



**DAAD**  
Deutscher Akademischer Austauschdienst  
German Academic Exchange Service



# PROCEEDINGS OF THE INTERNATIONAL WORKSHOP

## Tropical Bio-resources for Sustainable Development

"The Role of Innovation to Enhance German Alumni in Scientific and Professional Capacities"

### **Editors:**

Syarifah Iis Aisyah  
Nandi Kosmaryandi  
Anuraga Jayanegara  
Ronald F. Kuehne

IPB International Convention Center

August 13<sup>rd</sup>-15<sup>th</sup>, 2014  
Bogor, Indonesia

**PROCEEDINGS OF THE INTERNATIONAL  
WORKSHOP  
TROPICAL BIO-RESOURCES FOR SUSTAINABLE  
DEVELOPMENT**

“The Role of Innovation to Enhance German Alumni in  
Scientific and Professional Capacities”

13-15 August 2014  
Bogor, Indonesia

**Editors**

Syarifah Iis Aisyah (Bogor Agricultural University, Indonesia)  
Nandi Kosmaryandi (Bogor Agricultural University, Indonesia)  
Anuraga Jayanegara (Bogor Agricultural University, Indonesia)  
Ronald F. Kuehne (Georg-August-Universitaet Goettingen, Germany)



**Published by**

Directorate of Career Development and Alumni Affairs (CDA), Bogor  
Agricultural University  
Southeast Asia Germany Alumni Network (SEAG)  
Deutscher Akademischer Austauschdienst (DAAD)

**Editors**

Syarifah Iis Aisyah (Bogor Agricultural University, Indonesia)  
Nandi Kosmaryandi (Bogor Agricultural University, Indonesia)  
Anuraga Jayanegara (Bogor Agricultural University, Indonesia)  
Ronald F. Kuehne (Georg-August-Universitaet Goettingen, Germany)

**Publishing House**

IPB Press  
Jl. Taman Kencana No. 3 Bogor 16151  
West Java, Indonesia

ISBN: 978-602-98410-1-5



## **PREFACE**

---

It is really honoured and very pleased to have this 6<sup>th</sup> SEAG International workshop, which is organized by SEAG (South East Asia-Germany) Alumni Network-Indonesia, in collaboration with CDA (Career Development and Alumni Affairs), Bogor Agricultural University. SEAG is the German Alumni-networking group, which was established in year 2000, among countries in South-East Asia.

Since 1999, the Federal Ministry for Economic Cooperation and Development (BMZ) and the German Academic Exchange Service (DAAD) have been systematically supporting alumni networks of graduates from German Universities. The University of Goettingen, Kassel and Marburg established an alumni consortium to support and maintain efficiently local and regional alumni networks in Egypt-Arab-Region (GEAR), in Latin America (ReCALL), in Iran (GIAN) and in South East Asia (SEAG).

The objectives of the alumni networks are to establish an alumni database to enable the exchange of scientific experiences among the alumni and their host universities in Germany, and finally to create and maintain local and regional network. In order to achieve these goals, the consortium uses many tools, e.g. organizing symposium, mini workshop, international workshop, summerschool, etc.

For regional Indonesia, some Mini Workshops had been done several times which were taken place in many universities in different provinces. The first SEAG mini workshop had been done in Brawijaya University, Malang, on April 2003 for those alumni who work in Agriculture economy. The second one was executed in Soedirman University, Central Java on May 2004, for Agriculturist, and the third SEAG mini workshop was conducted in Taman Safari Bogor, May 2005 for Animal scientist. The fourth was in Sam Ratulangi University – North Sulawesi, for the society of forester, with the theme of Developing Public Awareness through Sustainable Forest Management. The fifth was conducted in USU (North Sumatera University) for area of Agricultural Technology, in November 2006. The Sixth was in IPB Bogor for horticulturist, on May 2007.

As academicians or researchers who gained education, training or part of it in Germany, we should play a role as key person in our scientific society. Our partners from Germany also believe that their support can only be

effectively provided if it is based on cooperation with key local players. Therefore development cooperation is very essentially dependent on identifying and integrating such key persons. Indeed, as German alumni, we have to show an effort to support for economic, technological and social transformation processes in our countries.

Some of us hold important positions in government, in the administration, in business and industry and in academia. We may act as multipliers and disseminators in and within our societies. We should also introduce the requisite specialist knowledge, provide motivation for innovation and guarantee cooperative capabilities in dealings with local and foreign partners. That is why we explore the theme of Tropical Bio-resources for Sustainable Development: The Role of Innovation to Enhance German Alumni in Scientific and Professional Capacities, for this workshop.

High appreciation is conveyed to the organizing committee from SEAG-Indonesia and CDA IPB for the effort to conduct this workshop. The very sincere thank is delivered to the German Academic Exchange Service (DAAD) for continues support financially and many other aspect give us invaluable opportunities to learn from each other, to improve individual and institution competences, and to experience a lot of things across universities.

Syarifah Iis Aisyah

SEAG INDONESIA  
CDA IPB

## TABLE OF CONTENTS

---

INTRODUCTION .....	1
WORKING GROUP 1: FUNDAMENTAL ASSESSMENT FOR BIO-RESOURCES	
1. Distribution pattern of <i>Alstonia scholaris</i> - a species containing rich medicinal substances - in different forest ecosystems ( <i>Bambang Irawan, Iskandar Z. Siregar, Reiner Finkeldey</i> ) .....	4
2. Radical scavenging activity of leafy amaranths as potential antioxidant sources ( <i>Muhammad Ikhsan Sulaiman, Rita Andini</i> ) .....	11
3. Yield evaluation of 17 chili pepper ( <i>Capsicum annuum</i> L.) lines in Bogor, West Java ( <i>Faradila Danasworo Putri, Muhamad Syukur, Syarifah Iis Aisyah</i> ) .....	17
4. Current research development of <i>in vitro</i> embryo production on farm animal in Indonesia ( <i>Mohamad Agus Setiadi</i> ) .....	23
5. Carrageenan prototype food product development of seaweed at Cluster Salabangka Islands of Central Sulawesi Province ( <i>Marhawati Mappatoba, Asriani Hasanuddin</i> ) .....	28
6. Inventory of Dipterocarpaceae at Soraya Research Station, Leuser Ecosystem Area ( <i>Iqbar, Essy Harnelly</i> ) .....	33
7. Influence of different supplemental niacin levels on intake, digestibility and rumen fermentation of dairy cows: a meta- analysis ( <i>Rossy E. A. Anggreini, Erika B. Laconi, Anuraga Jayanegara</i> ) .....	38
8. Influence of tannin concentration in ration on fermentation parameters of Rumen Simulation Technique (RUSITEC): a meta-analysis ( <i>Anuraga Jayanegara, M. Ridla, Erika B. Laconi, Nahrowi</i> ) .....	42
9. An observation on the scales of three species of <i>Varanus</i> using scanning electron microscopy ( <i>Evy Arida</i> ) .....	48
10. The potency of tropical endophytic bacteria as plant growth and biocontrol agents ( <i>Abdul Munif</i> ) .....	54
11. Effect of oxygen concentration on storage of sapodilla fruit ( <i>Achras zapota</i> l.) ( <i>Bambang Susilo, Rini Yulianingsih, Dyah Ayu Agustiningrum</i> ) .....	61
12. Heavy metals and other elements concentration in <i>Emilia sonchifolia</i> grown in topand overburden of Serpentine soil from Sorowako, Indonesia ( <i>A. Tjoa, H. Barus</i> ) .....	67

## WORKING GROUP 2: APPLIED RESEARCH AND SCALING-UP OF BIO-RESOURCE INNOVATION

1. Thermal hydrolyzed rice husk as bioherbicide to control sedge rice weed *Fimbristylis miliacea* (L.) Vahl (*H. Agusta, M. Syakir, D. Guntoro, M.B. Yunindanova, B. Arifin*) ..... 76
2. Potential sustainable maize-peanut production using appropriate biofertilizer technology in ultisols of Moramo district, South Konawe regency (*L. Karimuna, A. Maruf, Rahman, L.A. Sani*) ..... 81
3. Evaluation of estrus synchronization with sponge vaginal and artificial insemination technologies on sheep and goat (case study at Juhut village, Karang Tanjung sub district, Pandeglang district, Banten) (*Siti Darodjah Rasad, Rangga Setiawan, Toha, Kikin Winangun*)..... 92
4. Concentrate protein albumin (probumin) from snakehead fish (*Channa striata*); local product of food supplement as cheap albuminprotein source for community (*Abu Bakar Tawali, Meta Mahendradatta, Veni Hadju*)..... 96
5. Household scale environmentally friendly measures to reduce resource consumption (*Arief Sabdo Yuwono*) ..... 102
6. Use of white rot fungi- and bacterial rot in decomposition of cocoa pod waste and in growth reduction of *Phytophthora palmivora* and *Lasiodiplodia theobromae* (*Tutik Kuswinanti, Ade Rosmana, Vien Sartika Dewi, Baharuddin, Jamila*) ..... 109
7. Repellence test of spices (garlic, chili, and pepper) to rat (*Rattus rattus diardii* l.) (*Swastiko Priyambodo, Dewi Safitri*) ..... 114
8. Growth response of dragon fruit (*Hylocereus costaricensis*) on MS medium with Gandasil and Growmore in vitro (*Faridatul Mukminah, Busroni Asnawi, Tetra Tri Novi*) ..... 122
9. Effect of enriched phospho-compost application on the growth and phosphorous content of *Setaria splendida* Stapf (*R. Dianita, A. Rahman Sy, Ubaidillah*)..... 128
10. Implementation of life cycle assessment (LCA) on tempeh production in Bantul district - Yogyakarta special province – Indonesia (*Wahyu Supartono, Lina Widyasari, Didik Purwadi*) ..... 133
11. Study of characteristics floral and morphological hybrid rice parental lines on different seeding date (*P.N. Susilawati, M. Surahman, B.S. Purwoko, T.K. Suharsi, Satoto*) ..... 140
12. Natural grass and plant residue qualities and values to support lactating cows requirement on forage at Indonesian small scale enterprise and traditional dairy farming (*Despal, Jazmi Malyadi, Yessy Destianingsih, Ayu Lestari, Hari Hartono, Luki Abdullah*)..... 145



13. Effect of seed density and nutrient source on production and quality of green house fodder as dairy cattle feed (*Idat Galih Permana, Despal, Dara Melisa*) ..... 151

### WORKING GROUP 3: SCIENCE-POLICY INTERFACING ON BIO-RESOURCE CONSERVATION AND UTILIZATION

1. Tropical rain forest in Kalimantan as source of medicinal plants: a case study at Dayak Meratus ethnic in South Kalimantan (*Yudi Firmanul Arifin, Siti Hamidah*) ..... 159
2. Development of Gambir (*Uncaria gambir*) for rural economy: between policy and people aspiration (*Andy Ahmad Zaelany*)..... 166
3. Conservation of wildlife bio-resource management for livelihood (*Retno Iswarin Pujaningsih*)..... 172
4. Market integration analysis of sweetened condensed milk in Indonesia: do sweetened condensed milk prices follow the prices of imported milk and sugar? (*Venty Fitriany Nurunisa, Bonar M. Sinaga, Ratna Winandi A., Bernhard Brümmer*) ..... 178
5. Trend analyses of forest and land fires towards climate change in Indonesia (*Lailan Syaufina*) ..... 185
6. Agroforestry based medicinal plants and marketing partnership for community empowerment: cases in Bogor district and Sukabumi district, West Java province (*Leti Sundawati, Ninuk Purnaningsih, Edy Djauhari Purwakusumah*) ..... 191
7. A survey on the community socio-economic of the district of coral reef rehabilitation and management program (COREMAP) of Sikka, Flores Flores (*Vincentius Repu*) ..... 197
8. Influence of leadership style, organizational culture, and work motivation on employee performance in public company pawn shop branch office in Kupang City, East Nusa Tenggara, Indonesia (*Fred Marthinus Dethan*)..... 206
9. Management of natural resources in tropical peat swamp forest of Indonesia (*Ujang Suwarna*) ..... 213
10. Analysis of the competitiveness of pangasius fish farming in Kota Gajah Sub-district, Lampung Tengah District, Lampung Province (*Angga Yudhistira, Harianto, Bernhard Brümmer, Stephan Wessels, Nunung Kusnadi*)..... 219
11. The sustainability of coffee plantation in West Lampung, Lampung province, Indonesia (*Yeti Lis Purnamadewi*) ..... 226
12. The importance of biodiversity conservation and livelihood of customary community approaching in national park management in Indonesia (*Nandi Kosmaryandi, Sambas Basuni, Lilik B Prasetyo, Soeryo Adiwibowo*)..... 233

13. Competitiveness analysis of Indonesian shrimp farming, case study: PT. Surya Windu Kencana (SWK), East Java ( <i>Siti Maryam, Bernhard Brümmer, Gabriele Hörstgen-Schwark, Rachmat Pambudy</i> ) .....	242
14. Competitiveness and policy impact analysis of feedlots in Lampung ( <i>Labudda Paramecwari, Bernhard Brummer, Stefan Schwarze, Rachmat Pambudy</i> ) .....	248
15. The Contribution of Agricultural Sector Towards Culinary Business Development at Kupang Municipality East Nusa Tenggara Province ( <i>Markus Bunga</i> ) .....	254
16. The Morphological Character of the “Bendi” Horse as Short Distance Urban Transport Modes that are Environmentally Friendly ( <i>Sri Adiani, Dordia A. Rotinsulu, Ben J Takaendengan</i> ) ....	261
17. The diversity of fungi on polluted mangrove ecosystem at Belawan and Jaring Halus, North Sumatra province ( <i>Yunasfi, Pindi Patana</i> ) .....	266
18. Natural products exploration in frame of tropical plant bio-resource conservation and utilization ( <i>Enih Rosamah, Harlinda Kuspradini, Rita Khairani</i> ) .....	273
19. The impact of trade policy on international palm oil trade flows ( <i>Riska Pujiati, M Firdaus, Andriyono K Adhi</i> ).....	278
LIST OF PARTICIPANTS .....	284
COMMITTEE .....	287

## **INTRODUCTION**

---

### **A. Background**

Indonesian economy is sustained largely by domestic factors such as large population size abundant natural resources, especially tropical biological resources (tropical bio-resources). Position and Indonesia potentials in terms of richness of biological resources (biodiversity) and socio-culture (local wisdom) attract foreign partners to various international collaborations. Ministry of Research and Technology (RISTEK) has recorded an increasing number of requests of foreign research permits. International networks needs to be expanded including more participation of Indonesian universities, so that their capacity increases towards research and innovation.

International alumni from German Universities are recognized as an important asset at the era of globalization at which the use of soft-power approaches for effective networking is strongly encouraged. German alumni are also active in some fora/associations such as Perhimpunan Alumni Jerman (PAJ) and South East Asia-Germany (SEAG) Alumni Network. Apart from these fora, they are also active in other smaller ad hoc networks being established based on specific fields of interest such as food, water resources, biodiversity, etc. The future academic and administrative roles of German alumni in Indonesia are increasing with the long standing collaboration between Indonesia and German Universities. The enhancement of the alumni capacity is needed to cope with and actively take part in the current collaborative developments. Therefore, the German alumni meeting in Indonesia is proposed considering the number of alumni, increasing contacts and other drivers such as internationalization and future Indonesia's human resource development.

For the above reasons, with a full support from German Academic Exchange Service (DAAD), SEAG alumni network conducted the International Workshop on Tropical Bio-resources for Sustainable Development in Bogor, Indonesia, from 13-15 August 2014. Results of the workshop is documented in this Proceedings. Although there are editors for this Proceedings, the responsibility for correctness of content and proof for each paper remains to the individual authors.

## **B. Objectives**

1. To share lesson learned and best practices among alumni on bio-research innovation for sustainable development.
2. To enhance scientific and professional capacities of German alumni in conducting teaching, research and outreach.

## WORKING GROUP 1: FUNDAMENTAL ASSESSMENT FOR BIO-RESOURCES

---

1. Distribution pattern of *Alstonia scholaris* - a species contained rich medicinal substances - in different forest ecosystems (*Bambang Irawan, Iskandar Z. Siregar, Reiner Finkeldey*)
  2. Radical scavenging activity of leafy amaranths as potential antioxidant sources (*Muhammad Ikhsan Sulaiman, Rita Andini*)
  3. Yield Evaluation of 17 Chili Pepper (*Capsicum annum* L.) Lines in Bogor, West Java (*Faradila Danasworo Putri, Muhamad Syukur, Syarifah Iis Aisyah*)
  4. Current research development of *in vitro* embryo production on farm animal in Indonesia (*Mohamad Agus Setiadi*)
  5. Carrageenan prototype food product development of seaweed at Cluster Salabangka Islands of Central Sulawesi Province (*Marhawati Mappatoba, Asriani Hasanuddin*)
  6. Inventory of Dipterocarpaceae at Soraya Research Station, Leuser Ecosystem Area (*Iqbar, Essy Harnelly*)
  7. Influence of different supplemental niacin levels on intake, digestibility and rumen fermentation of dairy cows: a meta-analysis (*Rossy E. A. Anggreini, Erika B. Laconi, Anuraga Jayanegara*)
  8. Influence of tannin concentration in ration on fermentation parameters of Rumen Simulation Technique (RUSITEC): a meta-analysis (*Anuraga Jayanegara, M. Ridla, Erika B. Laconi, Nahrowi*)
  9. An observation on the scales of three species of *Varanus* using scanning electron microscopy (*Evy Arida*)
  10. The potency of tropical endophytic bacteria as plant growth and biocontrol agents (*Abdul Munif*)
  11. Effect of oxygen concentration on storage of sapodilla fruit (*Achras zapota* l.) (*Bambang Susilo, Rini Yulianingsih, Dyah Ayu Agustiningrum*)
  12. Heavy metals and other elements concentration in *Emilia sonchifolia* grown in top and overburden of Serpentine soil from Sorowako, Indonesia (*A. Tjoa, H. Barus*)
-

## Distribution pattern of *Alstonia scholaris* - a species containing rich medicinal substances - in different forest ecosystems

Bambang Irawan<sup>1,\*</sup>, Iskandar Z. Siregar<sup>2</sup>, Reiner Finkeldey<sup>3</sup>

<sup>1</sup>Forestry Faculty, University of Jambi, Indonesia

<sup>2</sup>Forestry Faculty, Bogor Agricultural University, 16680, Indonesia

<sup>3</sup>Institute of Forest Genetics, University of Goettingen, Germany

\* Corresponding author: birawan1@gwdg.de

---

**Abstract** *Alstonia scholaris* (L.) R.Br (Apocynaceae) is an evergreen tropical. It is native to tropical and subtropical Africa, Central America, Southeast Asia, Polynesia and Australia. *A. scholaris* is a species with high economical and ecological values. It is fast growing species. The latex provides a good quality chewing gum; the bark is a source of fibers. *A. scholaris* also contains many chemical substances that are important both for traditional and modern medicines. It is reported to contain various alkaloids, coumarins, flavonoids, leucoanthocyanins, simple phenolics, steroids, saponins and tannins. Ecologically, *A. scholaris* also plays an important role in the forest succession processes. An investigation on the distribution pattern of *A. scholaris* was conducted in three ecosystems in Jambi, namely jungle rubber (JR), close to primary forest (CPF), and secondary forest (SF). Six hectare plots have been developed in two lowland forest landscapes namely Senami Forest and Bukit Duabelas National Park (BDNP). All trees above 10 cm were recorded following standard inventory method. The results showed that *A. scholaris* could be found in all ecosystems except CPF in BDNP with the highest dominancy in the CPF of Senami Forest (0.02840) followed by JR of BDNP and SF in Senami. The density value of *A. scholaris* varied among the ecosystems. The highest value was 0.0940 which could be found in SF followed by CPF in Senami and JR in BDNP. The total volume with the highest of 12.32 m<sup>3</sup>/ha and frequency of 22 trees per hectare could be found SF in Senami. The mean diameter of *A. scholaris* varied from 17.86 cm to 31.18 cm that could be found in JR and SF in Senami respectively, while the tallest *A. scholaris* could be found in SF of Senami (10.50 m) followed by JR in BDNP with the height of 10.40 m.

