and adaptation of
countries in the Mekong basin to sustainable wetland resources management, food security and climate change. It will also support adaptative planning by decision-makers responsible for the Mekong river’s future.

5. Donnors of The Network

On behalf of the Network, we thanks to the following sponsors to the Network during the past (number=Training course):

- ASEAN Regional Center for Biodiversity Conservation (1)
- International Crane Foundation (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)
- John D and Catherine T MacArthur Foundation (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)
- IUCN/UNDP/GEF Mekong Wetland Biodiversity Conservation Programme (2, 3, 4)
- Rockefeller Foundation (2)
- Royal Netherlands Embassy in Vietnam (3)
- World WildLife Fund (WWF) Russel E. Train Education for Nature Program (3, 5)
- USGS National Wetland Research Center (5, 6, 7, 8, 9, 10)
- UNS, VNU-HCM, Vietnam (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)
- Mahidol University, Thailand (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)
- National University of Laos, Lao PDR (3)
- Royal University of Phnom Penh, Cambodia (4)
- Royal University of Agriculture, Cambodia (8)
- Cantho University, Vietnam (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)
- An Giang University, Viet Nam (10)
- Chulalongkorn University (6, 7)
- Champasak University (7)
- Universiti Sains Malaysia (7, 8, 9, 10)
- Louisiana State University, US (8, 9, 10)
- US Department of State SE Asia Regional Env. Hub Small Grants Program (7)
- Others

References


21
Development of Swamp Land for Rice Based Farming System

E. Eko Ananto and Kasdi Subagyono

Indonesian Center for Agriculture Technology Assessment and Development (ICATAD)
Jl. Perintis Kemerdekaan No. 10, Bogor, West Java, Indonesia

Abstract
There are estimated 33.36 million ha of swamp lands in Indonesia, which consists of tidal swamps 20.11 million ha and non-tidal swamps 13.26 million ha. About 9.53 million ha of tidal land were potential for agriculture, but only about 4.18 million ha has been reclaimed for agricultural production. Meanwhile, from the non-tidal swamps land area, only 730,000 ha were already cultivated. However, due to biophysical and socio-economic constraints the utilization is not optimum yet. Its indicated by lower level of productivity. On the other hand, specific packages of technology developed from research is available which may change the marginal status of tidal swamps land into prospective agricultural producing areas. Agricultural development in swamps land has to be initiated by improvement of land and water management both at macro and micro level, followed by proper cultural practices supported by effective rural institution and farmers participation. Crops management techniques involve the use of improve variety, location specific fertilization, soils amelioration if needed, effective pests/diseases control and use of farm machineries. The application of those packages of technology had increase the land productivity and yield of rice. The use of farm machineries to solve the labor shortage and improvement in harvest and post harvest handling will be increased better quality of milled rice. To ensure the successfully of the technology development require the support of relevance rural institution such as credit and input supply, processing and marketing of products, and impowering farmers capability.

1. Introduction
Since the last three decades, the main problem faced by the agriculture sector in Indonesia is the lack of productive agricultural land because it is used for non-agricultural sector, land degradation, and land fragmentation that causes the limited land holding per family farmers. These problems coupled with climate change can threaten agriculture achieving increased food production and livelihoods.

Swamp lands (tidal and non-tidal) is one of the natural resources that have great potential for agriculture, and scattered mainly in the larger islands such as Sumatra, Kalimantan, Sulawesi, Irian Jaya, and the potential for agriculture. The swamp lands in Indonesia is estimated 33.36 million ha. The land consists of 20.11 million of tidal

Reclamation of swamp lands for agriculture is an attempt to overcome the above problem by optimizing natural resources to compensate for shrinking agricultural land, improving standards of living, and equitable development between regions. In addition, the agricultural development in the swamp areas will also contribute to the increase in food production, especially rice. However, tidal land has not been utilized optimally. It is indicated generally by low productivity of the land and farmers welfare. Generally, cropping intensity in the surrounding areas is only once a year with low yield.

Through a systematic and intensive research program, Indonesian Agency for Agricultural Research and Development (IAARD) has established packages of specific location technologies that are capable to raise the image of marginally-known tidal swamp land to become a new frontier of agricultural lands and a center of food crops production areas, especially rice. The technology packages were combination of soil and water and agricultural cultivation technology. The successful of agricultural development in swamp lands are not only determined by the availability of appropriate technology, but also be supported and the availability of adequate water management infrastructures and supporting institution, including farmers participation and government policy.

2. Potency of Swamp Land

The swamp lands in Indonesia is estimated 33.36 million ha, spread over 7.15 million ha of Sumatra, Kalimantan 5.94 million ha, 0.37 million ha Sulawesi, Maluku and East Nusa 0.24 million ha, and Irian Jaya 6.42 million ha. The land consists of tidal swamps 20.11 million ha and non-tidal swamps 13.26 million ha, about 9.53 million ha of potential for agriculture, but only about 4.18 million ha that has been reclaimed for agricultural production. Meanwhile the non-tidal swamps land area of 13.26 million ha, only 730 000 ha were already cultivated (Table 1).

Table 1. Status of tidal swamp lands in Indonesia (Nugroho et al.,1993; Direktorat Jendral Pengairan,1998)

<table>
<thead>
<tr>
<th>Location</th>
<th>Tidal swamps (000 ha)</th>
<th>Non-tidal swamps (000 ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Potency</td>
</tr>
<tr>
<td>Sumatera</td>
<td>7.147</td>
<td>3.927</td>
</tr>
<tr>
<td>Kalimantan</td>
<td>5.939</td>
<td>2.795</td>
</tr>
<tr>
<td>Sulawesi</td>
<td>371</td>
<td>-</td>
</tr>
<tr>
<td>Maluku &amp; Nusa</td>
<td>237</td>
<td>-</td>
</tr>
<tr>
<td>Tenggara</td>
<td>6.415</td>
<td>2.808</td>
</tr>
</tbody>
</table>

Peatlands in Indonesia estimated 21 million hectares, scattered mainly in Sumatra, Kalimantan and Papua. However, because of the variability of land is very high, both...
in terms of peat depth, maturity and fertility, not all peatlands can be used for agricultural land, only about 6 million hectares for agriculture (Table 2).

Table 2. Total area of peatlands and feasible for agriculture in Indonesia (BB SDLP Research, 2008).

<table>
<thead>
<tr>
<th>Province</th>
<th>Total (000 ha)</th>
<th>Feasible for agriculture (000 ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riau</td>
<td>4.043</td>
<td>775</td>
</tr>
<tr>
<td>Jambi</td>
<td>717</td>
<td>334</td>
</tr>
<tr>
<td>Sumatera Selatan</td>
<td>1.484</td>
<td>1.145</td>
</tr>
<tr>
<td>Kalimantan Tengah</td>
<td>3.011</td>
<td>672</td>
</tr>
<tr>
<td>Kalimantan Barat</td>
<td>1.730</td>
<td>695</td>
</tr>
<tr>
<td>Kalimantan Selatan</td>
<td>331</td>
<td>163</td>
</tr>
<tr>
<td>Papua and Papua Barat</td>
<td>7.001</td>
<td>2.273</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>18.318</strong></td>
<td><strong>6.057</strong></td>
</tr>
</tbody>
</table>

Note: The total area of peatlands in Indonesia is about 21 million ha included peatlands in Nanggroe Aceh Darussalam Province, North Sumatra, West Sumatra, Bengkulu and East Kalimantan.

Expansion of peatland increased rapidly in some provinces, such as Riau, West Kalimantan and Central Kalimantan. For example in Riau Province, between 1982 - 2007 have been converted 1.83 million ha or 57% of the total peat forest area of 3.2 million ha of peatland due to the expansion of oil palm trees.

2.1 Land Typology and Flooding Type

Tidal swamp derived from the alluvial deposits, marine and peat dome. Marine group usually contains pyrite layers. According to the type and level of constraint that can be caused by physico-chemical factors of land, the tidal swamp is grouped into four main typologies, namely potential soils or deep sulphidic materials (2.07 million ha), acid sulphate soils or shallow sulphidic materials (6.70 million ha), peat soils (10.89 million ha), and saline-affected soils (0.44 million ha).

Potential soil is the tidal potential acid sulfate soil with a layer of pyrite of 2% is located at a depth of more than 50 cm of the soil surface, while the acid sulfate soil is a soil which pyrite layer having > 2% at a depth of less than 50 cm. Acid sulfate is divided into (a) the potential acid sulfate soil, when the pyrite layer has not been oxidized, and (b) actual acid sulfate soil, when pyrite layer already oxidized, which is characterized by the presence of sulfuric horizon and soil pH <3.5.

Peatland is land formed from water-saturated organic material and the organic carbon content 12-18%, or materials with unsaturated water and the organic carbon content by 20%. In detail, peat lands are subdivided into peaty soil, shallow peat soil, medium peat, deep peat and very deep peat soil. Saline land is land that influenced by salt water for more than 3 months in one year.
According the flooding characteristics, the land are grouped into four flooding types: type A (flooded during both high and neap tides), type B (flooded only during high tides), type C (never been flooded either during high or neap tides, with ground water surface <50 cm), and type D (never been flooded, with ground water surface, is >50 cm).

By grouping the tidal swamps land based on its typology and flooding characteristics, the direction and priority of the proper and suitable farming system in relation to the technology packages could be determined and developed effectively. Results of the site characterization showed that the distribution of land typologies differs throughout the targeted areas, which means that each location may consist of several typologies and flooding characteristics.

2.2 Water Canal Network

Reclamation of tidal land in Indonesia conducted by the local people and the government. Local people usually reclaimed land that located on both sides of the river as far as 1000-2000 m from the river. The land on both sides of the river usually has a biophysical or physico-chemical properties of the soil that is relatively better. Water canal utilize ditches empty to the river, so the leaching very effectively.

Reclamation by the government aimed to support the transmigration/resettlement program, and usually located far from the edge of the main river, the land biophysical or physico-chemical properties of the soil worse than land that was in the edge of river. Reclamation by the government is limited to the primary channel development / navigation, secondary and tertiary canal and its water gates, known as the macro water system, while the farmers responsible to micro water management in the farm level.

The macro level of water management network are generally grouped into five different canal networks, namely single-comb system, double-comb system, fork system, combination of fork and comb system, and staircase system. When the project started, all macro level water management networks were mostly not well maintained, some of which were not provided with either tertiary canals or water gate, and if any most of them were not function well.

The condition of the macro water canal is not entirely lacking in good condition and well maintained, generally a shallow, covered with grass or shrubs. Some do not include tertiary canals and gates, and do not work. This situation causes a decrease in the effectiveness of water management and impede the flow of water. This is a factor that causes low productivity.

3. Farming Systems Development

3.1 Soil and Water Management

One key to the success of the farming system development in the tidal swamp lands is the soil and water management system correctly, including network conditions. Tidal farm development should begin with the construction of the macro water system. The goal is to increase the effectiveness of water management in order to
meet the water needs of plants, leaching toxic elements and helps to improve the quality of land. The concept of tidal water system that is only for the purpose of drainage should be reviewed and modified according to the needs of agriculture. Utilization of tidal swamp land is based on typology, flooding characteristics, and crop adaptation, considering their impacts on the environment (Table 3). Land with flooding type A is subjected for lowland paddy field. While land with flooding type B is transformed into either lowland rice field or surjan system (a combination of raised beds and sunken beds). Land with flooding type C is developed for rainfed lowland rice field, upland or surjan system with gradual construction of raised beds (guludan) and sunken beds (tabukan). Land with flooding type D is arranged entirely for upland farming system or planted to estate crops.

Table 3. Guideline for tidal swamps land utilization (Wijaya-Adhi et al., 1995)

<table>
<thead>
<tr>
<th>Code</th>
<th>Typology</th>
<th>Flooding characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type A</td>
<td>Type B</td>
</tr>
<tr>
<td>Pot-1</td>
<td>Lowland</td>
<td>Lowland/surjan</td>
</tr>
<tr>
<td>Pot-2</td>
<td>Lowland</td>
<td>Lowland/surjan</td>
</tr>
<tr>
<td>SMP</td>
<td>Lowland</td>
<td>Lowland</td>
</tr>
<tr>
<td>SMA</td>
<td>-</td>
<td>Lowland/surjan</td>
</tr>
<tr>
<td>SMP-G</td>
<td>Peaty</td>
<td>Lowland</td>
</tr>
<tr>
<td>G-0</td>
<td>Lowland</td>
<td>Lowland/surjan</td>
</tr>
<tr>
<td>GDK</td>
<td>Lowland</td>
<td>Lowland</td>
</tr>
<tr>
<td>GSD</td>
<td>-</td>
<td>Conservation</td>
</tr>
<tr>
<td>GDL</td>
<td>-</td>
<td>Conservation</td>
</tr>
<tr>
<td>GSDL</td>
<td>-</td>
<td>Conservation</td>
</tr>
</tbody>
</table>

Shallow peat soils and peaty soils are recommended for upland farming, with careful maintenance of soil moisture to avoid irreversible drying of peat materials. However, if the shallow peat and peaty soils have flooding type A, they can be used for lowland rice field. Medium deep peat is best suited for estate crops. The deep and very deep peats are not suited for agriculture, and must be left for conservation forest areas.
Water management is implemented based on flooding type, with the main objectives to provide sufficient water requirement, to avoid pyrite oxidation, facilitates leaching out of toxic elements, conserving peat soil moisture, and preventing salinity.

Water management in the land with flooding type A and B is managed by one-way flow system, with the purpose to leach out toxic products of past pyrite oxidation, such as Fe$^{2+}$, Al$^{3+}$, and SO$_{4}^{2+}$. In this system, the inlet canals are equipped with flap gates that open to inside direction, and the outlet canals with flap gates open to outside direction (Figure 1). On land with flooding type B, the one-way flow system during dry season is also equipped with stop log (*tabat*) to retain water in the canal.

In the land with flooding type C and D, a “*tabat system*” is practiced (Figure 2). In the “*tabat system*”, secondary canals are equipped with stop log to retain incoming water from rain and tides in both field and canal, in order to provide water for crops and avoiding pyrite oxidation by maintaining ground water table above the pyrite layer.

---

**Figure 1.** Schematic diagram of the one way flow system on land with the flooding type A and B (Subagyono et al., 1999)
Figure 2. Schematic diagram of the *tabat* system on land with the flooding type C dan D (Subagyono et al., 1999)

Several suggestions for enhancing development of micro level water management are as follows:

1. Prior to construction of micro level water management, drainage canals (primary, secondary, and tertiary canals) should be repaired in order to perform properly. By doing so water can move freely and smoothly into and outside the field.

2. Construction of micro level water networks, such as quartery and boundary ditches, including field drainage furrows, should be carried out during the dry season before operation of farm activities.

3. Under the condition of limited farm labor, due to farmer’s off-farm activity, it is encouraged that the government gave subsidy to facilitate construction of micro level water networks by the farmers themselves.

4. Farmer institution to manage water use, such as Water User Association (P3A), need to be actively functioned, to carry out a proper water management operation.

### 3.2 Crop Management

Initially the purpose of reclamation of tidal swamp lands directed to support the transmigration program with food crops based farming system. Farming systems have to be developed in tidal swamps lands based on biophysical and socio-

International Seminar on University-Based Research for Wetland Development
Joint Program Between Lambung Mangkurat University and Government of South Kalimantan Province
Banjarmasin, Indonesia, 26-27th November 2012
economic conditions. Crop planted in rice based farming involve food crops, horticultural and perennial crops.

The ability to manage the land is generally less than the allocated land per family, due to the limited labor and capital as well as land less productive. Generally farmers planting rice only once a year with the cropping pattern rice-fallow and coconut. The farming system performed with low input, known as terbas-planting-lift, and low productivity and quality of rice. However, the economic value of oil palm plantations are higher, the tidal swamp lands that have been opened have been converted to the expansion of oil palm estate.

Farm technologies was developed in tidal lands should be site-specific and tobe adapted to the biophysical and social institutions. Technology should be a combination of soil and water management, farming techniques, supported social and economic institutions. Base on the typology of land, the priority given to the development of a typology of potential land, followed by peatland and acid sulfate soil.

Various studies show that tidal swamp lands have the prospect to be developed into farmland in order to support increasing of food crop production (Ismail et al, 1993). But be aware that even though it has good prospects, development of wetlands also have a various constraints, both biophysical and socio-economic aspects and institutional.

Increased food production in tidal lands can be done through the intensification and extensification with the opening of new land and increasing cropping intensity in the areas that have been cultivated. It is quite possible, because acreage tidal potential for agriculture is estimated 9.53 million hectares. Moreover, the current cropping intensity on existing cultivated areas generally planted only once per year with crop productivity is also still low. Various studies show that based on the agronomic reasons, planting 2-3 times a year is possible and productivity can also be increased by using improved varieties and appropriate technologies (Ismail et al, 1993; Ananto et.al., 2000).

In the early stages, can develop food-based agricultural systems and horticulture, with the main commodities of rice, corn, soybeans and vegetables. By using appropriate varieties and location specific technologies can provide high yields. Rice crop should be prioritized on the typology of potential and flooding type A and B, because stable and have high productivity. In the perspective of agribusiness, some commodities can be integrated into farming systems, such as chili, vegetables, bananas, coconuts, coffee, chicken and fish. Exploitation means essential commodities to increase family income.

Cultivation techniques are applied in the development of food crop farming systems include (Suprihatno et al., 1999; Ananto et al., 2000):
1. The use of adapted, improved varieties, including superior local variety.  
2. Location specific fertilization.  
3. Soil amelioration employing ash or lime, to increase soil-pH, specifically for acid sulphate and peat soils.  
4. Proper control of pests and diseases of crops, including weeds.  
5. The use of agricultural machineries, in both pre and post harvest handling, to solve labor scarcity problem, yield losses, and improving product quality.

Various locations of research and development of rice farming in the tidal lands, shows rice productivity is higher than the surrounding areas (ISDP, 2000; Ananto et al., 1999). Experience developing rice based farming systems at eight tidal South Sumatra (Ananto et al., 1999; Djajusman et al., 2000); Isbandi et al., 2000; Nuryanto et al., 2000; Saputra et al., 2000; Sutriadi et al., 2000; Yudarfis et al., 2000), shows that although the technology has not been applied to the package as a whole, improved water management and micro rice cultivation techniques, including the use of phosphate as much as 200-300 kg / ha as a source of P, its has been able to increase rice yields between 0.78 to 1.14 t / ha (Table 4). Stability of crop land between typology and type overflow is still low. However, the potential land typology of type A and B flood water, the rice crop is quite stable. Therefore, tidal wetlands typology of potential overflow of type A and B should be maintained as a commercial development with high productivity of rice farming.

In testing VUB rice (Inpari 1 and 4 and Inpara 3) at three locations of tidal swamp areas in South Sumatra (Makarti Jaya, Banyuasin II and Air Saleh0, looks average productivity Inpari 1, Inpari 4, and Inpara 3 respectively are 4.93 GKP ton / ha, 4.77 tons GKP / ha and 8.3 ton GKP / ha. While the implementation evaluation of the SL-PTT in tidal Banyuasin district, site productivity SL-PTT, Field Laboratory (LL), and in non-SL-PTT is as follows: GKP 4.63 tons / ha, 5.38 tons GKP / ha, and 3.98 tons of GKP / ha (BPTP South Sumatra, 2011).

To support the development of rice farming, the used of farm machineries is needed to overcome the labor shortage, especially in the activities of tillage, planting, as well as harvest and post harvest activities. Land preparation using tractor is aimed to puddle the soil and suppress weed growth. The intensive land preparation is also aimed to facilitate leaching process of toxic elements and land leveling. On the land with flooding type of A and B, rice is planted as lowland paddy field. No-till system can be done periodically, by using selective herbicides. The fertilizer levels used for rice on potential soils were 150 kg Urea, and 100 kg KCl per hectare. Whilst for acid sulphate and peaty soils, the amount were 200 kg Urea and 150 kg KCl per hectare. Phosphate fertilizer was applied as rock phosphate, with a common levels of 250-350 kg per hectare.
Table 4. Average yield of rice in different tidal land typology, South Sumatera
(Ananto et al., 1999; Djajusman et al., 2000; Isbandi et al., 2000; Nuryanto et al., 2000; Saputra et al., 2000; Sutriadi et al., 2000; Yudarifis et al., 2000)

<table>
<thead>
<tr>
<th>Typology/Flooding type</th>
<th>WS 97/98 (t/ha)</th>
<th>DS 98/99 (t/ha)</th>
<th>WS 99/00 (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land typology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential soil</td>
<td>3.54</td>
<td>3.15</td>
<td>4.09</td>
</tr>
<tr>
<td>Acid sulphate soil</td>
<td>3.02</td>
<td>-</td>
<td>3.22</td>
</tr>
<tr>
<td>Peaty soil</td>
<td>2.92</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Flooding type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>4.99</td>
<td>-</td>
<td>2.86 1)</td>
</tr>
<tr>
<td>B</td>
<td>4.46</td>
<td>3.20</td>
<td>4.71</td>
</tr>
<tr>
<td>C</td>
<td>2.96</td>
<td>3.10</td>
<td>3.72</td>
</tr>
<tr>
<td>D</td>
<td>2.64</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Average of cooperator farmer</td>
<td>3.43</td>
<td>3.15</td>
<td>3.84</td>
</tr>
<tr>
<td>Average of non-cooperator farmer</td>
<td>2.65</td>
<td>2.40</td>
<td>2.66</td>
</tr>
</tbody>
</table>

1) Rat damage 50%  2) Rat damage 90%  WS = Wet season  DS = Dry season

Controls of pests and diseases were carried out following the concept of Integrated Pest Management, and was particularly directed for major pests, such as rats, “orong-orong” (soil borer), army worms, stem borers, and wild pigs. Control for rat was particularly done according to the growth stages of crops. Mass control and fumigation were carried out before planting time, while baiting and another fumigating were during the plant growing periods. The major disease of rice in particular was blast, commonly attacking rice plants grown on the upland farming, with flooding type C and D.

Improved harvest and post-harvest activities using power thresher and dryers have been able to improve the quality and yield of milled-milled as shown in Table 5.

Table 5. Comparison of rice quality under different drying system (Sutrisno et al., 1999)

<table>
<thead>
<tr>
<th>Quality criteria/ Rendement</th>
<th>Sun-drying 34,83</th>
<th>Dryer machine 64,75</th>
<th>BULOG standard Min. 35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole grain</td>
<td>34,83</td>
<td>64,75</td>
<td>Min. 35</td>
</tr>
<tr>
<td>Broken grain</td>
<td>43,58</td>
<td>24,65</td>
<td>Max. 25</td>
</tr>
<tr>
<td>Gritty grain</td>
<td>5,87</td>
<td>2,75</td>
<td>Max. 2</td>
</tr>
<tr>
<td>Greenish/Milky grain</td>
<td>8,29</td>
<td>5,01</td>
<td>Max. 3</td>
</tr>
<tr>
<td>Yellowish grain</td>
<td>7,20</td>
<td>0,29</td>
<td>Max. 3</td>
</tr>
<tr>
<td>Rubbish</td>
<td>0,19</td>
<td>0,00</td>
<td>Max. 0,05</td>
</tr>
<tr>
<td>Unmilled grain</td>
<td>0,12</td>
<td>0,04</td>
<td></td>
</tr>
<tr>
<td>Rendement</td>
<td>59,60</td>
<td>62,10</td>
<td></td>
</tr>
</tbody>
</table>
4. Development Constraints

Tidal land is fragile marginal lands, unstable, changing according to the environment. Improper management of land from the beginning will have a negative impact, and takes a long time to recovered it, or even can not be restored.

4.1 Biophysical Constraints

1. Acid and contain toxic elements harmful soil condition, as the product of pyritic soil material due to over drainage.
2. Some of the water management structures are improper and under function limiting the optimum use of agriculture technology.
3. Pests and diseases infestation, which hard/difficult to control, as the result of either poor or unfavorable circumstances, such as existence of many, scattered shrubs and bushes, and large area of idle land.

4.2 Constraints of Socio-Economic and Institutional

1. Limited or even lack of labor/power and capital for conducting farming system;
2. Lack of rural supporting institutions in term of inputs supply and capital/credit, marketing and social institution such as Farmers Group and Water User Association (P3A).
3. Low product quality, and ineffective local agribusiness institution have decisive influence to low prices of produce, especially during period of harvest.
4. Weak or even lack of coordination among related institutions, especially in providing inputs supply in proper kind, amount and time, and marketing of agricultural product.
5. Limited or even lack of accessibility, and high cost of transportation either within or outside the area, to the centers of economic activity.

5. Priorities And Development Stages

5.1 Development Priorities

Tidal lands were marginal and fragile, reclamation for agriculture on a large scale necessary prudence (Alihamsyah and Ananto, 1998). Improper reclamation and mistake in land management will cause the environmental damage that takes a long time and high cost to fix it. Based on the status / condition of the land needed priorities, as shown in Table 6 (Adimihardja and Ananto, 2000).

<table>
<thead>
<tr>
<th>Status/condition</th>
<th>Priorities/Intervention</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Productivity</td>
<td>- Technical aspect: extention, supervision</td>
<td>Stabilized productivity and high income, added value, sustainability and keeping environment</td>
</tr>
<tr>
<td></td>
<td>- Institution development (Social-economic)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Development of agribusiness/agroindustry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Participative approach and bottom up planing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Involving the private sector's role</td>
<td></td>
</tr>
<tr>
<td>Low Productivity</td>
<td>- Introduction technology (government intervention/program)</td>
<td>Increasing productivity and income, keeping environment</td>
</tr>
<tr>
<td></td>
<td>- Institution establishment (Social-economic)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Subsidies of input</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Seek suitable farming system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Top-down approach and planning</td>
<td></td>
</tr>
<tr>
<td>Not Productive</td>
<td>- Reforestation</td>
<td>Conservation areas/Forest</td>
</tr>
<tr>
<td>Forest</td>
<td>- fire protection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- improvement of environmental quality</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Conservation</td>
<td></td>
</tr>
</tbody>
</table>

5.2 Development Stages

Agriculture development in tidal swap areas should be implemented through agribusiness system approach. Besides the availability of appropriate location-specific technologies, their implementation should be carried out through the coordination and integration of harmony and synergy among stakeholders and relevant agencies, and to be based on the farmers needs and supporting rural institutional. Systematic stages of agricultural development in the tidal swap areas is as follows.

1. Identification and Characterization of the Region
   In the initial stage, the identification and characterization of the region carried out in detail to determine the status of the region and development targets to be achieved. Identification and characterization aimed to delineate potential areas for agricultural development, in order to direct and prioritize the development of, the following actions or intervention programs, including alternative technologies and the development model matching with the conditions of biophysical and socio-economic.

2. Improving Agricultural Infrastructure
   One key to the success of agricultural development in tidal wetlands is a land management and governance of water right, including the conditions of the network. Tidal farm development must begin with the construction of the water system macro. If the condition of the water network is inadequate or not functioning properly, needs to improve the water system network. One also needs periodic maintenance of the canal, the goal is to improve the effectiveness of
regulation / control of water to meet the water needs of plants, and helps wash toxins to improve the quality of land. Management of the water system is done by setting up a network of the water according to the typology of land and type of flood water and adjusted to the needs of the plant. Tata flood water on land type A and B be subjected to one-way flow (one way flow system) to wash the elements / compounds that are toxic to plants (such as Fe2+, Al3+, and SO4=). This system, equipped intake tract with the door hinge (flap gate) opens inward and sewer include door hinge that opens to the outside. Special to flood land type C and D set with dignity system / partition (overflow) at a certain height in order to maintain the ground water according to crop needs.

3. Farming System Development

Agricultural technologies to be developed must be location specific. The technologies are a combination of soil and water management technologies, cultivation technologies, supported by adequate social and economic institutions. Rice crop land should be prioritized on the typology of potential and flood type A and B, because stable and have high productivity.

4. Farmers Empowerment and Rural Institution Development

This activity is primarily related to the increased participation of farmers in the planning and management of the farming system development, and improve the ability of rural institutions, both social and economics/agribusiness institution in the rural areas, including extention institutions, employment services institutions, financial and credit, farmers’ cooperatives and farmers' institutions such as farmer groups and farmer water user association (P3A). Empowered activities depending on socio-economic conditions that exist, and are participatory/bottom up approach. This activity aims to increase the farmers’ participation and improve the functioning of social institutions and agribusiness in rural areas, to make it more dynamic and independent.

6. Conclusion

1. Agricultural development specially rice farming in tidal swamp lands are a strategic effort to find alternatives to securing food production and offset shrinking agricultural land in Java and equitable development between regions, by exploiting natural resources optimally. Tidal lands can play a very strategic role in supporting the achievement of rice production.

2. Agricultural development in tidal swamp lands starts from the realization that land is marginal, unstable, potentially acid sulfate soil and peat are very susceptible to environmental destruction, and vulnerable to the threat of pests/diseases, social aspect/institutional and environmental needs be taken seriously. Agricultural development in peat land also potentially lead to the destruction of the environment, especially CO2 emissions and biodiversity losses with a consequent losses of genetic resources.

3. Be aware that the technologies of rice production for tidal swamp lands have already available, but have not been fully adopted by farmers, especially farmers transmigrant. Priorities of rice based farming system development in tidal swamp lands should focus on lands that have been reclaimed and have a moderate level of productivity (between 1-3 tons of paddy / ha) and high (> 3 tonnes of paddy / ha). While the land is not productive or already damaged by low productivity (<1
tonne paddy/ha) should be reforested or planted perennials suitable land conditions such as gelam, sago and sengon. Tidal wetlands are still forested should not be opened, and the safety of the environment needs to be protected from both fire disturbance, or destruction by human activities.

4. The success and sustainability of agricultural development in swamp lands is not only determined by the availability of reliable technology, but also by the availability of facilities/infrastructures and institutional support adequate, public participation and government policy. Therefore, its need for coordination, synchronization and integration between stakeholder/related agencies, with focus and oriented towards the achievement of development goals.

5. Environmental aspects should be taken seriously. For peat lands, the excess drainage will cause drying/oxidation of peat or decomposition which produces CO2 emissions. The peatlands have been degraded/dried peat will not be able to hold water according to its function, and will easily burn, producing CO2 emissions.

References


Environmental Hot Issue on Wetland Development

Nyoman Suryadiputra
Wetlands International Indonesia Programme

Abstract

Indonesia’s wetlands, which cover about 55 million hectares, consist of various types (dominated by peatlands and mangroves) and have a range of values and benefits. Broadly speaking, these wetlands can be grouped into coastal wetlands, marshes (peat and mangrove), rivers, floodplains, estuaries / river estuaries, lakes and artificial wetlands. The values and benefits of the various types of wetlands include: flood & drought control, coastal belt (protecting against sea water intrusion, abrasion/erosion and storms), transportation, recreation, research and education, sediment traps and water purification, nutrient retention and provision, dilution of pollutants, stabilization of microclimate, global climate control (carbon storage and carbon sequestration), provision of water to the community, recharging of groundwater, water supply for other wetlands, provision of forest products, wildlife and other food resources, fisheries resources, support for agriculture, energy resources, habitat for biodiversity, unique traditional values /culture, habitat for part or the entire lifecycle of flora and fauna. Large areas of Indonesia’s wetlands are being lost (about 40 million ha remain) due to conversion for plantations, aquaculture, public infrastructure and housing, and due to over-exploitation, pollution, land and forest fires, etc. This condition is very worrying. The main issues currently faced by wetlands in Indonesia are the conversion of peatlands for palm oil and paper industries/HTI and the destruction of coastal ecosystems (mangroves) due to aquaculture. This conversion has adversely affected our landscape, wildlife habitat and biodiversity, and the socio-economic conditions of the communities, while also exacerbating the release of carbon as a greenhouse gas, and increasing the threats due to global warming.

1. Background

1.1 Definition of the term “wetland”

The term “wetland” (“Lahan Basah” in Indonesian) first became known in Indonesia in about the year 1990. Previously, Indonesians had referred to wetlands according to their specific physical type, such as: swamp (rawa), lake (danau), paddyfield (sawah), aquaculture pond (tambak), etc. In addition, various sectoral departments also defined wetlands according to their own area of work. The definition of physical wetlands which unified all parties’ different perceptions became standard after the ratification of the Ramsar Convention by the Indonesian Government in 1991, as follows:

Wetlands are “Areas of swamp, brackish water, peatland, and waters; permanent or temporary; with water that is standing or flowing; fresh, brackish, or salty; including parts of the sea that are no deeper than six metres at low tide.” (Ramsar Convention).
1.2 Types of wetlands in Indonesia

Indonesia possesses various types of wetlands, which can generally be classified as follows:

- **Coastal Wetlands**: Mud Flats and Sand Flats, Coral Reef, Sea grass Beds, Mangrove, Small Island Wetlands
- **Swamps**: Freshwater Swamp Forest, Peatland and Peat Swamp, Marshes / Grass Swamps
- **Flowing Waters**: Rivers, Flood Plains, River Estuaries
- **Lakes and Artificial Wetlands**: Natural and Artificial Lakes (including Reservoirs and “situ”), Paddy fields, Fresh and Brackish Water Fish Ponds, Lagoons, Salt Pans

1.3 Wetlands possess various values and functions, which can be classified as follows:

- **Function and Value (Direct Benefit) of Wetlands**: Flood and drought control, Coastal protection from sea water intrusion, Coast line protection (from abrasion/erosion) and storm, Transportation routes, Recreation, Research and Education
- **Ecological Function**: Sediment trap and water purification, Nutrient retention and provision, Retention and dilution of pollutants, Stabilization of microclimate, Global climate control
- **Products**: Water supply for the community, Recharging of groundwater, Water supply for other wetlands, Provision of forest products, Source of wildlife and food, Source of fisheries, Support for agriculture, Source of energy
- **Attributes**: Forms a habit for a wide range of biodiversity, Unique traditions, culture and heritage, Habitat for part or whole of the life-cycle of flora and fauna.

1.4 Issues faced by wetlands in Indonesia

The hottest issues currently being faced by wetlands in Indonesia are caused mainly by: (1) a lack of understanding of the values and benefits of wetlands as an intact ecosystem, (2) poorly controlled development and (3) insufficient consideration paid to sustainability. The following contribute to the problems of wetlands in Indonesia: Inadequate policy (overlapping and unsynchronized) together with weak law enforcement, large-scale conversion (into oil palm plantations, acacia/HTI plantations, for mining, public infrastructure and housing), over-exploitation (sand quarrying, logging and over-harvesting), pollution (by industry, households), land and forest fires (especially in peatlands, due to drainage and land clearing) etc.

1.5 Lack of understanding of the values and benefits of wetlands as an ecosystem

As stated above, wetlands possess a range of values and benefits, including direct and ecological benefits, commodities produced, and attributes. The following is a discussion of examples that illustrate the lack of understanding by policymakers and
development implementers regarding the values and benefits of one type of wetland, resulting in degradation and various economic and other losses.

2. Lake Ecosystems and the Development of Floating Net Cages

A lake is a freshwater wetland ecosystem that has a range of values and direct benefits (including as a water reservoir, flood suppressant, and recharger of groundwater), ecological functions (stabilisation of microclimate, support for aquatic life, etc.), production values (fish production, electricity generation, water supply for the community, source of water for irrigation, etc.) and certain attributes (e.g. as habitat for a wide range of biodiversity, unique traditions, culture, etc.). However, many lakes (also reservoirs and *situ*) in Indonesia are experiencing serious problems, which are shallowing/siltation and pollution. Such conditions are caused by (among other things) the ever-increasing growth of floating net cage fish farming in large numbers with the fish being fed pellets. Surplus pellets (uneaten by the fish) sink to the lake bottom thus polluting the bottom layer of water (*hypolimnion*), making it rich in organic materials and nutrients but poor in oxygen. When overturn occurs, this polluted, oxygen-poor water from the *hypolimnion* will rise to the surface and kill many of the caged fish. Moreover, the increasing amount of nutrients will encourage the growth of weeds (such as water hyacinth) and excessive accumulation of organic materials (including dead weeds) thus leading to shallowing of the lake. Such conditions, if allowed to continue, will have further impacts such as flooding of the lake buffer during rain, insufficient debit during the dry season thus impacting on irrigation and HEP generation. Complex issues of this sort have occurred in many lakes and reservoirs in Indonesia. Measures to address/prevent these conditions could in fact be taken if lake management was adequately regulated in various relevant policies. For example, Government Regulation (Peraturan Pemerintah) no. 26 / 2008 on National Spatial Planning (RTRWN = Rencana Tata Ruang Wilayah Nasional) does not specifically discuss policy concerning water catchment area, water body, or lake buffer. Environment Ministerial Regulation No. 28 of 2009 focuses more on Pollution Load Capacity of Lakes but does not specifically discuss lake buffers. Also, there is not as yet any policy that clearly and firmly regulates the presence of floating net cages in standing waters (including lakes, reservoirs, *situ*), etc.

3. Mangrove Ecosystems and Pond Aquaculture

Mangrove Data Base 1997 Wetlands International – Indonesia Programme, gives the area of mangroves in Indonesia as covering around 6,758,100 Ha, but now only 3,189,359 Ha (Spalding 2010) or 3,244,018 Ha (according to PPSDAL-Bakosurtanal 2009version) remain. Previously, many only considered mangroves important in terms of coastline protection (prevention of abrasion and erosion), support for life (aquatic biodiversity), and prevention of sea water intrusion. Recently, however, in response to the increasingly talked-about issue of blue carbon, researchers have been surprised by a study reporting that in fact the amount of carbon stored in intact mangrove forest is extremely large, about 1,023Mg (= 1023 ton ) carbon per hectare or equivalent to 3754 ton CO2/ha (Donato et al, 2011). Sadly, however, the amount of intact mangrove forest remaining in Indonesia is ever decreasing. Apart from the study above, another issue that has recently become prominent is that of global
climate change, where mangroves have a strategic position in reducing climate change in their capacity as a carbon sequester and in increasing the coastal communities’ capacity to adapt. Besides this, it is acknowledged that the presence of mangroves can reduce the impact of coastal disaster (DDR, Disaster Risk Reduction). In view of all this, it is now time that it became compulsory for the (remaining) mangrove forests in Indonesia to be preserved (felling/conversion prohibited) and for arid aquaculture pond farms to be reforested urgently with mangroves along the dykes and in the middle of the ponds (sylvo-fishery approach). This would not only support the Indonesian Government’s commitment to the program to reduce GHG by 26% (as mentioned in the National Action Plan (RAN) and Regional Action Plan (RAD) policy on GHG/GRK reduction), but would also help protect the livelihoods of coastal inhabitants, who are becoming increasingly worried about the effects of global climate change. (Note: RAN/RAd GRK = Rencana Aksi Nasional/Daerah dalam penurunan Gas Rumah Kaca).

4. Peatland Ecosystems and Oil Palm Development

Currently, Indonesia is competing with Malaysia to meet the world’s demand for palm oil. Palm oil is not only used for food, but has recently been used by developed countries more as a source of energy (bio-fuel) for their industry and transport. This has caused the global demand for palm oil to increase and for producers, both large scale and small scale (small holders) to respond by clearing vast areas of land (mostly peatland). Such conversion, from the environmental viewpoint, is extremely worrying because, in addition to having an adverse impact on the biodiversity and its habitat, it also results in the release of large amounts of GHG emissions (not only when clearing the land, which frequently entails the use of fire, but also because the drainage system intended to lower the level of peatland groundwater causes oxidization of the peat and continuing subsidence. How much GHG is emitted as a result of this drainage is the subject of fierce debate among peat researchers in Southeast Asia (especially Malaysia and Indonesia) and Europe. In the field, a more worrying fact is the peatland subsidence which causes large numbers of oil palm trees to lean over and become inundated during rain, as opposed to GHG emissions, which are not visible to the eye. With regard to this, Wetlands International Indonesia Program is currently assessing the condition of oil palm plantations in Sumatera and Central Kalimatan. So far, a range of data has been collected from small holders and large companies. Assessments include the trees’ degree of leaning, oil palm fruit productivity, the extent of oil palm plantation distribution on peatland in relation to the policy/regulations in force, and the potential for inundation as a result of subsidence. At the time of writing this paper, this information had not yet been finalised, although the following preliminary conclusion could be drawn:

The number of oil palm trees that were leaning (some had even fallen over completely and were lying on the floor of the plantation) in one stretch of plantation belonging to smallholders in Jambi Province ranged from 3 to 34% (at 34 sample plots@ 1 ha/plot with tree age ranging from 3 to 7 years). The greatest degree of leaning occurred among oil palms aged 5-7 years with a peat ground water depth of > 60 cm below the surface and peat depth of > 2 metres. The condition was worse in private company owned oil palm plantation in Riau Province, where in one
concession of 3,787 Ha (all peatland), with a total of 509,241 trees (aged 4 to 19 years), as many as 333,989 trees (66%) were found to be leaning. The highest percentage of leaning trees was found among oil palm trees aged 5 years and older (56 – 97%). Nevertheless these leaning trees (in Riau) were still productive (2.7 to 25 ton TBS/Ha-Year; the highest production was found in trees aged 12 – 13 years), but had not experienced rotation/rejuvenation, which is usually performed after trees reach 25-30 years. Related to this information, the writer has the following concerns:

Apart from the issues of GHG emission and government policy/laws that must be obeyed, subsidence in peatland can also cause the oil palm plantation to fail in the future.

In the Upang Delta of South Sumatra, the surface of shallow peatland has been subsided for 8 years at an average rate of 2.5 cm/year (Chambers 1979). In Barambai, South Kalimantan, shallow peat is recorded to have subsided by 1.6-5.5 cm/year and on deep peatland by 2.4-3.2 cm/year (Dradjat et al. 1989). The average speed at which the peat is subsided in Indonesia and Malaysia, based on the latest data, is 2-4 cm/year, after its initial subsidence in the first years which can sometimes be as much as 60 cm/year (Andriesse 1997). The result of such subsidence is inundation, trees easily collapse, and building constructions (bridges, roads, drainage channels) rapidly hang and collapse (Sri Nadiati et al, 2004).

From the above information, it is clear that if a stretch of peatland experiences subsidence of up to 1.2 metres during the first 2 years of being cleared, followed by subsequent subsidence at a rate of around 3 cm per year, then by the end of the first rotation period (assuming 1 oil palm rotation to be 30 years) the depth of the peat will have experienced subsidence of 2.1 metres. If as a result of subsidence the height of the peatland is then lower than the surface level of neighbouring rivers and gravitational drainage cannot occur, then the oil palm plantation will be flooded and this could impact on its sustainability. Such conditions will be worse in locations with a greater rate of subsidence, such as Central Kalimantan, where JICA reported an average subsidence rate of 6 cm/year.

Bibliography


Dradjat, M., Soeprapto S., M. Shodiq Hidayat, and Mulyono N. 1989. Subsidence of peat soils in the tidal swamplands of Barambai, South Kalimantan. p. 168-


SUPPORTING PAPERS
Vegetation Structure And Herbivory In *Rhizophora* sp. Mangrove Stands Of Varying Planting Ages

Anang Kadarsah\(^1\) and D.N. Choesin\(^2\)

\(^1\)Department of Biology, Faculty of Mathematics and Natural Sciences, University of Lambung Mangkurat, Banjarbaru, 70714, Indonesia.

Email : anangunlam@gmail.com

\(^2\)Department of Ecology, School of Life Sciences and Technology, Bandung Institute of Technology, Bandung, 40132, Indonesia.

Abstract

The dynamics of the ecosystem structure over time will be used to determine the character and importance the ecosystem functions such as herbivory. Structural development of the vegetation and herbivory are an easy tools for evaluation the maturity of the ecosystem. The objective of this study was to determine how vegetation structure and herbivory as regulatory function change as ecosystems develop with age. The study was conducted in a restricted silvo fishery zone managed by resort forest stakeholder (RPH) Poponcol, Perhutani Unit III West Java in Subang, from January to December 2011. Within this area can be found *Rhizophora* sp. mangrove stands which have been purposely planted so that their ages are known with certainty. Comparisons were made among five stands of different ages, stands planted in 2007 (4 years), 1999 (12 years), 1990 (21 years), 1982 (29 years), and 1973 (38 years). Structural parameters (tree density, height, DBH (diameter at breast height) and biomass) were observed in three plots measuring 10 mx 10 m in each age stand. While herbivory were recorded through direct observation. We found that vegetation structure differed among stand ages (P <0.05). At the youngest stand (4 years), average tree height measured 1.56±0.33 meters, DBH 2.92±0.23 cm, and biomass 1.45 kg m\(^{-2}\); whereas at the oldest stand (38 years), average height measured 8.13±5.65 meters, DBH 16.29±7.23 cm, and biomass 108.62 kg m\(^{-2}\). The highest tree density was found at age 4 years (800 trees ha\(^{-1}\)) and the lowest at age 29 years (333 trees ha\(^{-1}\)). On the other hand, stand age had no effect on the level of insect herbivory (P> 0.05). Lowest herbivory levels were observed in age 4 years (7.4%) and highest in 12 years (11.3%). The general conclusion of this study is that planting age (as substitute for time) affected the complexity of certain parameters of ecosystem structure and ecosystem function. Vegetation structure varied among stands with indication of increasing complexity with age, whereas herbivory did not show a clear trend or pattern among stands. Results indicate complex relationship patterns which are not always obvious, or proportional, especially for herbivory as a regulatory functional parameters.

Keywords: structure, vegetation, herbivory, mangrove, Rhizophora

1. Introduction
In general, persistence an ecosystem will vary depending on the structure and composition of vegetation growing in it. Nevertheless vegetation structure have a positive impact on all components of the ecosystems (Barbour et al., 1999). Thus, this information becomes an important tool to recognize the various ecological processes such as zoning, succession, the presence of types, growth, primary productivity, mortality, survival, and distribution of propagules (McGowan, 2006), and it is also useful for evaluating the maturity to the ecosystem (Rinker & Lowman, 2004).

Herbivory is an important regulatory function primarily to set the rate of nutrient system and widely accepted playing a significant role of forest ecosystems. For most species, it is ranging from 3 –10 % of leaf area missing (Burrows, 2003). Insects and other herbivores feeding in the crowns of trees contribute to nutrient input from the canopy and probably increase the rate of nutrient cycling in many forest systems. Rainfall carries some products of herbivory as throughfall, combining the effects of dissolved insect frass and modified leachates from damaged foliage (Reynolds & Hunter, 2004). In addition herbivory will affect the vegetation appearance because damage leaves and apical buds. Herbivory also affected leaf longevity and leaf litter quality, particularly the young seedling plants (Schulze et al., 2002).

Mangroves are an assortment of tropical and subtropical trees and shrubs which have adapted to the inhospitable zone between sea and land. Mangroves are among the most productive and biologically diverse ecosystems in the world (Hogart, 2007). Based on the latest condition of the mangrove ecosystem today, there are a lot of attention paid by the scientists to increase appreciation about the importance of mangrove ecosystems. It’s still found a lack of data and knowledge, particularly related to aspects of vegetation structure and function (herbivory) with age resulting by ecosystem. The prevailing assumption is that vegetation structure and herbivory will change within creasing age or maturity; However, the mechanisms and patterns of relationships between structural development and herbivory with age (time) is not fully understood.

2. Methods

Study Site and Field Survey

The study was conducted in a restricted silvo fishery zone managed by RPH Poponcol, Perhutani Unit III West Java in Subang (Figure 1). Field survey and biological measurements were made in December 2011. This location was chosen because in one area can be found Rhizophora sp. mangrove stands which have been purposely planted so that their ages are known with certainty. Stands with different age is formed a chrono sequence which can be analogous to the difference in development time. Comparisons were made among five stands of different ages, stands planted in 2007 (4 years), 1999 (12 years), 1990 (21 years), 1982 (29 years), and 1973 (38 years). Availability of such information would be useful in improving the success of mangrove management (Ashton et al., 2003). Positively reciprocal mangrove service will result in a more productive, stable and sustainable (Begon et al., 2006).
Topography is generally sloping with a height between 0 - 4 m above sea level. Study site is located at 06° 13' 56.7" N - 06° 14' 16.4" N and 107° 45' 24.2" E - 107° 45' 52.2" E (See Figure 1). The wind generally comes from the northwest (29.35 %), northeast (22.01 %) and north (18.32 %). Wind speeds generally (41.35%) blowing in the range of 3 - 5 m s⁻¹ (Bappeda, 2007). The average temperature (27 °C at the night) and (33 °C during the day), while humidity ranged between 72% and 91%.

**Calculation of Mangrove Stand Structure**

Determination of mangrove species *Rhizophora* sp. done through by observation of roots, stems, leaves, flowers and fruit (Kitamura et al., 1997; Onrizal et al., 2005). Randomly assigned three plots measuring 10 m x 10 m. Parameters measured were the number of individuals, total height, diameter at breast height (DBH = diameter at breast height) based on the circumference of the stem as high as 1.3 m (meters) for all age groups of planting, and plant biomass. The equation of the density (individuals ha⁻¹) is divided by the number of individuals of a species widespread throughout the observation plot. Density value is further used to determine the significance of vegetation. The value represents a fundamentally important in the relative contribution of plant species in an overall site (Barbour et al., 1999).

Survival rate of mangrove vegetation is divided into three levels, namely seedlings, saplings, and trees. Seedlings have a requirement that is calculated from the germination of up to 1 m high, the saplings growth with height > 1 m and diameter at breast height < 2.5 cm (centimetres), and the trees have a high criterion > 1 m and DBH > 2.5 cm (CARICOMP, 2001). DBH is the diameter of the outer skin of a tree trunk measured at a height of 4.5 feet (1.3 m or use the metric system), on the surface of the tree (Ek et al. 2003). DBH usually calculated using the formula tree circumference divided by \( \pi = 3.14 \) (McGowan, 2006). Value is determined based on plant biomass via the formula equation Cintron Novelli:
Biomass = \( b((DBH^2)h)^m \) atau \( b((D_{30}^2)h) \) ........................ (1)

where \( b = 125.9576 \) and \( h = \) height (cm) and \( m = 0.8557 \) (CARICOMP, 2001).

**Calculation of Herbivory in Mangrove Rhizophora sp.**

Herbivory measurements made directly by a discrete sampling at low tide (Burrows, 2003). Parameters observed were herbivory attack patterns, as well as the extent of damage to the leaves or the leaves are consumed by herbivores. From every age stands planted *Rhizophora* sp. we are selected three plots randomly. From each plot is determined 3 trees as replicates, where in each of the selected tree of three branches of trees that form a canopy (shade). Then in every branch of the tree leaf samples were taken as many as 10 sheets, the sheets at the end of 5 and 5 pieces of the base. The leaves were harvested inserted into a plastic bag and labeled markers (Lowman, 1983).

The area of leaf that consumed by the insects was measured by placing marks and leaves a hole in a piece of paper. When it was discovered that the leaves are gone, then made approximate picture of the actual leaf. broad leaf area missing calculated based on the weight conversion chart paper with the weight of the leaves. The paper charts were weighed to obtain the weight (grams) in each unit area of 1 mm². All leaf samples from each site were weighed for the measurement of unknown weighed, and then converted to the weight of the graph paper as a benchmark. Percentage of leaf damage caused by herbivory known through a formula that affected leaf area divided by the total leaf area actually, and then multiplied by 10 (Burrows, 2003). While he total percentage of leaf damage (% herbivory) was calculated by the formula:

\[
\text{Percentage of Herbivory} = \frac{\sum fx}{ef} \quad \text{................................................................. (2)}
\]

\( f = \) frequency of the affected leaves and non-exposed herbivory, and \( x = \) percentage of leaf area consumed (Saifullah & Ali, 2004).

**3. Results and Discussion**

**Vegetation Structure of Mangrove Rhizophora sp.**

The main types are grown on the location of the observation is *Rhizophora mucronata*. This plant has the stilt roots; rough bark and rectangular cracks with raised edges; inflorescence like a fork with \( 2 \)-\( 3 \)-\( 5 \) flowers and green and yellow until browned (Kitamura et al., 1997) and (Onrizal et al., 2005). On stands 29 and 38 year-old began an association that is found plant *Acanthus* sp. Level of saplings was not found at all age of five were observed planting. There are only found two levels of living (trees and seedlings). Level of tree planting is found at all ages, while the seedlings are only found at the age of 21 to 38 years.

Density of mangrove tree *Rhizophora* sp. showed a tendency to decrease with increasing age of the plant. The highest density of trees found in the age of 4 years (800 trees ha\(^{-1}\)) and lowest in the age of 21 years (333 trees ha\(^{-1}\)). High density of trees at the age of 29 years (633 trees ha\(^{-1}\)), and lower at the age of 38 years (567 trees ha\(^{-1}\)). In contrast, seedling density did not show a specific pattern when associated with plant age. Seedling density of 21 years is 2267 individuals ha\(^{-1}\), was lower in the age of 29 years (1600 individuals ha\(^{-1}\)), and highest at the age of 38 years at 3767 individuals ha\(^{-1}\) (Table 1). IVI (Importance Value Index) *Rhizophora* sp. the highest (300) in age 4, 12, 47
and 21 years. Furthermore IVI this plant was found decline along with attendance plant association at the age of 29 years (Rhizophora sp. = 241.95 and Acanthus sp. = 58.05) and 38 years (Rhizophora sp. = 270.52 and Acanthus sp. = 29.48).

Table 1. The value of vegetation structure parameters in mangrove Rhizophora sp.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Kind of tree</th>
<th>Height (m)</th>
<th>DBH (cm)</th>
<th>Total of biomass (kg m⁻²)</th>
<th>Density (individuals ha⁻¹)</th>
<th>Index Value of Importance (IVI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Rhizophora sp.</td>
<td>1.56±0.3</td>
<td>2.92±0.2</td>
<td>1.45</td>
<td>800</td>
<td>300</td>
</tr>
<tr>
<td>12</td>
<td>Rhizophora sp.</td>
<td>5.17±1.2</td>
<td>5.15±0.9</td>
<td>7.96</td>
<td>600</td>
<td>300</td>
</tr>
<tr>
<td>21</td>
<td>Rhizophora sp.</td>
<td>5.32±1.5</td>
<td>10.14±2</td>
<td>11.03</td>
<td>333</td>
<td>300</td>
</tr>
<tr>
<td>29</td>
<td>Rhizophora sp.</td>
<td>5.23±2.5</td>
<td>12.39±5.44</td>
<td>49.14</td>
<td>633</td>
<td>241.9</td>
</tr>
<tr>
<td>38</td>
<td>Acanthus sp.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>58.1</td>
</tr>
<tr>
<td>4</td>
<td>Rhizophora sp.</td>
<td>8.13±5.6</td>
<td>16.29±7.23</td>
<td>108.62</td>
<td>567</td>
<td>270.5</td>
</tr>
<tr>
<td>38</td>
<td>Acanthus sp.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>29.5</td>
</tr>
</tbody>
</table>

Value of vegetation structure (height, DBH, and biomass) in the mangrove tree Rhizophora sp. showed an increase in line with the addition of plant life. High average age of the youngest trees (4 years) 1.56 ± 0.33 m; DBH 2.92 ± 0.23 cm and biomass 1.45 kg m⁻². This value increases at the age of 12 years of planting with an average height 5.17 ± 1.25 meter tree; DBH 5.15 ± 0.93 cm and biomass 7.96 kg m⁻². For the age of 21 years, the average height of 5.32 ± 1.59 m; DBH 10.14 ± 2.83 cm and biomass 11.03 kg m⁻². These values increased at the age of 29 years so that the average height 5.23 ± 2.51 m; DBH 12.39 ± 5.44 cm and biomass 49.14 kg m⁻². The increase continues until the plant reaches the age of 38 years with an average of 8.13 ± 5.63 meters high; DBH 16.29 ± 7.23 cm, and biomass 108.62 kg m⁻² (Table 1).

We use hypothesis testing to determine whether there is a difference vegetation structure of mangrove Rhizophora sp. between the ages of 4, 12, 21, 29, and 38 years.
Through Tests of Between-Subjects Effects obtained significant value of 0.015 (P <0.05) for the structure of the vegetation *Rhizophora* sp. The conclusion that the age structure affects vegetation planting mangrove *Rhizophora* sp. particularly height of plant, DBH and biomass.

**Abiotic Environmental Conditions in Mangrove *Rhizophora* sp.**

Abiotic environmental components measured in this study are the parameters air conditions (light intensity, temperature, and humidity) and the parameters of the water (pH of water, water temperature, salinity, and electrical conductivity) (See Table 2). In general, abiotic environmental conditions in mangrove *Rhizophora* sp. varying planting ages have the same relative range of values on a certain day of observation.

**Table 2 Summary of the results of measurements of the mean abiotic environmental conditions on the mangrove *Rhizophora* sp stands. different ages of planting**

<table>
<thead>
<tr>
<th>Num.</th>
<th>Parameters</th>
<th>The age of <em>Rhizophora</em> sp. mangrove stands (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>1.</td>
<td>Light intensity (Lux)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5840(5230-7150)</td>
</tr>
<tr>
<td>2.</td>
<td>Air temperature (°C)</td>
<td>28.9(27-30)</td>
</tr>
<tr>
<td>3.</td>
<td>Air humidity (%)</td>
<td>87.5(81-90)</td>
</tr>
<tr>
<td>4.</td>
<td>pH of water</td>
<td>5.7(5.5-5.8)</td>
</tr>
<tr>
<td>5.</td>
<td>Water temperature (°C)</td>
<td>28.5(28-29)</td>
</tr>
<tr>
<td>6.</td>
<td>Salinity (°/00)</td>
<td>19(18-20)</td>
</tr>
<tr>
<td>7.</td>
<td>Electrical Conductivity (dS/m)</td>
<td>32.3</td>
</tr>
</tbody>
</table>

Through the analysis of one-way ANOVA is known that the parameters of air conditions (air temperature, air humidity), did not differ between age planting (P> 0.05); Meanwhile, light intensity, salinity, pH, water temperature and conductivity it shows the difference between plant age (P <0.05).
Herbivory at Mangrove *Rhizophora* sp.

There are three patterns of herbivory or leaf consumption by insects i.e., marginal (attacks starting from the edge of the leaf toward the centre), internal (starts from the centre toward the edge) or a combination of both types (Johnstone, 1981 in Saifullah and Ali, 2004). Figure 2 shows about the examples patterns attack by herbivory are found in the mangrove *Rhizophora* sp. varying planting ages at RPH Poponcol, Subang, West Java.

![Herbivory Examples](image)

Figure 2. The examples three attack patterns of herbivory found in mangrove leaves *Rhizophora* sp.

Marginal is the pattern attacks of herbivory by insects that more common found in mangrove ecosystem than the other two patterns (Figure 3). In this case, the insects start eating from margin towards the mid rib (Saifullah & Ali, 2004). The highest marginal attack patterns found in stands of 12 years (66.7%) and the lowest at the age of 38 years (50%). Insect herbivory more use these patterns as part of the software will be chewed leaves first, and without destroying the framework (skeletonizing). The mode of eating was chewing and not skeletonizing or mining, which is the most common method in mangroves. So, it’s more advantageous in terms of foraging optimization (Johnstone, 1981 in Saifullah and Ali, 2004).

![Herbivory Patterns](image)

Figure 3. The attack pattern of herbivory on the leaves mangrove *Rhizophora* sp.
On the other hand, the extent of herbivory therefore depends on a host of factors affecting the palatability and value of leaves, and these vary with the age of the leaf, probably seasonally, and between species (Hogart, 2007). In this observation (Figure 4), herbivory in young leaves from all stages (ages) of mangrove Rhizophora sp more susceptible to herbivory, vary between 10.2% until 17.07%. According to Lowman (1983) the age of leaves related with nutrient content in the leaves, leaf thickness, predation and microclimate conditions.

Figure 4. Comparison percentage of herbivory between young and old leaves in mangrove Rhizophora sp.

The total rate of herbivory in total did not show any particular trend patterns across age in stands of mangrove Rhizophora sp. Figure 5 shows that the total herbivory varied between 7.45 and 11.32% with an average value of 9.385% of the total leaf matter. The lowest age in 29 years (7.51 ± 5.16%) and the highest in 12 years (11.32 ± 4.16%). However, the value of these observations have not been able to estimate the rate of leaf damage overall, because data collection was conducted during the time of observation. According to Burrows (2003) long-term observations (repetitions) in Avicennia marina and Rhizophora stylosa, managed to find the value of herbivory 3-6 times higher than short-term measurements.

<table>
<thead>
<tr>
<th>Ages of mangrove (years)</th>
<th>Total rate of herbivory (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>7.45±5.45</td>
</tr>
<tr>
<td>12</td>
<td>11.32±4.16</td>
</tr>
<tr>
<td>21</td>
<td>10.55±4.53</td>
</tr>
<tr>
<td>29</td>
<td>7.51±5.16</td>
</tr>
</tbody>
</table>

Figure 5. The total rate of herbivory varied between 7.45 and 11.32% with an average value of 9.385% of the total leaf matter.
Figure 5. Comparison of percentage of total herbivory levels between ages planted stands of mangrove *Rhizophora* sp.