**Keywords** *A. scholaris*, distribution pattern, different ecosystems, medicinal substances

---

## 1. Introduction

*Alstonia scholaris* (L.) R.Br (Apocynaceae) is an evergreen tropical. It consists of 40-60 species (according to different authors), native to tropical and subtropical Africa, Central America, southeast Asia, Polynesia and Australia, with most species in the Malaysian region. It is tolerant to a variety of soils and habitats. It can be seen as a small tree growing on coral or as a canopy species in inland primary or secondary forests. Most common in lowland coastal areas with annual rainfall of 1000-3800 mm but is found in up to 1000 m in altitude. One of its characteristics is an ability to grow on shallow soils [1]. Its favorable soils include alluvia, basaltic red earth, yellow earth with grey-brown topsoil, stony red earth on basic volcanic soils, sandy grey earth, brown earth from a volcanic mixture of rocks and soils derived from metamorphic rocks [2].

*A. scholaris* is a medium to large tree, about 40 m high with a somewhat tessellated corky grey to grey-white bark. The boles of larger trees are strongly fluted to 10 m. The outer blaze is cream to yellowish in colour with abundant, milky latex that flows rapidly when cut. Leaves in whorls of 4-8 in the upper axils; leaf stalks 1-1.5 cm long, the lamina obovate to elliptical or elliptical-lanceolate, glabrous or sparsely hairy, tapering towards the base, 11.5-23 x 4-7.5 cm. Upper surface is dark green, the lower green-white with 25-40 pairs of lateral veins on each side of the midrib and 2-6 mm apart. The tip of the leaf is rounded or shortly pointed, tapering towards the base. The inflorescence is a much-branched terminal panicle, up to 120 cm long; flowers 7-10 mm long white, cream or green; the tube hairy; lobes sparsely or densely pubescent, 1.5-4 mm long, the left margins overlapping; strongly perfumed. Fruit a pendulous, two-lobed, dehiscent follicle, brown or green, dry or woody, spindle-shaped, 15-32 cm long, 4-6 mm in diameter, containing numerous flat, oblong, brown seeds, 4-5 x 0.9-1.2 mm, with a tuft of hairs 7-13 mm long at each end. The seed does not taper to a point at either end [2].

*A. scholaris* is a species with high economical and ecological values. It is fast growing species. Muslimin and Lukman [3] reported that the diameter and height increment of *Alstonia angustiloba* was about 3.43 cm/year and 1.52 m/year. This increment is much comparable to many commercial species of industrial forest plantation such as Eucalypt and Acacia. It is an indigenous species of Sumatera. It can be found almost in every part of Indonesia [4]. The products of *A. scholaris* are used for many purposes. The latex provides a good quality of chewing gum; the bark is a source of fibers.

The density of the wood is 270-490 kg/cubic m at 15% mc. Heartwood cream to pale yellow, sapwood wide and visually indistinct from the heartwood. It often has strong odor and a bitter taste. It is used for fuel wood, pulp and paper production, pattern making, core stock, plywood, carving and moldings. Other products: Wood charcoal is used as gun powder [2].

Many publications reported that *A. scholaris* contained many chemical substances that are important both for traditional and modern medicines. It is reported to contain various iridoids, alkaloids, coumarins, flavonoids, leucoanthocyanins, reducing sugars, simple phenolics, steroids, saponins and tannins. It has been reported to possess antimicrobial, antiamebic, antidiarrheal, antiplasmodial, hepatoprotective, immunomodulatory, anticancer, antiasthmatic, free radical scavenging, antioxidant, analgesic, anti-inflammatory, antiulcer, antifertility and wound healing activities. In other parts of the world, it is used as a source cure against bacterial infection, malarial fever, toothache, rheumatism, snakebite, dysentery, bowl disorder, etc [5].

*A. scholaris* has been used in traditional systems of medicine for treating various ailments. The ripe fruits of the plant are used in syphilis and epilepsy. It is also used as a tonic, antiperiodic, and anthelmintic. The milky juice of *A. scholaris* has been applied to treat ulcers. The bark is the most intensively used part of the plant and is used in many compound herbal formulas [6]. It is a bitter tonic, alternative, and febrifuge and is reported to be useful for the treatment of malaria, diarrhea, and dysentery [7]; [8]. The leaf extract has also been found to own antimicrobial properties [9]. *A. scholaris* has also been reported to inhibit liver injuries induced by carbon tetrachloride, beta-d-galactosamine, acetaminophen, and ethanol as remarked by the reduced elevation of levels of serum transaminases and histopathologic changes such as cell necrosis and inflammatory cell infiltration [10].

Apocynaceae derives its economic importance from highly valued leaf anticancer alkaloids vincristine, vinblastine and antihypertensive root alkaloid ajmalicine [11, 12]. Shazly *et al.* [13] stated that ethanolic extract from the leaves of Apocynaceae contains the cardiotoxic glycoside, neriifolin, which has insecticidal activity. It contains a milky sap containing a compound called Thevetin, which is being used as heart stimulant but is extremely poisonous in its natural form. Oleander extract has been used in folk medicines and there are reports that long-term use of oleander may have positive effects in patients with prostate or breast cancer [14].



Ecologically, *A. scholaris* also plays an important role in the forest succession processes. It is a pioneer species which is easy to propagate and is able to grow in many types of soil. Therefore, it will occupy the most degraded forests for the first phase of succession. It has been managed as a fuel wood species in Sri Lanka under a short coppice rotation of 6-8 years. In a social forestry planting in India, the species reached 3.6 m height and 10 cm diameter at 3.5 years in mixed species. In plantations in Taiwan, it reached an average of 23.5 m in height and 51 cm dbh in 18 years. A maximum of 35 m in height and 109 cm dbh was attained at 41 years of age [2].

Even, *A. scholaris* is very promising tree species in term of its growth ability, wood properties, chemical content and pharmaceutical impacts, the understanding of this species is very limited mostly due to limited number of researchers studied this species. The objectives of this research are to analyze the distribution pattern and dimension of *A. scholaris* which naturally grow in different forest ecosystems and to study the forest composition and species diversity of forest ecosystem where of *A. scholaris* naturally grows.

## **2. Materials and Methods**

The study had been conducted in three ecosystems types in Jambi Province namely close to primary forest, secondary forest and jungle rubber. Two replications for each ecosystem had been applied which were taken from two landscapes namely Bukit Dua belas National Park (BDNP) and Senami Forest. One hectare of plot had been studied which were chosen based on purposive sampling with the presence of *A. scholaris* as the indicator. Six hectares of plot size was for overall study area. All trees above 10 cm had been recorded for their local name, diameter and height. The position of each sample tree had been plot in the millimeter block paper.

## **3. Results and Discussion**

### **3.1. Forest composition and species diversity**

The species diversity and abundance of trees were varied also among ecosystems. The highest species diversity was in the forest of the Bukit duabelas followed by secondary forest also in the Bukit duabelas NP. The number of trees of Senami forest was less compared to both ecosystems. It is also an indication that forest ecosystem in the Senami region was much more disturbed compared to Bukit duabelas NP. Data on species number,

number of climax and pioneer species, presenceness of *A. scholaris* indicated also the same phenomenon. However, the number of species in the forest and secondary forest ecosystems in both regions were still high enough (Table 1). As described by Collins [15] that at least 50 and up to 200 different tree species could be found in one hectare of a tropical rain forest.

Rain forests are often very structurally diverse. Even primary rain forest, which had not been logged, farmed or otherwise disturbed by humans, had numerous gaps due to the death of large old trees. These gaps are often caused by natural causes such as lightning strikes, windfalls, landslides, cyclones, typhoons, hurricanes and tornadoes, which occur regularly along the equatorial belt. Plants re-colonize the gap while others invade in competition with them. This will result in a secondary succession of several plant communities until a community similar to the original is restored [16].

Table 1. Forest composition and species diversity of three different forest ecosystems

No	Parameters	Ecosystem Types					
		Close to Primary Forest (CPF)		Secondary Forest (SF)		Jungle Rubber (JR)	
		Senami	BDNP	Senami	BDNP	Senami	BDNP
1	Number of trees	493	556	234	551	296	241
2	Number of Species	57	70	69	64	36	44
3	Pioneer species	35	28	46	35	25	28
4	Climax Forest species	22	42	23	29	11	16
5	Percentage of Pioneer species (%)	61.40	40.00	66.67	54.69	69.44	63.64
6	Average Diameter (cm)	21.73	22.46	23.85	21.27	21.88	21.77
7	Average Height (m)	10.99	11.42	10.70	11.98	11.88	11.80
8	Basal Area (m <sup>2</sup> )	20.83	26.67	12.81	21.19	12.21	9.92
9	Volume (m <sup>3</sup> )	163.62	200.08	87.64	141.60	81.71	67.08

### **3.2. Distribution pattern and dimension of *A. scholaris***

The number of *A. scholaris* in the research sites that have been found was varied among ecosystems. Many *A. scholaris* could be found in the secondary forest in Senami while it was absent near the Close to Primary Forest (CPF) of Bukit Duabelas National Park (BDNP). This finding proved that *A. scholaris* is light demanding species and only able to grow in the area where most of giants and big trees are absent. Further investigation showed that *A. scholaris* could be found in all ecosystems except CPF in BDNP with the highest dominancy in the CPF of Senami with the value of 0.02840) followed by in Jungle Rubber (JR) of BDNP and Secondary Forest

(SF) in Senami. The density value of *A. scholaris* varied among the ecosystems. The highest value was 0.0940 which could be found in SF followed by CPF in Senami and JR in BDNP. The total volume with the highest of 12.32 m<sup>3</sup>/ha and frequency of 22 trees per hectare could be found SF in Senami. The mean diameter of *A. scholaris* varied from 17.86 cm to 31.18 cm that could be found in JR and SF in Senami respectively while the tallest *A. scholaris* could be found in SF of Senami with the height of 10.50 m followed by JR in BDNP with the height of 10.40 m (See Table 2).

Table 2. Distribution pattern and dimension of *A. scholaris* growing in different forest ecosystem types

Ecosystem types	Diameter (cm)	Height (m)	Basal Area (m <sup>2</sup> )	V (m <sup>3</sup> )	Frequency	Relative Density	Dominancy
CPF – S	23.54	8.92	0.6200	3.79	13	0.0264	0.02840
SF – S	31.18	10.50	1.9319	12.32	22	0.0940	0.15033
JR – S	20.88	10.13	0.3080	1.75	8	0.0143	0.01186
CPF-BDNP	0.00	0.00	0.0000	0.00	0	0.0000	0.00000
SF-BDNP	17.86	7.71	0.2142	0.87	7	0.0127	0.01010
JR-BDNP	28.60	10.40	0.3477	2.13	5	0.0207	0.02487

The Table 2 showed that the *A. scholaris* was more dominant and had better dimension in Senami landscape compared to BDNP landscape. As described before, *A. scholaris* plays an important role in the forest succession processes. It is a pioneer species which is easy to propagate and able to grow in many types of soil therefore, it will occupy the most degraded forests for the first phase of succession [2].

#### Acknowledgements

The study was funded by Start-Up Funding Collaborative Research Centre (CRC) 990/EFForTS Project 2013.

#### 4. References

- [1] Danida Forest Seed Centre. 2000. Seed leaflet. *Alstonia scholaris*.
- [2] World Agroforestry Centre. 2012. Agro forestry tree database, A tree species reference and selection guide. ICRAF. <http://www.worldagroforestry.org>. Accessed on April 12<sup>th</sup>, 2012.
- [3] I. Muslimin, A.H. Lukman. 2006. Pola Pertumbuhan Pulaui Darat (*Alstonia Angustiloba* Miq) Di Kabupaten Musi Rawas Sumatera Selatan) Makalah Penunjang pada Ekspose Hasil-hasil Penelitian: Konservasi dan Rehabilitasi Sumberdaya Hutan. Padang, 20 September 2006.

- [4] I. Soerianegara, R.H.M.J. Lemmen. 1994. Timber trees: major commercial timbers. PROSEA. Bogor.
- [5] P. Kaushik, D. Kaushik, N. Sharma, A.C. Rana. 2011. *Alstonia scholaris*: It's Phytochemistry and pharmacology. Chron Young Science. [serial online] 2011 [cited 2012 Apr 12]; 2:71-8. Available from: <http://www.cyonline.org/text.asp?2011/2/2/71/82970>.
- [6] P.K. Warriar, V.P.K. Nambiar, C. Ramankutty. 1996. Indian Medicinal Plants. Hyderabad, India: Orient Longman.
- [7] R.E. Omoregbe, O.M. Ikuebe, I.G. Ihimire. 1996. Antimicrobial activity of some medicinal plants extracts on *Escherichia coli*, *Salmonella paratyphi* and *Shigella dysenteriae*. Afr J Med Med Sci; 25:373-5.
- [8] S.C. Lin, C.C. Lin, Y.H. Lin, S. Supriyatna, S.L. Pan. 1996. The protective effect of *Alstonia scholaris* R. Br. on hepatotoxin induced acute liver damage. Am. J. Chin Med. 24: 153-64.
- [9] N.K. Srivastava, A.K. Srivastava. 2007. Influence of gibberellic acid on <sup>14</sup>CO<sub>2</sub> metabolism, growth, and production of alkaloids in *Catharanthus roseus*. Photosynthetica 45: 156–160.
- [10] C.A. Jaleel, R. Gopi, G.M.A. Lakshmanan, R. Panneerselvam. 2006. Triadimefon induced changes in the antioxidant metabolism and ajmalicine production in *Catharanthus roseus* (L.). G. Don. Plant Sci. 171: 271–276.
- [11] M.M. Shazly, E.M. Zayat, W. Hermersd"orfer. 2005. Insecticidal activity, mammalian cytotoxicity and mutagenicity of an ethanolic extract from *Nerium oleander* (Apocynaceae). Ann. Appl. Biol. 136(2): 153–157.
- [12] T.K. Bose, R.K. Basu, B. Biswas. 1999. Cardiovascular effects of yellow oleander. Indiana State Medical Association 97(10): 407–410.
- [13] M. Collins. 1990. Last rainforest. Mitchell Beazley Publishers, London.
- [14] T.C. Whitmore. 1984. Tropical rain forests of the Far East (2<sup>nd</sup> edition) Clarendon Press. Oxford.

## Radical scavenging activity of leafy amaranths as potential antioxidant sources

Muhammad Ikhsan Sulaiman<sup>1,\*</sup>, Rita Andini<sup>1</sup>

<sup>1</sup>Department of Agricultural Processing Technology, Faculty of Agriculture, Syiah Kuala University

Darussalam, Banda Aceh, 23111, Indonesia

\* Corresponding author: misulaiman@thp.unsyiah.ac.id

---

**Abstract** Amaranths are popular leafy vegetables in the diet among the people in Asia particularly Indonesia. Previous study exhibited that the leaves of amaranths were rich in quality protein particularly containing high lysine, which is the limiting essential amino acid in cereals. Fast growing and high tolerance to drought, marginal land and extreme climate had made this nutritious plant as promising crop for human future. This research reported the DPPH radical scavenging activity of leaves of 16 amaranth's accessions from personal collection and USDA that were grown in polybags. The leaves were harvested before flowering. Total phenol and inhibition capacity of DPPH free radicals (IC<sub>50</sub>) as indication for radical scavenging activity were measured by using uv-vis spectrophotometer. The results indicated that *Amaranthus tricolor* from USA and *A. hybridus* from Zimbabwe was the weakest and the strongest IC<sub>50</sub> with 13.83 mg/ml and 1.30 mg/ml, respectively. Correlation was not observed between IC<sub>50</sub> and total phenol content. This result highlighted the importance of leafy amaranth as potential sources of antioxidant.

**Keywords** Amaranthus, radical scavenging activity, antioxidant

---

### 1. Introduction

Amaranths are popular leafy vegetables in the diet among the people in Asia particularly Indonesia. Amaranth is species that spreads widely in tropical to subtropical regions and found up to 2000 m above sea level [1]. Around 70 species of amaranth have been recorded worldwide harvested as grain, vegetable, forage, ornamental or grow wild as weed [2]. Increasing amount of amaranth grain has been used in food industries benefiting from its high level of oil and protein with particularly its excellent amino acids composition [3]. The leaves of amaranths are also good sources of protein and amino acid especially lysine [4]. Fast growing and high tolerance to drought, marginal land and extreme climate has made this nutritious plant as promising crop for human future [5].

Recently, researches in amaranth tend to explore the compounds in grain and leaves that have health benefit to human life. Oil extract of amaranth seed contained unsaturated fatty acids, lectins, tocopherols, tocotrienols, phytosterols, squalene, isoprenoid compounds, aliphatic alcohols, terpene alcohols, and polyphenols, which have properties to improving the immunity system, decrease pain and inflammation [3]. Grain, leave and flower of amaranths are reported having high antioxidant activity [6,7,8] in correspondence to the content of phenolic and flavonoid compounds. Interestingly, amaranth leaves exhibited more antioxidant capacity than those from seeds [9]. Different types of polyphenols in the grain [10] and the leaves of amaranths [11] were recognized as quinic acid, quercetin, kaempferol, gallic acid, caffeic acid, rutin and ferulic acid. Out of 70 betalain structures (50 betacyanins and 20 betaxanthines), 16 betachyanins and 3 betaxanthines are found in the family of Amaranthaceae [6]. Betalains are water-soluble pigments having antioxidant, anti-inflammatory, antibacterial, anticarcinogenic and anti-ageing properties.

This article reported DPPH radical scavenging activities of amaranth leaves of 16 cultivars from USDA and Indonesian collection. The results were expected to provide information on the potential of amaranth leaves as antioxidant source for human health benefit.

## **2. Materials and Methods**

### **2.1. Plant materials**

Amaranth seeds from different types (vegetable, grain and weedy) and species (*Amaranthus blitum*, *A. caudatus*, *A. dubius*, *A. graecizans*, *A. hybridus*, and *A. tricolor*) were obtained from USDA and personal collection gathered from different part of Indonesia (Table 1). The seeds were cultivated in polybag from August to September 2013 at Syiah Kuala University. Each accession was grown in three polybags as replication where each of them consisted of three plantlets. Leaves were harvested around 20 up to 50 days after sowing depending on its physiological maturity.