We use hypothesis testing to determine whether there is a difference in insect herbivory in mangrove *Rhizophora* sp. varying planting ages. Through Tests of Between-Subjects Effects obtained significant value of 0.445 ($P>0.05$). The conclusion is there is no influence between the ages of planting mangrove *Rhizophora* sp. against insect herbivory. Herbivory levels showed no clear trend patterns among plant life.

4. Conclusion

The results showed that the age (time) planting of mangrove *Rhizophora* sp. influence vegetation structure (height, density, DBH, and biomass). All components of vegetation structure show a pattern of change in line with the increase age of plants. However, herbivory as the regulation function varies with the age of the leaf, but does not seem to be affected by plant ages, and the levels showed no clear trend patterns among plant life. The extent of herbivory therefore depends on a host of factors affecting the palatability and value of leaves.

5. Acknowledgements

We thanks to Mr. Asep Supriatna, Mr. Sudana, Mr. Nono, Dimas Panjaitan, Udin, Gathot and all friends for field assistance and resort forest stakeholders (RPH) Poponcol, Perhutani Unit III West Java in Subang for site access permission and technical support. Conflict of interest statement. None declared.

References


Sustainable Tilapia (*Oreochromis niloticus*) Culture on Swamp Waters

Fatmawati, Noor Arida Fauzana, Pahmi Ansyari *)

*)Aquaculture Department, Faculty of Fisheries, Lambung Mangkurat University

Abstract

This study was conducted to determine the growth of tilapia fish that was cultured by feeding with probiotics supplement and to investigate the impact of feeding on the water quality of swamp waters. The study was carried out from September to November 2012 on swamp of Sungai Sipai Village, Banjar Regency, South Kalimantan Province. The experiment that consisted of 4 treatments was designed by completely randomization. The treatments comprised of feeding with pellet containing four level concentration of probiotics i.e 0% (treatment A), 3% (treatment B), 5% (treatment C), and 7% (treatment D). Every treatment was replicated three times.

The results showed that the culture of tilapia using diets of probiotics containing commercial pellets resulted in better growth of tilapia fish than that of probiotics less commercial pellets. Pellet feeding that contained 3% probiotics was the most efficient treatment in increasing the growth rates of relative weight (4.341%), survival rate (97.7%), and feed conversion ratio (2.40). Water quality of the fish culture was very supportive to the growth of tilapia. The quality value of water, which was released to environment, of pellets with probiotics treatments, was better than that of pellets without probiotics treatment. The culture of tilapia using pellets with probiotics was the most effective to reduce the rate of water quality deterioration.

*Keywords*: feed, probiotics, tilapia, feed conversion ratio, Swamp waters

1. Introduction

Tilapia is very popular as farmed fish because the fish is very easy to look after, respond to artificial feed, and has relatively fast growth. According to Effendie (1978), feeding in the intensive cultivation is one of the success factors in the cultivation, because it is the main factor affecting the fish growth.

The successful of tilapia farming development is also determined by the feasibility and accuracy of natural resource management and application of aquaculture technology. The limitations of natural resources in tilapia farming make technological improvements to select the more intensive pattern in order to stimulate the increase of tilapia production. On the other hand, the consequences of application of these technologies are the accumulation of residual feed and fish excretion, as well as other compounds in the bottom of the pond that may responsible for the main cause of the failure of intensive cultivation pattern.

Increase feeding in line with the growth of tilapia, further adds to the remaining feed and feces were discharged into the aquatic environment, as a result the consumption of dissolved oxygen to do decomposition increase. If this continues, there will be...
anaerobic and reductive conditions, especially in the bottom waters. These conditions could accelerate the anaerobic decomposition of organic material, subsequently produce toxic materials that may endanger the lives of cultured fish. The consequences of intensive farming is the additional feed from the outside of pond as result in feeding of the pond environment is insufficient. If the feeding technique is not well controlled, it may cause impaired water quality and eventually disturbs the production, and finally resulting in the decrease of fish culture in the swamp waters.

To prevent the negative effects of the use of artificial feed in an intensive fish farming system that meet nutritional requirements by solely on artificial feed, is only through the development of eco-friendly artificial feed. The artificial feed is prepared with the addition of probiotics or through a process that offer emanation of feed ingredients. The feed can produce a low feed conversion ratio, i.e high efficient feed utilization, improve and repair of power excitatory and the digestibility of fish feed. The use of probiotics in fish and shrimp farming now becomes common, for example the use of *Bacillus spp* as prebion. The application can improve water quality by maintain the microbial population balance, reduce the number of pathogens simultaneously, decrease the use of chemical compounds and increase the growth of fish (Wang *et al.*, 1999 in Irianto, 2003).

Based on the above background, it is required red to investigate the important of environmental friendly probiotic feed on a tilapia fish farming of the swamp waters. In addition, the ability of the environment to support long period farming is also need to be assesed.

2. Research Methods

2.1. Time and Location of Research

The study was conducted in September-November 2012. Research location is on the swamp waters Sungai Sipai village, Banjar regency, South Kalimantan.

2.2. Materials and Methods

2.1 Nets were 12 pieces in total and each of it is 0.75x1x1m³ in size.

2.2 Fish was used in this study are tilapia (*Oreochromis niloticus*) 4-6 cm in length and stocking density was 30/m².

2.3 Feed test that used in this study was a commercial pelleted feed that supplemented with probiotic RG, dominantly containing *Lactobacillus* sp. (ITB production).

2.4 The intruments used in sampling: such as digital scales, length gauges, scoop and washbasin.

2.5 The intruments used to measure water quality consist of DO meter, pH meter, and ammonia meter.

This study used a completely randomized design (CRD) with 4 treatments and 3 replications. The four treatments were as follows: Treatment A: pellets without probiotics, Treatment B: pellet with 3% probiotics, Treatment C: pellets with 5% probiotics and Treatment D: pellets with 7% probiotics.
3. Variables were observed in this study were:

3.1. Growth Rate of Relative Weight (%)

According to Effendie (2002), the growth rate of relative weight is defined as the percentage of weight change in a specified period of time, and stated as following equation:

\[ H = \frac{W_t - W_0}{W_0} \times 100\% \]

Description:
- \( H \) = weight relative growth rate (%)
- \( W_t \) = average final weight individual (g)
- \( W_0 \) = average initial weight individual (g)

3.2 Survival rate (%)

Survival is expressed as a percentage of number of fish that lived during the culture of a specified period. According to Effendie (2002), survival can be calculated using the following formula:

\[ S = \frac{N_t}{N_0} \times 100\% \]

Description:
- \( S \) = survival rate
- \( N_0 \) = number of live fish at the early culture
- \( N_t \) = number of live fish at the end of culture

3.3 Feed conversion ratio

According to Parker (2006), feed conversion ratio can be calculated using the following formula:

\[ FCR = \frac{F}{(W_t + D) - W_0} \]

Description:
- \( FCR \) = feed conversion ratio
- \( F \) = Number of total feed given (g)
- \( D \) = Total weight of fish that died during culture (g)
- \( W_0 \) = initial weight of fish population (g)
- \( W_t \) = final weight of fish population (g)

3. Results and Discussion

The rate of growth of the relative weight, survival rate and feed conversion ratio of the treated tilapia fish were observed, every two week, and the results were presented as follows:
3.1. Growth Rate of Relative Weight (%)

The growth rates of tilapia relative weight in each treatment during the culture are shown in Table 1 and Figure 1. Variance analysis of the data suggested that there was a significant difference in treatment response at 95% confidence level.

Table 1. Growth rates relative weight (%) of Tilapia

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Pellets without probiotic)</td>
<td>3,733a</td>
</tr>
<tr>
<td>B (Pellets with 3% probiotics)</td>
<td>4,341b</td>
</tr>
<tr>
<td>C (Pellets with 5% probiotics)</td>
<td>4,398b</td>
</tr>
<tr>
<td>D (Pellets with 7% probiotics)</td>
<td>4,367b</td>
</tr>
</tbody>
</table>

Description: The average values followed by the same letter do not differ demonstrated by Duncan multiple range test on the significant level of 5%.

Figure 1. Growth Rate Relative Weight of Tilapia (%) during the culture period

Figure 1 showed that an increase in growth due to the addition of probiotics in feed. The growth rate relative weight of tilapia fed commercial diets containing no probiotics (A) was lower than that of fish fed with the addition of a commercial probiotic (B, C and D). Based on the analysis and Duncan test range of variations in the type of feed used, the rate of growth of the relative weight of tilapia, it was known that there were differences among the treatments, where treatment B was commercial diets with the addition of probiotics as much as 3% by weight relative growth rate is 4.341% treatment which was more efficient than the other treatments.

The result also showed that tilapia maintained by feeding with probiotics, used better in energy sources feed. Commercial feed had been given was already met the minimal needs of tilapia, i.e the protein between 31.97 to 34.19%, fat 3.53 to 3.91% and crude fiber between 5.04 to 7.61%.

3.2. Survival Rate

Tilapia survival rate at the end of the study in all treatments and replicates were in between of 97.78% to 98.89% (Table 2).
Table 2. Tilapia survival rate

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Pellets without probiotic)</td>
<td>97.78a</td>
</tr>
<tr>
<td>B (Pellets with 3% probiotics)</td>
<td>97.78a</td>
</tr>
<tr>
<td>C (Pellets with 5% probiotics)</td>
<td>97.78a</td>
</tr>
<tr>
<td>D (Pellets with 7% probiotics)</td>
<td>98.89a</td>
</tr>
</tbody>
</table>

Description: The average value followed by the same letter do not differ demonstrated by Duncan multiple range test on the significant level of 5%.

Survival rate is the number of fish that lived during the culture period and the number of stock fish. The value could be inversely related to mortality. Survival rate is influenced by several factors, including age, quality of water, food and disease pests. It is also supported by water quality conditions well within the normal range for fish growth. Tilapia fish is known as well adapted fish either to a new environment or to the water temperature or other water qualities.

3.3. Feed Conversion Ratio

The value of feed conversion ratio is an overview of the level of efficiency of feed given. The smaller the feed conversion ratio, the more efficient of the feed was given in supporting the growth of fish (Mudjiman, 2000). Feed conversion ratio used to determine the poor quality of feed given to fish growth. The low feed conversion ratio means higher feed efficiency, and conversely higher feed conversion ratio, the lower the efficiency.

Tilapia fed with commercial pellet without probiotics (A) shows the highest feed conversion ratio compare to the feed conversion ratio of fish fed with probiotics supplement (B, C and D) Table 3).

Table 3. Feed Conversion Ratio (FCR)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (Pellets without probiotic)</td>
<td>2.57a</td>
</tr>
<tr>
<td>B (Pellets with 3% probiotics)</td>
<td>2.40b</td>
</tr>
<tr>
<td>C (Pellets with 5% probiotics)</td>
<td>2.42b</td>
</tr>
<tr>
<td>D (Pellets with 7% probiotics)</td>
<td>2.39b</td>
</tr>
</tbody>
</table>

Description: The average values followed by the same letter do not differ demonstrated by Duncan multiple range test on the significant level of 5%.

Analysis and Duncan test range of variations to the fish feed conversion ratio on feed type used exhibited that there were significant differences between treatment A (feed without probiotic) with other feeds fed probiotics, feed B(with the addition of probiotic feed3%), C(5%), D(7%). Feed conversion ratio varied in a range of 2.39 to 2.42 which gave a mean that in order to raise 1 kg weight of fish required 2.39 to 2.42 kg of feed.

General, the highest fish feed conversion ratio is up to grade 4 (Bardach et al., 1972). The addition of probiotics to the fish feed conversion ratio has a value lower than that
without probiotics. This suggested that the feed used was preferred to stimulate the appetite of fish; as a result fish eats more food. Feed with probiotics had a distinctive aroma that was different from that of without probiotics. The aroma of feed containing probiotics stimulates the appetite. Probiotics are living microorganisms that can suppress populations of pathogenic microorganisms in the host animal. Probiotics can alter the balance of microflora in the digestive tract, so that feed becomes easier digested by the fish.

3.4. Water Quality

Water quality affects fish culture growth directly or indirectly. Measurement of water quality parameters was carried out to determine the state of the waters of captivity. Several water quality parameters were measured including temperature, dissolved oxygen (DO), the degree of acidity (pH), ammonia (NH3). The results of water quality measurements during the culture period were shown on Table 4. Treatments of probiotic pellets caused the value of the quality of water entering to environment were better than that of pellets without probiotics treatment. The culture of tilapia using pellets with probiotics was more effective in reducing the rate of deterioration of water quality.

<table>
<thead>
<tr>
<th>Water Quality</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>1. Initial</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>27,1</td>
</tr>
<tr>
<td>DO (ppm)</td>
<td>4,5</td>
</tr>
<tr>
<td>Ammonia (ppm)</td>
<td>0,25</td>
</tr>
<tr>
<td>2. Final</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>27,1</td>
</tr>
<tr>
<td>DO (ppm)</td>
<td>5</td>
</tr>
<tr>
<td>Ammonia (ppm)</td>
<td>0,25</td>
</tr>
</tbody>
</table>

Description:  
A = feed without probiotic (0%),  
B = feed with the addition of 3% probiotics,  
C = feed with the addition of 5% probiotics,  
D = feed with the addition of 7% probiotics.

The degree of acidity (pH) is often used to indicate the quality of environment, as it may greatly affects the live of organisms. The results of pH measurement obtained during the study period were in the range of 6.05 to 7.74. Susanto (1999) stated that the optimum range of water pH that gives good results for tilapia breeding is 6.8 to 8.5. According to Kordi & Tancung (2007), the ideal pH for fish cultivation is 6.5 to 9.0, with an optimal range of 7.5 to 8.7. In general, freshwater fish can still live on water which has pH value as low as 4 and as high as 11. Water that has acidity below than 4 and above 11 bases could result in death of fish, while the waters have pH value between of 4-6 or 9-10 could slow down the fish growth so that the fish production decreases significantly.
Temperature is one of the physical properties that affect the growth and appetite of fish. The process of digestion runs very slowly at low temperatures but faster in warmer waters. The results of temperature measurements obtained during culture tilapia temperature were at range of 27.0-27.1°C. The water temperature ranges in this study were in the range of temperatures that can be tolerated to support the growth of the fish. Tilapia is very tolerant fish to a variety of water conditions. According to Kordi and Tancung (2007) optimum water temperature which gives good results for tilapia breeding is between 25-33°C.

The water temperature can affect aquatic life indirectly, through its influence on the solubility of oxygen in water. The higher the water temperature and the lower the solubility of oxygen in water, and instead the effect of temperature is another indirectly affect metabolism, solubility of gases, including oxygen and a variety of chemical reactions in water (Kordi & Tancung 2007).

Dissolved oxygen is the variable most critical water quality in fish farming. Fish need oxygen for combustion to produce energy needed for swimming activity, growth and reproduction. Therefore, it is clear that the availability of oxygen for the fish to determine the circle of fish activity. DO measurement results obtained during the study period in range of 4 to 5.0 ppm. According to Afrianto & Liviawati (1992), some types of fish are able to survive in water with a concentration of 3 ppm, but the minimum concentration that is acceptable most of the cultivation of aquatic species to live well is 5 ppm.

Ammonia (NH3) is the result of renovation of amino acids by various types of aerobic and anaerobic bacteria. Source of ammonia in the waters the fish itself, and ammonia levels will continue to increase along with the increase in fish activity, temperature and results in the decay of the pond (Lingga, 1985). Ammonia measurement results obtained during the study period in the range of 0.0125 to 0.25 ppm. Range obtained during this study is to support the life and growth of fish. This is in accordance with the opinion of Hora and Pillay in the Wardoyo (1985), that the levels of ammonia are good to support the growth of the fish no more than 2.00 ppm. According to Boyd (1982) ammonia nitrogen in the waters has two forms, i.e non-ionic ammonia (NH3) and ionic ammonium (NH4 +). Non-ionic Ammonia is toxic to fish, where the power level toxic of non-ionic ammonia in contact with fish for a short period is 0.6 to 2.0 ppm. According to Ali in the Bittner (1989), non-ionic ammonia is toxic to fish because it can damage the gills of fish tissue, leaves fish gill plates expand, as result respiratory function as a tool will be disrupted, and the fish hard to breathe and eventually die.

4. Conclusion
The addition of probiotics in commercial feed up to 7% could support the growth of tilapia, while the addition of 3% probiotic feeding provided more efficient in weight relative growth rate, survival, and feed conversion ratio.

The value of the quality of water entering to environment from probiotics pellet treatments were better than that of without probiotics treatment. The culture of tilapia using pellets with probiotics is the most effective to reduce the rate of deterioration of water quality.
References


Storage Efficiency Of N, P, K On Degraded Peatland By Giving Some Formula Ameliorant

Eni Maftu’ah¹, A. Ma’as² dan B.H. Purwanto²

1) ISARI, Jl. Kebun Karet, Loktabat, Banjarbaru
2) Gadjah Mada University, Yogyakarta, Jl. Bulak Sumur Yogyakarta,55581

Abstract

The availability of nutrients, especially N, P, K in the degraded peat is very low. The high organic acids can be lowering the pH of the soil, its causes the negatively charged nutrients (nitrate, phosphate) are very low too. Ameliorant can donate some of the cations both monovalent and polivalent which acts as a bridge cations, thus increasing the availability of nutrients, especially nitrogen and phosphate. The research objective was to determine the efficiency of the storage of N, P, K through application of some ameliorants on degraded peatlands. The experiment was conducted in the laboratory of ISARI, Banjarbaru. Peat soil taken from the degraded peatlands (ex-burn) on Kalampangan, Central Kalimantan. The treatments given are 8 kinds/formula ameliorant and two control treatments (+ NPK and -NPK). The treatments are arranged in CRD, with 3 replications. Research using soil coloum (lysimeter). The leaching was done every one week, by using aquades with a volume of 1,25 liter and then measured the volume of water that leached. The analysis of the leached water namely the concentration of N, P, K was done periodically at weeks 1, 2, 4, 6, and 8 after incubation. The results showed that the concentrations of N and K each observation period is relatively uniform, but P has increased significantly at 4 week after incubation. Concentrations of N, P, K leached highest at 100% treatment ameliorant from chicken manure. Storage efficiency of N, P and K vary, depending on the type of ameliorant. Ameliorant that can improve storage efficiency of N and K is ameliorant that consist of 80% agricultural weed + 20% dolomite, while P is a ameliorant that consist of 80% purun tikus grass + 20% dolomite. Overall storage efficiency elements of K > N > P.

Key words: ameliorant, storage efficiency of N, P, K, degraded peatland.

1. Introduction

The main problem in increasing the productivity of degraded peatland was acidity soil and the presence of a hydrophobic on top layer of peat. Availability of nutrients, especially N, P, K is very low as well as other nutrients such as micro elements Cu and Zn are also very low. Soil acidity caused by dissolution of organic acids as a result of decomposition of organic matter. Products that have been advanced decomposition of peat is humic substances (Mackowiak et al., 2001). Humic acids consist of material that resists weathered organic material of high molecular weight, and generally dark in color and are resistant to biological weathering (Logan et al., 1997). A weathered soil humic materials because physically protected activity and the occurrence of complex microbial decomposers organomineral so as to protect against microbial enzymatic (Qualls, 2003).
The low availability of P in the peat soil due to the ability of peat soils adsorb P is low, so a lot of P that leached out before it is absorbed by plants. Forms of nitrogen that are often found in degraded peatlands is nitrate. Ammonium in the oxygen-rich soil conditions become unstable and rapidly oxidized to nitrate with the outcome of which NO and N2O (Regina, 1998). Nitrate in peatlands easily leached because negatively charged, so quickly lost from the root zone. Improved efficiency of nutrient storage can be approximated by reducing the loss of nutrients from the root zone. Negatively charged nutrients (nitrate and phosphate) in order to survive in the environment of plant roots need delivery cations cations act as a bridge. Availability of K in peatlands are also generally low, except in peatlands that have been intensively cultivated. Complexation and dissolution of nutrients on peatland affected by the use ameliorant. Appropriate amelioration needed to overcome obstacles encountered in increasing the productivity of degraded peat.

Ameliorant materials have different potential to improve soil fertility, depending on the composition of the material. Based on the results of previous studies weeds purun tikus are known to have high total Fe concentrations (0.16%), which is expected to increase the availability of P. Chicken manure in addition to having the content of N, P, K higher total Fe also has a high (1.80%). The results be obtained by the incubation of chicken manure to increase the availability of N, but it is not known the level of storage efficiency. Ameliorant formulation of several different materials are intended to improve the quality of the storage efficiency of nitrogen, phosphorus and potassium in degraded peatlands. The purpose of this study was to determine the efficiency of storage N, P, and K through the formulation of some ameliorant in degraded peatlands.

2. Materials and Methods

The experiment was conducted at the Laboratory in Indonesian Swampland Agriculture Research Institute (ISARI) Banjarbaru, South Kalimantan. Material taken from the peat ex-burning in Kalampangan village, Palangkaraya, Central Kalimantan. Research conducted in March - June 2011. Peat material taken from 0-25cm depth, the 0-5 cm layer of hydrophobic conditions, while the hydrophilic layer 5-25.

The treatments provided are 8 types of formula ameliorant and 2 in the control treatment without NPK compound fertilizer (15:15:15) and with NPK compound (Table 1). Treatments were arranged in completely randomized design with three replications. Ameliorant dose used in the experiment stage is 20 tonnes / ha, equivalent to 8% of the weight of the peat soil to a depth of 25cm. Volume of water to leach was the 1250 ml for every leaching. This volume is based on the average amount of rainfall in the area Kelampangan, Central Kalimantan.

Ameliorant material consists of: mineral soil (Spodosol), agricultural weeds, chicken manure, purun tikus grass (Eleocharis dulcis) and dolomite, with a nutrient composition similar to Table 1. Agricultural weeds that used a mixture of weeds under the crop of sweet corn around the study site is dominated by grinting grass (Cynodon dactylon), and a grass wedusan (Ageratum conyzoides), and kentangan (Borreria latifolia). Purun tikus grass (Eleocharis dulcis) is a specific type of grass in tidal swamplands.

Weighing of soil was 1 kg under natural conditions (not dried) mixed with selected ameliorant included in plastic pots (PVC pipe) with a height of 25cm and a diameter of
16 cm. At the bottom of the PVC pipe was given the cover pipe, hollowed out the middle and tap connections as a way out of water. At the top and bottom of the filter paper was given. In this experiment all treatments were 300kg/ha NPK fertilizer, except for the control treatment. Water leached is collected in a container for chemical analysis of N, P, K. Ameliorant nutrient content of the material used is similar to Table 2.

Table 1. The composition of the formula used in the study of ameliorant

<table>
<thead>
<tr>
<th>Code</th>
<th>NPK fertilizer</th>
<th>Chicken manure (PA)</th>
<th>Agricultural weed (GP)</th>
<th>Mineral Soil (TM)</th>
<th>Purun tikus grass (PT)</th>
<th>Dolomite (KD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>+</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>A2</td>
<td>+</td>
<td></td>
<td>80</td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>A3</td>
<td>+</td>
<td></td>
<td></td>
<td>80</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>A4</td>
<td>+</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>A5</td>
<td>+</td>
<td>19.05</td>
<td></td>
<td>71.45</td>
<td></td>
<td>9.5</td>
</tr>
<tr>
<td>A6</td>
<td>+</td>
<td>50</td>
<td></td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A7</td>
<td>+</td>
<td></td>
<td></td>
<td>80</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>A11</td>
<td>+</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K1</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Nutrient content of some materials used as ameliorant

<table>
<thead>
<tr>
<th>Ameliorant materials</th>
<th>C</th>
<th>N</th>
<th>P</th>
<th>K</th>
<th>C/N</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>Fe</th>
<th>KA</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken manure</td>
<td>31.93</td>
<td>1.64</td>
<td>0.64</td>
<td>1.26</td>
<td>19.49</td>
<td>5.30</td>
<td>2.32</td>
<td>1.15</td>
<td>1.80</td>
<td>10.56</td>
<td>7.17</td>
</tr>
<tr>
<td>Agricultural weed</td>
<td>44.86</td>
<td>0.94</td>
<td>0.25</td>
<td>1.02</td>
<td>47.66</td>
<td>0.91</td>
<td>0.26</td>
<td>1.02</td>
<td>0.04</td>
<td>20.02</td>
<td>4.45</td>
</tr>
<tr>
<td>Purun tikus grass</td>
<td>44.48</td>
<td>1.18</td>
<td>0.08</td>
<td>0.99</td>
<td>37.82</td>
<td>0.85</td>
<td>0.19</td>
<td>0.99</td>
<td>0.16</td>
<td>16.11</td>
<td>4.12</td>
</tr>
<tr>
<td>Mineral soil</td>
<td>2.45</td>
<td>0.09</td>
<td>nd</td>
<td>nd</td>
<td>25.00</td>
<td>0.02</td>
<td>0.01</td>
<td>nd</td>
<td>0.03</td>
<td>5.39</td>
<td>4.56</td>
</tr>
<tr>
<td>Dolomite</td>
<td>nd</td>
<td>nd</td>
<td>nd</td>
<td>nd</td>
<td>-</td>
<td>22.83</td>
<td>8.86</td>
<td>nd</td>
<td>nd</td>
<td>nd</td>
<td>8.32</td>
</tr>
</tbody>
</table>

nd = not determine

64

International Seminar on University-Based Research for Wetland Development
Joint Program Between Lambung Mangkurat University and Government of South Kalimantan Province
Banjarmasin, Indonesia, 26-27th November 2012
Storage efficiency of N or P or K peat material as determined by the formula below (Masganti, 2003; Utami, 2010).

\[
EP(\%) = \frac{mg\ N\ or\ P\ or\ K\ (which\ given\ -\ leached)}{mg\ N\ or\ P\ or\ K\ which\ given} \times 100\%
\]

3. Results And Discussion
3.1. Concentrations of N, P, K in water leached

Concentration of N in water leached ameliorant shows the differences between treatments (Table 3). The concentration of nitrogen in water leached highest demonstrated by the treatment without ameliorant (K1). It is proved that the administration can increase the shelf ameliorant nutrients on peat that leached nutrients can be reduced.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Code</th>
<th>Period of observation (week after incubation)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>80%PA+20% KD</td>
<td>A1</td>
<td>11.67 bc</td>
</tr>
<tr>
<td>80% GP+20% KD</td>
<td>A2</td>
<td>7.47 bc</td>
</tr>
<tr>
<td>80% TM+20% KD</td>
<td>A3</td>
<td>4.67 bc</td>
</tr>
</tbody>
</table>

Figure 1. Schema of lysimeter tool that used
Concentration of N in water leached between observation periods differ depending on the type of ameliorant. However, it can be seen between treatments in water leached N concentrations are consistently highest at each observation period occurred in the control treatment + NPK (K1) which is not different from ameliorant 100% chicken manure (A11). Giving ameliorant absolutely necessary in order to improve the soil fertility of peat. Ameliorant besides contributing nutrients N, P, K also donated cations act as a bridge between the functional groups of peat with nutrients, especially nitrates and orthophosphat.

Chicken manure contains high N, the ratio of C / N, lignin and cellulose is low so that the rate of mineralization is faster than the other ameliorant. Chicken manure that no combined with dolomite or other materials that contain a high cation, will increase the chances of loss of N through leaching. N mineralization in peat soils with good aeration was faster, and NH$_4^+$ would be rapidly oxidized to NO$_3^-$ (Kurnain, 2005), so the chances of higher leached. Nitrate is negatively charged so it can not bind to the functional groups most negatively charged peat. As reported by Ruckauf et al. (2004) that the soil NO$_3^-$ peat is very easy to move and leached.

Giving dolomite lime combined with chicken manure (A1) can lower the concentration of N leached, so that the concentration of N leached at A1 lower than the A11 (Table 3). Dolomite lime containing cation Ca 22.8% and 8.86% Mg, was instrumental in the formation of cation bridges between the anion with functional groups are negatively charged so that nutrient can be retained within the complex anion exchange. Most of the N in the peat soil surface more quickly leached thus affecting the quality of surface water (Heathwaite, 1991 in Droogers et al., 2007).

An increase in the concentration of N in water leached in general to 2-6 weeks after incubation (WAP), and decreased at 8 WAP. Ameliorant materials, mainly the organic material has undergone mineralization at week 2nd. Decrease in the concentration of N, P, K in 8 WAP shows good nutrition from fertilizer, peat ameliorant and materials have decreased during the period. This condition also indicates there has been improvement
of physical properties of peat through aggregation and decrease pore drainage, so leaching is reduced.

The concentration of P in the water leached significantly different between treatments (Table 4). The highest P concentrations are consistently at several observation periods are also indicated by K1 (control + NPK) were not significantly different from treatment A11 (100% chicken manure). Chicken manure treatment more quickly provide P, but P is released can not survive long in the exchange complex and very easily leached, in the absence of added cations cations act as a bridge. The ability of peat soil is very low in storing P, and the necessary bridge between the functional groups of peat cation with P so that P remains on the exchange complex and protected from leaching (Masganti, 2003). Real changes in the concentration of P in the water leached at several observation periods (Table 4). But the trend can be seen in the water leached P concentration increased to 4 weeks after incubation, then decreased at 6-8 weeks after incubation.