**Table 1. Accession number, species, type and origin of the plant materials**

Acc No.	Species	Origin	Type	Acc No.	Species	Origin	Type
1	<i>A. blitum</i>	Medan	WD	9	<i>A. hybridus</i>	Zimbabwe	GR
2	<i>A. caudatus</i>	Jawa Barat	VG	10	<i>A. hybridus</i>	Yunani	GR
3	<i>A. cruentus</i>	Zimbabwe	GR	11	<i>A. tricolor</i>	Banda Aceh	VG
4	<i>A. cruentus</i>	Zimbabwe	GR	12	<i>A. tricolor</i>	India	VG
5	<i>A. dubius</i>	Jamaica	VG	13	<i>A. tricolor</i>	Taiwan	VG

Acc No.	Species	Origin	Type	Acc No.	Species	Origin	Type
6	<i>A. dubius</i>	Takengon	WD	14	<i>A. tricolor</i>	Medan	VG
7	<i>A. dubius</i>	Takengon	WD	15	<i>A. tricolor</i>	Jakarta	VG
8	<i>A. graecizans</i>	India	VG	16	<i>A. tricolor</i>	USA	VG

WD = Weedy, VG = Vegetable, GR = Grain

## 2.2. Chemicals

Methanol, Folin-Ciocalteu reagent,  $\text{Na}_2\text{CO}_3$  was obtained from Merck. Gallic acid and DPPH (2,2-diphenyl-1-picrylhydrazyl) was from Sigma-Aldrich Corp.

## 2.3. Extraction method

Ten grams of fresh leaves were mashed in a mortar directly after harvesting. The pulp of the leaves was poured with 100 ml methanol to an Erlenmeyer flask for extraction. Extraction was performed by shaking the mixture for three hours using orbital shaker with a rate of 8 rpm. After extraction time, filtration was done to obtain a filtrate and it was brought for analysis.

## 2.4. Radical scavenging capacity

Analyses of radical scavenging capacity were performed using the DPPH\* radical inhibition capacity by antioxidant compounds in the methanol extracted filtrate [6]. Standard curve was constructed by the reaction between 0, 25, 50 and 100 mg fresh leaves per liter and 0.5 ml 1 mM DPPH to get a final volume of 4.5 ml. During the reaction time of 3 hours at room temperature, a purple-color stable free radical of DPPH measured spectrophotometrically at 517 nm would be reduced into a yellow color diphenylpicryl hydrazine as a result of the reaction between the radicals and antioxidant compounds. DPPH radical scavenging activity was calculated by using the formula: % Inhibition =  $(A_0 - A_1)/A_0 \times 100$ . Where  $A_0$  was the absorbance of the control (without filtrate) and  $A_1$  was the absorbance in the presence of the filtrate.  $\text{IC}_{50}$  value was calculated from the standard curve indicating the capacity of the antioxidant in mg/ml to reduce fifty percent of the DPPH\* radicals. Reaction and measurement was conducted in darkness.

## 2.5. Total phenol

Total phenolic compounds was analyzed using Folin-Ciocalteu assay [6]. Briefly, 1 ml Folin-Ciocalteu reagent (a mixture of Folin Ciocalteu reagent and methanol, 1:9), 1 ml 20%  $\text{Na}_2\text{CO}_3$  and 0.95 ml aquadest was reacted with 50  $\mu\text{l}$  methanol extracted amaranth leaves in a cuvette. After vortexing and incubation time of 90 minutes at room temperature, the absorbance was measured using UV-Vis Spectrophotometer (Shimadzu UV1700, Japan) at

675 nm. Gallic acid was used as the standard and total phenol content was expressed as gallic acid equivalent (GAE) g/kg of fresh amaranth leaves.

## 2.6. Statistical analysis

Data were expressed as means of three replications.

## 3. Results and Discussion

Results obtained for radical scavenging capacity and total phenol content of the leaves of amaranth accessions are presented in Fig 1. Accession number 9, 5, 3 and 4 of *A. hybridus*, *A. dubius* and *A. cruentus* exhibited the strongest inhibition capacity of DPPH free radicals. On the other side, the weakest radical scavenging activity was in the group of *A. tricolor* (accession number 14, 15 and 16). The lowest the  $IC_{50}$  represents the strongest the capacity of leaves extract to reduce 50 percent of DPPH\* radicals because it is required small amount of leaves to neutralize 50 percent of free radical.  $IC_{50}$  of the amaranth leaves ranged from 1.3 to 18.3 mg fresh leaves/ml that was in accordance to [9]. As comparison with the common antioxidant in the food industry, ascorbic acid and butylated hydroxytoluene (BHT) has  $IC_{50}$  of 2.1 m  $\mu\text{g/ml}$  and 13.2  $\mu\text{g/ml}$  respectively [12]. The leaves of amaranth had around thousand times lower capacity of antioxidant than the common antioxidants because it was calculated from the raw material instead of concentrate. Therefore, the antioxidant capacity of amaranth leaves was still comparable to the common antioxidants.

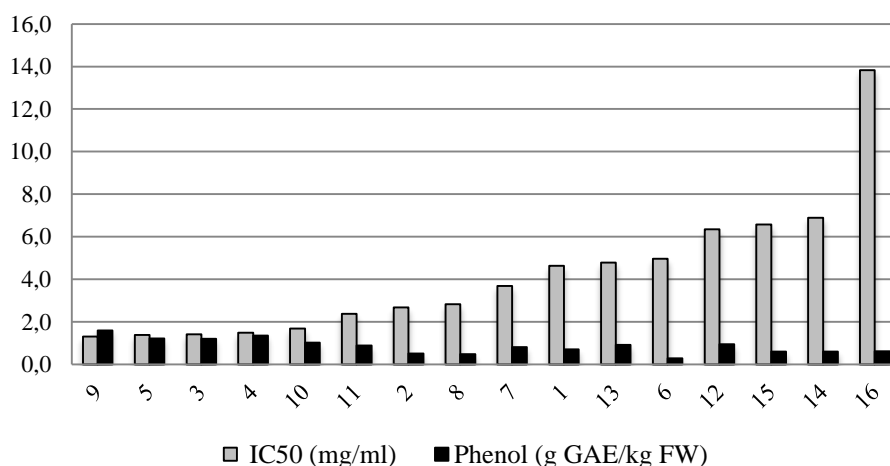


Figure 1. Radical scavenging activity ( $IC_{50}$ ) and total phenol content of the leaves of amaranth accessions



Among the amaranth types, the leaves of grain amaranths exhibited the strongest radical scavenging activity compared to weedy and vegetable amaranths (Fig 2). This result indicated the potential of grain amaranths for healthy food industry as their grain and leaves could be harvested.

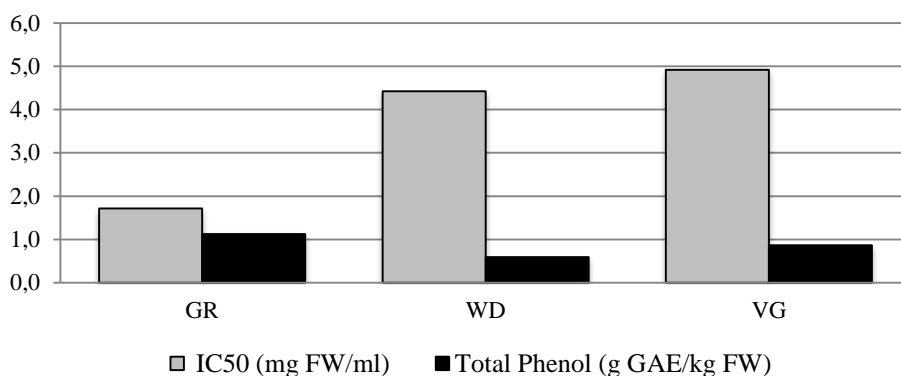


Figure 2. Comparison of radical scavenging capacity and total phenol content of the leaves of different amaranth type

The results expressed weak correlation between the total phenol content and IC<sub>50</sub> ( $r = -0.51$ ). This was in accordance to [3] where the antioxidant properties were not only determined by the phenolic compounds but also by non-phenol antioxidants such as ascorbic acid, tocopherols, flavonoids, unsaturated fatty acids and lectins. The compounds with radical scavenging activity or antioxidant in leafy amaranth are important to be explored to know further its potential as healthy food properties.

#### **4. Conclusions**

Amaranth leaves have strong radical scavenging activity and could be used as antioxidant for healthy food industries.

#### **Acknowledgment**

Acknowledgment is going to Mrs. Rita Andini and Mr. David M. Brenner for the provision of amaranth seeds as well as to DAAD who has provided financial support for this workshop.

#### **5. References**

- [1] G.J.H. Grubben. 1994. *Amaranthus L.* in Siemonsma JS, Piluek K (eds) *Prosea: Plant Resources of South-East Asia 8. Vegetables*. Prosea Foundation, Bogor, pp 82-86.

- [2] D.M. Brenner, D.D. Baltensperger, P.A. Kulakow, J.W. Lehmann, R.L. Myers, M.M. Slabbert, B.B. Sleugh. 2000. Genetic resources and breeding of *Amaranthus*. In Janick J (ed) Plant Breeding Reviews vol. 19. Wiley, USA, pp 227-285.
- [3] E. Vélez-Jiménez, K. Tenbergen, P.D. Santiago, M.A. Cardador-Martinez. 2014. Functional attributes of amaranth. *Austin J Nutri Food Sci* 2(1): 6.
- [4] R. Andini, S. Yoshida, R. Ohsawa. 2013. Variation in protein content and amino acids in the leaves of grain, vegetable and weedy types of amaranths. *Agronomy*, 3, 391-403. Available at: <http://www.mdpi.com/2073-4395/3/2/391> doi: 10.3390/agronomy3020391 [Accessed April 24, 2013].
- [5] E. Lozoya-Gloria. 1994. Biotechnology for an ancient crop: amaranth. In Paredes-Lopez O. *Amaranth: Biology, chemistry, and technology*, CRC Press, pp 1-7.
- [6] R.Y. Nsimba, H. Kikuzaki, Y. Konishi. 2008. Antioxidant activity of various extracts and fractions of *Chenopodium quinoa* and *Amaranthus* spp. seeds. *Food Chem* 106:760-766.
- [7] N. Ozsoy, T. Yilmaz, O. Kurt, A. Can, R. Yanardag. 2009. In vitro antioxidant activity of *Amaranthus lividus* L. *Food Chem* 116:867-872.
- [8] F.C. Stintzing, D. Kammerer, A. Schieber, H. Adama, O.F. Nacoulma, R. Carle. 2004. Betacyanins and phenolic compounds from *Amaranthus spinosus* L. *Zeitschrift fuer Naturforschung* 59:1-8.
- [9] O.A. López-Mejía, A. López-Malo, E. Palou. 2014. Antioxidant capacity of extracts from amaranth (*Amaranthus hypochondriacus* L.) seeds or leaves. *Industrial Crops & Products* 53:55-59.
- [10] S.K. Steffensen, A. Rinnan, A.G. Mortensen, B. Laursen, R.M. de Troiani, E.J. Noellemeyer, D. Janovska, K. Dusek, J. Delano-Frier, A. Taberner, C. Christophersen, I.S. Fomsgaard. 2011. Variations in the polyphenol content of seeds of field grown *Amaranthus* genotypes. *Food Chem* 129:131-138.
- [11] R. Paranthaman, P. Praveenkumar, S. Kumaravel. 2012. GC-MS analysis of phytochemicals and simultaneous determination of flavonoids in *Amaranthus caudatus* (Sirukeerai) by RP-HPLC. *J Anal Bioanal Techniques* 3:5.
- [12] O.P. Sharma, T.K. Bhat. 2009. DPPH antioxidant assay revisited. *Food Chem* 113:1202-1205.

## Yield evaluation of 17 chili pepper (*Capsicum annuum* L.) lines in Bogor, West Java

Faradila D. Putri<sup>1</sup>, Muhamad Syukur<sup>2,\*</sup>, Syarifah I. Aisyah<sup>2</sup>

<sup>1</sup>Graduate Student of Plant Breeding and Biotechnology, Bogor Agricultural University,  
Bogor, 16680, Indonesia.

<sup>2</sup>Lecturer of Department of Agronomy and Horticulture, Faculty of Agriculture, Bogor  
Agricultural University, Bogor, 16680, Indonesia

\*Corresponding author: mhsyukur@gmail.com

---

**Abstract** This yield evaluation research was done to evaluate and select new potential chili pepper line created by the Plant Breeding Program in the Department of Agronomy and Horticulture of Bogor Agricultural University. The objectives of this research were to evaluate the variability and yield of 17 new lines compared to three commercial varieties, and calculate estimated character broad sense heritability values. This research was done from November 2011 until May 2012 in Plant Breeding Laboratory, Department of Agronomy and Horticulture, Bogor Agricultural University (IPB) and Leuwikopo Experimental Station, Dramaga (6°56'34''S, 106°72'56''E). The genetic materials used in this research were 17 open pollinated chili pepper lines and three commercial varieties. This research was arranged in Randomized Complete Block Design with three replications. Result showed that genotype had a very significant influence in almost all character, except for the variable of total marketable fruit weight per plant and fruit length. There were new chili pepper lines that had higher yield than the compared commercial varieties, which are Pesona I-1, Pesona I-2, IPB 110005-91-17-3, IPB 120005-1-1-17, IPB 120005-5-11-2, IPB 009019-3-4-10 and IPB 110005-91-13- 4. The high estimated broad sense heritability value was found in all the observed quantitative characters. There are characters that had positive and significant correlation with chili pepper plant height, fruit length, fruit weight, fruit weight per plant, fruit per plant and potential productivity.

**Keywords** Correlation, heritability, yield evaluation

---

### 1. Introduction

Chili pepper (*Capsicum annuum* L.) is one of Indonesia's important vegetable that has a high economic value. Indonesia Vegetable Crop Research Center categorizes chili pepper as one of the leading vegetable commodities [1]. Chili pepper production and productivity in Indonesia

fluctuates each year. Suharsono [2] stated that at certain times, chili pepper demand in the community grows so high that the national production is unable to meet the increasing demand. One of the effort in increasing chili pepper productivity to meet the increasing demand is through releasing new and improved variety.

One of the main activities in releasing new variety is evaluating breeding lines. Yield evaluation needs to be done to understand the characteristic of the new breeding lines. This research was done to evaluate and select potential new chili pepper lines created by the Plant Breeding Program, Department of Agronomy and Horticulture of Bogor Agricultural University. If a line has satisfactory result, then it can be recommended for further research. Those lines are then expected to be developed and become a new chili pepper variety. The objectives of this research were to evaluate the yield of 17 new chili pepper lines and calculate its estimated broad sense heritability values as well as correlation value of the observed characters.

## **2. Materials and Methods**

This research took place in Plant Breeding Laboratory, Department of Agronomy and Horticulture, Bogor Agricultural University (IPB) and Leuwikopo Experimental Station, Dramaga (6°56'34''S, 106°72'56''E). This research was conducted from November 2011 until May 2012 in which rainfall ranges from 136-548.9 mm. Humidity were around 80-87% and temperatures were around 25.1-26.2°C.

There were three types of chili pepper used, namely big chili pepper, semi-curly chili pepper and curly chili pepper. As many as 17 new open pollinated F5 chili pepper lines, produced by the Department of Agronomy and Horticulture which came from the crossing of big chili pepper with curly chili pepper, was used. The lines were IPB 110005-91-13-12, IPB 110005-91-13-4, IPB 110005-91-17-18a, IPB 110005-91-17-3, IPB 110005-91-4-6, IPB 110005-91-4-8, IPB 120005-1-1-17, IPB 120005-5-11-1, IPB 120005-5-11-2, IPB 120005-5-19-3, IPB 009019-3-4-10, IPB 009019-3-4-7, Pesona I-1, Pesona I-2, IPB 002046-2-5-8, IPB 002046-2-14c-14 and IPB 002001-4-3b-5. The three commercial varieties used as comparisons were Trisula, Lembang 1 and Tit Super.

This research was arranged in Randomized Complete Block Design. It used 20 different chili genotypes with three replications. Each experimental unit consisted of a 5 x 1 meter plot with 10 plant samples. Data analysis was

done by using analysis of variance (ANOVA). If result shows differences, the Dunnett test was performed with  $\alpha = 5\%$ . Heritability value of characters are estimated to give genetic information in the selection process. Correlation analysis is used to describe the degree of relationship between two characters.

### 3. Results and Discussion

Analysis of variance recapitulation showed that genotype treatment had a very significant influence in almost all characters, except for the variable total marketable fruit weight per plant and fruit length. All of the characters observed had high estimated broad sense heritability value (Table 1). This shows that genetic factor has a higher influence on the plant's phenotype than environmental factors. For selection, characters should be chosen according to the moderate or high estimated heritability value so that the selected characteristic have a high probability to be passed down to the next generation.

**Table 1. F-test, probability and estimated broad sense heritability value**

No	Character	F-Value	Probability	h <sup>2</sup> bs (%)	Heritability Classification
1	Days to flowering	5.41**	<.0001	81.51	High
2	Days to harvest	12.61**	<.0001	92.07	High
3	Fruit weight	11.47**	<.0001	91.28	High
4	Fruit length	2.15*	0.0222	53.43	High
5	Fruit diameter	12.78**	<.0001	92.18	High
6	Total marketable fruit per plant	8.52**	<.0001	88.26	High
7	Total fruit per plant	9.10**	<.0001	89.02	High
8	Total marketable fruit weight per plant	2.24*	0.0167	55.45	High
9	Total fruit weight per plant	2.81**	0.0032	64.47	High
10	Potential productivity	2.48**	0.0085	64.47	High

\* and \*\* significant at 5% and 1% level, respectively; h<sup>2</sup>bs = broad sense heritability;

Table 2 exhibit observed characteristic in the chili pepper yield trial. IPB 110005-91-13-4 and IPB 009019-3-4-7 had the fastest average day to flowering than the other lines. It was also equal to the compared varieties flowering days. IPB 009019-3-4-7 also had the fastest average day of harvest out of all the new lines.

The new lines had an average fruit weight that ranged from 6.07-12.99 g. All of the lines had heavier weight than Lembang 1. Lembang I was a curly chili pepper which had smaller fruit form and weight. The majority of IPB lines were crossings from big chili pepper with curly chili pepper, which

resulted in big or semi-curly chili pepper that had a bigger fruit form and higher weight. In this research, 14 IPB lines had fruit lengths that were in the Quality I category (12-14 cm long) according to the Indonesia National Standard [3]. Line IPB002001-4-3b-5 had the largest fruit diameter, however it is not significantly different than Trisula and Tit Super.

Marketable fruits are normal chili pepper fruits that are not damaged, broken or defect caused by physiological factors, mechanical factors, pests and diseases. The average of the total marketable fruits of the lines ranged from 32-61 fruits per plant. All of the lines had lower marketable fruits per plant than Lembang 1, but not significantly different than Trisula and Tit Super. IPB 009019-3-4-10 had the highest total marketable fruit weight per plant but not significantly different than Trisula and Tit Super.

The new chili pepper lines potential productivity ranged from 11.34-17.8 ton/ha. Increase in total fruits per plant, fruit length and number of harvestable fruits results in increased chili pepper productivity [4]. This is proven when the line Pesona I-1 had the longest fruit length and the biggest potential productivity out of all the new lines.

Table 3 showed that there are character that have positive and significant correlation with fruit length, fruit weight, fruit weight per plant, fruit per plant and potential productivity. Characters that have a very significant and positive correlation are (1) fruit length with fruit weight per plant; (2) fruit weight with fruit diameter; (3) number of fruit per plant with fruit diameter, fruit weight and marketable fruit weight per plant; and (4) potential productivity with fruit length and fruit weight per plant.

Table 3. Chili pepper character correlation value

	FL	FW	FWP	FP	PRO
DYF	0.130	-0.087	0.367	0.520*	0.285
DYH	0.182	0.159	0.388	0.107	0.295
FL	-	0.298	0.695**	-0.028	0.615**
FD	-0.047	0.817**	0.309	0.689**	0.284
FW	0.298	-	0.531*	0.760**	0.480*
MFWP	-0.266	0.238	-0.155	-0.368	-0.048
FWP	0.695**	0.531*	-	-0.151	0.940**
MFP	-0.237	-0.774**	-0.453*	0.749**	-0.396
FP	-0.028	0.760**	-0.151	-	-0.181

\* and \*\* significant at 5% and 1% level; DYF = Days to flowering; DYH = Days to harvest; PH = Plant height; FL = Fruit length; FD = Fruit diameter; FW = Fruit weight; MFWP = Marketable fruit weight per plant; FWP = Fruit weight per plant; MFP = Marketable fruit per plant; FP = Fruit per plant; PRO = Potential productivity;

Table 2. Characters observed in yield evaluation of chili peppers lines

No	Genotype	Days to flowering	Days to harvest	Fruit weight (g)	Fruit length (cm)	FruitDiameter (mm)	Total marketable fruits per plant	Total fruits per plant	Total marketable fruit weight per plant (g)	Total fruit weight per plant (g)	Potential productivity (ton/ha)
1	IPB 110005-91-13-12	26	73 <sup>c</sup>	11.01 <sup>a</sup>	13.32	12.80 <sup>ac</sup>	48 <sup>a</sup>	74 <sup>a</sup>	394.82	518.59 <sup>a</sup>	15.61
2	IPB 110005-91-13-4	24	71	8.69 <sup>a</sup>	12.51	9.63 <sup>abc</sup>	41 <sup>a</sup>	79 <sup>a</sup>	307.63	528.49 <sup>a</sup>	16.57 <sup>a</sup>
3	IPB 110005-91-17-18a	26	72	10.35 <sup>a</sup>	12.75	13.35 <sup>a</sup>	59 <sup>a</sup>	86 <sup>a</sup>	391.86	511.81 <sup>a</sup>	16.04 <sup>a</sup>
4	IPB 110005-91-17-3	25	70	6.07 <sup>bc</sup>	13.16	8.53 <sup>bc</sup>	61 <sup>a</sup>	99 <sup>abc</sup>	290.03	410.46	12.56
5	IPB 110005-91-4-6	28 <sup>a</sup>	75 <sup>c</sup>	9.55 <sup>a</sup>	12.71	10.22 <sup>abc</sup>	54 <sup>a</sup>	89 <sup>a</sup>	320.03	421.92	13.21
6	IPB 110005-91-4-8	30 <sup>abc</sup>	79 <sup>bc</sup>	8.06 <sup>ab</sup>	11.47	10.93 <sup>abc</sup>	50 <sup>a</sup>	96 <sup>ac</sup>	298.53	455.65	11.81
7	IPB 120005- 1-1-17	28 <sup>a</sup>	85 <sup>abc</sup>	8.97 <sup>a</sup>	12.34	11.09 <sup>abc</sup>	33 <sup>a</sup>	100 <sup>abc</sup>	207.04 <sup>c</sup>	452.71	13.93
8	IPB 120005-5-11-1	27	74 <sup>c</sup>	10.76 <sup>a</sup>	13.16	11.93 <sup>ac</sup>	56 <sup>a</sup>	76 <sup>a</sup>	420.14 <sup>a</sup>	504.83 <sup>a</sup>	14.92
9	IPB 120005-5-11-2	27	76 <sup>c</sup>	8.49 <sup>ab</sup>	13.18	10.15 <sup>abc</sup>	55 <sup>a</sup>	87 <sup>a</sup>	387.91	534.53 <sup>a</sup>	17.10 <sup>a</sup>
10	IPB 120005-5-19-3	29 <sup>abc</sup>	77 <sup>bc</sup>	8.72 <sup>a</sup>	12.75	11.02 <sup>abc</sup>	51 <sup>a</sup>	90 <sup>a</sup>	345.58	523.45 <sup>a</sup>	16.03 <sup>a</sup>
11	IPB 009019-3-4-10	26	73 <sup>c</sup>	12.99 <sup>a</sup>	13.68 <sup>a</sup>	13.23 <sup>ac</sup>	45 <sup>a</sup>	74 <sup>a</sup>	433.29 <sup>a</sup>	569.72 <sup>a</sup>	17.10 <sup>a</sup>
12	IPB 009019-3-4-7	24	67	11.21 <sup>a</sup>	12.68	12.70 <sup>ac</sup>	32 <sup>a</sup>	49 <sup>a</sup>	297.21	392.26	11.34
13	Pesona I-1	29 <sup>abc</sup>	81 <sup>abc</sup>	11.83 <sup>a</sup>	13.96 <sup>a</sup>	12.27 <sup>ac</sup>	38 <sup>a</sup>	107 <sup>abc</sup>	318.30	596.56 <sup>a</sup>	16.51 <sup>a</sup>
14	Pesona I-2	28 <sup>a</sup>	81 <sup>abc</sup>	11.41 <sup>a</sup>	12.74	13.95 <sup>a</sup>	40 <sup>a</sup>	87 <sup>a</sup>	356.45	569.67 <sup>a</sup>	17.80 <sup>a</sup>
15	IPB 002046-2-5-8	29 <sup>abc</sup>	72	11.78 <sup>a</sup>	11.28	12.58 <sup>ac</sup>	36 <sup>a</sup>	56 <sup>a</sup>	322.49	416.93	13.34
16	IPB 002046-2-14c-14	28 <sup>abc</sup>	73 <sup>c</sup>	11.13 <sup>a</sup>	12.29	11.35 <sup>abc</sup>	35 <sup>a</sup>	60 <sup>a</sup>	339.16	462.56	14.80
17	IPB 002001-4-3b-5	25	74 <sup>c</sup>	11.30 <sup>a</sup>	11.16	15.61 <sup>a</sup>	41 <sup>a</sup>	68 <sup>a</sup>	355.91	479.27	15.34
18	Lembang I	24	75	3.45	10.89	6.68	108	152	231.91	297.00	9.50
19	Trisula	24	72	11.46	11.71	14.38	42	64	335.50	411.59	11.65
20	Tit Super	24	67	10.62	11.64	16.00	48	60	371.55	417.63	13.04

Numbers followed by the letters a, b and c respectively showed significant difference from Lembang-1, Trisula and Tit Super based on the Dunnett test at level of 5%.

## **4. Conclusion**

Genotype had a very significant influence in almost all characters, except for total marketable fruit weight per plant and fruit length. High estimated broad sense heritability value was found. All characters were more influenced by genetic factors than environmental factors. There are characters that had positive and significant correlation with chili pepper fruit length, fruit weight, fruit weight per plant, fruit per plant and potential productivity. Pesona I-1, Pesona I-2, IPB 110005-91-17-3, IPB 120005-1-1-17, IPB 120005-5-11-2, IPB 009019-3-4-10 and IPB 110005-91-13-4 had higher yield than the compared varieties. Further research should be conducted so that those lines can become new chili pepper varieties.

## **5. References**

- [1] T.A. Soetiarso, W. Setiawati and D. Musaddad. 2011. Keragaan pertumbuhan, kualitas buah dan kelayakan finansial dua varietas cabai merah. *J. Hort.* 21(1): 77-88.
- [2] M. Suharsono, A. Alwi, A. Purwito. 2009. Pembentukan tanaman cabai haploid melalui induksi ginogenesis dengan menggunakan serbuk sari yang diradiasi sinar gamma. *J. Agron. Indonesia* 37 (2): 123–129.
- [3] National Standardization Agency of Indonesia. 1998. Cabai Merah Segar. Badan Standarisasi Nasional. Jakarta
- [4] V.K. Sharma, C.S. Semwal, S.P. Uniyal. 2010. Genetic variability and character association analysis in bell pepper (*Capsicum annuum* L.). *J. Hortic. For.* 2(3): 058-065.



## Current research development of *in vitro* embryo production on farm animal in Indonesia

Mohamad A. Setiadi<sup>1,\*</sup>

<sup>1</sup>Division of Reproduction and Obstetrics, Department of Veterinary Clinic, Reproduction and Pathology, Faculty of Veterinary Medicine, 16680, Bogor Agricultural University, 16680, Indonesia

\* Corresponding author: setiadi03@yahoo.com

---

**Abstract** Reproductive biotechnology has been widely used to improve animal genetic quality and increasing of animal population. Our laboratory has conducted several research on *in vitro*. Research was done on basic science to understand some phenomena of *in vitro* embryonic development to produce high quality embryo. Several research of *in vitro* sheep embryo has been done such as parthenogenetic development, improvement of oocyte selection, influence of antioxidant on oocyte maturation, fertilization and early embryonic development, while some research of *in vitro* bovine embryo such as influence of single media on the development of *in vitro* embryo, different technique of fertilization on bovine embryonic development. In the future, research will be focused on the application of embryo sexing technique to obtain embryo sex-identified and to be applied in the field. It is concluded that *in vitro* embryo production in farm animal in Indonesia is still required improvement on the technique to obtain optimum embryo production to be applied in the field.

**Keywords** Bovine, development, embryo, *in vitro*, sheep

---

### 1. Introduction

Reproductive biotechnology has been widely used to improve animal genetic quality and animal population. The technology also very useful to save endangered species. It is therefore development of reproductive biotechnology is a key success to improve farm animal population.

Several reproductive technologies that have been developed to improve animal genetic quality and increasing population such as artificial insemination, embryo transfer, *in vitro* embryo production and genetic engineering as first, second, third and fourth generation of reproductive biotechnology respectively.

In the first generation of reproductive biotechnology, artificial insemination has been widely applied to improve genetic quality in breeding system. The technology is very familiar also in animal husbandry either in beef cattle or the dairy cattle. This technology has been supported by providing huge number of frozen semen by the two big Artificial Insemination Center in Lembang West Java and Singosari East Java. Even several provinces has also established local artificial insemination center to support the application of AI technology. However, even this technology has been contributed to improve farm animal population but farm animal especially beef and dairy cattle populaton are still low.

It is therefore, it is still required to develop technology to accellerate animal populaton and to improve genetic quality. It seems that next generation of biotechnology such as embryo transfer have good prospect to increase farm animal population. Embryo transfer required availability of embryo to be transfered. There are two types of technology to provide embryo for embryo transfer technology namely from in vivo embryo production by MOET (multiple ovulaton and embryo tansfer) and in vitro embryo production using slaughterhouse material and from live donor by Ovum Pick Up (OPU) technology. This paper will not give an in depth methodical approach to these technologies, but a brief description of acchievement of our laboratory on in vitro embryo production in Indonesia.

## **2. Results and Discussion**

### **2.1. Sheep *in vitro* embryo production**

Research on *in vitro* embryo development has been conducted in our laboratory since year 2000, with mainly using sheep and bovine oocytes. Focus research on in vitro sheep embryo production were begun by several researchs on improvement of oocytes maturation as basic research. Research was initiated by using different type medum [1] with several supplementation into maturation medium to improve capability of oocyte to become matured, fertilized and developed toward early embryonic development [2].

Several research on improvement ability of oocyte to be fertilized and early embryonic development such as influence of several medium [2] and supplementation of medium with an antioksidant such as Glutathion [3, 4],  $\alpha$ -tocoferol [5],  $\beta$ -mercaptoethanol [6], and sericin [7] to improve efficient of *in vitro* embryo production. Another research has been conducted also to anlyse influence time of transportation on oocyte quality [8]. This result

suggested that oocyte from the ovary transported at 37°C for 5 hours still have high competency to develop for *in vitro* maturation and fertilization compared to 4°C. Furthermore, to improve developmental competence of sheep oocyte *in vitro* was done also oocytes selection method by detection the activity of glucose-6-phosphate dehydrogenase (G6PD) using brilliant cressyl blue [9].

Another focus of our reserach were directed to cryopreserve of semen and epididymal sperm as source of male gamete for *in vitro* embryo production. Scientific publications on epididymal sperm cryopreservation has been published [10]. It was concluded that epididymal sperm can be used for *in vitro* embryo production.

In the providing good quality of oocytes, research has been conducted by using lapaoscopic ovum pick up (LOPU) [11]. Although oocyte obtained by LOPU technique was still low, because of low number of follicle development in one ovary. Thus another research was conducted by stimulating using gonadotrphin [12], this result suggested that stimulator with gonadotrphin could improve number of follicle development, however is required skill in the collection technique to be improved.

## **2.2. Bovine *in vitro* embryo production**

There is only limitation laboratory in Indonesia that has been developed in *in vitro* embryo production. Another problem as restriction factor to develop of bovine *in vitro* embryo production is the limitation of number of female cattle to be saughtered as government regulation. It is therefore difficult to obtain number of ovary as source of oocytes.

However, our laboratory has been developed some researchs on bovine *in vitro* embryo production. Setiadi [13] reported that more than 81.5% bovine oocytes derived from slaughter house can reach maturation stage at metaphase II. Furthermore, it was showed also that single medium based on TCM 199 could support until cleavage stadium under *in vitro* condition not differ with routine media for embryo production.

Another research focus on improvement in obtaining good quality high competence of bovine oocytes was done by selection technique using Brilliant Cressyl Blue [14]. The result of ther research suggested that selected oocytes by BCB showed high competence to be matured and fertilized *in vitro*. However, cleavage rate and blastocyst rate of embryo production are still low [13]. Further improvements are continuesly done

with the application new techniques such as improvement on fertilization, culture technique and producing sexed embryo.

### **3. Conclusion**

Embryo production system in the laboratory is still need improvement to achieve high quality embryo and for direct application to the recipient.

### **4. References**

- [1] Yulnawati, M.A. Setiadi, A. Boediono. 2006. Penggunaan médium CR1aa untuk produksi embrio domba *in vitro*. J. Ilm Tern dan Vet 11(2): 131-136.
- [2] A. Boediono, Yulnawati, M. A. Setiadi. 2006. Tingkat pematangan inti oosit domba dari ovarium dengan status reproduksi dan medium maturasi yang berbeda. J. Hayati. 13(4): 131-136.
- [3] Hasbi, S. Gustina, M.A. Setiadi, I. Supriatna. 2012. Tingkat Pematangan inti oosit domba dan Pembentukkan pronukleus setelah parthenogenesis dengan penam bahan glutathione. J. Vet 13(4): 445-452.
- [4] Hasbi, S. Gustina, M.A. Setiadi, I. Supriatna. 2010. Efektivitas penambahan glutathion (GSH) pada medium maturasi terhadap tingkat pematangan inti oosit oosit domba. Prosiding Sem. Nas. Peran Teknologi Reproduksi Hewan Dalam Rangka Swasembada Pangan Nasional, Bogor, 6-7 Oktober 2010, Indonesia pp. 139-141.
- [5] S. Gustina, Hasbi, M.A. Setiadi, I. Supriatna. 2010. Tingkat pematangan inti oosit domba dengan penambahan  $\alpha$ -tocopherol dalam medium maturasi *in vitro*. Prosiding Sem. Nas. Peran Peran Teknologi Reproduksi Hewan Dalam Rangka Swasembada Pangan Nasiona, Bogor, 6-7 Oktober 2010, Indonesia pp. 142-144.
- [6] O.A. Bintara, M.A. Setiadi, N.W.K. Karja. 2013. Tingkat Perkembangan oosit domba yang dimaturasi dalam media yang ditambahkan dengan 2-mercaptoethanol secara *in vitro*. Prosiding sem Nas. Asosiasi Reproduksi Hewan Indonesia (ARHI).
- [7] C. Yasmin, M.A. Setiadi, T. Otoi, N.W.K. Karja. 2014. Developmental competence of sheep oocytes matured in sericin supplemented media *in vitro*. ACTA Vet. Hungarica (in Press).
- [8] A. Febretrisiana, M.A. Setiadi, N.W.K. Karja. 2014. Tingkat Fertilisasi oosit domba dari ovarium yang disimpan pada suhu dan waktu ovarium yang berbeda secara *in vitro*. J. Kedokteran Hewan (In Press).

- [9] M.A. Setiadi, I. Supriatna. 2010. Seleksi kemampuan pematangan oosit domba menggunakan teknik brilliant cressyl blue. *J. Vet* 11(4): 251-256.
- [10] F. Pamungkas, M.A. Setiadi, N.W.K. Karja. 2012. Chaacteristic and in vitro Fertilization ability of ram spermatozoa: compparison of epididymal and ejaculated spermatozoa. *J. Med Pet* 35(1): 38-44.
- [11] M.A. Setiadi, I. Supriatna, A. Boediono. 2007. Koleksi sel telur dengan teknik laparoscopi untuk produksi embrio dan transfer embrio pada domba. *J. Ilm Pert Indon.* 12(2): 116 -122.
- [12] M.A. Setiadi, I. Supriatna, A. Boediono. 2004. Follicle development after Gonadotrophin treatment in Garut sheep for laparoscopic ovum pick up. 5th International Seminar and Workshop South East Asia – Germany (Seag) Alumni, Phnom Penh, Cambodia.
- [13] M.A. Setiadi, N.W.K. Karja. 2013. Tingkat Perkembangan awal embrio sapi in vitro menggunakan media tunggal berbahan dasar Tissue Culture Medium 199 (TCM 199). *J. Kedokteran Hewan* 7(2): 150-154.
- [14] Z. Muttaqin, N.W.K. Karja, M.A. Setiadi. 2014. Kemampuan maturasi dan fertilisasi oosit yang diseleksi menggunakan teknik pewarnaan Brilliant cresyl Blue (BCB). *J. Vet* (In Press).

## **Carrageenan prototype food product development of seaweed at Cluster Salabangka Islands of Central Sulawesi Province**

**Marhawati Mappatoba<sup>1,\*</sup>, Asriani Hasanuddin<sup>1</sup>**

<sup>1</sup>Faculty of Agriculture, Tadulako University, Palu, Indonesia

\*Corresponding author: wati chairil@hotmail.com, asriani-tht-untad@yahoo.com

---

**Abstract** Food product development is directed to respond the needs of consumers who nowadays concern more on healthy diet food. Processed seaweed products are included into healthy food, both semi-processed products such as Carrageenan and end processed products such as candy, bread and cheese stick. The research objective was to get an overview of carrageenans levels of seaweed that cultivated in different locations, as well the opportunity to increase income of coastal community of processed seaweed to end products. Results showed that the carrageenan from the Karantu village has best chemical, physical and functional properties contains 36.83% of carrageenans, slightly higher than found in Padabale village, 36.43% respectively. This finding is in line with the result that has been done on coastal suitability in our former study (2011), which is met the standards of FAO, FCC, EEC and the EU (E407). The method of making an end processed product begins with the preparation of materials in different recipes at laboratory level. The result of end processed products such as candy, bread and sticks made from seaweed puree showed that the most preferred by panelist is candy-2, bread-3 and cheese stick-1. Based on this organoleptic test the best receipt obtained then introduced to women seaweed farmers at Salabangka Island, capital city of South Bungku District. The economic analysis showed that all end processed products made with the best receipt will bring profit while have of R/ C-ratio > 1. Furthermore, this study aimed to map prototype of carrageenan prototype but in fact only one sampling of seaweed that met research schedule due to several constraints, with this limitation however from the analysis still could recommend that the two villages with best carrageenan yield can be settled as "nursery" as a blue print plan for developing seaweed. And the end processed products which were favored by panelists (sweets and cheese stick) on each type should be developed towards commercial production under supervision of Central Sulawesi government.