Table 4. P concentration in water leached periodically (ppm)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>code</th>
<th>Period of observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>80%PA+20% KD</td>
<td>A1</td>
<td>9.54 cde</td>
</tr>
<tr>
<td>80% GP+20% KD</td>
<td>A2</td>
<td>6.33 de</td>
</tr>
<tr>
<td>80% TM+20% KD</td>
<td>A3</td>
<td>6.33 de</td>
</tr>
<tr>
<td>20%PA+20%GP+20% PT+20%TM+20% KD</td>
<td>A4</td>
<td>15.90 b-d</td>
</tr>
<tr>
<td>19.05%PA+9.5%KD</td>
<td>A5</td>
<td>11.53 b-e</td>
</tr>
<tr>
<td>50% PA+50%GP</td>
<td>A6</td>
<td>23.86 a</td>
</tr>
<tr>
<td>80%PT+20%KD</td>
<td>A7</td>
<td>3.14 e</td>
</tr>
<tr>
<td>100% PA</td>
<td>A11</td>
<td>17.86 abc</td>
</tr>
<tr>
<td>CONTROL + NPK</td>
<td>K1</td>
<td>21.75 ab</td>
</tr>
<tr>
<td>CONTROL - NPK</td>
<td>K2</td>
<td>3.28 e</td>
</tr>
</tbody>
</table>

Mean periodic 12.22 30.74 35.39 23.86 21.79

Description: PA = chicken manure, GP = agricultural weeds, PT = purun tikus grass, TM = mineral soil, KD = dolomite. The numbers followed by the same letter in the same column indicates no significant different between treatments by DMRT test α = 5%

P concentrations decrease at 6th week may be due to the role of base cations cations as a bridge between P ions with organic groups (P - Ca - COO-), so that P is not leached. Alternatively, the amount of P in the peat soil incubated either P derived from fertilizer and ameliorant has decreased at 6th week, so that leached also lower compared to the beginning of the incubation period. In general, concentrations of P leached higher than N and K. Phosphorus availability in the peat soils are generally low so that the plants
often lack. Degraded peat and peat soils with low water levels containing organic P associated with fulvic and humic acids in the top layer is low and increases with increasing depth of peat (Ziolek, 2007).

Peat soils have the ability to adsorb low P fertilizer (Maas, 1997). This is because the peat soil contains many reactive functional group is a functional group with a low molecular weight ie citric acid, malic and oxalic and functional group of high molecular weight humic and fulvic acids are. That particular group has a negative charge, so it is necessary that P element cations bridge to survive in the complex exchange. Addition ameliorant with base cations are expected to reduce the amount of P that leached, because cations can act as a bridge cations (Masganti, 2003). Hartatik et al. (2004) reported Fe cations are capable to improving the provision of storage capacity P by peat, so the loss of P through leaching can be reduced.

The influence of the concentration of K types ameliorant leached in water are presented in Table 5. K concentration in water leached highest at each observation period indicated by ameliorant treatment without (control) were given NPK fertilizer (K1). Real changes in K concentration between periods of observation on all types ameliorant, except in ameliorant A6, A7 and A11.

Table 5. K concentration in water leached periodically (ppm)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Code</th>
<th>Period of observation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>80%PA+20% KD</td>
<td>A1</td>
<td>13,30 ab</td>
</tr>
<tr>
<td>80% GP+20% KD</td>
<td>A2</td>
<td>8,29 b</td>
</tr>
<tr>
<td>80% TM+20% KD</td>
<td>A3</td>
<td>10,24 b</td>
</tr>
<tr>
<td>20%PA+20%GP+20% PT+20%TM+20%KD</td>
<td>A4</td>
<td>15,50 ab</td>
</tr>
<tr>
<td>19,05%PA+9,5%KD+71,45%TM</td>
<td>A5</td>
<td>8,47 b</td>
</tr>
<tr>
<td>50% PA+50%GP</td>
<td>A6</td>
<td>15,03 ab</td>
</tr>
<tr>
<td>80%PT+20%KD</td>
<td>A7</td>
<td>15,55 ab</td>
</tr>
<tr>
<td>100% PA</td>
<td>A11</td>
<td>15,85 ab</td>
</tr>
<tr>
<td>CONTROL + NPK</td>
<td>K1</td>
<td>23,75 a</td>
</tr>
<tr>
<td>CONTROL - NPK</td>
<td>K2</td>
<td>6,09 b</td>
</tr>
</tbody>
</table>

Mean Periodic | 13,19 | 17,73 | 15,24 | 13,61 | 15,09

Description: PA = chicken manure, GP = agricultural weeds, PT = purun tikus grass, TM = mineral soil, KD = dolomite. The numbers followed by the same letter in the same column indicates no significant different between treatments by DMRT test α = 5%

Treatment provision ameliorant form of 100% chicken manure (A11) tends to indicate the concentration of K in water leached higher than the other treatments at each
observation period. This condition explains that organic material containing high nutrients and easily decomposed and mineralized will quickly release nutrients, but the nutrients are released K will also easily leached. Potassium is nutrient essential that mobile relative in peat, so prone to leaching (Bohn et al., 2001; Gorham and Janssens, 2005).

3.2. Storage efficiency of N, P, K

Storage efficiency of N, P and K was calculated from the amount of N, P, K are given through reduced NPK fertilizer with N, P, K were leached. The amount of N, P, K leached from the known concentrations of N, P, K leached in water multiplied by the volume of water leached. Cumulative amount of N, P, K leached during the study period are presented in Table 6.

Total N, P, K leached most often found in K1 treatment (control + NPK) and A11 (100% chicken manure), followed by the A6 (50% chicken manure + 50% agricultural weeds) to N, and A7 (80% purun tikus + 20% dolomite) for K. Based on the research of incubation, chicken manure can increase the availability of N, P, K highest, but the nutrients are leached faster. Provision of dolomite in the chicken manure will donate base cations (Ca, Mg, K) that can reduce leaching especially phosfat ion and nitrate.

Table 6. Total N, P, K leached during the observation period

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Code</th>
<th>Amount of N, P, K leached (mg)</th>
<th>N</th>
<th>P</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>80%PA+20% KD</td>
<td>A1</td>
<td>81,29 bc</td>
<td>157,13a</td>
<td>91,27bc</td>
<td></td>
</tr>
<tr>
<td>80% GP+20% KD</td>
<td>A2</td>
<td>45,61 d</td>
<td>103,23b</td>
<td>73,48c</td>
<td></td>
</tr>
<tr>
<td>80% TM+20% KD</td>
<td>A3</td>
<td>56,98 cd</td>
<td>113,05b</td>
<td>91,26bc</td>
<td></td>
</tr>
<tr>
<td>20%PA+20%GP+20%PT+20%TM+20%KD</td>
<td>A4</td>
<td>81,97 bc</td>
<td>173,27a</td>
<td>89,89bc</td>
<td></td>
</tr>
<tr>
<td>19,05%PA+9,5%KD</td>
<td>A5</td>
<td>84,74 bc</td>
<td>175,68a</td>
<td>77,89bc</td>
<td></td>
</tr>
<tr>
<td>50% PA+50%GP</td>
<td>A6</td>
<td>96,09 b</td>
<td>173,99a</td>
<td>97,39bc</td>
<td></td>
</tr>
<tr>
<td>80%PT+20%KD</td>
<td>A7</td>
<td>75,41 bc</td>
<td>82,17b</td>
<td>99,89b</td>
<td></td>
</tr>
<tr>
<td>100% PA</td>
<td>A11</td>
<td>104,07 ab</td>
<td>186,09a</td>
<td>111,08c</td>
<td></td>
</tr>
<tr>
<td>CONTROL + NPK</td>
<td>K1</td>
<td>125,77 a</td>
<td>197,93a</td>
<td>156,49a</td>
<td></td>
</tr>
<tr>
<td>CONTROL - NPK</td>
<td>K2</td>
<td>7,62 e</td>
<td>10,18c</td>
<td>13,99d</td>
<td></td>
</tr>
</tbody>
</table>

Description: PA = chicken manure, GP = agricultural weeds, PT = purun tikus grass, TM = mineral soil, KD = dolomite. The numbers followed by the same letter in the same column indicates no significant different between treatments by DMRT test α = 5%

Storage efficiency of N, P, K least shown in K1 (control) and ameliorant be 100% chicken manure (A11) (Figure 2). Chicken manure release N, P, K higher in a faster
time, so the opportunity for the highest well leached. Storage efficiency of N and K was highest in ameliorant A2 (80% of agricultural weeds + 20% dolomite). Compared with the purun tikus grass, the agricultural weeds have nutrient composition that more complete and higher cellulose and lignin contents is lower, making it easier to decompose. Giving dolomite can help decomposition ameliorant, but also donated alkaline cations. Ameliorant A2 (80% of agricultural weeds + 20% dolomite) provide balance amount of anions and cations in solution peat, so the number of anions leached less.

P storage efficiency was highest in ameliorant A7 (80% purun tikus + 20% dolomite) followed by ameliorant A2 (80% agricultural weeds + 20% dolomite). Purun tikus contains Fe higher than agricultural weeds. Fe ions can increase the strength of the bond between phosphate ions with functional groups of peat compared cations Al$^{3+}$, Ca$^{2+}$, Cu$^{2+}$. Iron cations can act as a bridge cations (binder) P at the site by forming a complex reactive organic peat-Fe-P, so P is not lost leached (Litoar et al., 2005). Based on research Erdogen et al. (2007), there is a difference between the ability of metal ions to adsorb humic acid, Fe > Pb > Cu > Al > Zn, Fe > Pb > Al > Cu > Zn at pH 2.5 and 3.5, while at pH 4.5 and 5.5 Fe = Pb = Cu = Al > Zn. Ameliorant formulations by combining several ingredients needed in addition to overcome material limitations ameliorant, as well as to improve the effectiveness of the ingredients in improving the fertility of degraded peat.

![Figure 2. Storage efficiency of N, P, K due to treatment type ameliorant](image)

A1 = 80% chicken manure + 20% dolomite, A2 = 80% agricultural weeds + 20% dolomite, A3 = 80% mineral soil + 20% dolomite, A4 = 20% chicken manure + 20% agricultural weeds + 20% mineral soil + 20% purun tikus grass + 20% dolomite, A5 = 19.05% chicken manure + 71.45% mineral soil + 9.5% dolomite, A6 = 50% chicken manure + 50% agricultural weeds, A7 = 80% purun tikus grass + 20% dolomite, A11 = 100% chicken manure, K1 = control

The amount of storage efficiency of N, P, K varies, depending on the type of ameliorant. Overall storage efficiency elements of K > N > P. The low N storage efficiency shown by the control treatment (K1), ameliorant entirely with chicken manure (A11) and ameliorant be 50% chicken manure + 50% agricultural weeds (A6). P storage efficiency and lowest K in K1 and A11 treatment.
4. Conclusion

The concentrations of N and K each observation period is relatively uniform, but P has increased significantly at 4 weeks after incubation. Concentrations of N, P, K leached highest at 100% treatment ameliorant from chicken manure. Storage efficiency of N, P and K vary, depending on the type of ameliorant. Ameliorant that can improve storage efficiency of N and K is ameliorant that consist of 80% agricultural weed + 20% dolomite, while P is a ameliorant that consist of 80% purun tikus grass + 20% dolomite. Overall storage efficiency of elements i.e., K > N > P.

References


Ratna Setyaningrum1), Rudi Fakhriadi2), Fahrini Yulidasari3)

1) Department of Occupational and Environmental Health, Public Health Major, Medical Faculty, Lambung Mangkurat University  
   Email: ratnastyar@yahoo.com

2) Department of Epidemiology and Biostatistika, Public Health Major, Medical Faculty, Lambung Mangkurat University

3) Department of Nutrition and Maternal and Child Health, Public Health Major, Medical Faculty, Lambung Mangkurat University

Abstract

Dengue Hemorrhagic Fever (DHF) is one of infectious diseases that became the world's health problems. In 2009 there were 130 DHF cases in Banjarbaru and the most DHF patients died in Guntung Payung District of 7 people. Factors affecting the incidence of dengue fever, among others, host, environment, and the presence of larvae. This study aims to find out risk factors for DHF based on family behavior that is the knowledge, attitudes and actions concerning the eradication of the breeding place in the working area of Guntung Payung Health Center. This study is an observational analytic study with case-control study design. Study sample with a purposive sampling technique was 50 people with 25 control persons and 25 persons cases. Based on odds ratios test with 95% degree of confidence in knowledge (OR = 7.944), attitude (OR = 7.875), and action (OR = 14.636) on the eradication of the mosquitoes nest is a risk factor for incidence of dengue. Concluded that human factors are risk factor for dengue disease in the working area of Guntung Payung Health Center, Banjarbaru City.

Key words: dengue fever, the knowledge, the attitude, the action in breeding place eradicating

1. Introduction

Dengue hemorrhage fever (DHF) was one of the contagious diseases that caused problem in the world, especially in the developing countries. Based on the data of World Health Organization, the mean mortality of the DHF was 15% or 25 thousand annual deaths of the patients. In Indonesia, the DHF has been the case since 1968 in Surabaya (Supartha, 2008). The DHF case in Indonesia was found in various regions. In 1980, all of the province of Indonesia has been affected by the DHF. In the period of 1996-2005 there were 334,685 DHF cases with 3,092 patients dead. The DHF became classic problem because it always happens annually, especially a the beginning of wet season (Suirta, 2007).

Indonesia was a tropic country and hence had high risk of the DHF because its causal vector of Aedes aegypti was found anywhere in the settlement areas and in public areas, except the areas of 1000 meters above sea level. The DHF implicated widely in both...
material and moral losses in terms of hospitalization and medical treatment costs, the loss in working productivity and the most fatal was the loss of lives (Wakhyulianto, 2005; Pujiyanto et al., 2008).

There were always DHF cases in South Kalimantan annually. In 2005 there was DHF case with the incidence rate (IR) = 9.3/100,000 population and the case fatality rate (CFR) of 2.6%. In 2006 the DHF case increased with the IR = 12.45/100,000 population and the CFR of 1.31%. The highest case took place in Banjarmasain City, Banjarbaru and Banjar district (Dinas Kesehatan Provinsi Kal-Sel, 2007).

Banjarbaru was an endemic region of the DHF. Based on the data of the DHS of Banjarbaru Health Office it was see that in 2008 there were 53 DHF patients in Banjarbaru with the total population of 152,719 individuals and one of them had died. The incidence rate (IR) in Banjarbaru City was 33.7/100,000 population and the case fatality rate (CFR) of 1.9%. In 2009 there were 130 DHF cases in Banjarbaru city with the highest mortality taking place in Guntung Payung sub district (7 patients dead).

There were some factors influencing the DHF such as: 1) the habit of the people in storing fresh water for daily use, 2) bad environment sanitation; 3) dense settlement area; 4) lack of fresh water supply; 5) not using mosquito net and mosquito essence; 6) bad trash management; and 7) wet season (Fathi et al., 2005; Departemen Kesehatan RI, 2005; Notoadmodjo, 2003).

Based on the description above, it was necessary to conduct a study analyzing the risk factors of the DHF in the covering area of the Guntung Payung Public Health Center of Banjarbaru City. The study aimed to investigate the risk factors of the DHF based on the family behavior, including the knowledge, the attitude and the action in breeding place eradicating in the covering area of the Guntung Payung Public Health Center of Banjarbaru City.

2. Method

The study was an observational and analytic one with case control design to find out the risk factor of the DHF based on the family behavior, including the knowledge, the attitude and the action in breeding place eradicating. The concept of the study is illustrated in the figure 1.1 below.

Figure 1.1. The Concept of the Study of the Risk Factor of Dengue Hemorrhage Fever
The samples of the study were drawn using purposive sampling technique that resulted in 50 individuals of the members of the population in the covering area of the local government clinic of Guntung Payung who were further divided into 25 individuals ad control (with no case of the DHF) and 25 individuals as case (affected by the DHF), with the following inclusion criterion:

a. The members of the society who were willing to be the respondents.
b. The society that served as the control was not affected by the DHF in the period of January-June 2010.
c. The society that served as the case has been affected by the DHF for in the period of January-June 2010.

The primary data related to the family behavior, including the knowledge, the attitude and the action in eradicating breeding place was collected using direct interview with the respondents guided by questionnaire.

The data were subsequently edited for completeness and analyzed using odd ration at the confidence interval 90% to analyze the risk factor of the family behavior (the knowledge, the attitude and the action in eradicating breeding place).

3. Results and Discussion
   A. The Characteristics of Respondents
   The study of the people in the covering area of the Guntung Payung Public Health Center of Banjarbaru City was conducted on the basis of the inclusion criteria and resulted in 50 respondents who were further divided into 25 individuals as cases and 25 individuals as controls.

   1. Age
   The age of the respondents is summarized in the figure 1.2 based on the results of the study of the 25 cases and the 25 controls.

   ![Figure 1.2 The Characteristics of the Respondents’ Age](image-url)

   The results of the study as illustrated in the figure 5.1 showed that the respondents’ age of both the control and the cases was 15-49 years or 52% and 56%, respectively. Based on the study by Djallalluddin (2001) of the DHF incidence in Banjarbaru, the age risk of
the DHF was 5-14 years (23). The study indicated that the age 15-49 years is human active age (Djallaludin et al., 2004).

2. Sex

Based on the results of the study of the 24 cases and the 25 controls indicated the percentage of the respondents’ sex as summarized in the figure 1.3.

[Figure 1.3 The Characteristics of the Respondents’ Sex]

The results of the study illustrated in the figure 5.2 showed that the percentages of the respondents’ sex of the cases and the controls were 52% and 56%, respectively. Based on the study by Cut Irsanya N (2005), the sex did not influence the incidence of the DHF. Meanwhile, the factors of environment, the behavior and the habit of the society influence the DHF incidence.

B. The Risk Factor of the DHF in the Sub district Guntung Payung

Based on the odd ratio at the confidence interval 95% the results were summarized in the table 1.1.

Table 1.1 The Results of the Study of the Risk Factors in the Covering Area of the Guntung Payung Public Health Center

<table>
<thead>
<tr>
<th>No</th>
<th>DHF Risk Factors</th>
<th>Odd Ratio (OR)</th>
<th>Confidence Interval (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>1</td>
<td>The knowledge of breeding place eradication</td>
<td>7.944</td>
<td>1.884</td>
</tr>
<tr>
<td>2</td>
<td>The attitude toward breeding place eradication</td>
<td>7.875</td>
<td>2.071</td>
</tr>
<tr>
<td>3</td>
<td>The action in eradicating breeding place</td>
<td>14.636</td>
<td>2.820</td>
</tr>
</tbody>
</table>

C. The Analysis of the Risk Factor of the Behavior on the DHF Incidence

It was clearly observed from the table 1.1 that the behavior, including the knowledge of the breeding place eradication, was the risk factor of the DHF. The respondents with
low knowledge were at risk of the DHB 7.944 times higher than those with high knowledge of mosquito nest eradication.

Based on the odd ratio test at the confidence interval 95% it was found that the attitude toward the mosquito nest eradication was the risk factor of the DHF ($OR = 7.875$), indicating that the respondents with low attitude toward the breeding place eradication were at risk of the DHF 7.875 times higher than those with high attitude toward the mosquito nest eradication.

Based on the odd ratio test at the confidence interval 95%, it was found that the action in eradicating breeding place was the risk factor of the DHF incidence ($OR = 14.636$), indicating that the respondents who did not acted to eradicate breeding place were at risk of the DHF 14.636 times higher than those who acted to eradicate the mosquito nest.

It was confirmed by Amrul Hasan and Dian Ayubi’s study that there was a significant correlation between the knowledge of, the attitude toward and the action of the society in eradicating the breeding place and the DHF incidence in Lampung City. The attitude was behavioral pattern or the tendency or active anticipation, predisposition to adapt to social situation. In a simple term, it could be expressed that it was the response to conditioned social stimuli. It was concluded that the lower the attitude of the society toward the prevention of the BHF, the bigger the possibility for the BHF to take place (Fathi et al., 2005; Nilam Sari, 2005).

Low individual participation in eradicating breeding place resulted from the lack of the awareness of the importance of the breeding place eradication and it subsequently caused ignorant attitude toward government’s recommendation and invitation to organize the breeding place eradication. Localizing the breeding place of the *Aedes aegypti* would influence the density of the mosquito and would give significant impact to the reduction of the spreading of the disease (Hasan & Ayubi, 2007).

Fathi’s study (2005) showed that there was a significant correlation between the knowledge of, the attitude toward and the action to eradicate breeding place and the incidence of the BHF in Mataram city. The breeding place eradication consisted of: people who regularly draining water stored in containers, for example once a week, tightly closing fresh water containers, and burrung used containers such as used cans, used plastic containers, and so on able to contain rain water that could be nesting place for the mosquito (referred to as 3M action) and abating action, which was to spread temephos (abate) into the fresh water containers at the dose 1 ppm o 1 gram temephos SG in 1 liter of water that had three months residual effect (Fathi et al., 2005).

The health behavior was essentially the response of individuals (organisms) to the stimulus related to the illness and the disease, health care service system, food, and environment. Human response and reaction both passive (knowledge, perception and attitude) and active (real or practical action) was important. The most important of the health behavior was emergence and the change in the behavior because the behavior was the objective of the health education and dissemination supporting other health programs (Arifah, 2008).
4. Conclusion and Recommendation

4.1 Conclusions

Based on the analysis with odd ration test at the confidence interval 95%, it was found that:

1. The respondents with low knowledge were at risk of the BHF 7.944 times higher than those with high knowledge of the breeding place eradication.
2. The respondents with low attitude toward the breeding place eradication were at risk of the BHF 7.875 times higher than those with high attitude of the mosquito nest eradication.
3. The respondents who did not act to eradicate the breeding place were at risk of the BHF 14.636 times higher than those who act to eradicate the breeding place.

4.2 Recommendations

1. It was necessary to conduct further study of the risk factors of the habit of society and the climate on the BHF incidence.
2. It was necessary to invite active participation of all of the members of the society in the effort to eradicate breeding place.
3. It was necessary to improve the DHF dissemination program, especially by empowering the health officers in the covering area of the Health Office of Banjarbaru City in order to increase the awareness of the local people of clean self and environmental health living behavior.

Reference


Converting Wetlands to Oil Palm Plantation in South Kalimantan; Law of Spatial Planning and Environmental Perspectives, A Case Study on Barito Kuala District

1) Abdul Halim Barkatullah, 2) Ifrani, 3) Lies Ariany and 4) Lena Hanifah

1), 2), 3), 4) Law Faculty, Lambung Mangkurat University
1) E-mail: dr.halim_barkatullah@yahoo.co.id; 2) E-mail: ifrani@gmail.com; 3) E-mail: liesa_pisces@gmail.com and 4) E-mail: lena.hanifah@gmail.com

Abstract

Area of oil palm plantation is increasing rapidly in many districts of South Kalimantan. The expansion of the oil palm plantation, particularly those in district that rich with the wetlands area while the dryland areas extensively developed. Socio-legal Method is chosen to elucidate the issues on the conversion of wetland to palm cultivation in South of Kalimantan, especially in Barito Kuala district, in law of spatial planning perspectives. The results showed that Barito Kuala is confronting both the spatial law and environmental law when the status of Barito Kuala as a center for rice, orange and rambutan is challenging by the expansion of oil palm plantation. This research suggested that the palm plantation on wetland should carefully consider on the status of the area utilization according to the spatial planning regulations. In other way, the spatial planning regulations must be considered to the environment law, whether the utilization of the area for palm cultivation could harm the preservation of the environment, especially the wetland environment.

Keywords: Converting, Wetlands, Oil palm plantation, Spatial law, environmental law.

1. Introduction

Development activities need land and space so the development could do the functions. Any policies on the land and space will affect not only the life quality of the citizen, but also affect the environment at the same time. The mismanagement of the space and land will bring negative return to the development itself. South Kalimantan has the uniqueness regarding to its geographical territory. It has only two quarters of the land is the dry land while the rest of it is wetlands. It made the province government has to carefully design the spatial policies to maximize the use of the land and space and minimizing the useless land.

The definition of the wetlands according to the Environmental Defender’s Office is an area flooded or waterlogged often enough to have both terrestrial and aquatic characteristics (Sommer, 1987). Wetland is any area of low-lying land where the water table is at or near the surface for most of the time, resulting in open water habitats and waterlogged land areas (Jones, 1990). Convention on Wetlands of International Importance especially Waterfowl Habitat, known as Ramsar Convention, gave definition to wetland as area of marsh, flend, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or
salt, including areas of marine water the depth of which at low tide does not exceed six meters.

Wetland is a big supermarket for the biological diversities and is vulnerable to any disturbance that could harmful its existence. The vulnerability could cause by nature such as earthquake, fire, and climate exchange, or caused by human such as reclamation for agriculture or housing. Wetland is endangered ecosystem because of its strategic area and its characteristic as an ubiquitos area. Ubiquitos means being everywhere.

Some areas of wetlands in South of Kalimantan are peatland. It is similar to the wetland areas in Barito Kuala. Barito Kuala is a district that has huge area of wetlands. The promising economical growth of oil palm plantation fascinating some people to do what it takes to expand the cultivation. Oil palm plantation in Barito Kuala growth rapidly and massively, whether expanded by big company, or by the community itself in form of people plantation. In 2008, the wide of palm plantation in Barito Kuala is only 2075 ha, while in 2009 increased to 4.800 ha, and still counting. It is in contrary to the wide of food crops areas which rapidly decrease, as in 2009, the wide of food crops areas is 232.335 ha, decreased to 231.063 ha in 2010. It such an ironic to recall that Barito Kuala, according to Local Act 9 Spatial Regulation 2000 that regulated about the development of priority areas regarding the potentiality and role of each district in South of Kalimantan, is one of the center for food crops and local fruit cultivation.

The objectives of this research were to elucidate: a) The issues on the conversion of wetland to palm cultivation in South of Kalimantan in law of spatial planning perspectives. b) The Government Policies on conservating wetland in South of Kalimantan, a case study on Barito Kuala District.

2. Methods

Socio-legal Method is chosen as the method of the research, with the approach of interdiscipliner or mixed between normative research with the sociology that used the qualitative analysis. Socio-legal method represented an interface with a context within which law exists (Beckmann, 2005). This method tried to fulfill the need of detailed and accurate explanation upon the law issues and studying the existence of law in book along with the law in action. It recognized the conflict between theory and the legal phenomena. The debate on the set of rule of conduct which enforced and ruling the citizen to obey the written norms, but also adjusted the conflicts of legal centralism.

The research included two phases;

a. Documentary Research

The aim and the purpose of this phase basically to open the way to solve the research issues.

b. Field Research

The empirical data collected focused on semi-structured interview with the purposive sample, and key actors.
3. Results and Discussion

3.1 Law of The Spatial Planning

The high demand on the availability of the land for the economic and development activities has become the critical issue in Indonesia, particularly in South of Kalimantan. It forced the government to plan carefully and accurately in the scope of spatial planning in order to assure the purpose right. The preamble of 1945 Constitution of Republic Indonesia paragraph 4 and article 33 are the main concept of the Indonesian law of Spatial Planning. The paragraph 4 said:

“To form a government of the state of Indonesia which shall protect all the people of Indonesia and all the independence and the land that has been struggled for, and to improve public welfare, to educate the life of the people and to participate toward the establishment of a world order based on freedom, perpetual peace and social justice.”

Article 33 verse 3 said:

“The land, the waters and the natural resources within shall be under the powers of the State and shall be used to the greatest benefit of the people.

The constitution gave the State the main role to control the land, waters and natural resources. It embraced the government the authority to manage, taking and exploiting the resources. All those activities economically valuable, therefore the strong regulation is needed to ensure that the exploitation on the land and natural resources met the main purpose to pursue the greatest benefit of the people.

The purpose of spatial planning is to manage the limited land and space to the unlimited function, to gain the maximum benefits. The main concept is to have the synchronized, balanced and sustainable use of the land and space, along with the preservation of the environment. This purpose needs the effort to keep the harmonization between the spatial planning policies and the development planning, especially on the plan that consumed land and space.

As the big five of the most populous countries in the world, Indonesia responded to the importance of the spatial planning law by enacting Law Number 26 Year 2007 concerning Spatial Management. The Spatial Management Law mandated the provinces and the districts/cities to prepare the local regulation concerning the spatial plan. Before it was mandated, some provinces and districts already enacted the local regulation regarding to the previous Spatial Planning Law, the Law Number 24 year 1992. South Kalimantan is one of those provinces, enacted the law of spatial management/planning under the previous spatial planning law. It was the urgent issue to South Kalimantan to harmonize and synchronize the regional regulation of spatial planning to Law Number 26 year 2007 concerning Spatial Management. Here is the process of consulting and evaluation in preparing local government regulation for province:
Barito Kuala has the local regulation concerning Spatial Planning, but it also enacted before the Spatial Management Law 2007. The local government is still preparing the new regulation. Here is the process of consulting and evaluation process in preparing local government regulation for country/city spatial plan:

*National Spatial Plan Coordination Board, 2009

Figure 1. Consultation and evaluation Process In Preparing Local Government Regulation For Province Spatial Plan (RTRW Provinsi)

*National Spatial Plan Coordination Board, 2009

Figure 2. Consultation and evaluation Process In Preparing Local Government Regulation For District Spatial Plan (RTRW Kab/Kota).
3.2 The Potentiality of Wetland in Barito Kuala

Kalimantan is the home for about 5.7 million peatland or 27.8% of total peatlands area in Indonesia. Wetland (alluvial) took the large part of its geological structure, about 22.76%. Along the river banks were the peatland or swampland. River still took part as the main source of living, while the population grew and pushed people to slowly left the river banks, and exploited the land.

The following table will show the type of soil in South Kalimantan:

**Table 1** Luas Wilayah menurut Jenis Tanah Tiap Kabupaten/Kota (Ha) Tahun 2010

<table>
<thead>
<tr>
<th>Kabupaten / Kota</th>
<th>Jenis Tanah/Soil type</th>
<th>OGH</th>
<th>PMK Plateau</th>
<th>PMKL</th>
<th>PMK Mountain</th>
<th>KPMK</th>
<th>Aluvial</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Kabupaten/Regency</th>
<th>OGH</th>
<th>PMK Plateau</th>
<th>PMKL</th>
<th>PMK Mountain</th>
<th>KPMK</th>
<th>Aluvial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanah Laut</td>
<td>33</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>60 735</td>
<td>140 348</td>
</tr>
<tr>
<td>536</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kotabaru</td>
<td>-</td>
<td>-</td>
<td>154 220</td>
<td>-</td>
<td>180 500</td>
<td>193 995</td>
</tr>
<tr>
<td>Banjar</td>
<td>31</td>
<td>-</td>
<td>135 790</td>
<td>-</td>
<td>161 319</td>
<td>117 508</td>
</tr>
<tr>
<td>001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barito Kuala</td>
<td>96</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>141 306</td>
</tr>
<tr>
<td>316</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tapin</td>
<td>159</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5 588</td>
<td>12 399</td>
</tr>
<tr>
<td>865</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hulu Sungai Selatan</td>
<td>77</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>62 550</td>
</tr>
<tr>
<td>212</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hulu Sungai Tengah</td>
<td>58</td>
<td>31 563</td>
<td>-</td>
<td>48 448</td>
<td>8 877</td>
<td>-</td>
</tr>
<tr>
<td>312</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
South Kalimantan is well-known for its mine sources, such as oil and coal. But both oil and coal only mined in several districts/cities, especially on plateau or the highland areas such as Tanjung, Rantau and BatuLicin. For the lowland areas that have no mine sources, they have to push beyond the limit of the resources to get the income to finance the development. But the mine-resources is hardly sustainable and non-renewable, it will run out fast. That is one reason why The long-term of South Kalimantan’s vision is the Agro-Industry regional of Trade and Service. The agro industry tends to be eco-friendly industry. Agro-industry is the industry based on activity that added values to the product, so it will be high marketable. In other way, it will accelerate the growth of jobs, improving the equitable distribution of income, and promoting economic development. Industry pattern will integrated to the agriculture potentiality of South Kalimantan.

Agro-industry has its weakness for its high demand on the land availabilities. The overlapping land utilization will become the crucial threat if the land not planned and managed well along with the regulation.

### 3.3 The Conversion of Wetland to Palm Cultivation in Barito Kuala

As for Barito Kuala that has been established as the center of rice production, orange and rambutan plantation, the agro-industry is a must. Table 1 showed that the biggest area is for coconut agriculture, followed by oil palm on the next position. As the charm of economic values of the palm, it growth and expanded rapidly. In 2006, the wide of

<table>
<thead>
<tr>
<th></th>
<th>Hulu Sungai Utara</th>
<th>Tabalong</th>
<th>Tanah Bumbu</th>
<th>Balangan</th>
<th>Kota/ Municipality</th>
<th>Banjarmasin</th>
<th>Banjarbaru</th>
<th>Kalimantan Selatan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30</td>
<td>23</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>61 795</td>
<td>-</td>
<td>519 881</td>
</tr>
<tr>
<td></td>
<td>395</td>
<td>437</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>18 858</td>
<td>-</td>
<td>31 563</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>161 028</td>
<td>-</td>
<td>-</td>
<td>89 375</td>
<td>-</td>
<td>521 986</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>70 343</td>
<td>-</td>
<td>10 316</td>
<td>-</td>
<td>48 448</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7 267</td>
<td>-</td>
<td>806 336</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>855 717</td>
<td>-</td>
<td>855 717</td>
</tr>
</tbody>
</table>

*Development Data of South of Kalimantan 2011*

OGH=Organosol Gley Humus, PMK=podsolik merah kuning; PMKL=Podsolik Merah Kuning Litosol, KPMK=kompleks podsolik merah kuning
The following table is The Recapitulation of Agriculture Potency of Barito Kuala:

<table>
<thead>
<tr>
<th>Kecamatan</th>
<th>Rubber</th>
<th>Coconut</th>
<th>Oil Palm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tabunganen</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tamban</td>
<td>10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mekarsari</td>
<td>75</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Anjir Pasar</td>
<td>500</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Anjir Muara</td>
<td>25</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Alalak</td>
<td>10</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Mandastana</td>
<td>5</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Belawang</td>
<td>15</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Wanaraya</td>
<td>600</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Barambai</td>
<td>426</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>RantauBadauh</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Cerbon</td>
<td>50</td>
<td>325</td>
<td></td>
</tr>
<tr>
<td>Bakumpai</td>
<td>20</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Marabahan</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Tabukan</td>
<td>35</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Kuripan</td>
<td>10</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Jejangkit</td>
<td>-</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1.701</td>
<td>14,249</td>
<td>450</td>
</tr>
<tr>
<td>Year 2009</td>
<td>1.679</td>
<td>14,249</td>
<td>368</td>
</tr>
</tbody>
</table>

The oil palm cultivation area is 63.73 ha, in 2007 167.85 ha, and then in 2008 it turned into 10,775.85 ha (www.baritokualakab.go.id).
According to the interview with Plantation and Forestry Unit of Barito Kuala Government, there were no conversion concession of agriculture area to oil palm plantation (October 2012). But due to the geological region of Barito Kuala which its large part was wetland (including peatland), the palm cultivation is culturally cultivated in the wetland area. There were misunderstandings about the wetland. Most of people considered wetland area, including peatland, as unusable area, unproductive land. It could be seen on the statement of the interview that it was not crucial thing that wetland, despite its function as environment guard and home for millions biological diversities, converted to oil palm plantation.

Barito Kuala also known for its Gelam (*Melaleuca cajuputi*) forest. Gelam is one of the important trees to be the foundation of the wetland house. The demand of the gelam was sustainable, and gelam only grow on wetland area. But again, the charm of the palm cultivation made people converting Gelam Forest area to expand the palm cultivation.

Basically, the conversion was allowed by Minister Of Agriculture Regulation number 14 year 2009 concerning The Guidelines of the Peatland Utilization for Palm Cultivation gave the chances as long as it met the following criteria:

a. The cultivation shall be on the community land and cultivation area.
b. The thick of the peatland is less than 3 metres.
c. The mineral land substratum below the peatland is not quartz sand and not acid-sulphate land.
d. Level of the peatland maturity was saprik or hemik.
e. Level of the peatland fertility was eutropic.

Thereby, the palm cultivation on wetland should carefully consider on the status of the area utilization according to the spatial planning regulations. In other way, the spatial planning regulations must be considered to the environment law, whether the utilization of the area for palm cultivation could harm the preservation of the environment, especially the wetland environment.

**References**


Benda Beckmann, *Mobile People, Mobile Law Expanding Legal Relations in a Contracting World*, United Kingdom Ashgate Publishing, 2005,


[www.baritokualakab.go.id](http://www.baritokualakab.go.id) diakses pada 20 Oktober 2012.
Analysis Of Barito Channel Tidal Harmonic Pattern And Water Level Rise Effects To Banjarmasin City Hydrotopography

Fathurrazie Shadiq¹, Rony Riduan², and M. Azhari Noor¹

¹ Department of Civil Engineering, Engineering Faculty of Lambung Mangkurat University, Banjarmasin, Indonesia
² Department of Environmental Engineering, Engineering Faculty of Lambung Mangkurat University, Banjarmasin, Indonesia

Abstract
Banjarmasin city which is partly located at lowland area in Barito channel is greatly influenced by Barito estuary water level changes. The effects of global warming phenomena have been identified affecting sea level change. A study is required to analyze the impact of sea water level changes to the hydrotopography condition of Banjarmasin city. The objectives of this research are to analyze tidal and hydrometric data of Barito estuary and channel, prediction of tidal water level pattern using harmonic analysis, and mapping the effects of Barito channel water level changes to Banjarmasin city hydrotopography, related to its flooded area. Tidal harmonic constants (amplitude and phase respectively) obtained from field measurement and harmonic analysis are 1.404 for Z⁰, 0.568; -129.93 for M², 0.587; -144.34 for S², 0.081; 305.76 for N², 0.092; 222.51 for K₁, 0.140; 115.55 for K₂, 0.153; 4.68 for O₁, 0.110; 61.36 for P₁, 0.004; -28.95 for M₄, and 0.0008; 159.23 for MS₄. Tidal characteristic is mixed predominantly semi-diurnal tide (Formzahl number 0.25). Accumulation of water level rise effect in Barito channel and Banjarmasin city hydrotopographic condition are significant factors to the escalation of potential flooded area. Prediction result shows that in the year of 2050 and 2100 water level will rise about 0.48 m and 0.93 m. Potential flooded area will increase significantly if water level reaches 7 m. Precaution and prevention effort is necessary, especially related to drainage network in Banjarmasin city. Drainage channel normalization and revitalization of drainage systems by considering the tidal effects are important to prevent and reduce the water inundation and flooded area in Banjarmasin city.

Keywords: Barito estuary, tidal, Banjarmasin, hydrotopography.

1. Introduction
Currently, there has been strong enough evidence and perceived by humanity that global sea level conditions have improved to a level that is quite alarming and will continue to happen in the future. Several studies indicate that sea level rose occurs significantly in this the 20th century.

The main cause of the increase in global sea level is an increase in temperature caused by the warming of the oceans and the melting of ice sheets in some parts of the world. The research is conducted in Barito estuary and channel, because the rise of water level in Barito estuary (Figure 1) will greatly affect Banjarmasin city hydrotopography. Historical records and previous researches in Barito estuary and its channel show that the sea level steadily increased at 1-2.5 mm per year since year 1900 (Ami et al., 2008).

Since 1992, with the new method of measuring sea level based on analysis of satellite imagery and GIS (Global Information System) based approach, indicates that sea level
rise has reached 3 mm per year. This could lead to a change in tidal characteristics in Barito estuary and its channel. In general, the sea level rise would result in an increase of flooded area in Banjarmasin city (Shadiq dan Fajar, 2008).

![Satellite Imagery of Barito Channel (Google maps, 2012)](image)

The objectives of this research are to analyze tidal and hydrometric data of Barito estuary and channel, prediction of tidal water level pattern using harmonic analysis (least square method), and mapping the effects of water level changes to Banjarmasin city hydrotopography, related to its flooded area.

2. **Method**

Methods used in this research are field tidal and hydrometric measurement of Barito estuary and channel, tidal harmonic constants generation using least square method, tidal prediction calculation, tidal routing analysis to Banjarmasin city, and flooded area estimation. Field measurements performed with tidal data measurement for 29 days and then analyzed using least square method to obtain the tidal harmonic constants (Shadiq, 2007). After obtaining the tidal harmonic constants and tidal prediction, then the hydrodynamic analysis was conducted to estimate water level changes in the vicinity of the Banjarmasin city due to tidal influence (Riduan, 2009). Flooded area is estimated using GIS based analysis.

Softwares used in this research are spreadsheet software, statistical software, tidal harmonic analysis using least square method (HKT software), hydrodynamic analysis using EFDC (Environmental Fluid Dynamics Code) sofware, and GIS’s based flooded area analysis sofware.
3. Research and Discussion

Field measurements of tidal water level was obtained for 29 days. This data was then analyzed using least square method to obtain the tidal harmonic constants \((S_0, M_2, S_2, N_2, K_2, K_1, O_1, P_1, M_4\) and \(M_{S4}\)). The result of least square tidal harmonic analysis is in Table 1. These constants are necessary for the prediction of tidal pattern in Barito Estuary (Shadiq, 2005).

Table 1. Least Square Tidal Harmonic Analysis Result

<table>
<thead>
<tr>
<th>No</th>
<th>Constituents</th>
<th>Symbol</th>
<th>Description</th>
<th>Period (hour)</th>
<th>(\omega) (rad/hour)</th>
<th>Amplitude (m)</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Average water level</td>
<td>(Z_0)</td>
<td>-</td>
<td>-</td>
<td>1.4038</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Main lunar constituent</td>
<td>(M_2)</td>
<td>semi diurnal</td>
<td>12.4206</td>
<td>0.5059</td>
<td>0.5677</td>
<td>-2.2676</td>
</tr>
<tr>
<td>2</td>
<td>Main solar constituent</td>
<td>(S_2)</td>
<td>12.0000</td>
<td>0.5236</td>
<td>0.5866</td>
<td>-2.5192</td>
<td>-144.3386</td>
</tr>
<tr>
<td>3</td>
<td>Lunar constituent, due to Earth</td>
<td>(N_2)</td>
<td>12.6582</td>
<td>0.4964</td>
<td>0.0809</td>
<td>5.3366</td>
<td>305.7635</td>
</tr>
<tr>
<td>4</td>
<td>Soli-lunar constituent, due to the</td>
<td>(K_2)</td>
<td>11.9673</td>
<td>0.5250</td>
<td>0.0917</td>
<td>3.8835</td>
<td>222.5101</td>
</tr>
<tr>
<td>5</td>
<td>Soli-lunar constituent</td>
<td>(O_1)</td>
<td>diurnal</td>
<td>23.9346</td>
<td>0.2625</td>
<td>0.1404</td>
<td>2.0167</td>
</tr>
<tr>
<td>6</td>
<td>Main lunar constituent</td>
<td>(P_1)</td>
<td>25.8194</td>
<td>0.2434</td>
<td>0.1529</td>
<td>0.0816</td>
<td>4.6757</td>
</tr>
<tr>
<td>7</td>
<td>Main solar constituent</td>
<td>(M_4)</td>
<td>24.0658</td>
<td>0.2611</td>
<td>0.1103</td>
<td>1.0710</td>
<td>61.3646</td>
</tr>
<tr>
<td>8</td>
<td>Main lunar constituent</td>
<td>(M_{S4})</td>
<td>quarterly</td>
<td>6.2103</td>
<td>1.0117</td>
<td>0.0037</td>
<td>-0.5052</td>
</tr>
<tr>
<td>9</td>
<td>Soli-lunar constituent</td>
<td>-</td>
<td>6.1033</td>
<td>1.0295</td>
<td>0.0008</td>
<td>2.7791</td>
<td>159.2307</td>
</tr>
</tbody>
</table>

Verification of the tidal component analysis result is conducted by comparing observations data with generated value from tidal component analysis (Figure 2). This proved to be satisfactory, based on the similar pattern of observation data plot and harmonic analysis value. The summary of Barito tidal characteristic is given in Table 2.
Based on the results of pure tidal component analysis, predictive patterns of Barito estuary tidal pattern is obtained (Figure 3). The result of one year water level fluctuation prediction shows varied value of water level in the range of 0-3 m.

Barito estuary water level changes occur due to a variety of influences, including the effects of changes in seabed bathymetry, tidal motion mechanism, as well as the effect of global warming to the sea water level. The research result of sea water level rise estimation for Barito estuary and its channel shows that in the year of 2050 and 2100 water level will rise about 0.48 m and 0.93 m, with total affected flood area in Banjarmasin city is 30,120 km² and 90,260 km².
Banjarmasin city cross sectional profile (Figure 4) is part of analysis result from DEM (digital elevation model) generated from GIS based software. This data is used to estimate the area of Banjarmasin city which is located below predicted Barito water level, and mapping of potential flooded area as the result of water level rise in Barito.

Simulation results (Figure 5 and Figure 6) indicate that the change in Barito channel water level will affect the extent of potential flooded area in Banjarmasin city. Significant impact on the water level rise will occur when it reaches 7 m. At that depth value, the simulation result of potential flooded area in Banjarmasin city increased drastically.

![Figure 4. Banjarmasin City Cross Section Profile](image)

![Figure 5. Water Level Rise Effect to Flooded Area in Banjarmasin City](image)
International Seminar on University-Based Research for Wetland Development
Joint Program Between Lambung Mangkurat University and Government of South Kalimantan Province
Banjarmasin, Indonesia, 26-27th November 2012
4. Conclusions

The tidal harmonic constants (amplitude and phase respectively) obtained from 29 days field measurement and harmonic analysis are 1.404 for $Z_0$, 0.568; -129.93 for $M_2$, 0.587; -144.34 for $S_2$, 0.081; 305.76 for $N_2$, 0.092; 222.51 for $K_2$, 0.140; 115.55 for $K_1$, 0.153; 4.68 for $O_1$, 0.110; 61.36 for $P_1$, 0.004; -28.95 for $M_4$, and 0.0008; 159.23 for $MS_4$.

Tidal characteristic in Barito estuary from the Formzahl number calculation is categorized as mixed predominantly semi-diurnal tide.

This water level rise effect in Barito channel and existing condition of Banjarmasin city hydrotopographic are significant factors to the risk of escalation in flooded area. Prediction result shows that in the year of 2050 and 2100 water level will rise about 0.48 m and 0.93 m. Based on simulation result, existing tidal condition lead to the potential flooded area about 4.781 km². This potential flooded area will increase drastically if Barito water level rises to 7 m.

5. Recommendation

Precaution and prevention effort to reduce the effect of changes in Barito water level is necessary, especially related to drainage system in Banjarmasin city. Drainage channel normalization and revitalization of drainage systems by considering the tidal effects and
ecohydraulic are important to prevent and reduce the risk of flooded area in Banjarmasin city.

**References**


Effect Of Planctonic Microalgae Growing On Reduction Of Ammonia Concentration In Waste Water Used By Holding Of Giant Fresh Water Prawn Caught

Djasmani Hisbi

Faculty of Fisheries, Lambung Mangkurat University, Banjarbaru, South Kalimantan, Indonesia

Abstract

A laboratory experiment of planctonic microalgae growth found the reduction of the ammonia level from around 50 ppm to be 1 ppm during 24 days of experiment. The reduction of ammonia concentration was faster when an aeration was implicated, that was the concentration of ammonia from around 70 ppm to be 0.5 ppm during 8 days of the experiment. High concentration of the ammonia in the waste water was allowed by high microalgae abundance. The fast reduction of ammonia concentration was, nevertheless, incorporated by low growth or low abundance of planctonic microalgae living in the waste water.

1. Introduction

After catching of giant freshwater prawn (*Macrobrachium rosenbergii*) in the natural water resource wetland such as river, canal irrigation, marsh, and other water areas, most commonly done by the farmer, to put the live prawn in a temporary holding place containing normal fresh water. The live prawn, as normal animal, is doing metabolism activity inside of his body and resulting some kind of chemical dirty material including ammonia in the holding water. The previous research done by Hisbi et al. (1993) mentioned that water holding for the prawn contained ammonia as high as 7.28 ppm after being used 4 days at density of 0.23 kg prawn in 1 liter water. More densities of the prawn would result in higher concentration of ammonia.

Waste water containing ammonia at concentration more than 1 ppm will be toxic for water animals such as fish and shrimp/prawn, at commonly larval and juvenile stages (Boyd, 1989). Solution of ammonia in water, nevertheless, will benefit for growth of some kinds of water microorganisms such as planctonic microalgae (Wijaya et al., 1993).

In order to find beneficial effect of planctonic microalgae growing on reduction of ammonia concentration in waste water that had been used for temporary holding of fresh prawns caught, a laboratory experiment was conducted.

2. Method

This experiment was done in a laboratory using 2 factor of a factorial design (Sudjana, 1989). Factor A was concentration of ammonia in waste water and factor B was inoculation number of planctonic microalgae. Each factor used 3 stages with 3 replicates. There were done 2 experiments i.e. the first and second experiments were successively involved and without involved aerations. The brief factorial design of the experiments showed on Table 1 as follows.

---

98
Table 1. Brief experiment designed

<table>
<thead>
<tr>
<th>Factor B : Replication :</th>
<th>Factor A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 K</td>
</tr>
<tr>
<td>2 N : 3 : P1</td>
<td>P2</td>
</tr>
<tr>
<td>1 N : 3 : P4</td>
<td>P5</td>
</tr>
<tr>
<td>0 N : 3 : P7</td>
<td>P8</td>
</tr>
</tbody>
</table>

Notes:
1. K value was ammonia concentration that were 70 ppm and 50 ppm in the beginning of the first and second experiments successively.
2. N value was planctonic microalgae abundance in 5 ml waste water that were 464.5 ind./ml and 734.8 ind./ml in the beginning of the first and second experiments successively.

Data obtained from the two experiments involving ammonia (ppm) and planctonic microalgae abundance (ind./ml.) were done every 2 days during 14 days experiment for ammonia until the reduction to be around 0.5 ppm of the first experiment and every 4 days during 24 experiments for ammonia until the reduction to be around 1 ppm of the second experiment. The obtained data were tabulated and analyzed using variance analysis (Steel dan Torrie, 1993). The processing analysis were directed to prove a hypothesis that “the growth of planctonic microalgae decreased ammonia concentration in waste water after use as holding or after caught of freshwater prawn Macrobrachium rosenbergii.”

Waste water of the experiment was prepared amount of freshwater that used for temporary (some days) holding amount of live animal prawn after caught by the farmer from Martapura river, until the waste water containing ammonia released from metabolism activity of the live prawn body.

3. Results

1. Ammonia concentration.

Ammonia concentration decreased fastly in waste water of the first experiment (with implicated aeration), that was from 70 ppm in beginning (T1.1) to be around 0.5 ppm (T1.4) in the last of experiment. Result analysis of the data showed higher different significantly between columns (ammonia concentration), but between rows (planctonic microalgae inoculation) and interaction between column and row showed without different significantly. Different with the first experiment, data for the second experiment (without incorporated aeration) showed that significantly different and normal different were done between columns, between rows, even though column and row interaction. Ammonia concentration on the second experiment (without incorporated aeration) showed lower reduction (that was 50 ppm decreased to 0.5 ppm during 24
days) compared with the first experiment (with implicated aeration) (that was 70 ppm to be around 1 ppm during days 14 days).

Data for ammonia concentration was presented at appendix 1.

2. Planctonic microalgae abundance.

Planctonic microalgae abundance was lower found in the first experiment. The higher abundance value were found as 97.3 ind./ml. in waste water first experiment (T1.3, P2 day 6), but in the second experiment the higher abundance value were found as 2996.7 ind./ml. in the waste water secon experiment (T2.3, P8 day 12).

Analysis data of planctonic microalgae abundance in the firt experiment showed higher different significantly between columns, but between rows and interaction column and row were without different significantly. Next for the second experiment, higher different signficantly or different significantly that showed by data analysis only for between columns, but between rows and interaction column and row was without different significantly.

There were found 11 genus of microalgae identificated in inoculation and next identification found 21 genus of microalga growth in the first experiment. The dominat planctonic microalgae growth at first experiment involved genus Coelastrum, Paranema, Tetraedron, and Phytoconis. In the second experiment identified 15 genus, and Scenedesmus, Chlorella, and Cocystis more frequently found in the second experiment.

Data for abundance value and identified genus of planctonic microalgae were presented at appendix 2 and appendix 3, respectively.

4. Discussion

The aeration process was implicated in the first experiment in order to homogenize nutrition and temperature inside of waste water as medium for growth of planctonic microalgae (Martosudarmo and Wulani, 1990). Without estimated before, ammonium concentration in the first experiment was decrease fastly, accompanied by low abundance of the planctonic microalgae. During 8 days of experiment, the ammonia concentration decreased from 70 ppm to be around 0.5 ppm, together with the higher abundace microalgae at the only 97.3 ind./ml. and optimum microalgae abundace happened at day 6 of the experiments.

Different condition was experinced by the second experiment which was conducted without aeration incoparated. Ammonia concentration decreased slowly from 50 ppm at the beginning day becoming around 1 ppm after the experiment was conducted during 24 days. At the time, growth of planctonic microalgae abundaced increasingly. During 24 days experiment, ammonium concentration decrease slowly, while abundance planctonic microalgae increased fastly. At the 4 days experiment, abundance planctonic microalgae increased hihger fastly compared with experinced in the first experiment. Condition of the second experiment without aeration incoparated became the good planctonic microalage growth in the waster water (Fulks and Main, 1991). Possibly, growth planctonic microalgae in waste water could produce organic plant that can be processed to be as Singgle Cell Protein or natural food for larvae and juvenile fishes and prawns for fishery business (Nobile, 1986).
5. Conclusion

Growth of planctonic microalgae using waste water that had been used for temporary handling of giant fresh prawn *microbrachium rosenbergii* could reduced ammonia concentration and beneficial for growing and increasing abundance planctonic microalgae. Aeration incorporated in the process decreased fastly ammonia concentarion but obstructed or prohibited growth of planctonic microalgae.

6. Acknowledgements

The author is grateful to Rector of Lambung Mangkurat University, Prof.Dr. H.Muhammad Ruslan, MS. for providing the workshop/seminar event. Special thanks to the head with members of Organizing Committee, especially for their hard works for Dr. Ahmad Alim Bachri, SE., MSi. and Dr. Ir. H. Abdul Hadi, M.Agr. as success handling of this workshop/seminar.

References


### Appendix 1. Data of Ammonia Concentration.

1. Ammonia concentration (NH₃-N) averagely (ppm) at the first experiment.

<table>
<thead>
<tr>
<th>Time Recordings</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P1</td>
</tr>
<tr>
<td>T1.0</td>
<td>70.0</td>
</tr>
<tr>
<td>T1.1</td>
<td>60.0</td>
</tr>
<tr>
<td>T1.2</td>
<td>20.0</td>
</tr>
<tr>
<td>T1.3</td>
<td>10.7</td>
</tr>
<tr>
<td>T1.4</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Notes:
Data were recorded every 2 days.

2. Ammonia concentration (NH₃-N) averagely (ppm) at the second experiment.

<table>
<thead>
<tr>
<th>Time Recordings</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P1</td>
</tr>
<tr>
<td>T2.0</td>
<td>50.0</td>
</tr>
<tr>
<td>T2.1</td>
<td>25.0</td>
</tr>
<tr>
<td>T2.2</td>
<td>16.7</td>
</tr>
<tr>
<td>T2.3</td>
<td>8.3</td>
</tr>
<tr>
<td>T2.4</td>
<td>5.0</td>
</tr>
<tr>
<td>T2.5</td>
<td>3.3</td>
</tr>
<tr>
<td>T2.6</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Notes:
Data were recorded every 4 days.
Appendix 2. Data of Abundance planctonic microalgae.

1. Abundance value of planctonic microalgae at the first experiment (ind./ml.)

<table>
<thead>
<tr>
<th>Time Recordings</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>P2</td>
</tr>
<tr>
<td>T1.0</td>
<td>-</td>
</tr>
<tr>
<td>T1.1</td>
<td>24.0</td>
</tr>
<tr>
<td>T1.2</td>
<td>46.0</td>
</tr>
<tr>
<td>T1.3</td>
<td>68.7</td>
</tr>
<tr>
<td>T1.4</td>
<td>67.3</td>
</tr>
<tr>
<td>T1.5</td>
<td>40.0</td>
</tr>
<tr>
<td>T1.6</td>
<td>20.7</td>
</tr>
<tr>
<td>T1.7</td>
<td>8.7</td>
</tr>
</tbody>
</table>

Notes:
Data were recorded every 2 days.

2. Abundance value of planctonic microalgae at the second experiment (ind./ml.)

<table>
<thead>
<tr>
<th>Time Recordings</th>
<th>Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>P2</td>
</tr>
<tr>
<td>T2.0</td>
<td>-</td>
</tr>
<tr>
<td>T2.1</td>
<td>633.3</td>
</tr>
<tr>
<td>T2.2</td>
<td>904.7</td>
</tr>
<tr>
<td>T2.3</td>
<td>1337.3</td>
</tr>
<tr>
<td>T2.4</td>
<td>646.0</td>
</tr>
<tr>
<td>T2.5</td>
<td>387.3</td>
</tr>
<tr>
<td>T2.6</td>
<td>213.3</td>
</tr>
</tbody>
</table>

Notes:
Data were recorded every 4 days.
Appendix 3. Data of Dominance value for Planctonic Microalgae

1. Dominance value for genus name of planctonic microalgae growth in the first experiment.

<table>
<thead>
<tr>
<th>Time recording</th>
<th>Genus name</th>
<th>Dominance value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Abundance (K)</td>
</tr>
<tr>
<td>T1.1</td>
<td>Coelastrum</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>Paranema</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Phytoconis</td>
<td>0.9</td>
</tr>
<tr>
<td>T1.2</td>
<td>Coelastrum</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td>Eudorina</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>Tetraedron</td>
<td>1.4</td>
</tr>
<tr>
<td>T1.3</td>
<td>Coelastrum</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>Paranema</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td>Tetraedron</td>
<td>2.1</td>
</tr>
<tr>
<td>T1.4</td>
<td>Coelastrum</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>Paranema</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>Chlamydomonas</td>
<td>1.7</td>
</tr>
<tr>
<td>T1.5</td>
<td>Coelastrum</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>Paranema</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Tetraedron</td>
<td>1.1</td>
</tr>
<tr>
<td>T1.6</td>
<td>Coelastrum</td>
<td>1.7</td>
</tr>
<tr>
<td></td>
<td>Paranema</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>Phytoconis</td>
<td>0.9</td>
</tr>
<tr>
<td>T1.7</td>
<td>Coelastrum</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>Paranema</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>Phytoconis</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Notes:
1. K was abundance value (ind./ml.).
2. F was frequensi.

2. Dominance value for genus name of planctonic microalgae growth in the second experiment.
<table>
<thead>
<tr>
<th>Time recording</th>
<th>Genus name</th>
<th>Dominance value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Abundance (K)</td>
<td>Frequence (F)</td>
</tr>
<tr>
<td>T2.1</td>
<td><em>Scenedesmus</em></td>
<td>31.3</td>
</tr>
<tr>
<td></td>
<td><em>Chlorella</em></td>
<td>30.3</td>
</tr>
<tr>
<td></td>
<td><em>Cocystis</em></td>
<td>27.6</td>
</tr>
<tr>
<td>T2.2</td>
<td><em>Scenedesmus</em></td>
<td>64.4</td>
</tr>
<tr>
<td></td>
<td><em>Chlorella</em></td>
<td>56.3</td>
</tr>
<tr>
<td></td>
<td><em>Tetraedron</em></td>
<td>56.0</td>
</tr>
<tr>
<td>T2.3</td>
<td><em>Chlorella</em></td>
<td>151.1</td>
</tr>
<tr>
<td></td>
<td><em>Scenedesmus</em></td>
<td>141.9</td>
</tr>
<tr>
<td></td>
<td><em>Cocystis</em></td>
<td>95.3</td>
</tr>
<tr>
<td>T2.4</td>
<td><em>Scenedesmus</em></td>
<td>73.0</td>
</tr>
<tr>
<td></td>
<td><em>Chlorella</em></td>
<td>68.0</td>
</tr>
<tr>
<td></td>
<td><em>Cocystis</em></td>
<td>52.7</td>
</tr>
<tr>
<td>T2.5</td>
<td><em>Chlorella</em></td>
<td>38.2</td>
</tr>
<tr>
<td></td>
<td><em>Scenedesmus</em></td>
<td>35.9</td>
</tr>
<tr>
<td></td>
<td><em>Cocystis</em></td>
<td>30.3</td>
</tr>
<tr>
<td>T2.6</td>
<td><em>Chlorella</em></td>
<td>17.2</td>
</tr>
<tr>
<td></td>
<td><em>Scenedesmus</em></td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td><em>Cocystis</em></td>
<td>14.7</td>
</tr>
</tbody>
</table>

Notes:
1. K was abundance value (ind./ml.).
2. F was frekwensi.
Study Of Technical And Non Technical Aspects Of Tambak Hanyar Polder Management

Novitasari) and Reza Adhi Fajar)

)Engineering Faculty, Lambung mangkurat University, Ministry of Education and Culture
Email: NS_Vita@yahoo.com

)Civil Engineering Departement, POLIBAN, Ministry of Education and Culture
Hasan Basry Street, Banjarmasin City, South Kalimantan Province, Indonesia
Email: reza_poliban@yahoo.com

Abstract

Tambak Hanyar Polder is a folk polder in South Kalimantan with an area of 1474 hectares and functional polder area is 1050 hectares that lie in Astambul District and Martapura District with embankment along 19 km. The Polder management still held together by people living in and around polder. This study used the technical approach and non-technical approach to the form or questionnaire persuasive approach, frequently asked questions and provide workshops directly to the public about the importance of community participation in resource management, particularly swamp people living in the Tambak Hanyar Polder. The technical aspects were studied by direct observation and public consultation, involving local government officials around the polder, religious leaders and some of community delegations. The results showed that some re-design have to be done to improving the quality of polder in irrigation water system. Conclusions of technical aspects are repairing gate and tertiary channels, and adding pump system. Non technical aspects found a solution to the lack of community knowledge about the importance of participation in the development Tambak Hanyar Polder, where the polder conditions can be used for mixed farming of the diversification of agriculture, crop and ducks farms in the polder to solve problems.