**Keywords** Carrageenan, food product, income

---

## **1. Introduction**

Central Sulawesi Province is already well known as central production of seaweeds *Eucheuma cottonii* which reached 79.004,7 ton (wet seaweed) with equivalent of 98.875,59 ton dried seaweed, and mostly produced from Morowali at Salabangka Island [1]. At recently, the position of this advantage commodity is still at the raw material level which the seaweed farmers directly sells at the local market with low price, therefore, effort to introduce the product development of seaweeds is important [1].

Nowadays, the utilization of seaweeds is not only for healthy food, but also for raw materials for pharmacy and cosmetics industries, that can be seen from the analysis result shows that the content of complete amino acid was relatively higher then *provisional pattern* of amino acid with determined by FAO/WHO [3]. Unfortunately, the potential value of seaweed is still far away from the farmers at Salabangka of Morowali Regency, therefore, this article tried to provide the diversification of product development, which possible to introduce to the seaweed's farmers of *Eucheuma cottonii*. Despite from empowering the skills of women household of seaweed's farmers, it's also for supporting the diversification food National Program based on local commodity in increasing family nutrition.

## **2. Materials and Methods**

Based on the research objective was to get an overview of carrageenans levels of seaweed that cultivated in different locations, as well the opportunity to increase income of coastal community if processed seaweed to end products. This research was taken place at Agrotechnology Laboratory and at Salabangka Island.

Analyzing the carrageenan content base on each location of seaweed culture from Salabangka Island can be used to predict the potential values of carrageenan at the global market, which had been done at the first year of this research. The method of making an end processed product begins with the preparation of materials in different recipes at laboratory level. The result of end processed products such as candy, bread and sticks made from seaweed puree. Based on the organoleptic test the best receipt obtained then introduced to women seaweed farmers at Salabangka Island, capital city of South Bungku Sub-district Morowali Regency. The simple economic analysis with formula of R/ C-ratio will be applied.

### 3. Results and Discussion

In line with the research aim was to estimate the potential income generating base on developing products of seaweeds due to the formula which resulted from the laboratory research. The best recipe obtained from the organoleptic test was then introduced to women seaweed farmers at Salabangka Island, capital city of South Bungku District Morowali Regency of Central Sulawesi Province.

#### 3.1. Analysis of Formula Product Development

In this stage, the activity focused on finding the composition of combination ratio of seaweed porridge to produce candy, bread and cheese stick which will be tested in the skim of organoleptic test. The examining values of testers was in the range of 1-5, which 5 is the best, and vice versa. The composition of seaweed as input production were various, the value of tester as well, such describes below.

Table 1. Formula of raw material for candy production

Description and volume	Composition (% b/b)		
	Candy-1	Candy-2	Candy-3
Seaweed porridge (g)	100	200	300
Sugar/sucrose (g)	50	100	150
Syrup (liquid) (ml)	400	400	400
Citric Acid (%)	0.1	0.1	0.1
Water (ml)	1000	1000	1000
Essence/color (%)	0.2	0.2	0.2

Source: Tim of Competitive Research, 2012

Table 2. The average degree of score value candy product

Treatment	Preferences		
	Color	Texture	Taste
Candy-1	3.8	3.2	4.2
Candy-2	4.6	3.8	4.2
Candy-3	2.0	2.4	2.0

Source: Tim of Competitive Research, 2012

Development of candy products with 3 types of formula products shows that the finalist like the most of ratio 200 g porridge candy-2, even though candy-1 also reached the same taste of 4,2. The reason behind that was due to the content of amount carrageenan is suitable especially for texture test, and the other hand, there are no different taste between candy-2 and candy-1. Moirano [4] in Astawan *et al* [5] said that on the suitable ratio between seaweed porridge with sugar will perform the increasing gel texture, and it might be the reason of it.



Furthermore, the formula product of bread and cheese stick with using the same raw material (porridge seaweed) for development bread and cheese stick products can be explained such mention at Table 3.

**Table 3. The average degree of score value bread products**

Treatment	Preferences		
	Colour	Texture	Taste
Bread-1	3.0	3.3	3.1
Bread-2	3.2	3.4	3.2
Bread-3	3.6	3.6	4.2

Source: Tim of Competitive Research, 2012

Based on organoleptic test according to taste and color bread were found that the formula bread-3 reach the highest value from panelist for all variables (color, texture and taste). In line with the development product of cheese stick in which the average score values can be seen at Table 4 below.

**Table 4. The average degree of score value cheese stick**

Treatment	Preferences		
	Colour	Texture	Taste
Cheese stick-1	3.4	4.0	4.0
Cheese stick-2	3	3	3.2
Cheese stick-3	2.8	2.8	3.0

Source: Tim of Competitive Research, 2012

Based on organoleptic test according to color of cheese stick was found that the formula cheese stick-1 reach the highest value from panelist, which use the composition of 250 g porridge of seaweed and 500 g tapioca powder with degree of tasty was maximum 4. On the other hand, the examiner shows the lower value for formula cheese stick-3 of 500 g porridge and 1000 g tapioca powder.

### **3.2. Income Analysis of Products Development**

Analysis of income gaining of diversification seaweed final products is to know the opportunity of creating income among the local women through this simple technology. Despite of it, this practicing can be seen as effort for diversification of food and family nutrition [6]. According to the amount of raw material and the prediction price of those best selection formula products (candy, bread and cheese stick), the analysis of R/C ratio can be done.

Table 5. Analyze R/C ratio of making the best final products

Description	Type of the best products		
	Candy-2	Bread-3	Cheese stick-1
Revenue (Rp)	30.000	90.000	100.000
Total Costs (Rp)	16.600	32.536	27.000
Net Income	13.400	57.464	73.000
R/C-Ratio	1.81	2.77	3.70

Source: Tim of Competitive Research, 2012.

Table 5 shows that the highest R/C ratio belongs to cheese stick-1 which reach 3.70, and the other hand, the bread-3 reach R/C ratio of 2.77. Those can be explained that all development products have potential chance to promote in the skim of commercial production. The R/C ratio of candy-2 is about 1.81, it can be said that if someone producing candy-2 with costs of Rp 1000, she or he will get earning of 1.8 times Rp 1000 those were the valuable business opportunities. Furthermore, this study could recommend that the two villages with best carrageenan yield can be settled as "nursery" as a blue print plan for developing commercial seaweed business.

#### **4. Conclusion and Recommendation**

Two important conclusion, they are; firstly the most highly preferences among development products are cheese stick-1, bread-3 and candy-2. Secondly, the result of economic analysis shows that all end product were benefitable due to the value gaining of R/C-ratio > 1, which cheese stick-1 reached R/C ratio of 3.70. It's recommended that even though, the best preferences value of each product can be developed in commercial scale with providing SOP for small scale enterprise, but it is still needed advance training to produce completely product with interesting packaging through facilitating equipment under supervision of Morowali Regency.

#### **5. References**

- [1] M. Mappatoba, E. Rosyida, A. Laapo. 2008. Analysis of coastal utilization areas for seaweed culture through *ecological footprint* approach at Salabangka of Morowali Regency. STRANAS Report of DP2M, UNTAD, Palu.
- [3] J.T. Anggadiredja, A. Zatinika, H. Purwoto, S. Isti. 2006. Seaweed. Seri Agribisnis, Jakarta.
- [5] L.M. Astawan, 1998. Seaweed Culture. Kanisius, Yogyakarta.
- [6] V.J. Chapman, D.J. Chapman. 1980. Seaweeds and Their Uses, Third Edition, Chapman and Hall. Methuen and Co Ltd, London.

## Inventory of Dipterocarpaceae at Soraya Research Station, Leuser Ecosystem Area

Iqbar<sup>1,\*</sup>, Essy Harnelly<sup>1</sup>

<sup>1</sup>Department of Biology, Syiah Kuala University, Banda Aceh, 23111, Indonesia

\*Corresponding author: iqbar@fmipa.unsyiah.ac.id

---

**Abstract** This research was about Dipterocarpaceae inventory at Soraya Research Station Leuser Ecosystem area. The method applied was belt transect in the location of 20 Ha with 10% intensity. Determination of sampling plot was using purposive sampling. The parameter observed was species as well as number of species. The result showed that there were 11 species of Dipterocarpaceae found in the sampling plot. All the species found were belongs to sub family Dipterocarpoideae namely 5 species from tribe Dipterocarpeae and 6 species from the Shoreae tribe.

**Keywords** Dipterocarpaceae, inventory

---

### 1. Introduction

Dipterocarpaceae is one of big family plant and plays an important role in the tropical forest for timber source. This family dominates in the tropical lowland rainforest trees of South-East Asia. Dipterocarpaceae family has three sub families, 17 genera and approximately 500 species that has been spread accross tropical region of Africa, Asia, and South America [1]. This family can easily characterized by peculiar two-winged fruits. The family Dipterocarpaceae *sensu stricto* is homogenous for only Asian plants while the Dipterocarpaceae *sensu lato* include three sub subfamilies: Dipterocarpoideae in Asia, Pakaraimoideae in South America and Monotoideae in Africa and South America [2]. Dipterocarpoideae sub family is the highest number of species among these three subfamily, and considered to be a hot spot of biological diversity [3], where Shorea is the main dominant genus in this sub family.

The distribution of Dipterocarpaceae on the earth is depending on the spreading of sun light and climate type. Based on its distribution, the most important genus as well as economically important is Shorea genus. This genus mostly distributed in Indonesia, especially in Sumatra and Kalimantan. In Indonesia, Shorea genus encompasses about 200 species in 11 section, of which 163 species while its sister genus Hopea comprises more than 100 species [3].

Soraya research station is one of the research stations in the area of Leuser Ecosystem. It is located administratively 20 km from Subulussalam Regency, Aceh Province, Indonesia. The topography in this area ranged from 75 – 350 m above sea level (ASL). The research area is lowland forest [4].

Our aim in this research was to inventorying number of Dipterocarpaceae species as well as counting the number individual of each species which found in Soraya research station, Leuser ecosystem area.

## **2. Materials and Methods**

The method applied in this research is using belt transect, on the purposive area, about 2 ha (10 % of about 20 ha). The observation plot was measured 5 m x 50 m along the transect line. The total numbers of observation plots are 80 plots. The data was collected by observing the availability of Dipterocarpaceae species on the observation plot. The observation covered species and individual number of species. Each plant species found was put into herbarium collection for the identification purposes and data collection. The number of species per plot was used to quantify the vegetation analysis.

## **3. Results and Discussion**

### **3.1. The species of Dipterocarpaceae in the Soraya Research Station**

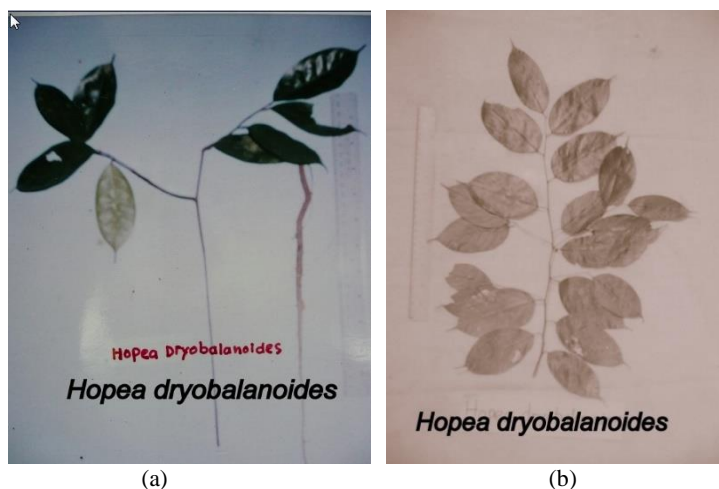
The total number of Dipterocarpaceae of the total 80 observation plots (2 ha) was 145 individuals, 11 species and 4 genera (Table 1.)

Table 1. The Dipterocarpaceae species and its number of species in Soraya Research Station

No	Species	Number of species
1	<i>Dipterocarpus baudii</i> Korth	5
2	<i>Dipterocarpus cornutus</i> Dyer	2
3	<i>Dipterocarpus grandiflorus</i> Blanco	19
4	<i>Dipterocarpus humeratus</i> v.Slooten	3
5	<i>Dipterocarpus rigidus</i> Ridl	2
6	<i>Hopea dryobalanoides</i> Miq.	73
7	<i>Parashorea lucida</i> (Miq.) Kurz.	9
8	<i>Shorea dasyphylla</i> Foxw.	14
9	<i>Shorea johorensis</i> Foxw	4
10	<i>Shorealepidota</i> (Korth.) Blume	6
11	<i>Shoreapalembanica</i> Miq.	8
Total		145

The Dipterocarpaceae member found in the research area belonged to Dipterocarpoideae sub family, both members of Dipterocarpeae tribe

(*Dipterocarpus* genus) or Shoreae tribe (*Shorea*, *Parashorea* and *Hopea* genera). The result showed that the dominance individual number of species found in Soraya research station was *Hopea dryobalanoides* Miq, about 73 individual or 50,3 % of individual all species (Picture 1).



Picture 1. *Hopea dryobalanoides* Miq (a) seedling and (b) leaves

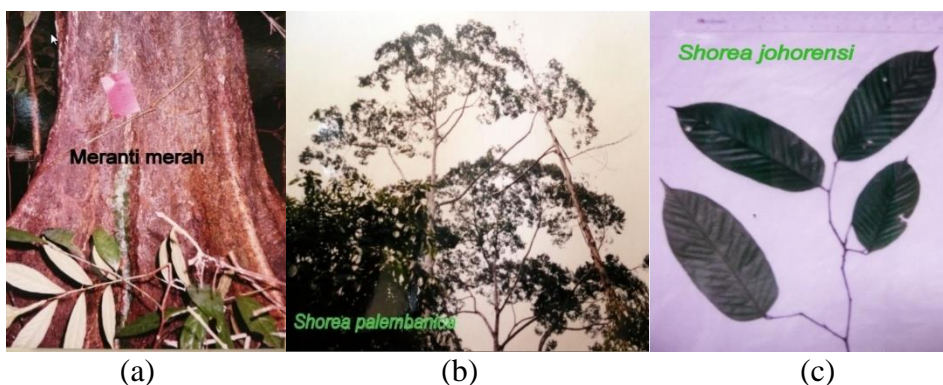
The local name of *Hopea dryobalanoides* Miq is Damar Mata Kucing. Beside the wood quality, this species is also well known for its good quality of resin [1]. Dammar has many commercial applications, though many of these uses are less important nowadays due to the advent of synthetic materials. The abandon of this species in Soraya research station indicated that this species probably did not interested compared to the other member of Dipterocarpaceae.

Another species which was dominated the research area was *Dipterocarpus grandriflorus* Blanco (13.1 %). This species is known with the local name Keruing Belimbing. This species is a common medium hardwood tree in South-East Asia and India [1]. Based on the IUCN List, this species is critically endangered [5]. Not like *Hopea* genus which height is about <40 m (emergent tree), the genus of *Dipterocarpus* is known as upper canopy tree (> 50 m).



Picture 2. The leaves, fruit and bark of *Dipterocarpus grandiflorus* Blanco.

Among the Shoreae tribe, *Shorea dasyphylla* Foxw is the most dominant species in the Soraya research station. This species is known as Light Red Meranti. According to IUCN list, this species is endangered [4]. Actually, *Dipterocarpus* and *Shorea* genera were mostly well known in the timber world trade [6]. All shorea members which were found in this research area (*S. dasyphylla* Foxw., *S. johorensis* Foxw., *S. lepidota* (Korth.) Blume., and *S. palembanica* Miq.) belong to Red Meranti (Picture 3).



Picture 3. (a) Red Meranti bark and buttress, (b) *S. palembanica*, (c) *S. johorensis*

#### 4. Conclusion

Based on the inventory of Dipterocarpaceae species in Soraya Research Station, we found that:

- Dipterocarpaceae family in Soraya research station was dominated with Dipterocarpoideae sub family.
- There were 11 species of Dipterocarpaceae which belonged to Dipterocarpeae tribe (*Dipterocarpus* genus) and Shoreae tribe (*Shorea*, *Parashorea* and *Hopea* genera)

- The Most dominant species found in the research area was *Hopea dryobalanoides* Miq (73 species) meanwhile the less species found are *Dipterocarpus rigidus* Ridl (2 species) and *Dipterocarpus cornutus* Dyer (2 species).

## **5. References**

- [1] P.S. Ashton. 1982. Dipterocarpaceae. In: M.D. Dissanayake, F.R. Fosberg (eds) *Revised handbook to the flora of ceylon I*. Smithsonian Institute Press, Washington, D.C. pp 364 – 423.
- [2] S. Apanah. 1993. Mass flowering of dipterocarp forests in a seasonal tropics. *J. Of Bioscience*. 18 (4): 457– 474.
- [3] C.P. Cao. 2006. Genetic variation of the genus *Shorea* (Dipterocarpaceae) in Indonesia. PhD. Thesis. Georg-August Universitaat, Goettingen.
- [4] Leuser Management Unit (LMU). 1997. Annual Report of Soraya Research Station, Medan.
- [5] <http://www.iucnredlist.org/search>
- [6] I. Kartasujana, A. Martawijaya. 1979. *Kayu Perdagangan Indonesia, Sifat dan Kegunaannya*. Lembaga penelitian Hutan, Bogor.

## **Influence of different supplemental niacin levels on intake, digestibility and rumen fermentation of dairy cows: a meta-analysis**

**Rossy E. A. Anggreini<sup>1</sup>, Erika B. Laconi<sup>2</sup>, Anuraga Jayanegara<sup>2,\*</sup>**

<sup>1</sup> Graduate School of Nutrition and Feed Science, Bogor Agricultural University, Bogor, 16680, Indonesia

<sup>2</sup> Department of Nutrition and Feed Technology, Bogor Agricultural University, Bogor, 16680, Indonesia

\* Corresponding email: anu\_jayanegara@yahoo.com

---

**Abstract** Rumen microbes can synthesis niacin but at fewer amount. Niacin is occasionally supplemented into dairy cows' ration to improve their production performance especially during early lactation period. The present study was aimed to assess the effect of different supplemental niacin levels on intake, digestibility and rumen fermentation of dairy cows through a meta-analytical study. A database was constructed from published literatures reporting niacin supplementation on dairy cows. A total of 49 studies from 46 published articles were integrated into the database. Different niacin levels at various supplemental levels were specified, i.e. 0 to 24 mg; nutrient intake and rumen fermentation parameters were integrated as well. Data were analyzed by a mixed model methodology in which different studies were treated as random effects whereas niacin levels were treated as fixed effects. The significant effect was stated when  $P < 0.05$ . When a parameter showed  $0.05 < P < 0.1$ , then the effect was considered to have a tendency to be significant. The results showed that different levels of niacin supplementation did not significantly influence nutrient intake, digestibility and rumen fermentation of dairy cows ( $P > 0.05$ ). It is concluded that supplementation of niacin has less effect in improving intake, digestibility and rumen fermentation.