Keyword: community participation, management, polder, Tambak Hanyar Polder

1. Introduction

In general, Tambak Hanyar Polder is a swamp area with the kind of non-tidal swamp, in low-land topography, so the area can be flooded due to rain because of poor drainage. This area needed an embankment to separate hydrological regime from water outside. The polder area can be used for agriculture. Tambak Hanyar Polder is a folk polder in South Kalimantan with an area of 1474 hectares and functional polder area is 1050 hectares that lie in Astambul District and Martapura District with embankment along 19 km, included 11 villages, namely Kampung Melayu, Kampung Melayu Tengah, Kampung Melayu Ilir, Akar Baru, Banua Anyar, Antasan Senor, Tambak Anyar Ulu, Tambak Anyar Ilir, Astambul, Sungai Tuan Ulu. This polder only 10 km apart from Martapura city.

Tambak hanyar embankment has until recently been used by comunity as transportation access between villages. Tambak Hanyar Polder is also surrounded by a river whose source of water comes from Riam Kiri River, Martapura River, Tuan River and Tambangan River. At polder passed 5 river which also serves as irrigation system, e. i., Haji Ali River, Jakaria River, Rantau Bujur River, Pasipatan River dan Tambak Hanyar River. There are 5 main gates in those river, and there are 31 smaller gates that function as intake and drainage system, and well known as tabat. This polder equipped with
gates and channels built by community. Polder management still held together by people living in and around polder.

In Tambak Hanyar Unit, people cultivate their land with local paddy. Drainage system in Tambak Hanyar is not functioning optimally, caused by the silting of channels and the overflow of water due to rainfall in the downstream polder. As the result, paddy field in the area are flooded continuously. Nowadays, most of embankment of Tambak Hanyar Polder broken and a decline in some parts of the embankment so that the embankment submerged in water. And almost all the gates do not work properly.

![Figure 1. Polder Tambak Hanyar (Study Area)](image)

with:
I = H.Ali Basin  
II = Jakaria Basin  
III = Pasipatan Basin  
IV = Rantau Bujur Basin  
V = Tambak Hanyar Basin
= rice field  
= Embankment  
= Bridge and gate  
= secondary river  
= primary river  
= Secondary sluice  
= Basin Boundary

Figure 1. Polder Tambak Hanyar (Study Area)
2. Purpose
This research focuses on non technical aspect of polder management by manage the community with the goal of community involvement in finding solutions for sustainable management of polder for the benefit of the communities around the polder due to lack of community participation, beside technical aspect in polder management.

3. Method
This study used the technical approach and non-technical approach to the form or questionnaire persuasive approach, frequently asked questions and provide workshops directly to the public about the importance of community participation in resource management, particularly swamp people living in the Tambak Hanyar Polder. The technical aspects were studied by direct observation and public consultation, involving local government officials around the polder, religious leaders and some of community delegations.

4. Results
Based on that questionnaire and field study at polder and around polder, the acquired image on the polder system problems that can be seen in figure 2.

![Figure 2. Mapping Issues of Tambak Hanyar Polder](image)

4.1 Technical Aspect of Polder Management
Problem identification in the technical aspect of water system in polder management include decreased quality and performance of the polder system, the quality and quantity of water (hydrological and hydrometric) which then need to be examined further scientifically to formulate environmental improvements, planting system (water system and improvement of soil) accordance with the needs of the community.
In a related problem solving technical aspects gained a few points improvement include:

1. Repairing System for Water Management in the Polder, for example:
   a. to repair entry gate (by employing pumps)
   b. to repair disposal gate (by employing pumps),
   c. to repair river system in polder, and
   d. to repair lower embankment to bound water regime.

2. Repairing integrated Basin System, *one rive, one man, one management* from upstream area, midle area and downstream area, for example:
   a. to repair upstream of Martapura Basin that had been changed to mining that make river sediment,
   b. to improve quality of water released by mining.

4.2 Non Technical Aspect of Polder Management

The inventory found that only 3 gates found from 5 main gates, whose condition is poorly maintained, and some tabat (small gates) was broken. In addition to the technical aspects that lead to less optimal development Tambak Hanyar Polder, lack of community participation that can be seen in their lack of interest in the community to become members of water use farmer association or well known as P3A.

Problems caused by non-technical aspects of the declining of agricultural products and by taking into account the needs of the community. Non technical management include several aspects of the institutional, empowerment and participatory monitoring.

5. Discussion
Based above research, researchers suggest operations and maintenance management in Tambak Hanyar which include:


b. Preparation of Operation and Maintenance: Organization; Staff Operations and Maintenance; Facilitation & Equipment; Description of Duties & Operations and Maintenance manuals; Systems & Inventory Data

c. Society P3A: organizational structure; Operation and Maintenance of the P3A; Formation P3A

The suggestion is shematically given in Figure 4.

Figure 4. Problem Solution of Institutional Aspects of Tambak Hanyar Management

In addition to improvements to the points above, the technical improvements of river in polder system with spatial irrigation field are also suggested. For these, people should be willing to sacrifice by providing some of their land to river improvement. The improvement can also be done by applying diversification farming systems that well known as “watun” irrigation system by planting crops in the different month between upstream polder area and downstream polder area, that expected to increase agriculture system in polder.

6. Conclusions

The results showed that some re-design have to be done to improving the quality of polder in irrigation water system. Conclusions of technical aspects are repairing gate and tertiary channels, and adding pump system. Non technical aspects found a solution to the lack of community knowledge about the importance of participation in the development Tambak Hanyar Polder, where the polder conditions can be used for mixed farming of the diversification of agriculture, crop and ducks farms in the polder to solve problems.
Funded By:

The National Sector Capacity Building Network (NSCBN Project) under WISMP 2010 with JSDA Indonesia, Kalimantan Region.

Reference


Hearing Function Conservation By Ear Plug And Traditional Sarong Method: Observational Study Among “Saijaan” Fisherman Pulau Laut Utara Sub District, Kotabaru

1*Qomariyatus S, 2 Ratna S, 3 Leni M, 4M.Trisetya HS

1,2,4 Occupational Health and Safety Department, Public Health Major, Medical Faculty, Lambung Mangkurat University

3 Environment Health Department, Public Health Major, Medical Faculty, Lambung Mangkurat University

*email: publichealth.unlam@gmail.com

Abstract

Noise can induce temporary and permanent auditory effect which is influenced by intensity of noise. Saijaan fisherman in Kotabaru use machine with high intensity of noise to catch the fish. This research aimed to examine the effectivity of ear plug and traditional sarong as a hearing threshold value conservation among Saijaan Fisherman Pulau Laut Utara Sub District, Kotabaru. This is a quasi experimental research by pre and post test one group design. Population and Sample by simple random sampling as many as 325 fishermen members Saijaan Fisherman Pulau Laut Utara Sub District, Kotabaru who met the inclusion criteria (same engine type, Age 23-42 years, working period 5-15 years, are suffering from hearing loss since birth). it is known that 25 people (78.1%) respondents had nerve deafness and 7 of 32 respondents (21.9%) respondents had nerve deafness. Because the average length of exposure of 66 minutes at 103.16 dB noise, long supposed to 103.16 dB noise exposure up just 7.5 minutes. Fishermen are exposed to the sound of the ship's engine in under 30 minutes still no one had nerve deafness by 4 people (12.5%). respondents exposed to 110 dB noise should only be exposed to a maximum of 2 minutes. Fishermen are exposed to the sound of boat engines in more than 30 minutes had nerve deafness as many as 21 people (65.63%) and fishermen were exposed to the sound of boat engines for more than 30 minutes were not as many nerve deafness had 3 people (9.38%). The results of the chi-square of 95% between the long exposure noise machine ships with hearing impairment threshold, here is an expected cell values <5, Fisher's Exact Test obtained p-value = 0.047 (p-value <0.05), test statistically there is a long exposure noise machine ships with a hearing impairment threshold fishermen Saijaan. Noise intensity exceeds the threshold may result in hearing loss and deafness, attention from the government and stockholder provide training in occupational diseases such as minimizing noise. To fishermen in order to use personal protective equipment such as earplugs to reduce exposure to the ship's engine sound intensity.

Keyword: noise, ear plug, traditional sarong, fishermen saijaan, hearing threshold value

1. Introduction

Health and safety is an important issue in any operational process in both traditional and modern sectors, especially in a society that is being moved from a custom switch to
other habits (1). The total area of 1,860,359.67 km² Indonesia and 37,530, is a 52 km² area of South Kalimantan. Indonesia has 17,504 islands are scattered throughout the country, and 320 are on the island of Borneo island (2). While the vast waters of Indonesia reached 5.8 million km² (3). Until the year 2004 the number of marine fishermen particularly in South Kalimantan reached 66,697 people and 24% of this amount or 15,961 people in the District Kotabaru (4). fisherfolk sense that every working person catching fish or directly involved in fishing and fish management is done by the family (5).

The fishermen catch fish on a fishing line 1 (one) includes coastal waters measured from sea level at the lowest ebb on every island up to 6 (six) miles towards the sea (6). The noise levels above 85 dB can cause irreversible disruption in the ear (choclea) even on other structures. Noise level Cleaner can also disrupt work activities, causing disruption of power from the Agency for Healthcare research (WHO) report, in 1988 there were 8-12% of the population worldwide suffer from occupational diseases are a result of noise and in some forms. That number is expected to continue to increase each year (8).

Hearing loss of 3.85% for impulsive noise and hearing loss of 27.78% for continuous noise. And the relationship between the period of employment with hearing loss (9). The monitoring that level, most fishermen are impaired thresholds that level / volume everyday talk using voice above normal (loud). (7).

2. Objective
This research aimed to examine the effectivity of ear plug and traditional sarong as a hearing threshold value conservation among Saijaan Fisherman Pulau Laut Utara Sub District, Kotabaru.

3. Method
This is quasi experimental research by pre and post test one group design.

Population and Sample use limited population, fishermen included members Saijaan Pulau Laut Utara Sub District, Kotabaru that meet the following inclusion criteria (29): the same type of engine, Age between 23-42 years, working period 5-15 years, are suffering from hearing loss since birth. Total population 66 people of 336 fishermen who had diinklusi. The sample with simple random sampling. (30) total sample of 35 people.

4. Results And Discussion
Tabel 1. Measurement of Respondent Hearing

<table>
<thead>
<tr>
<th>Number of Respondent</th>
<th>Left Rinne</th>
<th>Right Rinne</th>
<th>Webber</th>
<th>Left Schawabach</th>
<th>Right Schawabach</th>
<th>Conclusion</th>
<th>Noise Intensity (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent 1</td>
<td>Positive</td>
<td>Positive</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>109</td>
</tr>
<tr>
<td>Number of Respondent</td>
<td>Left Rinne</td>
<td>Right Rinne</td>
<td>Webber</td>
<td>Left Schawabach</td>
<td>Right Schawabach</td>
<td>Conclusion</td>
<td>Noise Intensity (dB)</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------</td>
<td>-------------</td>
<td>--------</td>
<td>-----------------</td>
<td>------------------</td>
<td>------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Respondent 2</td>
<td>Negative</td>
<td>Positive</td>
<td>Right</td>
<td>Abridgment</td>
<td>-</td>
<td>Not</td>
<td>95</td>
</tr>
<tr>
<td>Respondent 3</td>
<td>Positive</td>
<td>Negative</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>101</td>
</tr>
<tr>
<td>Respondent 4</td>
<td>Positive</td>
<td>Negative</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>109</td>
</tr>
<tr>
<td>Respondent 5</td>
<td>Positive</td>
<td>Positive</td>
<td>Right</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>110</td>
</tr>
<tr>
<td>Respondent 6</td>
<td>Positive</td>
<td>Positive</td>
<td>Nothing</td>
<td>Abridgment</td>
<td>-</td>
<td>Not</td>
<td>97</td>
</tr>
<tr>
<td>Respondent 7</td>
<td>Positive</td>
<td>Positive</td>
<td>Nothing</td>
<td>Abridgment</td>
<td>-</td>
<td>Not</td>
<td>95</td>
</tr>
<tr>
<td>Respondent 8</td>
<td>Positive</td>
<td>Positive</td>
<td>Right</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>102</td>
</tr>
<tr>
<td>Respondent 9</td>
<td>Positive</td>
<td>Positive</td>
<td>Right</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>104</td>
</tr>
<tr>
<td>Respondent 10</td>
<td>Positive</td>
<td>Positive</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>102</td>
</tr>
<tr>
<td>Respondent 11</td>
<td>Positive</td>
<td>Positive</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>98</td>
</tr>
<tr>
<td>Respondent 12</td>
<td>Positive</td>
<td>Positive</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>107</td>
</tr>
<tr>
<td>Respondent 13</td>
<td>Positive</td>
<td>Positive</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>109</td>
</tr>
<tr>
<td>Respondent 14</td>
<td>Positive</td>
<td>Positive</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>106</td>
</tr>
<tr>
<td>Respondent 15</td>
<td>Positive</td>
<td>Positive</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>110</td>
</tr>
<tr>
<td>Number of Respondent</td>
<td>Left Rinne</td>
<td>Right Rinne</td>
<td>Webber</td>
<td>Left Schawabach</td>
<td>Right Schawabach</td>
<td>Conclusion</td>
<td>Noise Intensity (dB)</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------</td>
<td>-------------</td>
<td>--------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Respondent 16</td>
<td>Positive</td>
<td>Positive</td>
<td>Right</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>101</td>
</tr>
<tr>
<td>Respondent 17</td>
<td>Positive</td>
<td>Positive</td>
<td>Right</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>101</td>
</tr>
<tr>
<td>Respondent 18</td>
<td>Positive</td>
<td>Positive</td>
<td>Right</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>110</td>
</tr>
<tr>
<td>Respondent 19</td>
<td>Positive</td>
<td>Positive</td>
<td>Nothing</td>
<td>Abridgment</td>
<td>-</td>
<td>Not</td>
<td>98</td>
</tr>
<tr>
<td>Respondent 20</td>
<td>Positive</td>
<td>Positive</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>104</td>
</tr>
<tr>
<td>Respondent 21</td>
<td>Positive</td>
<td>Positive</td>
<td>Nothing</td>
<td>Abridgment</td>
<td>-</td>
<td>Not</td>
<td>95</td>
</tr>
<tr>
<td>Respondent 22</td>
<td>Positive</td>
<td>Positive</td>
<td>Nothing</td>
<td>Abridgment</td>
<td>-</td>
<td>Not</td>
<td>97</td>
</tr>
<tr>
<td>Respondent 23</td>
<td>Positive</td>
<td>Positive</td>
<td>Right</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>99</td>
</tr>
<tr>
<td>Respondent 24</td>
<td>Positive</td>
<td>Positive</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>107</td>
</tr>
<tr>
<td>Respondent 25</td>
<td>Positive</td>
<td>Negative</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>107</td>
</tr>
<tr>
<td>Respondent 26</td>
<td>Positive</td>
<td>Positive</td>
<td>Nothing</td>
<td>Abridgment</td>
<td>-</td>
<td>Not</td>
<td>99</td>
</tr>
<tr>
<td>Respondent 27</td>
<td>Positive</td>
<td>Positive</td>
<td>Nothing</td>
<td>Abridgment</td>
<td>-</td>
<td>Not</td>
<td>100</td>
</tr>
<tr>
<td>Respondent 28</td>
<td>Positive</td>
<td>Positive</td>
<td>Right</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>110</td>
</tr>
<tr>
<td>Number of Respondent</td>
<td>Left Rinne</td>
<td>Right Rinne</td>
<td>Webber</td>
<td>Left Schawabach</td>
<td>Right Schawabach</td>
<td>Conclusion</td>
<td>Noise Intensity (dB)</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------</td>
<td>-------------</td>
<td>--------</td>
<td>-----------------</td>
<td>-----------------</td>
<td>-----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Respondent 29</td>
<td>Positive</td>
<td>Positive</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>107</td>
</tr>
<tr>
<td>Respondent 30</td>
<td>Positive</td>
<td>Negative</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>104</td>
</tr>
<tr>
<td>Respondent 31</td>
<td>Positive</td>
<td>Positive</td>
<td>Nothing</td>
<td>Abridgment</td>
<td>-</td>
<td>Not</td>
<td>98</td>
</tr>
<tr>
<td>Respondent 32</td>
<td>Positive</td>
<td>Negative</td>
<td>Left</td>
<td>Abridgment</td>
<td>-</td>
<td>Nerve deafness</td>
<td>110</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>103.16</td>
</tr>
</tbody>
</table>

Based on the table 1, respondents who experienced nerve deafness as many as 25 of the 32 respondents (78.1%) and were not as many as 7 people out of 32 respondents (21.9%).

Table 2 Distribution Frequency of Hearing Protective Equipment Using (ear plug) among respondent

<table>
<thead>
<tr>
<th>Earplug using</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine</td>
<td>14</td>
<td>43.17</td>
</tr>
<tr>
<td>Not Routinely</td>
<td>18</td>
<td>56.25</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
<td>100</td>
</tr>
</tbody>
</table>

From Table 2 is known that most of the fishermen are not regular in using ear plugs. The fishermen felt ear plug that they use is not convenient to their ears as they are not used, so some fishermen still not routine in using ear plugs.
From Table 3 it is known that the majority of respondents (78.12%) had hearing impairment negatively. Hearing impairment can be affected by many factors, one of which is the high noise and not using APP (ear plug) properly.

In the implementation of the measures contained fewer distractions there are voices from around the measurement. It can not affect the maximum results in the can. In addition, there are no rooms are soundproofed so that the measurement is only done in the room which is considered approximately constant. Then also the honesty of respondents currently function measurements hear.

Table 4. Hearing Function based on Hearing Protective Equipment using obedience

<table>
<thead>
<tr>
<th>Hearing protective equipment</th>
<th>ROUTINE</th>
<th>Count</th>
<th>Expected Count</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Positive</td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,1</td>
<td>10,9</td>
<td>14,0</td>
</tr>
<tr>
<td>NOT ROUTINELY</td>
<td></td>
<td>5</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,9</td>
<td>14,1</td>
<td>18,0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>7</td>
<td>25</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7,0</td>
<td>25,0</td>
<td>32,0</td>
</tr>
</tbody>
</table>

From Table 4 is known there are 2 of 14 fishermen that use hearing protective equipment routinely experience a decline in function positively hear. While 5 of 18 fishermen that use hearing protective equipment experienced a decline in the function of hearing positive. Statistical test results are presented in Table 5.
Table 5. Analysis of effect hearing protective equipment and hearing function

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymp. Sig. (2-sided)</th>
<th>Exact Sig. (2-sided)</th>
<th>Exact Sig. (1-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>0.839(b)</td>
<td>1</td>
<td>0.360</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuity Correction(a)</td>
<td>0.235</td>
<td>1</td>
<td>0.628</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>0.867</td>
<td>1</td>
<td>0.352</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fisher’s Exact Test</td>
<td></td>
<td></td>
<td></td>
<td>0.426</td>
<td>0.318</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>0.813</td>
<td>1</td>
<td>0.367</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

On the assumption that prior to the implementation of this study was no effect of the use of hearing protection devices for hearing function, but from the results of the study states that there is no effect of the use of hearing protection devices for hearing function. This can happen because the influence of other factors such as the sensitivity of someone who has a wide range.

This study links between the use of hearing protection devices with functions hear the fishermen members Insan. The lack of influence between two variables can occur because it is influenced by the length of exposure per day, years of service, the correct way of using APP and others. This is what makes the relationship to the two variables is meaningless.

P-value obtained is greater than the alpha $P > 0.05$, not significant or meaningful hypothesis is rejected. It can be seen in the results of the proportion of the risk with no risk of between fishermen that use APP routine and non-routine there is not a significant difference, it can be seen in the comparison between the two criteria is as much as 2/14 or 0.14 fisherman who had a reduction in the use of APP hear regularly and 5/18, or 0.27 fisherman who had a reduction hearing on the use of a non-routine APP. From these calculations show that the proportion of the difference between routine and non-routine has a relatively small difference is not significant, so it can not show any significant effect.

Risk factors that cause accidents systematically fall into three groups: environmental factors, occupational factors and human factors. In addition to these factors, accidents can also occur due to the behavior of labor that do not use Personal Protective Equipment (PPE), which serves as a tool to protect workers from possible exposure to workplace hazards that cause accidents.
5. Conclusion And Recommendation

5.1. Conclusion

1. 56.25% respondent do not use hearing protective equipment routinely
2. 78.12% respondent had hearing impairment negatively
3. There is no significant effect of hearing protective equipment using and hearing function.

5.2. Recommendation

Need to perform measurements using more modern tools such as audimetry. In addition, there needs to be a better supervisor to oversee compliance fishermen use a hearing protection (ear plugs), by making a family member or chairman of Insan as supervisor. Need to be examined in a larger number of respondents and longer term research.

Reference


Physical and Numerical Modelling of The Mitigation of Settlements due to Footing Interaction in Clay

Rustam Effendi
Departement of Civil Engineering, University of Lambung Mangkurat
E-mail: rustamff@googlemail.com

Abstract

Physical model tests are described in which two closely-spaced strip footings were loaded in sequence and the deformations in the underlying kaolin clay were determined using particle image velocimetry. The insertion of a vertical wall, partially penetrating the clay between the footings, was studied as a possible means of mitigating interaction effects but was only found to be effective if the wall was vertically restrained. This was confirmed in finite element analyses of the model tests that are also described. The analyses were generally successful in reproducing the observed behaviour patterns, including the asymmetry that developed as a consequence of the loading sequence. Additional restraints that existed in the physical models probably accounted for an incorrect prediction of the sense of tilting of one of the foundations.

Keywords: footing, clay, settlement, deformation.

1. Introduction

Geotechnical engineers are aware that the interaction of stresses applied to compressible soil by closely spaced footings may result in tilting of the footings and unwelcome differential settlements. This can occur if the footings are loaded simultaneously or if a new foundation is constructed and loaded adjacent to an existing footing. A similar tilting effect is possible for whole buildings if these are, together with their foundations, sufficiently rigid, as Figure 1 demonstrates. The most severe tilting is likely to be caused by the consolidation of clay soils.

Figure 7: Example of building settlement interaction
From the consolidation settlement viewpoint, the interaction of footings is routinely assessed by using the theory of elasticity to predict the distribution of vertical stresses. This is used in combination with knowledge of soil compressibility to predict the settlement, assuming that one-dimensional conditions apply. Footing, or indeed building, rigidity is usually ignored, or allowed for crudely, and therefore accurate predictions of interaction effects are not made.

Despite its obvious relevance in the context of dense urban development and redevelopment, the problem does not appear to have received much attention from researchers. While some research have been conducted into the interaction of adjacent footings on sand using physical models (Stuart, 1962; Das and Larbi-Cherif, 1983; Graham et al., 1984), the authors could not locate any comparable studies of footing interactions on clay. The question also arises of whether effects such as those shown in Figure 1 can be avoided or mitigated without resorting to the use of deep foundations. One possible solution involves the installation of a vertical wall, e.g. a sheet pile wall, between the buildings. However, it may be reasoned that, to be effective, the wall would have to be restrained against vertical movement. This could be achieved either by making the wall sufficiently deep or by supporting a less deep wall at intervals on end bearing piles reaching down to a sufficiently hard stratum.

This paper describes an investigation of the interaction of footings on clay in which the footings are considered to represent the almost rigid foundations of entire buildings. Small-scale physical models were created in which the deformations beneath the footings could be recorded photographically. In parallel with this, numerical modelling was undertaken to predict the behaviour of the physical models with the aim of validating the numerical approach so that it could be applied to predict full-scale behaviour. The research was designed to investigate and elucidate the effect of installing a vertical wall between the footings as a possible means of reducing settlement interaction.

2. Physical Model Test

Model preparation and testing

Because it was not intended that the models should represent a particular full-scale prototype, there were no rigorous scaling requirements. However, it was important to represent the essential features of the problem adequately. To match the numerical analysis, the strain conditions in the models were intended to be as close as possible to plane strain.

Soil beds were prepared by consolidating Speswhite kaolin one-dimensionally in a container measuring 400 mm by 150 mm by 450 mm deep. The kaolin had a liquid limit of 62%, plastic limit of 31% and specific gravity of 2.6. Kaolin slurry was mixed at a water content of 138% and consolidated beneath a rigid piston with a final effective vertical stress of 50 kPa. It was then allowed to swell under a stress of 5 kPa after which the height of the clay was about 200 mm. The changes of void ratio during the consolidation of the six clay beds that were prepared and tested are shown in Figure 2.
Figure 8: Changes of void ratio with effective vertical stress during clay bed preparation

The load was then released and one side of the container was removed. The exposed side surface of the clay was sprinkled with flock to provide texture for subsequent image analysis and covered with a transparent (Perspex) side panel, which was bolted to the container. During these operations care was taken not to disturb the clay and to ensure that the transparent panel was in contact with it. The rigid piston was then removed and, as shown in Figure 3, two 100 mm wide and 15 mm thick footings, also made of Perspex, were placed on the top surface of the clay, separated by a gap of 20 mm. The length of each footing was such as to fit within the model container walls with a clearance, normally, of about 0.5 mm at each end. Each footing could be loaded at its centre with a pneumatic ram. As load was applied, its magnitude could be recorded using a 2 kN load cell and the settlement at the centre of the footing could be monitored using a linear variable differential transformer (LVDT). In order to allow drainage, a 1 mm thick porous plastic sheet was placed underneath each footing and 1 mm diameter holes were drilled through the footing on a 10 mm square grid. Finally, a layer of lead shot about 100 mm thick was placed on top of the clay and over the footings to restore the effective vertical stress of 5 kPa and a water table was established just above the top clay surface to prevent drying of the clay.

Figure 9: Diagrams of model test set-up
Each test began with loading of one footing (Footing 1) in 5 kPa steps of average bearing pressure to a final value of 80 kPa. Each load increment was left until consolidation was judged to be complete, usually 24 hours. Before the second footing (Footing 2) was loaded in a similar fashion, in some tests a vertical aluminium sheet 1.5 mm thick was pushed into the clay mid-way between the footings to a depth of 100 mm. The average penetration rate was about 10 mm/min. This sheet, or wall, either “floated” in the clay or was restrained against vertical movement by two 5 mm diameter supporting rods penetrating to the base of the container. The displacements caused by the insertion of the wall were allowed to subside, typically for about 24 hours, before loading of the second footing began.

Throughout the test, photographs were taken of the textured side of the model using an 8 mega-pixel digital camera. This was fixed to a frame mounted off the model container. Using particle image velocimetry (PIV) techniques pioneered by White et al. (2003), the movements of the clay below the footings, as well as some markers placed on the ends of the footings, were determined. Close range photogrammetry was employed, following White and Bolton (2004), to transform displacements measured in image space to those occurring in object space and corrections were made for the refraction error caused by viewing through the Perspex panel (Effendi, 2007).

3. Test Results

The model test programme and key results are summarised in Table 1. Three pairs of tests were carried out: tests without a wall between the footings (double footing tests, Tests DF1 and DF2), tests with a floating wall between the footings (sheet pile wall tests, Tests SP1 and SP2) and tests with a vertically restrained wall between the footings (fixed wall tests, Tests FX1 and FX2). The settlements given in the table were both recorded by the LVDTs at the footing centres and determined by using PIV to analyse the movements of the markers on the ends of the footings. The latter movements were also used to determine the footing tilts. The settlements obtained from PIV were up to 3 mm smaller than those recorded at the footing centres due to bending, and perhaps tilting, of the footings in the plane at right angles to the transparent panel, indicating that plane strain conditions were not perfectly achieved. However, bending of the footings in the plane of the panel appeared negligible. As the LVDT data were continuously recorded, for either footing it was possible to plot the settlement under each load increment applied to the footing against the logarithm of time and identify the point at which the relationship became linear. As when interpreting data from one-dimensional consolidation tests, it was assumed that, thereafter, settlement was due to creep and that primary consolidation was complete, Figure 4.

<table>
<thead>
<tr>
<th>Loading on Footing 1</th>
<th>Loading on Footing 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOOTING 1</td>
<td>FOOTING 2</td>
</tr>
<tr>
<td></td>
<td>FOOTING 1</td>
</tr>
</tbody>
</table>

Table 3: Summary of physical model test results
<table>
<thead>
<tr>
<th>Test</th>
<th>Plain double footing</th>
<th>Double footing with a floating wall</th>
<th>Double footing with a vertically restrained wall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LVDT</td>
<td>Marker</td>
<td>LVDT</td>
</tr>
<tr>
<td>DF1</td>
<td>29.3</td>
<td>-</td>
<td>12.5</td>
</tr>
<tr>
<td>DF2</td>
<td>17.4</td>
<td>16.2</td>
<td>11.7</td>
</tr>
<tr>
<td>SP1</td>
<td>23.2</td>
<td>21.6</td>
<td>13.5</td>
</tr>
<tr>
<td>SP2</td>
<td>19.7</td>
<td>18.4</td>
<td>13.6</td>
</tr>
<tr>
<td>FX1</td>
<td>12.1</td>
<td>10.4</td>
<td>9.6</td>
</tr>
<tr>
<td>FX2</td>
<td>16.8</td>
<td>15.2</td>
<td>12.1</td>
</tr>
</tbody>
</table>

Marker results unavailable for Test DF1

Tilt: (+) = clockwise rotation
(-) = counter clockwise rotation
Figure 10: Settlements during first loading plotted against time

Figure 5 shows the settlements of the first footing to be loaded plotted against time, using LVDT data. Although the timing of the load increments varied, it can be seen that the final settlements in Tests DF2, SP1, SP2 and FX2 fall in a reasonably narrow range, approximately 17-23 mm. However, there are two outlying results. In Test DF1 a significantly greater settlement (29.3 mm) was caused by an unloading and reloading cycle part way through the loading sequence; the additional settlement observed during this cycle, which occurred at a time of around 6000 minutes, was about 7 mm. In Test FX1 a significantly smaller settlement (12.1 mm) was attributed to friction between the footing and container walls. In this test only, the normal clearance between the footings and the container walls was reduced in an attempt to stop clay being squeezed around the end of the footing and into the gap.

Figure 11: Examples of consolidation time estimation
The final images for PIV analysis were selected at the times shown in Figure 5. The earliest available image after the completion of consolidation under the final load increment was selected, but nevertheless some creep under the final load had occurred. Typical displacement vectors and derived contours of vertical displacement beneath the first footing are shown in Figure 6 using the PIV data from the clay surface. For clarity, only vectors from alternate patches in each row are shown. Footing settlements inferred from the contours of settlement in the clay were invariably lower, by 1-2 mm, than those determined using the markers on the footings themselves. It is believed that the movements of the clay close to the footing and next to the transparent panel were not representative of those occurring in the interior of the model due to the clay being squeezed into the gap between the end of the footing and the panel, as mentioned above. Consequently, the contours close to the underside of the footing should be regarded as unreliable.

Figure 12: Typical displacements caused by first loading (a) vectors and (b) contours of vertical displacement

The effect of installing a wall between the footings is illustrated in Figure 7. As the wall was inserted, a wedge of soil was pushed up beneath the second footing and slight
additional settlement occurred beneath the first footing. After wall installation, virtually no movement of the second footing took place but settlement continued under the first footing due first to consolidation and then to creep. Figure 8 shows an example of vertical displacements variation at the footing centres with time during and after wall installation.

![Diagram showing vertical displacements variation at footing centres with time](image)

**Figure 13:** Typical displacements caused by wall installation

The settlement-time plots due to loading on the second footing are given in Figure 9. The datum for these plots was taken as the start of the loading on the second footing. The final settlements of the second footing (Figure 9b) show good repeatability except for tests FX1 and FX2 where it is only fair. It is thought that the smaller settlement in Test FX1 was again caused by friction between the footing and the container walls. Only small settlements were recorded beneath the first footing (Figure 9a) and there is some variance in the results. In the case of Tests SP1 and SP2, it is possible that this was linked to variations in the effect of wall installation, which caused more settlement.
beneath the first footing in Test SP1 than in Test SP2 (Effendi, 2007). Friction at the container walls probably accounts for the reduced settlement in Test FX1 compared with Test FX2.

![Figure 15: Settlements during second loading plotted against time for (a) first footing and (b) second footing](image)

An obvious feature of these results is the reduction of settlement under the second footing compared to that observed previously under the first footing (Figure 5). Figure 9a suggests that the floating wall had little effect in mitigating the interaction but that the vertically restrained wall had a significant beneficial effect. This is again evident in the contours of vertical displacement in Figure 10. It should be emphasised that some of the displacement under first footing was the result of creep due to the original loading stage and, where applicable, wall installation.
Figure 16: Vertical displacements caused by second loading (a) without a wall (b) with a floating wall and (c) with a vertically restrained wall
4. Finite Element Analysis

Analysis details

The analysis was carried out using the program SAFE and the BRICK constitutive model (Simpson, 1992). This model has the ability to model non-linear and kinematic yielding behaviour and has shown promise for modelling ground movements in both soft and stiff clays arising from geotechnical construction. The input parameters, as mainly defined by Simpson (1992), are given in Table 2. The one-dimensional compression and swelling parameters, λ and κ, were chosen to provide a good prediction of the observed behaviour during preparation of the model clay beds, Figure 2. The use of the BRICK model ideally demands good quality, non-standard test data to define the s-shaped curve of stiffness degradation with strain from which the string length and \(G_t/G_{\text{max}}\) parameters are derived. However, no such data were available for the clay used in the models and the values chosen by Simpson to model Singapore marine clay were somewhat arbitrarily adopted. The values of \(i\), governing the elastic stiffness, and \(v\) were similarly chosen. The BRICK model implemented in SAFE and used for the present work is capable of modelling 3D problems and has some modifications compared with the originally published model. The swelling line is straight rather than curved on a plot of volumetric strain versus the logarithm of the mean effective normal stress and an additional parameter, \(\beta_\phi\), models the effect of over consolidation on strength, leaving \(\beta_G\) (simply \(\beta\) in Simpson (1992)) to model the effect on stiffness. A second additional parameter, \(\mu\), governs the shape of the failure envelope in the \(\pi\) plane.

<table>
<thead>
<tr>
<th>String length</th>
<th>(G_t/G_{\text{max}})</th>
<th>Material proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00008</td>
<td>0.9200</td>
<td>0.0800</td>
</tr>
<tr>
<td>0.00020</td>
<td>0.7500</td>
<td>0.1700</td>
</tr>
<tr>
<td>0.00040</td>
<td>0.5300</td>
<td>0.2200</td>
</tr>
<tr>
<td>0.00080</td>
<td>0.2900</td>
<td>0.2400</td>
</tr>
<tr>
<td>0.00200</td>
<td>0.1300</td>
<td>0.1600</td>
</tr>
<tr>
<td>0.00400</td>
<td>0.0750</td>
<td>0.0550</td>
</tr>
<tr>
<td>0.00800</td>
<td>0.0440</td>
<td>0.0310</td>
</tr>
<tr>
<td>0.01800</td>
<td>0.0170</td>
<td>0.0270</td>
</tr>
<tr>
<td>0.03600</td>
<td>0.0035</td>
<td>0.0135</td>
</tr>
<tr>
<td>0.07500</td>
<td>0.0000</td>
<td>0.0035</td>
</tr>
</tbody>
</table>

\(\beta_G = 4\) \hspace{1cm} \(\beta_\phi = 2\) \hspace{1cm} \(\mu = 1.3\)

\(\Box = 0.0032\) \hspace{0.5cm} \(\Box = 0.08\) \hspace{0.5cm} \(\Box = 0.017\)

\(\nu = 0.2\).

The finite element mesh, comprising 830 8-noded isoparametric elements and exactly matching the geometry of the physical models, is shown in Figure 11. Both the lateral and bottom boundaries were restrained against all movement. Elements representing the footings and the wall, where present, were given linear elastic properties deemed
appropriate for Perspex and aluminium: for Perspex $E = 3 \times 10^6 \text{kPa}$ and $\nu = 0.38$, and for aluminium $E = 6.9 \times 10^7 \text{kPa}$ and $\nu = 0.33$ (Dwight, 1999).

Figure 17: Finite element mesh

Using a feature provided in SAFE, the entire stress history of the soil in the physical model was simulated (Figure 2). Starting from a very low stress level, the soil was first consolidated under an effective vertical stress of 50 kPa and then allowed to swell under a surcharge pressure of 5 kPa applied to the upper surface. A vertical load of 7.5 kN was applied to the centre of one footing in 15 increments so as to raise the average pressure on the underlying soil to 80 kPa. During this event the soil was assumed to be fully drained and the other footing’s elements were removed from the mesh. The installation of a vertical wall could not be simulated. Where needed, walls were “wished into place” by substituting wall properties for soil properties in the appropriate elements. In some instances vertical restraint was provided by setting the settlement of the nodes at the base of the wall to zero. The second footing’s elements were restored and this footing was then loaded in a similar fashion to the first footing, again with fully drained conditions.

4. Results of analysis

Three analyses were conducted whose results are summarised in Table 3. Computed contours of final vertical displacement due to the load on the first footing, Figure 12, may be compared with typical observations of the physical models (Figure 6b). The predicted footing settlement lies in the middle of the experimental range (based on results in Table 1 for Tests DF2, SP1, SP2 and FX2). Figure 12 also shows the footing dragging down the surrounding soil surface, whereas in the physical model it tended to punch more cleanly into the soil.
Vertical displacements arising from loading on the second footing in the absence of a vertical wall are illustrated in Figure 13a. It can be seen (by comparison with Figure 10a) that the observed displacement pattern has been fairly well captured, although the induced tilt of the second footing is in the opposite sense to that observed and zone of soil displaying settlement is more extensive. Corresponding results for the case of a floating wall and a vertically restrained wall are shown in Figs 13b and 13c respectively (for comparison with Figs 10b and 10c) and similar comments apply. In all cases, the computed footing settlements (Table 3) are substantially lower than the observed values (Table 1). For the first footing, ongoing creep beneath the footing contributed significantly to the observed settlement, as already mentioned, and this partly accounts for the difference. Possible reasons for the discrepancy in the case of the second footing are discussed below.
Figure 19: Computed contours of vertical displacement caused by second loading (a) without a wall (b) with a floating wall and (c) with a vertically restrained wall.

Table 5: Summary of numerical modelling results

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Loading on Footing 1</th>
<th>Loading on Footing 2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain double footing</td>
<td>18.3</td>
<td>7.0</td>
<td>-0.69</td>
<td>2.4</td>
</tr>
<tr>
<td>Double footing with a floating wall</td>
<td>6.1</td>
<td>6.1</td>
<td>-0.54</td>
<td>1.9</td>
</tr>
<tr>
<td>Double footing with a vertically restrained wall</td>
<td>5.8</td>
<td>5.8</td>
<td>-0.41</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Tilt: (+) = clockwise rotation
(-) = counter clockwise rotation

5. Discussion

This work has demonstrated that a floating wall may be largely ineffective in reducing footing interaction, while a significant benefit may be obtained with a vertically restrained wall. This is clear in Tables 1 and 3 where the central settlement and tilt of the first footing due to loading of the second footing are given. The improvement
mechanism with the vertically restrained wall is revealed in Figure 14 showing the computed final distribution of shear stress on each side of the wall. On the left of the wall (second footing side) a net downward force is transferred into the wall rather than into the soil on the right (first footing side), so shielding the latter from an increase of vertical stress. Further research is needed to check whether vertically restrained walls would be as effective in a variety of prototype situations.

![Graph showing shear stress distributions on a vertically restrained wall](image)

**Figure 20: Distributions of shear stress on a vertically restrained wall**

The comparisons made in the previous section provide some encouragement for similar analysis to be applied to predict prototype behaviour, assuming that a plane strain idealisation is appropriate. However, it is a concern that the direction of tilt of the second footing was always wrongly predicted and that its settlement was under-predicted. Figure 15 shows the predicted displacements due to loading of the first footing and, by comparison with Figure 6a, it can be seen that horizontal displacements beneath the second footing were over-predicted by the analysis. In the analysis, the first footing also moved horizontally in the direction of the second footing and most of the available soil strength was mobilised to resist a bearing capacity failure. In the physical models horizontal movement of the footing was prevented by the loading system and the some resistance would have been mobilised on the container walls to supplement the soil strength. Thus, horizontal movements did not propagate beneath the second footing to the same extent. In the analysis, it is believed that the horizontal movements increased the stiffness of the soil to subsequent vertical loading and that this effect diminished with distance from the model centreline. This would explain both the under-predicted settlement and incorrectly predicted tilt direction of the second footing. Other factors may also have been involved. For example, in the analysis fully drained deformations were assumed, whereas in the physical models partially drained deformations must have occurred as each load increment was applied. It is also possible that the soil shear strength itself could have been under-predicted.
It is a limitation of the analysis that the effect of installing the walls was not included, although in the physical models this effect was not large. In the case of a diaphragm wall, the installation could perhaps be modelled following Ng et al. (1995).

An interesting feature of the experimental results, also captured by the analysis, is the asymmetry of deformation that developed, even in the absence of a wall between the footings. Observed and computed final settlement contours with the datum taken at the start of the first footing loading are compared in Figure 16. This asymmetry would not be predicted by routine methods of calculation.
6. Conclusion

The problem of settlement interaction of relatively stiff shallow foundations on clay has been studied with a combination of physical and numerical modelling. It is concluded that the installation of a vertically restrained, and perhaps partially penetrating, wall in compressible ground between two closely spaced strip foundations can significantly reduce interaction. However, an unrestrained or floating wall with a depth of the same order as the foundation width is unlikely to be effective. Further analysis is needed to explore the potential of vertically restrained walls to reduce interaction in prototype situations.

The use of the BRICK constitutive model in the finite element analysis proved generally successful in predicting settlement interaction behaviour patterns, including the asymmetry that can develop when identical foundations are constructed at different times. An incorrect prediction of the sense of tilting of one of the foundations can probably be attributed to additional restraints that existed in the physical models.

7. Acknowledgements

The Author is grateful to the technical staff at the University of Sheffield for their skilful assistance. He also thanks Dr. David White of the University of Western Australia (formerly of the University of Cambridge) for permission to use his PIV software and Dr. Janne Heikkilä of the University of Oulu Finland for his camera calibration subroutines. He also appreciates the staff of Oasys Limited for providing the SAFE program and for associated support. The author was supported financially by a scholarship from the Directorate General of Higher Education of Indonesia under the Technological and Professional Skills Development Project (TPSDP Batch III).

References


Design Of Paddy Field On The Wetland Area In Rakumpit District Central Kalimantan

Maya Amalia\(^1\), Petrisly Perkasa\(^2\), Muhammad Noor\(^2\), Agus Sulistio\(^2\)

\(^1\)Lecture at Civil Engineering Departement of Lambung Mangkurat University  
Email: maya_ftunlam@yahoo.co.id

\(^2\)Post Graduate Student of Civil Engineering, Lambung Mangkurat University

Abstract

The escalation of food productions can be achieved through agricultural field extensification. Agricultural extensification efforts related to the availability of land and water, infrastructure, and the availability of skilled labors. The expansion of rice cultivation was organized by the government on location in the Rakumpit District, Central Kalimantan Province. The purpose of this study was to design field with a target area of 100 ha of wetland area in the District Rakumpit, City of Palangkaraya. Objectives of this research is the formulation of design fields corresponding to the target field conditions on a stretch of land area up to 100 ha in District Rakumpit. The layout of the field and its tertiary irrigation canals, drainage channels, stop logs, farm roads, as well as complementary components required. Location of paddy fields totaling 50 section, size of each 1 ha. Each is surrounded by paddy fields around the channel connected to the tertiary canal where a stoplog made to regulate the tertiary canal water level so that water can get into the channel and then watering the rice terraces. Tertiary canal amounted to 5 pieces of the tap water from the secondary channel. The main farm road by 3m flanked by drainage fields. Farm road is connected to the farm road on the secondary channel.

Keywords: Rakumpit, paddy field, drainage, wetland

1. Introduction

Paddy rice cultivation with paddy field irrigation has multi-functional roles not only to provide food securely but also to maintain other functions such as economic culture and environment. One of the important functions related to environmental issues is flood prevention and water conservation. A number of studies of these functions have been carried out mainly in Japan from the early 1980s. The studies described the functions of paddy fields to increase the water storage capacity of river basins, lower the peak flow of rivers, and increase groundwater recharge (Sujono, 2010)

An increasing number of rice production can be achieved through extensification rice production. Agricultural extension efforts related to the availability of land and water, infrastructure, and the availability of skilled labor (Nuhung, 2003)

Local Government has proposed wetland paddy field design in several locations. The scheme was launched by design paddy fields in the villages along the Rungan river, the
target area with the number of heads of families in each village. For the year 2010 has been declared the study design paddy field with a target area of 100 ha for 50 head of families in the Village of Gaung Baru, District Rakumpit

A technical design must be held on the target district. This design should be made carefully covering all components in detail the construction of the construction field below cost calculation needs. Design should be based on the measurement of various parameters required accurately.

2. Objectives

The purpose of this research is to develop design field with a target area of 100 ha in the Village of Gaung Baru, Rakumpit District, Palangkaraya City.

![Figure 1: Location of study Rakumpit District](image)

Wetland areas is always flooded areas or at certain times due to bad stagnant or absence of the natural drainage system. Place the swamp area is not limited by the height (elevation) of land. In high places can be found in the swamp area of geological depression. Stagnant water in the depression is due to the accumulation of rainwater runoff basin, the water circulation can occur due to water evaporation and additional land.
Development of low land by the government at an early stage (stage I) in the form of construction of the drainage system is open, with no flow control structures, equipped with the preparation of land, houses, roads, bridges, schools and health facilities. Conversion of wetlands into agricultural areas to the development of the channel will disturb the atmosphere of the natural marsh. (Subagy, 1998).

Geographically is located at 113 ° 43 ' E and 1 ° 48 ' South Latitude. The village is relatively isolated, hard to reach the village because not connected by road (Anonim, 2009). The land is planned to be located in the area of low fields near the river and a branch of the River Rungan Bengamat. In geomorphology site is part of the wetland behind the embankment. Outside the planned area slightly elevated topography (slope 3-8%), but at the rather high there are still parts of the flooded surface. This is because the soil has a water-resistant coating. Set of water is then accumulated in the concave parts to form a permanent puddle, so although a bit far from the river wetland formations appear different characteristics of the swamp behind the embankment (Darsono, 1995).

Land planned for the paddy field is where the accumulation of organic material remnants of natural vegetation over time due to plant debris decomposes difficult in these conditions. Therefore, it has a land area classified as organic soil.

3. Method

Preparation Phase, consisting of situation maps, questionnaire and a form for recording the implementation and data collection.

Survey data compiled and analyzed to determine / define the geographical position and the extent of land certainly elected, making maps and design drawings, as well as the calculation of cost requirements:

1. Analysis of the topography and hydrology include: setting limits layout rice terraces and water system. To illustrate the conditions are created for the transverse and longitudinal profiles.

2. Analysis of the nature and depth of the peat soil are as a basis for establishing the layout and design of the rice field construction (embankment and map) as well as construction and building water lines and roads.

3. Preparation of design; includes paddy field mapping plan (layout, distribution plots, irrigation canals, water gates and farm roads), as well as depictions of construction plans (drawings of irrigation and drainage, water and building farm roads) following the implementation of the construction method.

4. Result and Discussion

Component design paddy fields:

1. Layout; configuration paddy fields, water management and farm roads.

2. The layout is organized taking into consideration the irrigation water at the location and design of the primary channels that have been built with the point of the water in the canal belt secondary.

3. Area of each plot of 1 ha paddy fields made equal to the number corresponding to the number of farmers.
5. **Acknowledgement**

1. Public Work Department of Palangkaraya Central Kalimantan
2. Departement of Magister Civil Engineering Lambung Mangkurat University

**References**


Tabunganen Unit After 30 Years Of Reclamation

Ulfa Fitriati ¹, Muhammad Afief Ma’ruf ¹

¹Department of Civil Engineering, Engineering Faculty of Lambung Mangkurat University

Abstract

Tabunganen unit has one primary canal 2.76 km, the left secondary canal 9.558 km and the right secondary canal 9.744 km, also 147 tertiary canal with length 205 km and the area 5,600 ha. Farm productivity just 1.05 ton/ha, only once in a year and use local paddy. This research aim is to optimize the performance of tidal irrigation at Tabunganen unit. The water quality conditions on the secondary canal according to water quality standard are measured as follows. DO at the beginning of secondary channel is 4–4.6 mg/l and the end of secondary channel is 0–3 mg/l. Fe respectively is 0.1–0.3 mg/l and 0.1–2 mg/l, organic matter 15.8–28.44 mg/l and 64–47.4 mg/l, DHL 0 mS and 0–0.5 mS, pH 4.9–5.06 and 5.15–5.3. Micromanagement water system to regulate the circulation of water and water level condition on land would require the canal sluice, but since the tertiary canal is also used by farmers for transportation, channel sluice is made in quarterly channel. The tide pools has been covered with sediment and overgrown planting. It makes the water quality in the end secondary canal become worse. Sluice like tabat can be easily implemented for low operational and maintenance costs. Water outflow from paddy field use pipes or culverts equipped with sand bags to control the water. Kemalir channel can accelerate the disposal of toxic substances in the soil. Kemalir channel is also made around the paddy field so when the tide enters the field, it is not directly flush the nutrient layer on the surface of the land but inundate the paddy field slowly.

Keywords : Tabunganen, reclamation, tidal, tabat, kemalir

1. Introduction

Tabunganen Unit (figure 1) has one primary canal 2.76 km, the left secondary canal 9.558 km and the right secondary canal 9.744 km, also 147 tertiary canal with length 205 km and the area 5,600 ha. Farm productivity just 1.05 ton/ha, only once in a year and use local paddy. Recently, tidal pools has been covered with sediment and overgrown plants (figure 2).
Figure 23. Tabunganen Unit
Figure 24. The Tide pools (kolam pasang) has been covered with sediment and overgrown planting. It makes the water quality in the end secondary canal become worse.

The water quality condition at the beginning and the end of secondary canal according to water quality measurement for tidal irrigation (Hardjos, 2007).

Table 6. Water Quality Measurement

<table>
<thead>
<tr>
<th>Element</th>
<th>At the beginning of secondary canal</th>
<th>At the end of Secondary canal</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO_air (mg/l)</td>
<td>4–4,6</td>
<td>0 – 3</td>
</tr>
<tr>
<td>Fe (mg/l)</td>
<td>0,1–0,3</td>
<td>0,1 – 2</td>
</tr>
<tr>
<td>Organic matter (mg/l)</td>
<td>15,8 – 28,44</td>
<td>12,64–47,4</td>
</tr>
<tr>
<td>DHL (mS)</td>
<td>0</td>
<td>0 – 0,5</td>
</tr>
<tr>
<td>pH</td>
<td>4,9 – 5,06</td>
<td>5,15 – 5,3</td>
</tr>
</tbody>
</table>
2. Result and Discussion

Micro management water system to regulate water circulation and inundation level on land would require the canal sluice, but since the tertiary canal is also used by farmers for transportation, channel sluice is made in quarterly channel.

Figure 26. Water micro management at Tabunganen Unit

Sluice like tabat can be easily implemented for low operational and maintenance costs. Water outflow from paddy field use pipes or culverts equipped with sand bags to control the water.
Kemalir channel can accelerate the disposal of toxic substances in the soil. Kemalir channel has width of 30 cm and 20 cm depth. The distance between channel ranges from 8 to 12m. Kemalir channel is also made around the paddy field so when the tide enters the field, it is not directly flush the nutrient layer on the surface of the land but inundate the paddy field slowly.

Control drainage need to be implemented during tillage until planting session. The sluice will be closed during the high tide, and partially opened during the low tide. Conversely for the maximum effect of rain during planting to harvest, the sluice opened permanently. At low rainfall sluice closed permanently, and re-opened when high rainfall condition occurs.
References

Antidiarrheal Activity of Tanjung Leaf Infusa (*Mimusops elengi* L.)

Khoerul Anwar, Nashrul Wathan, Nani Kartinah

Department of Pharmacy, Faculty of Mathematics and Sciences,
University of Lambung Mangkurat Banjarbaru
Corresponding author : Khoerul Anwar
Email : endrasance@yahoo.com

Abstract

Tanjung (*Mimusops elengi* L.) leaves empirically used for diarrhea treatment. The aims of this research is to determine antidiarrheal activity of tanjung leaves infusa in mice. Tanjung leaves infusa was made by extracted the dried powder of leaves of tanjung in infusa pan with aquades. The result of chemical identification showed that tanjung leaves infusa contains flavonoid, saponin, and tannin. Twenty five mice were divided into 5 groups i.e negative control, positive control, group I, group II, and group III. Mice was not feeding one hour before the experiment. The negative control group was given Na-CMC 0,5%. The positive control group was given loperamide 0,104 mg/kgBW. Group I, II, and III were given tanjung leaves infusa at dose 15 mg/20 gBW; 22,5 mg/20 gBW; and 30 mg/20 gBW respectively. One hour after treatment, mice were given castor oil 0,75 mL orally. Monitoring was arranged for every 30 minutes after castor oil giving until 300th minutes. Observed parameters include diarrhea onset, diarrhea frequent, feces consistency, feces weight, and diarrhea duration. The data of observed parameters were analyzed by ANOVA used SPSS method version. The result of this study showed that infusa of tanjung leaves at dose 30 mg/20 gBW has antidiarrheal activity equal with positive control group.

Keywords : antidiarrheal, leaves, *Mimusops elengi* L., infusa

1. Introduction

Indonesia is a tropical country with a rich diversity of medicinal plants. Medicinal plants are widely used for traditional medicine, although there also has been packaged in a modern dosage forms. Included in the traditional classes of drugs such as traditional drugs that can be obtained without a prescription and the raw material can be planted around the house. The reason for the used of traditional medicine in addition to opinion its more economical, the side effects are considered smaller than synthetic drugs, and trying factors to prove the efficacy of traditional medicine.

Traditional medicine has provided the basis for the formation of the steadily traditional health care system (Complementary and Alternative Medicine = CAM) since thousands of years ago. Since the last decade, traditional medicine is widely in demand across the continent, not only in developing countries but also in developed countries where conventional health controlled principal role in the national health care system. This is evident from the many traditional medicinal preparations sold in pharmacies or prescribed by a medical practitioner in the developed countries. Evidence also suggests that traditional medicine has contributed to conventional healthcare. It can be shown
many modern medicines in the market today which is the result of the development of traditional medicine such as digoxin, quinine, and vinblastine (Mustafa, 2005).

One of the herbs that have been used in the plant is tanjung leaves (Mimusop selengi, L). Tanjung leaves widely used to treat diarrhea, asthma, inflammation of the nose, and sore throat. This plant is shade plants, the leaves are very dense and tight and fragrant flowers (Heyne, 1987). Leaves, flowers, plants and leather of tanjung were known efficacious as a medicine (Kloppenburg-Versteegh, 1988). Based on this consideration, this study will test the antidiarrheal of infusa leaf tanjung on mice.

2. Materials and Methods

2.1 Research Tools

The tools used in this research are laboratory glassware (Pyrex Iwaki Glass®), infusa pot, blender (National®), hotplate, syringes (Terumo®), analytical balance (Ohaus®), mice scale (Adam®), oral sonde (Terumo®), and waterbath (Memment®).

2.2 Materials Research

The materials used in this study is imodium, hydrochloric acid (HCl), anhidridat acetic acid 1%, distilled water, tanjung leaves, a solution of iron (III) chloride (FeCl3), NaCl 0.9%, Na-CMC, reagents Mayer, and magnesium metal powders.

2.3 Animals

Test animals used were mice, normal, strain Balb/c, 20-30 grams weight and the age of 2-3 months.

2.4 The study was conducted with the following stages:

1. Preparation of crude leaves of tanjung.
2. Preparation of tanjung leaves infusa.
3. Screening of chemical constituents of tanjung leaves infusa.
   a) Flavonoid test
      Extracted fluid results (infusa) was dropped on filter paper 2 drops, then steamed with ammonia. Flavonoids are characterized by the color yellow to orange (Harborne, 2006).
   b) Alkaloid test
      Infusa fluid was diluted with hydrochloric acid 2% or sulfuric acid 2 N. The solution was divided into two tubes (tube I added 3 drops of Mayer solution, tube II added Dragendorf solution). The presence of alkaloids was indicated by yellowish white precipitate to Mayer reagent and brownish orange to Dragendorff reagent (Harborne, 2006).
   c) Saponin test
      To 0.5 mL tanjung leaves infusa in a test tube, 10 mL of hot water was added, cooled, and shaken for 10 seconds. The positive results was indicated by the formation of a stable foam for 10 minutes as high as 1 cm to 10 cm (Depkes RI, 1995).
d) Tannin test

To 1 mL tanjung leaves infusa in a test tube, the distilled water of 2 mL and 2-3 drops of FeCl₃ were added. The presence of tannin was indicated by the formation of dark blue or black coloursolution (Kristanti et al., 2008).

4. Antidiarrheal activity test in mice orally with the methods of protection against diarrhea by oleumricini.

a) Mice were divided into 5 groups, namely the negative control group, the positive control group, and the 3 treatment groups. Each group consisted of 5.

b) One hour before the experiment began, the mice were fasted.

c) Mice in negative control group were given CMC-Na 0.5 mL/20 gBW, positive control group dose loperamide 0.0104 mg/20 gBW, group Itanjung leaves infusa dose of 15mg / gBW, group IItanjung leaves infusa dose of 22.5 mg / gBW, and group IIItanjung leaves infusa dose of 30 mg/ gBW. Dosage given orally.

d) Mice were placed in filter paper layered individual cages for observation.

e) One hour after treatment mice were given 0.75 mL of oleumricini orally.

f) Do observations of mice every 30 minutes up to 300 minutes after administration of oleumricini.

g) Observed parameters included the onset of the diarrhea, the consistency, frequency of diarrhea, and the amount/ weight of stool and the time course of diarrhea.

5. Data collection and analysis

Analysis of the data from this study can be seen by comparing the results of the test group with the control group. Stool consistency parameters evaluated descriptively observing solid-thin the stool. For the data onset of diarrhea, frequency of diarrhea, stool weight, duration of diarrhea and differences between groups were analyzed statistically. The obtained data were tested normality with Shapiro-Wilk test and Levene's test of homogeneity of variance. If normally distributed and homogeneous parametric analysis is carried out by One-way ANOVA at α = 0.05. If there is a significant difference between treatments, then followed by Post hoc analyzes using Tukey HSD test. But if it is not distributed normally or not homogeneous, then the non-parametric analysis, the Kruskal-Wallis test at α = 0.05, followed by Mann-Whitney test if there are significant differences between treatments.

3. Results and Discussions

3.1 Results

3.1.1 Chemical identification test infusa leaf tanjung

Identification test results showed that the tanjung leaves infusa contained flavonoids, saponins and tannins (Table 1). From the intensity of the color formed, is expected to have a high tannin content. Flavonoids and saponins expected to be less because of the intensity of the color is less intense and the formed foam is less steady.
Table 1. Chemical identification test results infusa leaf tanjung

<table>
<thead>
<tr>
<th>No</th>
<th>Test</th>
<th>Result</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Flavonoids</td>
<td>Formed yellow-orange colour</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>Alcaloids</td>
<td>White precipitate not formed</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Saponins</td>
<td>Formation of stable foam as high as 1 cm for 10 min</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>Tannins</td>
<td>Formed blackish colour</td>
<td>+</td>
</tr>
</tbody>
</table>

3.1.2 Antidiarrheal activity test of tanjung leaves infusa

In antidiarrheal activity test of tanjung leaves infusa with oleumricini induction method, the measured parameters were onset of diarrhea, stool consistency, frequency of diarrhea, stool weight, and duration of diarrhea. Observations were made every 30 minutes for 6 hours. Antidiarrheal test results can be seen in Table 2. The results of normality test data with the Shapiro-Wilk test and Levene's test of homogeneity of variance indicated that the data were normally distributed and homogeneous. Furthermore, parametric data were analyzed by One-way ANOVA at \( \alpha = 0.05 \), followed by Post hoc analyzes using Tukey HSD test.