**Keywords** meta-analysis, niacin, concentration, dairy cow

---

### **1. Introduction**

Dairy cows require supplementation of niacin in the diet at sufficient levels because the rumen microbes can produce niacin in small amounts only. Niacin plays a role in generating energy in the Krebs cycle (ATP cycles) [1]. Energy deficiency leads to body fat mobilization of dairy cows to be used as energy and then increases beta-hydroxybutiric acid concentration; this condition stimulates ketosis, a metabolic disorder, to occur [2]. It is



expected that niacin supplementation can overcome the negative energy balance in dairy cows especially during early lactating period. This study was aimed to know the influence of niacin supplementation levels on intake, digestibility and rumen fermentation profiles of lactating dairy cows by using meta-analysis method.

## **2. Materials and Methods**

### **2.1. Database development**

A database was developed from published literatures reporting addition of niacin at various levels on nutrient intake, digestibility and rumen fermentation of lactating dairy cows. Literature search was conducted using data search generators, i.e. Google scholar and Scopus to collect articles with the keywords “niacin” and “dairy cow”. Accordingly, levels of niacin supplementation were specified in the database. After collection of literatures, a total of 49 studies from 46 published articles with the above-mentioned keywords were obtained; the articles were published from 1981 to 2013.

### **2.2. Statistical analysis**

The data obtained were subjected to a statistical meta-analysis based on mixed model methodology [3, 4]. The model used was linear model, considering niacin supplementation levels as fixed effects and different studies as random effects. The following model was employed:

$$Y_{ij} = B_0 + B_1X_{ij} + s_i + b_iX_{ij} + e_{ij}$$

where  $Y_{ij}$  = dependent variable,  $B_0$  = overall intercept across all studies (fixed effect),  $B_1$  = linear regression coefficient of  $Y$  on  $X$  (fixed effect),  $X_{ij}$  = value of the continuous predictor variable (niacin supplementation level),  $s_i$  = random effect of study  $i$ ,  $b_i$  = random effect of study  $i$  on the regression coefficient of  $Y$  on  $X$  in study  $i$ , and  $e_{ij}$  = the unexplained residual error. Model statistics used were P-value and Akaike information criterion (AIC). Significance of an effect was stated when P-value <0.05. Additionally, when P-value lied between 0.05 to 0.1, an effect was stated as a tendency to be significant. All statistical analyses were performed with SAS Software version 9.1.

### 3. Results and Discussion

#### 3.1. Influence of niacin supplementation on intake and digestibility of dairy cows

The effects of niacin supplementation levels on dry matter intake (DMI), dry matter digestibility (DMD), organic matter digestibility (OMD), crude protein digestibility (CPD), neutral detergent fiber digestibility (NDFD) and acid detergent fiber digestibility (ADFD) were insignificant (Table 1). In another study, supplementation of niacin at different levels increased rumen microbial population and nutrient degradation in the rumen. Niacin supplementation at 0.75 to 3.75 g/cow/d increased cattle growth by 0.7 to 10.9%; however, supplementation of niacin above 7.5 g/cow/d caused negative effects on the performance [1]. The present meta-analysis reveals that niacin supplementation does not produce consistent results. A plausible explanation is that the supplementation may effectively contribute to dairy cows only during a certain lactation period, most probably in early lactation, not the whole.

Table 1. Intake and digestibility of dairy cows on different supplemental niacin levels

Response Parameter	Unit	N	Parameter estimates				Model statistics	
			Intercept	SE	Slope	SE	P-value	AIC
DMI	kg/d	85	21.1	0.88	-0.013	0.014	0.340	360.8
DMD	%	14	65.3	2.07	-0.034	0.063	0.609	66.0
OMD	%	7	71.3	1.89	-0.144	0.093	0.220	32.5
CPD	%	9	53.4	11.52	-0.088	0.072	0.312	50.9
NDFD	%	20	43.6	6.69	-0.102	0.126	0.433	126.3
ADFD	%	22	42.2	4.12	-0.065	0.114	0.582	133.9

DMI, dry matter intake; DMD, dry matter digestibility; OMD, organic matter digestibility; CPD, crude protein digestibility; NDFD, neutral detergent fiber digestibility; ADFD, acid detergent fiber digestibility; N, number of data; SE, standard error; AIC, Akaike information criterion.

#### 3.2. Influence of niacin supplementation on rumen fermentation of dairy cows

Results of meta-analysis showed that niacin supplementation did not affect the rumen fermentation, i.e. VFA profiles and ammonia concentration (Table 2). It appears that niacin has less effect for rumen microbes, but the effect is more obvious for the host animals. Other authors reported that niacin supplementation affected the production of total VFA and acetate and propionate, but had minimal influence on butyrate production [5]. Niacin supplementation can improve rumen microbial population and, hence, such supplementation may increase fermentation of feed in the rumen especially

propionate [2] and can improve the fermentation of carbohydrates, thus increasing production of total VFA [6]. It might be that different results in rumen fermentation is due to the influence of the different treatment, measurement total VFA from rumen fluid and the type of feed given to dairy cows.

Table 2. Influence different supplemental niacin levels on rumen fermentation of dairy cows

Response Parameter	Unit	N	Parameter estimates				Model statistics	
			Intercept	SE	Slope	SE	P-value	AIC
				Intercept		Slope		
VFA Total	mM	23	129.3	18.31	0.610	0.544	0.283	200.0
C2	%	16	63.7	2.16	-0.017	0.053	0.760	68.8
C3	%	16	21.3	1.83	0.021	0.043	0.638	63.6
C2/C3	%	16	3.1	0.36	-0.003	0.007	0.731	18.1
C4	%	16	11.2	0.44	-0.002	0.023	0.950	40.5
NH <sub>3</sub>	%	16	97.9	18.18	-0.324	1.056	0.766	150.6

VFA, volatile fatty acid; C2, acetate; C3, propionate; C2/C3, acetate to propionate ratio; NH<sub>3</sub>, ammonia concentration; N, number of data; SE, standard error; AIC, Akaike information criterion.

#### 4. References

- [1] B.E. Brent, E. E. Bartley. 1984. Thiamin and niacin in the rumen. *J. Anim. Sci.* 59: 813-822.
- [2] J.M. Campbell, M. R. Murphy, R. A. Christense, T. R. Overton. 1994. Kinetics of niacin supplements in lactating dairy cows. *J. Dairy Sci.* 77: 566-575.
- [3] D. Sauvant, P. Schmidely, J.J. Daudin, N.R. St-Piere. 2008. Meta-analysis of experimental data in animal nutrition. *J. Anim.* 1: 1203-1214.
- [4] N.R. St-Pierre. 2001. Integrating quantitative findings from multiple studies using mixed model methodology. *J. Dairy Sci.* 84: 741-755.
- [5] S.M. Dennis, M.J. Arambel, E.E. Bartley, D.O. Riddell, A.D. Dayton. 1982. Effect of heated or unheated soybean meal with or without niacin on rumen protozoa. *J. Dairy Sci.* 65: 1643-1652.
- [6] I.D. Niehoff, L. Huther, P. Lebzien. 2009. Niacin for dairy cattle. *Brit. J. Nutr.* 101: 5-19.

## **Influence of tannin concentration in ration on fermentation parameters of Rumen Simulation Technique (RUSITEC): a meta-analysis**

**Anuraga Jayanegara<sup>1,\*</sup>, M. Ridla<sup>1</sup>, Erika B. Laconi<sup>1</sup>, Nahrowi<sup>1</sup>**

<sup>1</sup> Department of Nutrition and Feed Technology, Bogor Agricultural University, Bogor, 16680, Indonesia

\* Corresponding author: anuragaja@apps.ipb.ac.id

---

**Abstract** The objective of this study was to summarize and to quantify the effects of tannin on fermentation parameters of rumen simulation technique (RUSITEC) through a meta-analysis approach. Experiments reporting tannin concentration and rumen fermentation using the RUSITEC system were integrated into a database, and comprised of 6 studies and 25 treatments. Parameters recorded were nutrient digestibility, gas production, methane (CH<sub>4</sub>) emission, short-chain fatty acid (SCFA) profiles, pH, ammonia (NH<sub>3</sub>) and microbial population (bacteria and protozoa). The analysis of the data assembled in the database was based on mixed model methodology in which different studies were treated as random effects whereas tannin concentration was treated as fixed effects. Results revealed that *in vitro* crude protein digestibility (CPD), neutral detergent fiber digestibility (NDFD) and acid detergent fiber digestibility (ADFD) decreased linearly as the tannin concentration increased with the *P*-value of 0.047, 0.005 and 0.004, respectively. Comparing the magnitude of reduction in CP and fiber digestibility by the influence of tannin, the compound appeared to cause higher negative effect on CP digestibility than that of fiber as indicated by the slopes. However, the overall OMD did not significantly decrease although the slope remained negative. Methane emission tended to decrease at higher tannin concentration when expressed per unit of substrate (*P*=0.066) and significantly decreased when expressed per unit of total gas produced (*P*=0.005). It can be concluded that tannin is a potential compound for mitigating ruminal methane emission but its use on the other hand also decrease nutrient digestibility.

**Keywords** tannin, rumen, fermentation, rusitec, meta-analysis

---

### **1. Introduction**

Tannin is among plant secondary compounds produced by plants in their intermediary metabolism. It is polyphenolic compound with diverse

structure (such as between hydrolysable and condensed tannin) and molecular weight but has similar property: it binds and precipitates protein [1]. With respect to ruminant nutrition, tannin is considered to have both beneficial and detrimental nutritional effects. Some of the beneficial effects of tannin are better utilization of dietary protein, faster growth rate, higher milk yield and improved animal health through prevention of bloat and nematode infection. Negative effects of tannin have been associated with its toxicity to rumen microbes and the animals especially when present at high concentration in ration (>50 g/kg dry matter) [2].

Research on tannin in relation to ruminant nutrition has been conducted under various experimental conditions, either *in vivo* (directly to the animal), *in sacco* (fistulated animal) or *in vitro* (laboratory equipment that mimic rumen fermentation). The latter method is divided into two groups, i.e. *in vitro* batch and *in vitro* continuous culture. Research synthesis of tannin effect on rumen digestion and fermentation based on *in vivo* and *in vitro* batch studies across various ruminant species has been previously performed through a meta-analytical approach [3]. However, the studies based on *in vitro* continuous culture like in rumen simulation technique or RUSITEC [4] have not been summarized. In the present study, therefore, a meta-analysis was conducted to summarize and to quantify the effects of tannin concentration on fermentation parameters of RUSITEC.

## **2. Materials and Methods**

RUSITEC experiments reporting tannin concentration and rumen fermentation were integrated into a database (comprised of 6 studies and 25 treatments). The studies were Sliwinski et al. [5], Hess et al. [6-7], Tiemann et al. [8], Bekele et al. [9] and Khiaosa-ard et al. [10] (Table 1). Parameters recorded were nutrient digestibility, gas production, methane (CH<sub>4</sub>) emission, short-chain fatty acid (SCFA) profiles, pH, ammonia (NH<sub>3</sub>) and microbial population (bacteria and protozoa). Tannin forms were either from non-extracted or extracted tannins of plant origins, and constituted of different tannin types, i.e. hydrolysable, condensed or unspecified or mixed tannins. Such different tannin types were not a main point of interest but rather the amount or concentration of the tannin in the ration. Therefore, they were not stated as a categorical variable and not included in the statistical model. Studies reporting treatments with addition of polyethylene glycol (PEG) were excluded from the database since the substance may neutralize the effects of tannins under rumen environment.

The analysis of the data assembled in the database was made by a statistical meta-analysis approach [11]. Studies were treated as random effects whereas tannin concentration was treated as fixed effects using MIXED procedure of SAS version 9.2. The following statistical model was employed:

$$Y_{ij} = B_0 + B_1X_{ij} + s_i + b_iX_{ij} + e_{ij}$$

where,  $Y_{ij}$  = dependent variable,  $B_0$  = overall intercept from all studies (fixed effect),  $B_1$  = linear regression coefficient of Y on X (fixed effect),  $X_{ij}$  = value of the continuous predictor variable (dietary tannins),  $s_i$  = random effect of study i,  $b_i$  = random effect of study i on the regression coefficient of Y on X in study i, and  $e_{ij}$  = the unexplained residual errors. The study variable was declared in the CLASS statement since it does not contain any quantitative information. Data were weighted by the number of replicates each study and scaled to 1 to take into consideration of unequal variance among studies. Microbial population data were transformed into their logarithmic units to allow linear relationships with the independent variable. Model statistics presented are  $P$ -value and coefficient of determination ( $R^2$ ).

Table 1. Studies included in the meta-analysis of the effect of tannin concentration on fermentation parameters of rumen simulation technique (RUSITEC)

Study no.	Reference	Basal feed	Tannin source	Tannin level (g/kg DM)
1	Sliwinski et al. (2002a)	Grass hay, silage and barley	Chestnut	0 to 2.5
2	Hess et al. (2006)	Koronivia grass	<i>Cratylia argentea</i> , <i>Calliandra calothyrsus</i>	0 to 135
3	Hess et al. (2008)	Koronivia grass	<i>Leucaena leucocephala</i> , <i>Flemingia macrophylla</i> , <i>Calliandra calothyrsus</i>	0 to 62.2
4	Tiemann et al. (2008a)	Koronivia grass	<i>Vigna unguiculata</i> , <i>Calliandra calothyrsus</i>	0 and 71
5	Bekele et al. (2009)	Koronivia grass	<i>Samanea saman</i> , <i>Acacia angustissima</i> , <i>Sesbania sesban</i> , <i>Cajanus cajan</i>	0 to 45
6	Khiaosa-Ard et al. (2009)	Grass-clover hay	<i>Onobrychis viciifolia</i> , <i>Acacia mearnsii</i>	0 and 78.9

### 3. Results and Discussion

*In vitro* crude protein digestibility (CPD), neutral detergent fiber digestibility (NDFD) and acid detergent fiber digestibility (ADFD) decreased linearly as the tannin concentration increased with the *P*-value of 0.047, 0.005 and 0.004, respectively (Table 2). Comparing the magnitude of reduction in CP and fiber digestibility by the influence of tannin, the compound appeared to cause higher negative effect on CP digestibility than that of fiber as indicated by the slopes. An increase of tannin concentration by 1 g/kg declined CPD by 2.921 mg/g. The decrease was lower for the NDFD and ADFD, i.e. 1.231 and 1.549 mg/g, respectively. However, these figures might change if the slopes were corrected by the intercepts due to substantial different digestibility between CP and fiber at dietary tannins equal to 0 g/kg. All of these relationships had high  $R^2$ , i.e. higher than 0.4. The results support a theory that tannin may form complexes with some nutrients such as protein and carbohydrate and, therefore, may reduce their digestibility in the digestive tract of ruminants [1-2, 12]. However, the overall OMD did not significantly decrease although the slope remained negative. This was also the case for the total gas production.

Methane emission tended to decrease at higher tannin concentration when expressed per unit of substrate ( $P=0.066$ ) and significantly decreased when expressed per unit of total gas produced ( $P=0.005$ ). The latter had a high  $R^2$ , i.e. 0.677. Explanation of the methane decrease due to tannin appears to be because of the decrease in digestibility of nutrients, particularly fiber, which decreases  $H_2$  production as a substrate for methanogenesis as well as direct inhibition on methanogen population; the latter occurs since tannin is toxic to some groups of rumen microbes including the methanogen [3, 13]. Tannins had almost no effects on all SCFA variables, except that the substance linearly decreased  $C_4$  ( $P=0.013$ ,  $R^2=0.403$ ). Dietary tannin had also no significant effects on ruminal pH,  $NH_3$ , bacteria and protozoa population.

Table 2. Equations for linear regression of the effect of tannin concentration on fermentation parameters of rumen simulation technique (RUSITEC)

Response parameter	n	Parameter estimates						$R^2$
		Intercept	SE intercept	<i>P</i> intercept	Slope	SE slope	<i>P</i> slope	
OMD (mg/g)	25	441.9	36.81	<0.001	-0.672	0.3918	ns	0.178
CPD (mg/g)	14	644.2	76.19	0.014	-2.921	1.2914	0.047	0.407
NDFD (mg/g)	25	323.6	26.56	<0.001	-1.231	0.3801	0.005	0.411

Response parameter	n	Parameter estimates						R <sup>2</sup>
		Intercept	SE	P intercept	Slope	SE slope	P slope	
ADFD (mg/g)	14	277.1	20.42	<0.001	-1.549	0.4102	0.004	0.543
Gas (ml/g)	14	81.1	28.69	Ns	-0.170	0.1298	ns	0.220
CH <sub>4</sub> (ml/g)	25	10.9	1.89	0.002	-0.0255	0.01301	0.066	0.231
CH <sub>4</sub> (ml/l gas)	14	170.4	47.73	0.07	-0.582	0.1631	0.005	0.677
Total SCFA (mmol/l)	23	83.5	10.89	0.002	-0.0003	0.04986	ns	0.000
C <sub>2</sub> (% total SCFA)	23	63.5	1.84	<0.001	0.0002	0.00929	ns	0.000
C <sub>3</sub>	23	22.2	1.83	<0.001	0.0155	0.01129	ns	0.140
C <sub>4</sub>	23	10.9	1.99	0.005	-0.0139	0.00501	0.013	0.403
<i>iso</i> -C <sub>4</sub>	19	0.72	0.229	0.052	0.0007	0.00117	ns	0.042
C <sub>5</sub>	19	2.75	0.894	0.054	-0.0007	0.00166	ns	0.019
<i>iso</i> -C <sub>5</sub>	19	0.89	0.307	0.063	-0.0011	0.00101	ns	0.126
<i>iso</i> -SCFA	19	1.61	0.349	0.019	-0.0005	0.00166	ns	0.009
C <sub>2</sub> /C <sub>3</sub>	23	2.93	0.234	<0.001	-0.0011	0.00166	ns	0.036
pH	25	7.00	0.050	<0.001	0.0001	0.00035	ns	0.010
NH <sub>3</sub> (mmol/l)	25	6.44	1.862	0.018	-0.0285	0.01822	ns	0.155
log bacteria (10 <sup>9</sup> /ml)	23	9.11	0.313	<0.001	0.0008	0.00063	ns	0.114
log protozoa (10 <sup>4</sup> /ml)	23	3.58	0.127	<0.001	0.0004	0.00127	ns	0.008

ADFD, *in vitro* acid detergent fiber digestibility; C<sub>2</sub>, acetate; C<sub>3</sub>, propionate; C<sub>4</sub>, butyrate; CPD, *in vitro* apparent crude protein digestibility; n, number of treatment; NDFD, *in vitro* neutral detergent fiber digestibility; OMD, *in vitro* organic matter digestibility; R<sup>2</sup>, coefficient of determination; SCFA, short-chain fatty acids; SE, standard error.

## 4. Conclusion

Tannin is a potential natural compound for mitigating ruminal methane emission but its use on the other hand also decrease nutrient digestibility. Further investigation is therefore required to determine an optimum concentration of tannin in ration in which it mitigates methane emission and simultaneously supports rumen digestion and fermentation.

## 5. References

- [1] H.P.S. Makkar. 2003. Effects and fate of tannins in ruminant animals, adaptation to tannins, and strategies to overcome detrimental effects of feeding tannin-rich feeds. *Small Rum. Res.* 49: 241-256.
- [2] I. Mueller-Harvey. 2006. Unravelling the conundrum of tannins in animal nutrition and health. *J. Sci. Food Agric.* 86: 2010-2037.
- [3] A. Jayanegara, F. Leiber and M. Kreuzer. 2012. Meta-analysis of the relationship between dietary tannin level and methane formation in



- ruminants from *in vivo* and *in vitro* experiments. *J. Anim. Physiol. Anim. Nutr.* 96: 365-375.
- [4] J.W. Czerkawski and G. Breckenridge. 1977. Design and development of a long-term rumen simulation technique (Rusitec). *Brit. J. Nutr.* 38: 371-384.
- [5] B.J. Sliwinski, C.R. Soliva, A. Machmüller and M. Kreuzer. 2002. Efficacy of plant extracts rich in secondary constituents to modify rumen fermentation. *Anim. Feed Sci. Technol.* 101: 101-114.
- [6] H.D. Hess, T.T. Tiemann, F. Noto, S. Franzel, C.E. Lascano and M. Kreuzer. 2006. The effects of cultivation site on forage quality of *Calliandra calothyrsus* var. Patulul. *Agrofor. Syst.* 68: 209–220.
- [7] H.D. Hess, M.L. Mera, T.T. Tiemann, C.E. Lascano and M. Kreuzer. 2008. *In vitro* assessment of the suitability of replacing the low-tannin legume *Vigna unguiculata* with the tanniniferous legumes *Leucaena leucocephala* or *Calliandra calothyrsus* in a tropical grass diet. *Anim. Feed Sci. Technol.* 147: 105-115.
- [8] T.T. Tiemann, C.E. Lascano, M. Kreuzer and H.D. Hess. 2008. The ruminal degradability of fibre explains part of the low nutritional value and reduced methanogenesis in highly tanniniferous tropical legumes. *J. Sci. Food Agric.* 88: 1794-1803.
- [9] A.Z. Bekele, C. Clement, M. Kreuzer and C.R. Soliva. 2009. Efficiency of *Sesbania sesban* and *Acacia angustissima* in limiting methanogenesis and increasing ruminally available nitrogen in a tropical grass-based diet depends on accession. *Anim. Prod. Sci.* 49: 145-153.
- [10] R. Khiaosa-ard, S.F. Bryner, M.R.L. Scheeder, H.R. Wettstein, F. Leiber, M. Kreuzer and C.R. Soliva. 2009. Evidence for the inhibition of the terminal step of ruminal  $\alpha$ -linolenic acid biohydrogenation by condensed tannins. *J. Dairy Sci.* 92: 177-188.
- [11] D. Sauvant, P. Schmidely, J.J. Daudin and N.R. St-Pierre. 2008. Meta-analyses of experimental data in animal nutrition. *Animal* 2: 1203-1214.
- [12] N. Silanikove, A. Perevolotsky and F.D. Provenza. 2001. Use of tannin-binding chemicals to assay for tannins and their negative postingestive effects in ruminants. *Anim. Feed Sci. Technol.* 91: 69-81.
- [13] M.H. Tavendale, L.P. Meagher, D. Pacheco, N. Walker, G.T. Attwood and S. Sivakumaran. 2005. Methane production from *in vitro* rumen incubations with *Lotus pedunculatus* and *Medicago sativa*, and effects of extractable condensed tannin fractions on methanogenesis. *Anim. Feed Sci. Technol.* 123-124: 403-419.

## **An observation on the scales of three species of *Varanus* using scanning electron microscopy**

**Evya Arida<sup>1, \*</sup>**

<sup>1</sup>Museum Zoologicum Bogoriense, Research Center for Biology, Indonesian Institute of Sciences, Cibinong Science Center, Cibinong 16911, Indonesia

\* Corresponding author: [evya001@lipi.go.id](mailto:evya001@lipi.go.id)

---

**Abstract** Skins of Monitor lizards (*Varanus* spp.) have been in trade for a number of decades and used for fashion products due to their decorative aspect and material durability. These lizards live in different habitat types in Indonesia. I explored scale morphology of three species using Scanning Electron Microscopy (SEM) to compare variations among these three species, each of which represents a habitat type. The Asian Water monitor (*Varanus salvator*) represents semi-aquatic habitat, the Mangrove monitor (*Varanus indicus*) represents coastal habitat, and the Green monitor (*Varanus prasinus*) represents forest habitat. Skin samples cut from the dorsal and ventral parts of the body, hind leg, and tail were prepared for SEM and images thereof were taken for descriptive analysis. I found variations in shape, size, and arrangement of scales among the species studied; however, these variations are also shown within species. Whether scale variations among species are related to habitat types, skin samples of other species need to be included for analysis. It is also recommend further investigation to test whether these variations are phylogenetic. Knowledge on the scale morphology of Monitor lizards can be useful for wildlife forensics, for example to trace the species of source, as well as to identify leather originality.

**Keywords** Monitor lizard, SEM, scales, scanning electron microscopy, habitat

---

### **1. Introduction**

The exportation of reptile skins from Indonesia has taken place since the Dutch colonialism, with a figure of 2 million skins in the 1930s [1]. Internationally, the trade of reptile skins was reported to continue with 10 million wild-caught reptiles killed each year in the 1980s. In particular, 2.3 million of Monitor lizard skins were traded annually in the same decade from several countries for leather industries [2]. The attractive skin pattern of these lizards for fashion products seems to suggest the steady demands

for Monitor lizard skins in the next few decades. Annual export quota released recently by CITES set more than 400,000 of Asian Water monitor skins alone to be traded internationally [3]. However, the overall trade volume decreased from 1.4 million skins in 2000 to 0.7 million skins in 2008 [4].

Wildlife forensics plays an important role in the legal trades of CITES-listed species such as *Varanus salvator*, which is among the most exploited monitor lizard species in the world [5]. Falsification of shipping data may occur under this species' identity for nationally protected species such as *Varanus indicus* due to their morphological resemblance to non-experts' eyes. Therefore, identification of processed skins or leathers based on scale morphology is useful, in case only a small part of the skins for trade is available for assessment. There are five categories of general scale morphology to determine variations, i.e. scale outline, scale size and shape uniformity, scale topography, scale microstructure, and scale arrangement [1].

I explored variations in scale size, shape, and arrangement of three Monitor lizard species, i.e. *Varanussalvator* (Asian Water monitor), *Varanus indicus* (Mangrove monitor), and *Varanus prasinus* (Green Tree monitor) to provide preliminary data of scale morphology for this group. Monitor lizard species live in different habitats. Thus, each of the sampled species in this study is aimed to be representative of a unique habitat, i.e. semi-aquatic habitats (river banks, lakes sides, etc.), coastal habitat, and forest habitat, respectively.

## **2. Materials and methods**

Alcohol-preserved museum specimens were used for this study, i.e. MZB.Lace.5946 (*Varanussalvator*), MZB.Lace.7712 (*Varanus indicus*), and MZB.Lace.2053 (*Varanus prasinus*). A total of six skin cuts were sampled from each specimen representing a single species that is associated with a particular habitat. Three cuts of 1 x 1 cm were taken from the dorsal side of the body, right hind leg, and tail. Three other cuts were taken from the ventral side of the respective parts.

Chemical fixation is applied to prepare skin samples. Cleaning of samples was done by soaking them in Cacodylate buffer of p.H 8.4 for 2 hours followed by agitation using ultrasonic cleaner for 5 minutes. Samples were soaked in 2.5% Glutaraldehyde for a few hours before running a fixation process, which involves soaking samples in 2% tannic acid for 6 hours and

rinsing with Cacodylate buffer for 20 minutes with buffer change every 5 minutes (3 times). Dehydration was done in 5 gradual steps, starting from 50% alcohol, 70%, 85%, 95%, to absolute ethanol. Each step was done for 20 minutes. However, alcohol was changed every 5 minutes (3 times) at 50% concentration and after 10 minutes (once) at absolute concentration. At 50% to 85% concentration, tubes of samples were placed on ice, whereas placed at room temperature for concentration above 85%. Samples were dried using freeze drier, but soaked in tertiary butanol for 10 minutes twice and followed by freezing beforehand. Each sample was mounted on a metal stub using double tape and coated with gold using a sputter coater. Observation was conducted using JEOL JSM 5310 LV at 35 X magnification and standard size images (680 X 480 pixels) of dorsal and ventral scales were taken for descriptive analysis.

### 3. Results and Discussion

The overall scale morphology can be shown at 35X magnification. A general structure of a relatively large plate-like scale lined with smaller granula-shaped is common in my samples except for ventral tail scales.

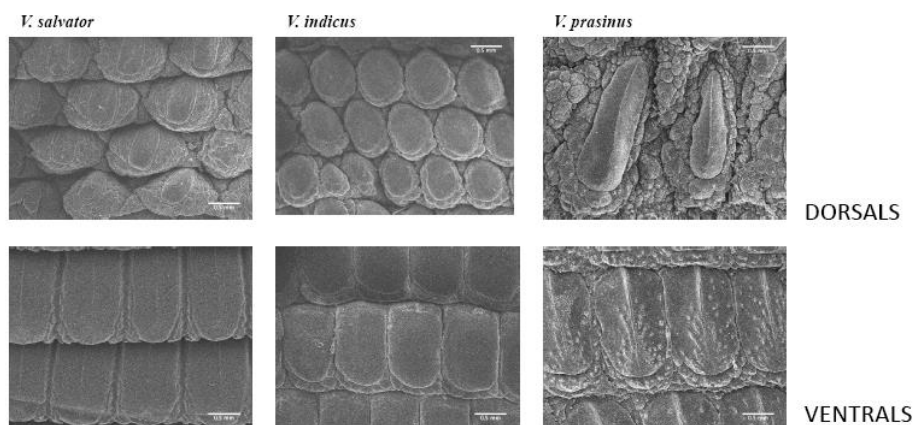


Figure 1. Body scales of *V. salvator*, *V. indicus*, and *V. prasinus*

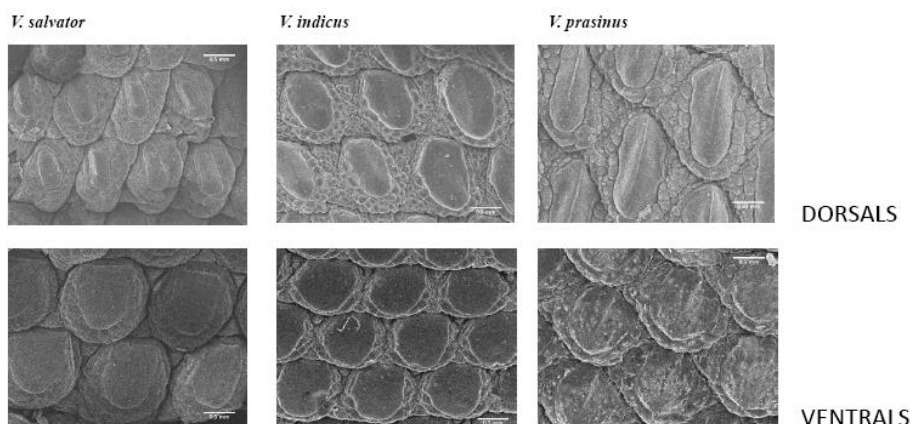


Figure 2. Scales on the right hind limb of *V. salvator*, *V. indicus*, and *V. prasinus*

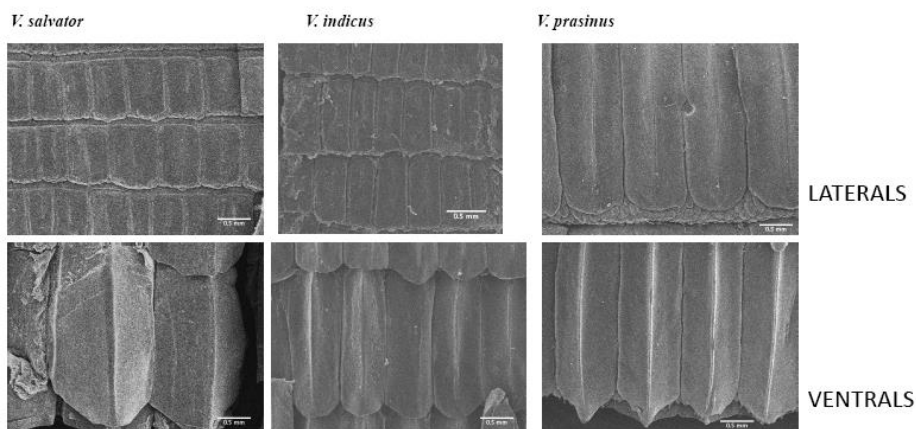


Figure 3. Tail scales of *V. salvator*, *V. indicus*, and *V. prasinus*

Scales in the three species showed variations in size and shape of dorsal and ventral scales. Variations in scale arrangement are observable at this magnification for all three species, although some are not possibly shown. A lower magnification than 35X is unavailable in said SEM to capture some variations in scale arrangement.

The size of dorsal body scales and dorsal tail scales of *V. prasinus* (Fig. 1 and Fig. 3, respectively) is relatively large than those of the other two species. Thus, whereas scale arrangement of *V. salvator* and *V. indicus* can be shown at 35X magnification, that of *V. prasinus* cannot be shown at this magnification. In addition, variations in scale arrangement of ventral tail scales of *V. salvator* and *V. prasinus* were not completely captured by the minimum magnification of said SEM.

Among the studied samples, the Asian Water monitor has the smallest scale at the dorsal part of body, hind limb, and tail. In contrast, the Green Tree monitor has the largest dorsal scale character. This might indicate that other arboreal species living in forest habitat tend to have larger dorsal scales than species living in semi-aquatic habitat. To test whether scale variations among species are related to habitat types, skin samples of other species need to be included for analysis. Furthermore, phylogenetic relationships among varanid species may also be examined based on scale characters.

Dorsal body scales are variable in shape, i.e. oval in *V. salvator*, almost round in *V. indicus*, and elongate in *V. prasinus*. Ventral body scales are rectangular basally and rounded apically in *V. salvator* and *V. indicus*, whereas almost oval in *V. prasinus*. Dorsal and ventral scales of *V. salvator* showed somewhat overlap and only lateral tail scales are non-overlapping. Overlapping scales are most observable in the ventral hind limb scales of *V. prasinus* (Fig. 2) and in the ventral tail scales of *V. indicus* (Fig. 3). Non-overlapping scale arrangement is most observable in ventral body scales (Fig. 1) and lateral tail scales (Fig. 3) of *V. indicus*.

Scale variations are also found among the three sampled parts in an individual, i.e. body, hind limb, and tail. However, replicates for each species are still needed to look at consistencies among scale variation within species. Body scales and hind limb scales tend to be oval in shape, whereas tail scales tend to be rectangular and relatively long than wide. Sizes of body scales and hind limb scales tend to be smaller than that of tail scales. Overlapping scale rows of the tail seems to be consistent at the ventral side for all sampled species but yet to be tested for consistency within species.

In addition to variations in size, shape, and arrangement, the presence or absence of scale accessories such as keels and pits are also observable among samples. Keeled scales are observable in all six skin cuts of the Green Tree monitor. Scales are also keeled in the other two species although inconspicuous, e.g. ventral scales of hind limb (Fig. 2) and lateral scales of tail (Fig. 3) of the Asian Water monitor. Keels may also be absent, e.g. on the body scales of the Mangrove monitor (Fig. 2). Pits maybe observable despite being subtle on ventral hind limb scales of *V. prasinus* and lateral tail scales of *V. indicus*. Interestingly, pits seem to be absent on all the sampled scales of *V. salvator*.

Based on characteristic scale morphology, identification of traded skins and leathers to trace species of source may be possible in the future. Thus,

knowledge on the scale morphology of Monitor lizards can be applied for wildlife forensics. Additionally, scale morphology can also be useful to detect leather originality, given variations and details in Monitor lizard skins that may be explored and applied to key for characteristic features.

#### **4. References**

- [1] D.L. Martin. 2012. Identification of reptile skin products using scale morphology In: J. E. Huffman, J. R. Wallace (Eds). *Wildlife Forensics: Methods and Applications* John Wiley & Sons, Ltd., West Sussex, pp. 161-200.
- [2] M. Jenkins, S. Broad. 1994. *International trade in reptilian skins: a review and analysis of the main consumer markets 1983-91*. Traffic International, Cambridge.
- [3] CITES Secretariat. 2014. CITES National Export Quotas for 2014 [serial online] 2014. Available at: <http://cites.org/sites/default/files/common/quotas/2014/ExportQuotas2014.pdf>
- [4] UNCTAD. 2012. *Improving International Systems for Trade in Reptile Skins Based on Sustainable Use*. United Nations, New York and Geneva.
- [5] A.P. Pernetta. 2009. Monitoring the trade: using the CITES database to examine the global trade in live Monitor lizards (*Varanus* spp.). *Biawak* 3(2): 37-45.

## **The potency of tropical endophytic bacteria as plant growth and biocontrol agents**

**Abdul Munif<sup>1,\*</sup>, Suryo Wiyono<sup>1</sup>**

<sup>1</sup>Department of Plant Protection, Faculty of Agriculture, Bogor Agricultural University,  
Bogor, 16680, Indonesia

\* Corresponding author: abdulmunif@ipb.ac.id

---

**Abstract** Endophytic bacteria resident within plant tissues have attracted attention due to their interesting features related to plant growth and for the biocontrol activity against plant pests and diseases. In this study, endophytic bacteria was isolated from different tropical plants, including rice, pepper and various of forest trees. The isolation of endophyte was conducted using surface-sterilized method with alcohol and sodium hypochlorite. The results showed more than 260 isolates of bacterial endophyte were isolated. The isolates were evaluated to select their effect on plant growth and biocontrol activity against plant pathogenic fungi and plant parasitic nematodes on rice, pepper and tomato. The results showed more than 36 isolates of endophytic bacteria were able to increase plant growth on tomato and rice and 20 isolates of endophytic bacteria with biocontrol activity against plant pathogenic fungi *Pyricularia grisea* causal agent of blast disease on rice and also able to reduce the infection of plant parasitic nematodes *Meloidogyne* spp on tomato and pepper in the greenhouse. This result indicated that some of tropical endophytic bacteria are ideal candidates for the biological control agent and plant growth promotion.

**Keywords** Biological control, endophytic bacteria, *Meloidogyne* spp., plant growth, *Pyricularia grisea*

---

### **1. Introduction**

Endophytic bacteria are defined as those microorganisms that reside within the inner parts of plants without causing any disease symptoms (Hallmann et al. 1997). Practically, Endophytes are bacteria or fungi that can be isolated from surface-disinfected plant tissues or extracted from within the plants and that are not observed to harm the host plants. Endophytes exist in a range of tissue types within a broad range of plants, colonizing the plant systemically with bacterial colonies and biofilms, residing latently in intercellular spaces, inside the vascular tissue or within cells (Ulrich et al. 2008).