After being given oleumricini, diarrhea occurred at a variety in each test group. From the table it can be seen that the higher dose given of tanjung leaves infusa, the longer the time from the occurrence of diarrhea. The results of the analysis of one-way ANOVA showed a significant difference between the negative control with the positive control, infusa leaf tanjung doses 22.5 and 30 mg/20 gBW. Between the negative control group with tanjung leaves infusa dose of 15 mg/20 gBW did not differ significantly, which means the leaves infusa tanjung dose of 15 mg/20 GBB can not take time away from the diarrhea.

Table 2. The test results antidiarrheal infusa leaf tanjung

<table>
<thead>
<tr>
<th>Group</th>
<th>Replication</th>
<th>Onset of Diarrhea (minute)</th>
<th>Frequent of diarrhea (times)</th>
<th>Stool weight (mg)</th>
<th>Diarrhea duration (minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative control (CMC-Na 5%)</td>
<td>1</td>
<td>50</td>
<td>7</td>
<td>970</td>
<td>235</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>60</td>
<td>7</td>
<td>1008</td>
<td>240</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>54</td>
<td>7</td>
<td>1076</td>
<td>236</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>40</td>
<td>6</td>
<td>971</td>
<td>240</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>58</td>
<td>6</td>
<td>962</td>
<td>242</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>52.4</td>
<td>6.6</td>
<td>997.4</td>
<td>238.6</td>
</tr>
<tr>
<td>Positive control (loperamid 0.0104 mg/20 gBW)</td>
<td>1</td>
<td>105</td>
<td>3</td>
<td>380</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>115</td>
<td>3</td>
<td>495</td>
<td>113</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>110</td>
<td>2</td>
<td>260</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>100</td>
<td>3</td>
<td>516</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>120</td>
<td>3</td>
<td>434</td>
<td>116</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>110</td>
<td>2.8</td>
<td>417</td>
<td>115.8</td>
</tr>
<tr>
<td>Group I Tanjung leaves</td>
<td>1</td>
<td>60</td>
<td>7</td>
<td>1112</td>
<td>215</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>70</td>
<td>5</td>
<td>916</td>
<td>210</td>
</tr>
</tbody>
</table>
The frequency of diarrhea was observed from the number of processes that emit defecation liquid stool consistency, slimy, or mushy. The frequency of diarrhea in mice due to induction of oleumricini for each group showed mixed results. Mice in the negative control group have greater frequency of diarrhea. From the results of ANOVA test is known that there are significant differences between the negative control with the positive control, tanjung leaves infusa doses 22.5 and 30 mg/20 gBW. Between the negative control with tanjung leaves infusa dose of 15 mg/20 gBW did not differ significantly, which means the tanjung leaves infusa dose of 15 mg/20 gBW can not decrease the frequency of diarrhea. Loperamide, tanjung leaves infusa doses 22.5 and 30 mg/20 gBW decrease the frequency of diarrhea in mice.

The weight of feces was observed as a model inhibition of diarrhea. The greater weight of feces produced, indicating smaller inhibition of diarrhea. Biggest stool weight is given by the negative control, tanjung leaves infusa dose of 15; 22.5; 30 mg / 20gBW and loperamide respectively. From the results of ANOVA test is known that there are significant differences between the negative control with the positive control, tanjung leaves infusa doses 22.5 and 30 mg/20 gBW. Between the negative control with tanjung leaves infusa dose of 15 mg/20 gBW did not differ significantly.

Diarrhea conditions in mice for this study began with the issuing defecation watery stool consistency, slimy or mushy. After a solid stool consistency released, diarrhea considered cured. Difference in time is called the duration of diarrhea. In the negative control the longest duration of diarrhea, while tanjung leaves infusa 30 mg/20 gBW duration of diarrhea at least for a while. The results of ANOVA analysis showed the duration of diarrhea in the negative control group significantly different to all other treatments. It can be concluded that all doses tanjung leaves infusa can shorten the duration of diarrhea.
3.2 Discussion

Diarrhea occurs because of imbalance mechanism of absorption and secretion in the small intestine that would increase the amount of fluid expelled along with the feces. As a result, the consistency of the stool will become soft or liquid. Oleumricini used as inducer occurrence of diarrhea because of the role of prostaglandins in the mechanism autocoid and diarrhea. The release of ricinoleic acid from oleumricini causes irritation and inflammation of the mucosa of the small intestine that trigger the release of prostaglandins. Increased intestinal motility and secretions caused by the release of prostaglandins (Chitma et al., 2004). As a positive control used loperamide. Its mechanism of action was reduced intestinal motility that caused reduced defecation frequency and more solid stool consistency (Tjay & Rahardja, 2007).

Tanjung leaves empirically used for the treatment of diarrhea. Infusa is a preparation made with quote bulbs with hot water at a temperature of 90 °C for 15 min. It represents the way that people use the leaves to boil dry tanjung leaves, and then drink its boiled water to treat diarrhea. Identification test carried out on tanjung leaves infusa to find compounds that could extracted in water solvent. The result of identification test showed that the tanjung leaves infusa contain flavonoids, saponins and tannins. That compounds is expected efficacious as antidiarrheal.

The ability of flavonoids as antidiarrheal attributed to its ability to inhibit intestinal motility and hydroelectrolit secretion (Rao et al., 1997) that increased in conditions of diarrhea. In vitro and in vivo studies also showed that flavonoids can inhibit intestinal fluid secretion caused by prostaglandin E2 (Sanchez et al., 1997). The antioxidant properties of flavonoids thought to be responsible for inhibiting some of the enzymes involved in the metabolism of arachidonic acid (Meite et al., 2009).

Tannins can relieve diarrhea with collapsed intestinal mucous membrane because it has the effect of adstringensia (Tjay & Rahardja, 2002) so that it can inhibit the secretion of fluid and electrolytes. Tannins also been shown to protect the intestinal mucosa of irritation caused by oleumricini (Fajrin, 2009). Saponins are compounds producing foam when shaken in water. Saponins as antidiarrheal chemicals can increase the permeability of the intestinal wall and improves absorption of nutrients (Kristanti et al., 2008).

From this study it can be concluded that the tanjung leaves infusa has antidiarrheal activity in oleumricini induced mice and the tanjung leaves infusa dose of 30 mg/20 gBW has not significantly different antidiarrheal activity in mice compared to the positive control loperamide 0.0104 mg/20 gBW.

References


Bioecology of Nonpathogenic Fusarium Specific Location of Tidal Swampland

Ismed Setya Budi, and Mariana

Lecturer, Faculty of Agriculture, Lambung Mangkurat University
Jl. A. Yani Po Box 1028 Banjarbaru 70714
Phone: +6281933753340 Email: isb_unlam@yahoo.co.id

Abstract

Bioecology is individual environmental information relating to an individual's life in order to grow and develop in the environment or suitable habitat. It is a major requirement that must be known before applying the concept of an integrated disease control. The information of bioecology played as a major factors that can be used to suppress the growth of pathogens, so that will not cause any harm and damage to crops. Tidal swampland with four different types of tipology (tipology A, B, C, and D), has different characterize of bioecology, so the existence of microbes in that tipology will also be different. The use of nonpathogenic Fusarium (NPF) that specific location of tidal swampland as biological control agents has not been done. Nonpathogenic fusarium is able to reside in the plant for a long time without causing any harm to the plant. It is expected to protect plants from pathogens interference in tidal swampland continuously. The research aims to gain information in order to exploit the NPF as biological control agents through determining it bioecology and it ability to protect rice plants against harmful pathogens Fusarium wilt. It is expected that NPF could become biological control as an integral part of sustainable farming systems in tidal swampland. The results showed that the intensity of Fusarium wilt disease was higher in the rainy season in the typology A, B and C, while in typology intensity of Fusarium wilt disease high in the dry season. FNP growth assay in vitro depends on: the temperature (25-30°C) and pH (6.5 to 7.5). FNP can be distinguished from Fusarium pathogens based on colony color and growth, makrokonidia diameter, speed of growth in the media, and the power of the antagonist. The test results proved that in in-vivo test, antagonist of FNP which applied through the soil a week before planting with a dose formulations 30 kg/ha was quite high (over 80%), while the application in soaking seeds in spore density of 106 for 24 hours before planting, resulted better in inhibiting the progression of the disease (above 90%). The ability of FNP to suppress disease found better than the synthetic fungicide. It appears that the power intensity of the disease result in antagonists FNP only ranged from 19.68% -27.55%, while the intensity of the disease in fungicides application as much as 53.36%.

Keywords: Bioecology, Nonpathogenic Fusarium, tidal swampland.

1. Introduction

Tidal swampland with four different types of tipology (tipology A, B, C, and D), has different characterize of bioecology, so the existence of microbes in that tipology will also be different. Bioecology is an individual environmental information relating to an individual's life in order to grow and develop in the environment or suitable habitat.
It is a major requirement that must be known before applying the concept of an integrated disease control (Mudjiono, 1998). The information of bioecology played as a major factors that can be used to suppress the growth of pathogens, so that will not cause any harm and damage to crops.

The use of nonpathogenic *Fusarium* (FNP) that specific location of tidal swampland as biological control agents has not been done. Nonpathogenic *fusarium* is able to reside in the plant for a long time without causing any harm to the plant. It is expected to protect plants from pathogens interference in tidal swampland continuously.

The research aims to gain information in order to exploit the FNP as biological control agents through determining it bioecology and it ability to protect rice plants against harmful pathogens Fusarium wilt. It is expected that NPF could become biological control as an integral part of sustainable farming systems in tidal swampland. Its related to ability of NPF as endophytic microorganisms that are expected to induce plant resistance against many pathogens (Alabouvette *et al.*, 2003).

2. Methods

Nonpathogenic *Fusarium* isolated from healthy plants that grows among unhealthy plants. Surface part of plant sterilized and then grew it on Potato Dextrose Agar (PDA). Purification of isolates has been done by taking one part of the pathogen (single spore isolation) (Papavizas, 1967). To determine five isolates that have the highest inhibitory power, all isolates were obtained to test the inhibition of the pathogen in-vitro testing in direct opposition pairs (Fig. 1). Calculation of the inhibition antagonists using the formula Fokhema *et al.* (1959), namely:

\[
I = \left( r_1 - r_2 \right) \left( r_1 \right) - 1 \times 100
\]

Description:

\[
I = \text{percentage of inhibition}
\]

\[
r_1 = \text{radius of a colony that grows in the opposite direction with a colony } B
\]

\[
r_2 = \text{radius of the growing colony } A \text{ colony towards } B
\]

![Figure 1. How to isolate the laying of two Petri dishes](image)

Noted: A = Nonpathogenic *Fusarium*, B = pathogenic

Temperatures at 20, 25, 30, 35 and 40°C and humidity at 60, 70, 80, 90 and 100% take a role as treatment to grow nonpathogenic *Fusarium*. Lactic acid or KOH was added in pH treatments to reach pH medium at 3.5, 4.5, 5.5, 6.5 and 7.5. Biology of NPF observed through colony color, colony growth rate and diameter of macrospora. Observations were done on the fourth day of the diameter of the colony.
Ability of the antagonist from selected isolates done through in-vivo tested, by observing the intensity of the disease in endophytic dose treatment at 20, 30, 40 and 50 kg/ha and application time (one week before planting, at planting, and one week after planting + when planting). The design environment used was CRD with six replications.

3. Results

Observations on typology A, B and C of tidalswampland showed that the intensity of Fusarium wilt disease high during the rainy season and decreased in the dry season. Meanwhile on the typology D intensity of the disease was high in rainy season and higher in the in the dry season (Figure 2).

Figure 2. The intensity of Fusarium wilt disease on rice field in tidal swampland in rainy season and dry season.

Hermann (2004), In Argentina, origin of Fusarium oxysporum f. sp. dianthi, the genetic diversity among pathogenic isolates together with co-occurring nonpathogenic isolates on carnation was investigated. In all, 151 isolates of F. oxysporum were obtained from soils and carnation plants from several horticultural farms.

Environmental conditions are flooded, not only related to the root system, but also can alter the availability of some key elements such as N, P, Fe, and Mn. Consequently also affects the absorption of nutrients and nutrient utilization by rice plants. Availability and uptake of K, Zn, Ca, and Mg may increase or decrease before or after the flooded (Huber, 1980; Wells, 1996).

Flooding leads to changes in the physical, chemical, and biological soil, leading to soil and plant relationships differently with soil and plant relationships that are not flooded (Balitbang Pertanian, 1988).

Several isolates was found on isolation of the rice plant stem. Based on the test antagonist in pairs followed by reinokulasi to rice plants, four isolates were found have the highest capabilities in suppress the disease. Four isolates were also shown not to cause disease in plants so it is believed as a FNP.

Nonpathogenic Fusarium grew optimum at temperature 25 to 30°C. At a temperature of 15°C diameter colony an average of 4.22 mm, at a temperature of 20°C diameter colony grew to 50.8 mm, at a temperature of 25°C diameter colony grew to 75.6 mm. However at a temperature of 30°C diameter colony was decrease to 72.1 mm, and more reduced to 18.7 mm at temperature of 35°C (Figure 3).
Observations of all isolates indicated that NPF growth is influenced by pH. At the lowest test (pH 3.5), FNP-c1.2 turned out to be the most stressed which only amounted to 27.7 mm in growth, while the largest growth is isolates FNP-d2.5 as much as 44.4 mm. Best growth of FNP ranged from 5.5 to 7.5 mm, while the FNP-c1.2 isolates ranged from 60.5 to 89.3 mm. The result test of pH above pH 7.5, isolates FNP-d2.5 reached diameter of 83.6 mm and the FNP-d4.3 isolates of 84.5 mm of growth (Figure 4).

The test of inhibition FNP-dependent shown the present of variation in the ability of the origin of isolates (soil type). Isolates from typology D of tidal swampland (FNP-d4.3 and FNP-d2.5), had a power resistor larger than isolates from typology C of tidal swampland (FNP-c1.2 and FNP-c2.7). Average power of inhibitory isolates FNP-d4.3 by 80.1%, and the FNP-d2.5 isolates of 79.4%. While the FNP-c1.2 isolates by only 60.7% and FNP-c2.7 isolates of 63.5% (Figure 5).
Test of time influence FNP application on in-vivo, shown that application on one week before planting get better results than applications FNP at planting. Treatment of soaking seeds for 24 hours with isolates FNP,FNPd-2.5 and FNP c-1.2 was better than the application to the soil a week before planting or at planting time application (Figure 6).

Test pairs in the media between FNP and the Fusarium wilt pathogen, shown that inhibition occurs in antibiosis mechanisms, due to formation of inhibition zone. But then the Fusarium wilt pathogens were not allow to develop, while the FNP grew steadily to cover the surface of the Fusarium wiltpathogen. Thus the mechanism of inhibition occurs in addition to the space competition and antibiosis also happens mechanisms of parasitism.

Observations of colony colour, showed that Fusarium wilt pathogen was darker in color than the FNP. The mycelium growth of Fusarium wilt pathogen was more dense, while the FNP looks more diffuse with mycelium that grew into the air. FNP colonies were able to grow faster because of hyphae that spread over the surface of the media in high number. Also diameter makrokonidia of FNP greater than Fusarium wilt pathogen. Thus the characteristics of makrospora FNP who has thick walls and a larger diameter can still be used as a differentiator from the plant pathogen Fusarium makrospora, while Fusarium pathogens appear more slender than the FNP (Figures 7 and 8). Grow on medium speed standard PDA, where Fusarium pathogens will look slower growth with evidence of smaller diameter than the FNP.
The ability of FNP to suppress disease found better than the synthetic fungicide. It appears that the power intensity of the disease result in antagonists FNP only ranged from 19.68% - 27.55%, while the intensity of the disease in fungicides application as much as 53.36%. Applications with a combination of two kinds of FNP (FNP-d4.3 + FNP-d2.5) causes the intensity of the disease is only 19.68%, even though the test was not statistically significantly different than the treatment of a variety of FNP (Figure 11).

![Graph showing percentage of diseased plants after treatment application](image)

**Gambar 11.** The percentage of diseased plants after treatment application

4. **Discussion**

This proves that the tidal swampland that is sometimes flooded due to the direct influence of tidal sea water have a different microbes so that each type of tidal land have a unique ecosystem.

The presence of antagonistic fungi able to suppress disease progression in addition, are also capable as a supplier of nutrients for plant growth (Altomare *et al*., 1999; Hanson and Howell, 2004 and Harman, 2006).

FNP ability no less than *Trichoderma* sp. according to Benhamou *et al* (2002) for its ability colonized the surface of plant roots quickly so be protective for pathogenic disorders, but according to Tamietti *et al*. (1993) more precisely the role because of its ability to produce enzymes chitinase, β-glucanase 1-3 and 1-4 glucosidase, and even added by Thomashow and Weller (1996) due to several factors such as the presence of toxins, antibiotics and siderofor.

Interaction of *Fusarium graminearum* and *F. moniliforme* in maize ears the highest levels of disease and ergosterol and disease rating were correlated for both pathogens, but the highest correlation coefficients were obtained in the *F. graminearum* treatment. Effect of temperature on the growth rate of the two species explained some of the field results, with temperatures in the silks being more favorable to *F. moniliforme*. on the growth rate on silks obtained by the incorporation of radiolabeled precursor to ergosterol demonstrated that *F. graminearum* was able to grow well at 26 to 28°C, whereas *F. moniliforme* grew well over a broader range, including at higher temperatures (Reid .1999)

The use of combination variation antagonist proven to improve inihition. These results are the same as testing performed by Duijff *et al* (1998) which show that there are
synergistic in the use of a combination of *Pseudomonas fluorescens* WCS417 + FNP so as to inhibit the development of Fusarium wilt pathogen better than singly. Alabouvette *et al.* (2003) succeeded in reducing the variability of control in different environmental conditions by using two kinds of antagonist that is *F. oxysporum* avirulen coupled with a group *Pseudomonas fluorescens* in controlling wilt disease in various crops.

The ability of the FNP inhibits progression of some diseases have pointed Weller, 1988), plant defense mechanisms triggered by a certain imbasan as the agents that are antagonists endofit. Information previously presented by Loon *et al* (1998) that as an induction agent resistance (induced resistance) which can trigger plant defenses may include certain chemicals, non-pathogenic microorganisms, pathogenic or virulent race inkompatibel. The ability of fungal pathogens endofit inhibitor developments the mechanism of antibiosis, competition and mikoparasi.

Guetsky *et al* (2002), two biocontrol agents, a yeast (*Pichia guilermondii*) and a bacterium (*Bacillus mycoides*), were tested separately and together for suppression of *Botrytis cinerea* on strawberry leaves and plants. When both biocontrol agents were applied in a mixture, conidial destruction was more severe. The improvement in control efficacy achieved by introducing one or more mechanisms at a time was calculated. *Pichia guilermondii* competed with *Botrytis cinerea* for glucose, sucrose, adenine, histidine, and folic acid.

Two biocontrol agents, a yeast (*Pichia guilermondii*) and a bacterium (*Bacillus mycoides*), were tested separately and together for suppression of *Botrytis cinerea* on strawberry leaves. Applied separately, the biocontrol agents significantly inhibited spore germination, lesion formation, and lesion development at most temperatures, relative humidities, and spray-timing combinations (temperatures: 10, 15, 20, 23, 25, and 30°C; relative humidities: 78, 85, 96, and 100%; and spray-timings: 0, 4, and 7 days before inoculation). Control efficacy achieved by the biocontrol agents applied separately ranged between 38 and 98% (mean 74%) and the coefficient of variation ranged from 9.7 to 75%. Application of more than one biocontrol agent is suggested as a reliable means of reducing the variability and increasing the reliability of biological (Guetsky *et al*., 2011).

Bao and Lazarovits (2001). Differential colonization of tomato roots by nonpathogenic and pathogenic *Fusarium* n contrast, mycelia of *F. oxysporum* f. sp. *lycopersici* were found in the vascular bundles. Thus, direct interactions between the two fungi likely happen in the root surface cell layers. Gardener (2004), isolate *Bacillus* and *Paenibacillus* spp. in agricultural systems in agricultural fields and may directly and indirectly contribute to crop productivity. Multiple *Bacillus* and *Paenibacillus* spp. can promote crop health in a variety of ways. Some populations suppress plant pathogens and pests by producing antibiotic metabolites, while others may directly stimulate plant host defenses prior to infection. Some strains can also stimulate nutrient uptake by plants, either by promoting rhizobial and mycorrhizal symbioses or by fixing atmospheric nitrogen directly.

Duijff *et al.* (1999), Two biological control agents, nonpathogenic *Fusarium oxysporum* Fo47 and *Pseudomonas putida* WCS358, were evaluated for suppression of Fusarium wilt of flax grown in nutrient solution and for suppression of the population density and metabolic activity of the causal organism *F. oxysporum* f. sp. *lini* strain Foli3GUS on 163
root surfaces. Reduced by the nonpathogenic strain, and Fusarium wilt was suppressed. At a Fo47 to Foln3GUS inoculum ratio of 10:1, Fo47 decreased the severity of Fusarium wilt to a smaller extent and it also reduced -glucuronidase activity without reducing the density of Foln3GUS on flax roots.

Hh et al. (1997), Nonpathogenic *Fusarium oxysporum* strain Fo47 controls the incidence of Fusarium wilt. Strain Fo47 protected tomato against Fusarium wilt in all four bioassays. Inoculation with Fo47 increased chitinase, -1,3-glucanase, and -1,4-glucosidase activity in plants, confirming the ability of Fo47 to induce resistance in tomato.

5. Conclusion

The intensity of Fusarium wilt disease was higher in the rainy season in the typology A, B and C, while in typology intensity of Fusarium wilt disease high in the dry season. FNP growth assay in vitro depends on: the temperature (25-30°C) and pH (6.5 to 7.5). FNP can be distinguished from Fusarium pathogens based on colony color and growth, makrokonidia diameter, speed of growth in the media, and the power of the antagonist. The test results proved that in in-vivo test, antagonist of FNP which applied through the soil a week before planting with a dose formulations 30 kg/ha was quite high (over 80%), while the application in soaking seeds in spore density of 10⁶ for 24 hours before planting, resulted better in inhibiting the progression of the disease (above 90%). The ability of FNP to suppress disease found better than the synthetic fungicide. It appears that the power intensity of the disease result in antagonists FNP only ranged from 19.68% -27.55%, while the intensity of the disease in fungicides application as much as 53.36%.

References


165


Von Alten, H., A. Lindemann & F. Schönbeck. 1993. Stimulation of vesicular arbuscular mycorrhiza by fungicides or rhizosphere bacteria. Mycorrhiza 2 :


The Raffinose, Glucose And Fructose In Extract Of Sweet Potato Nagara White From South Borneo

Rini Hustiany

Program Studi Teknologi Industri Pertanian, FakultasPertanian, Universitas Lambung Mangkurat, Banjarbaru
Jl. A. Yani KM 32 Banjarbaru, Kalimantan Selatan
Email : hustiany@yahoo.com

Abstract

Sweet potato is a functional food as a prebiotic, a producer of sugar and oligosaccharides such as raffinose, glucose, and fructose. This study aimed to observe the effect of the type of solvent on the content of raffinose, glucose and fructose in extracts of sweet potato Nagara white. Sweet potato stored at chilling temperature (± 5°C) in one month. Sweet potato grinded and extracted with different types of solvents, namely ethanol 100%, acetonitrile100%, ethanol: acetonitrile 50:50, ethanol: water 70:30, acetonitrile: water 70:30, ethanol: water 30:70, and acetonitrile: water 30:70 at room temperature, stirring speed of 150 rpm for 2 and 3 days. The amount of raffinose, glucose and fructose determined by HPLC RID (Refractive Index Detector). The content of raffinose, glucose, and fructose in sweet potato were high if sweet potato extracted using ethanol: water 30:70 and 70:30 with extraction 2 days. The content of raffinose is 1.11 to 1.69% (w / v), glucose is 3.52 to 4.14% (w / v), and fructose is 3.80 to 5.46% (w / v). Based on our finding that it is suggested to produce raffinose, glucose, and fructose is high, the sweet potato extracted using ethanol:water 70:30 or 30:70 for 2 days.

Keyword : sweet potato, raffinose, glucose, fructose, extraction

1. Introduction

South Borneo is producer of sweet potatoes such as sweet potato Nagara. Sweet potatoes Nagara are founded in the North and South Daha, district of Hulu Sungai Selatan. The sweet potato Nagara is native plant in the area. There are several types of sweet potatoes Nagara, one of which is a sweet potato Nagara white. The sweet potato Nagara white is sweet potato with white flesh.

The sweet potato can produce sugars and oligosaccharides, such as glucose, fructose, and raffinose. The sugar provides sweet and enhance consumer acceptance. The oligosaccharide is a functional food and a ingredient food can not be digested. Hustiany (2012) states that the sweet potato Nagara white in a fresh condition containing glucose, fructose, sucrose and maltose, and raffinose. When the sweet potato Nagara white is stored at room temperature for one month, it has decreased the amount of glucose and fructose than in fresh condition and will increase the amount of sucrose, maltose and raffinose. If stored at chilling temperature for one month, the sweet potato Nagara white containing sucrose, maltose and raffinose.
The materials contain sugars and oligosaccharides can be isolated with a polar solvent, such as acetonitrile:water (65:35, v/v) dan ethanol (Muzquiz et al. 1999); ethanol 8-10% (French et al. 1959); acetonitrile:water (85:15, v/v) (Da Costa Leite et al. 2000); acetonitrile:water and water (Park et al. 2001), and water (Kennedy et al., 1989).

The purpose of this study was to determine the effect of solvent type on the content of raffinose, glucose, and fructose in extracts of sweet potato Nagara white.

2. Methods

The first, the sweet potato Nagara white stored at chilling temperature (± 5 °C) for one month. The sweet potato Nagara white is dried, crushed, and extracted with different types of solvents, namely ethanol 100%, acetonitrile100%, ethanol: acetonitrile 50:50, ethanol: water 70:30, acetonitrile: water 70:30, ethanol: water 30:70, and acetonitrile: water 30:70 at room temperature, stirring speed of 150 rpm for 2 and 3 days. The sample used for extraction is 50 g/150 ml solvent. After 2 and 3 days, and the extracts filtered through cotton and Whatman No. 40. The solvent was evaporated and the filtrate was diluted to 10 ml, so the concentration being 0.033 g/ml.

The amount of raffinose, glucose and fructose determined by HPLC RID (Refractive Index Detector). The column used was Metacarb Ca Plus with a length of 30 cm and a diameter of 1 cm. Column temperature used was 85°C. The samples injected 10 μl with the mobile phase is H2O. The flow rate of mobile phase is 1 ml / min. The method used was isocratic. The standard was also injected, namely glucose, fructose, and raffinose.

3. Results and Discussions

The content of raffinose, glucose and fructose found in the extract of sweet potato Nagara white with various solvents (Table 1).

<table>
<thead>
<tr>
<th>Type of Solvent</th>
<th>Extraction (Days)</th>
<th>Concentrations (% w/v)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Raffinose</td>
</tr>
<tr>
<td>Ethanol 100%</td>
<td>2</td>
<td>not detection</td>
</tr>
<tr>
<td>Ethanol 100%</td>
<td>3</td>
<td>0.31</td>
</tr>
<tr>
<td>Acetonitrile 100%</td>
<td>2</td>
<td>not detection</td>
</tr>
<tr>
<td>Acetonitrile 100%</td>
<td>3</td>
<td>not detection</td>
</tr>
<tr>
<td>Ethanol : Acetonitrile 50:50</td>
<td>2</td>
<td>not detection</td>
</tr>
<tr>
<td>Ethanol : Acetonitrile 50:50</td>
<td>3</td>
<td>not detection</td>
</tr>
<tr>
<td>Ethanol : Water 70:30</td>
<td>2</td>
<td>1.69</td>
</tr>
<tr>
<td>Ethanol : Water 70:30</td>
<td>3</td>
<td>1.40</td>
</tr>
<tr>
<td>Acetonitrile : Water 70:30</td>
<td>2</td>
<td>0.10</td>
</tr>
<tr>
<td>Acetonitrile : Water 70:30</td>
<td>3</td>
<td>not detection</td>
</tr>
</tbody>
</table>
The use of ethanol, acetonitrile and water itself is already widely used to isolation raffinose, glucose, and fructose as Park et al. (2001); Da Costa Leite et al. (2000); Murquize et al. (1999); Kennedy et al. (1989); and French et al. (1959). The extract of sweet potato Nagara white with different types of solvent containing glucose and fructose at different concentrations (Table 1). But not the whole extract of sweet potato Nagara white containing raffinose.

The content of raffinose, glucose and fructose found in many sweet potato extract using ethanol: water, either 70:30 or 30:70 ratio were extracted for 2 days. The raffinose, fructose, and glucose is better to use a higher polarity solvents, such as water and ethanol, though acetonitrile also including the polar solvent. However, if the solvent used is 100% ethanol or acetonitril 100% are not good extract of sweet potato to produce raffinose, glucose and fructose. Neither the ethanol:acetonitrile 50:50 is also not good extract of sweet potato to produce raffinose, glucose and fructose.

The extraction using ethanol:water - either with a lot of ethanol content and a lot of water content - can produce raffinose, glucose and fructose were significant. As for the 100% ethanol is not good for extracting raffinose, glucose and fructose found in sweet potatoes. So, apparently there is an interaction between ethanol and water to be able to bind to raffinose, glucose and fructose in sweet potatoes with good. So, to isolation raffinose, glucose and fructose in sweet potato is better to use ethanol: water.

The extraction for two days showed better results than the extraction for three days. Whereas the hypothesis, the longer the extraction process, the more the raffinose, glucose and fructose were extracted. But instead, the extraction for two days resulted raffinose, glucose and fructose were extracted more than three days. It is thought, on raffinose, glucose and fructose degradated becomes smaller molecules again, such as organic acids and ethanol. The possibility of this degradation occurs are the extraction is done at room temperature and the organic solvent is water and ethanol.

The different things happen when extraction using acetonitrile: water – either with a lot of acetonitril content or a lot of water content - the extraction for 3 days produces more raffinose, glucose and fructose compared to extraction for 2 days. It is thought, acetonitril:water can prevent contamination from microorganisms during extraction at room temperature. As a result the raffinose, glucose, and fructose are not degradated becomes smaller molecules in acetonitrile:water.

4. Conclusions

Based on our finding that it is suggested to produce raffinose, glucose, and fructose is high, the sweet potato extracted using ethanol: water70:30 or 30:70 for 2 days.
References