Although the plant-endophyte interaction has not been fully understood, it has been reported that many isolates provide beneficial effects to their hosts like preventing disease development by synthesizing novel compounds and antifungal metabolites. Investigations of biodiversity of endophyte strains for novel metabolites may identify new drugs for the treatment of human, plant and animal diseases (Strobel et al. 2004). Several bacterial endophytes have been shown to support plant growth and increase nutrient uptake by providing phytohormones (Jacobson et al. 1994), low molecular weight compounds (Frommel et al. 1991), enzymes (Glick et al. 1998), antimicrobial substances like antibiotics and siderophores (O'Sullivan and O'Gara 1992).

Some endophytes offer increased resistance to pathogens thus making them ideal candidates for biological control (Madhaiyan et al. 2004). Other beneficial effects of endophytes to plants include nitrogen fixation (Barraquio et al. 1997), increased drought resistance (Nowak et al. 1995), thermal protection (Redman et al. 2002), survival under osmotic stress (Creus et al. 1998) and more recently, their potential for enhanced degradation of several pollutants has also been investigated (Doty 2008). Therefore, a better understanding of endophytic microorganismes may help to elucidate their function and potential role more effectively in developing sustainable systems of crop production. So far, most information on endophytic bacterial diversity has been obtained by using culture-dependent approaches. In this paper we focus on the culturable root bacterial endophytes of rice and pepper and their possible contribution in the growth of the plant and the biological control activities.

## **2. Material and Methods**

### **2.1. Plant material and isolation of endophytes**

Endophytic bacteria were collected and isolated from roots of upland rice, pepper and forest trees. The isolation of endophytes was conducted using surface-sterilized method with alcohol and sodium hypochlorite. Plant samples of roots were obtained from farmer's rice field. Rice had been grown in this field for more than 10 years. Samples of rice plants at the tillering stage were collected from the wetland rice field in February 2011 and immediately transported to the laboratory. Surface Sterilization of Rice Roots Rice roots were washed with tap water to remove attached clay. Subsequently, the roots were immersed in 70% ethanol for 3 min, washed with fresh sodium hypochlorite solution (2.5%) for 5 min, rinsed with 70% ethanol for 30 s, and finally washed five times with sterile distilled water.

To confirm that the sterilization process was successful, the aliquots of the sterile distilled water used in the final rinse were set on tryptic soy agar (TSA) medium plates for bacterial endophytes and potato dextrose agar (PDA) for fungal endophytes. The plates were examined for bacterial growth after incubation at 27 °C for 2 days. Rice root samples that were not contaminated as detected by culture-dependent sterility test were used for further analysis.

## **2.2. Plant growth test**

The Isolate of endophytic bacteria were pre-cultured on TSA and then resuspended in 4 ml of 2% methyl cellulose solution. The rice seeds var. Batutegi were soaked in the bacterial suspension for 30 minutes and then seeded into pots containing an unsterilized soil/sand mixture (1:1, v/v). Each pot received 3 seeds. After 12 days plants were harvested and root and shoot length were measured.

## **2.3. Antibiosis test**

The endophytes were tested to determine their effect on plant growth using seed treatment and the biocontrol activity against fungal pathogen *Pyricularia grisea* in vitro. *In vitro* antibiosis was tested on PDA and TSA using the dual-culture technique. Fungal plugs (d = 10 mm) of 6 day old cultures were placed in the center of each Petri dish and the endophytic bacteria were streaked in two lines approximately 2 cm from the fungus. Petri dishes were maintained at 25°C until radial growth in the control reached the border of the plate.

## **2.4. Antibiosis activity of endophytic bacteria towards *R. solani***

A total of 200 bacterial endophytes were tested for antibiosis against the fungal pathogens *R. solani*. *In vitro* antibiosis was tested on PDA using the dual-culture technique. Isolate of *R. solani* plugs (d = 10 mm) of 6 day old cultures were placed in the center of each Petri dish and the endophytic bacteria were streaked in two lines approximately 2 cm from the fungus. The bacterial strains were precultured on tryptic soy agar (TSA) for 2 days at 24°C. Plates with the fungus alone served as control. Petri dishes were maintained at 25°C until radial growth in the control reached the border of the plate. Antibiosis were scored as '+' in the presence of a inhibition zone or as '-' in the absence. The experiment was replicated two times.

## **3. Results and Discussions**

More than 260 isolates of bacterial endophyte were isolated. The results showed that population of endophytic bacteria varied from  $2,0 \times 10^4$  - up

to  $1,5 \times 10^6$  cfu (*colony forming unit*) per gram plant tissue. The results showed that some isolates of endophytic bacteria are able to promote the plant growth of rice.

Table 1. Populations of root endophytic bacteria isolated from upland rice the effect on plant growth and antibiosis activity against *Rhizoctonia solani*

Origin of isolate	Variety of rice*)	Population of endophytic bacteria (cfu/gr fresh root)	Total of isolated bacteria**)	Numbers of isolates with plant growth***)	Numbers of isolates with antibiosis on <i>R. solani</i> ****)
Lebak (Banten)	Gogo lebak (l)	$1.3 \times 10^3 - 6.7 \times 10^4$	14	2	3
Sukabumi (West Java)	S.Patenggang (l)	$2.6 \times 10^3 - 8.7 \times 10^5$	21	5	3
	Batutegi (m)	$2.6 \times 10^3 - 1.9 \times 10^6$	19	6	4
	Limboto (m)	$2.9 \times 10^4 - 3.0 \times 10^6$	21	3	3
	Wayroten (l)	$2.0 \times 10^3 - 8.0 \times 10^4$	18	2	2
	Tawi (l)	$1.1 \times 10^4 - 2.3 \times 10^5$	19	6	7
Pringsewu (Lampung)	Cikembar (l)	$1.0 \times 10^3 - 2.2 \times 10^4$	17	3	3
	Sirogol (l)	$2.6 \times 10^3 - 6.6 \times 10^5$	28	10	5
	Tambun (l)	$2.3 \times 10^4 - 1.3 \times 10^6$	26	4	3
Bogor (West Java)	Cantik (l)	$3.1 \times 10^4 - 1.3 \times 10^6$	23	7	3
	Padi gogo (l)	$1.2 \times 10^4 - 2.4 \times 10^6$	23	7	7
Blora (Central Java)	S.Bagendit (m)	$3.4 \times 10^3 - 1.8 \times 10^4$	12	1	-

\*) (l) local variety, (m) modern variety

\*\*) A total of endophytic bacterial isolates which are collected from each variety

\*\*\*) isolates of endophytic bacteria of rice seedling

\*\*\*\*) Antibiosis test assay under in vitro on TSA) and PDA medium

Endophytic bacteria are able to lessen or prevent the deleterious effects of certain pathogenic organisms caused by fungal and bacterial disease, viral origin and in some instances even damage caused by insects and nematodes. The beneficial effects of bacterial endophytes on their host plant appear to occur through similar mechanisms as described for rhizosphere-associated bacteria. These mechanisms have been reviewed in great detail by Backman and Sikora (2008). The result of antibiosis test showed that some of isolates of bacterial endophytes and fungal endophytes resulted antibiosis activity under in vitro condition. Testing in vitro antagonism of endophytes against fungal pathogens provides a rapid method to pre-select biological control candidates based on antibiosis. Results showed that some bacteria inhibited the growth in vitro of *Rhizoctonia solani* and *Pyricularia grisea*.

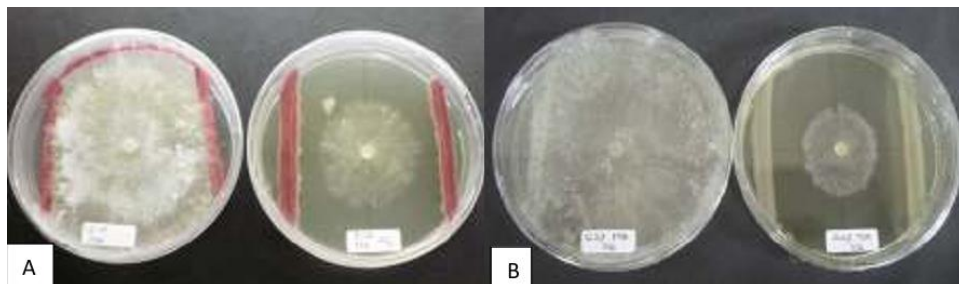


Figure 1. Two Isolate of endophytic bacteria with different antibiosis activity against *Pyricularia grisea* on PDA and TSA medium, isolate Ci10 (A) and isolate Si27 (B).

Research has been conducted on the plant growth-promoting abilities of various microorganisms. Endophytes also promote plant growth by a number of similar mechanisms. These include nitrogen fixation activity, phosphate solubilization activity, indole acetic acid production and the production of a siderophore. Endophytic organisms can also supply essential vitamins to plants (Pirttila et al. 2004). Moreover, a number of other beneficial effects on plant growth have been attributed to endophytes and include osmotic adjustment, stomatal regulation, modification of root morphology, enhanced uptake of minerals and alteration of nitrogen accumulation and metabolism (Compant et al. 2005). It is believed that certain endophyte bacteria trigger a phenomenon known as induced systemic resistance (ISR), which is phenotypically similar to systemic-acquired resistance (SAR) (Ryan et al. 2008).

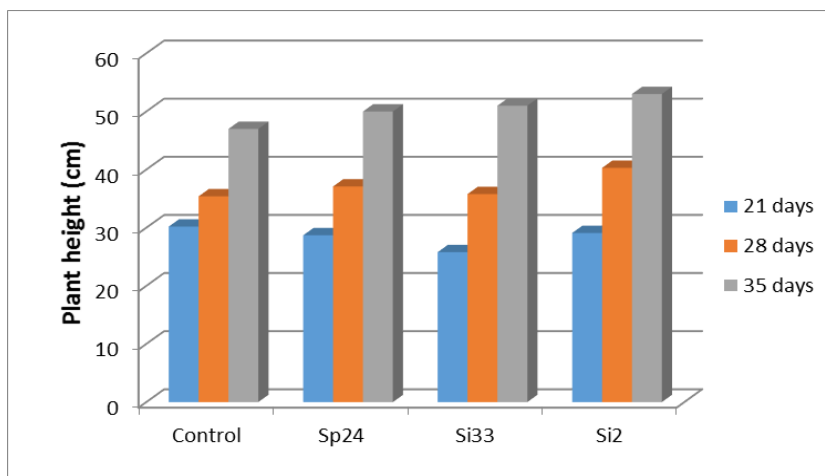


Figure 2. Effect of selected endophytic bacteria on plant height of rice var. Batutegi at 21, 28 and 35 days after planting.

The results from this study demonstrated that root endophytic bacteria from rice plants were able to promote growth of host plant and inhibit miselium of *R. solani* under in vitro condition. Although the mechanism by which the endophyte promote growth was not investigated in this study, it suggested that endophyte could be attributed to the production of hormones and phytohormone, such as gibberellins and auxin (IAA) (Chen et al. 1997). Unique endophytes could be used directly to treat seeds or transplants limiting substantially the side-effects of abiotic and biotic factors on the biological agent by almost immediately protecting them within plant tissue.

#### 4. References

1. P.A. Backman and R.A. Sikora. 2008. Endophytes: An emerging tool for biological control. *Biological Control* 46:1–3. doi:10.1016/j.biocontrol.2008.03.009
2. Y.F. Chen, C.L. Li, D.J. Han, H.L. Ren. 1997. The hormone-like activity of *Fusarium graminearum* toxin in wheat tissue culture. *Acta Agric. Boreali-Occidentalis Sinica* 6:22-25.
3. S. Compant, B. Duffy, J. Nowak, C. Cl, E.A. Barka. 2005. Use of plant growth-promoting bacteria for biocontrol of plant diseases: principles, mechanisms of action, and future prospects. *Appl Environ Microbiol* 71: 4951–4959.
4. S.L. Doty. 2008. Tansley review: enhancing phytoremediation through the use of transgenics and endophytes. *New Phytol* 179:318–333.
5. M.I. Frommel, J. Nowak, G. Lazarovits. 1991. Growth enhancement and developmental modifications of in vitro grown potato (*Solanum tuberosum* sp. *tuberosum*) as affected by a nonfluorescent *Pseudomonas* sp. *Plant Physiol* 96:928–936
6. B.R. Glick, D.M. Penrose, J. Li. 1998. A model for the lowering of plant ethylene concentrations by plant growth promoting bacteria. *J Theor Biol* 190:63–68.
7. J. Hallmann, A. Quadt-Hallmann, W.F. Mahaffee. 1997. Endophytic bacteria in agricultural crops. *Can J Microbiol* 43:895–914.
8. C.B. Jacobson, J.J. Pasternak, B.R. Glick. 1994. Partial purification and characterization of 1-amino-cyclopropane-1-carboxylate deaminase from the plant growth promoting rhizobacterium *Pseudomonas putida* GR 12–2. *Can J Microbiol* 40:1019–1025
9. H. Lata, X.C. Li, B. Silva. 2006. Identification of IAA producing endophytic bacteria from micropropagated echinacea plants using 16S rRNA sequencing. *Plant Cell Tissue Organ Cult* 85:353–359

10. D.J. O'Sullivan, F.O. Gara. 1992. Traits of fluorescent *Pseudomonas* sp. involved in suppression of plant root pathogens. *Microbial Rev* 56:662–676.
11. A. Pirttila, P. Joensuu, H. Pospiech, J. Jalonen, A. Hohtola. 2004. Bud endophytes of Scots pine produce adenine derivatives and other compounds that affect morphology and mitigate browning of callus cultures. *Physiol Plant* 121: 305–312.
12. R.P. Ryan, K. Germaine, A. Franks, D.J. Ryan, D.N. Dowlin. 2008. Bacterial endophytes: recent developments and applications. *FEMS Microbiol Lett* 278:1–9.
13. G. Strobel, B. Daisy, U. Castillo. 2004. Natural products from endophytic microorganisms. *J Nat Prod* 67:257–268.
14. K. Ulrich, A. Ulrich, D. Ewald. 2008. Diversity of endophytic bacterial communities in poplar grown under field conditions. *FEMS Microbiol Ecol* 63:169–180.

## Effect of oxygen concentration on storage of sapodilla fruit (*Achras zapota* L.)

Bambang Susilo<sup>1,\*</sup>, Rini Yulianingsih<sup>1</sup>, Dyah Ayu Agustiningrum<sup>1</sup>

<sup>1</sup>Faculty of Agricultural Technology, University of Brawijaya, Malang, Indonesia

\*Corresponding author: bmsusilo@gmail.com

---

**Abstract** Sapodilla fruit (*Achras zapota* L.) is one of tropical fruit commodities from Indonesia. It is one of important fruit in agricultural sector that has a high economy. Sapodilla fruit is a klimateric fruit that is damaged easily. The process of respiration is increase rapidly in the ripening phase. By decreasing the rate of respiration, the ripening process will be inhibited. Modified Atmosphere Storage (MAS) is one method of controlling the concentration of the gas in the storage room so that the respiration of the fruit can be controlled as well. The aim of this research is to study the effect of the oxygen (O<sub>2</sub>) concentration used in the storage chamber on respiration rate and shelf life of sapodilla fruit. The fruit is stored in the room at various concentrations of oxygen and then measured the rate of their respiration. The treatment used in this study using O<sub>2</sub> concentrations in 5 variations. Sapodilla fruit storage was done at normal conditions (21% O<sub>2</sub>), and 4 other treatments performed at lower O<sub>2</sub> concentration: 12.4 – 12.5% O<sub>2</sub>, 9.2 – 9.3% O<sub>2</sub>, 5.9 – 6.1% O<sub>2</sub>, and 3.5 – 3.7% O<sub>2</sub>. Storage was done at room temperature ( $\pm$  27°C). The parameters observed during storage include O<sub>2</sub> uptake rate, the CO<sub>2</sub> production rate, texture, color, weight loss, water content, Total Dissolved Solids (TDS), and the physical condition of the fruit. The experiment was conducted in three replications and observations were made once a day. The results showed that the O<sub>2</sub> concentration in the modified atmosphere storage affects the sapodilla fruit respiration rate and shelf life. O<sub>2</sub> uptake rate is getting lower as well as lower O<sub>2</sub> concentration in air storage. In the observations on each parameter can be seen that the shelf life of sapodilla fruit in normal conditions is 4 days. The longest shelf life of sapodilla fruit is 8 days which ripening was occurred in the storage treatment with O<sub>2</sub> concentration of 5.9 to 6.1%. While the lowest concentration of O<sub>2</sub> (3.5 to 3.7%), sapodilla fruit is not ripening until 9 days.

**Keywords** oxygen concentration, modified atmosphere storage, sapodilla fruit

---

## **1. Introduction**

Sapodilla fruit (*Achras sapota L.*) is tropical fruit from Indonesia. It has the potential to be exported. Sapodilla fruit is generally consumed as fresh fruit, therefore the quality and freshness is the important thing. Sapodilla fruit is a climacteric fruit that is easily damaged, due to the process of respiration which increases in ripening phase. In tropical air condition, the shelf life is ca. 3-5 days. After optimal ripeness, it is very easy to overripe and immediately entered the stage of senescence. Extension of shelf life of sapodilla fruit is the most difficult problem [1].

One method to improve the shelf life is modified atmosphere storage technique by regulating the composition of the atmosphere such as oxygen (O<sub>2</sub>), carbon dioxide (CO<sub>2</sub>), and nitrogen (N<sub>2</sub>) in air composition. Hartanto and Jasman [2] said that sapodilla fruit is able to survive only for 3-5 days at room temperature (27°C). While at the same storage temperature, sapodilla fruit stored with modified atmosphere storage techniques on some varieties of atmospheric composition has a shelf life of 9-12 days to reach the optimum.

The aim of this research is to study the effect of the use of oxygen (O<sub>2</sub>) concentration used in air storage towards respiration rate and shelf life of sapodilla fruit with a different treatment than previous studies.

## **2. Materials and Methods**

Local sapodilla fruit (as known as sawo manila) picked from trees when it still in raw conditions, then washed on flow water and brushed using soft sponge. Nitrogen for gas treatments, and alcohol 70% to sterilized the equipments. The tools used in this study were respiration chamber, vacuum pumps, scales METLER E2000, Color Analyzer PCE-RGB2, penetrometer Force Gauge PCE-FM20, O<sub>2</sub> and CO<sub>2</sub> Analyzer Model 902D Dual Trak, oven, spray hose, measuring glass, and digital camera.

The preliminary study included two stages, respiration chamber manufacturing and oxygen concentration data observation in specific interval pressure. Vacuum pressure applied in this preliminary study are -63 cmHg, -60 cmHg, -57 cmHg, -54 cmHg, -51 cmHg, -48 cmHg, -45 cmHg, -42 cmHg, -39 cmHg, -36 cmHg, -33 cmHg, -30 cmHg. The treatment used in this study using O<sub>2</sub> concentration in 5 variations. Sapodilla fruit storage was done at normal conditions (21% O<sub>2</sub>), and 4 other treatments performed at lower O<sub>2</sub> concentration 12.4 - 12.5% O<sub>2</sub>, 9.2 - 9.3% O<sub>2</sub>, 5.9 - 6.1% O<sub>2</sub>, and 3.5 - 3.7% O<sub>2</sub>. Storage was done at room temperature ( $\pm$  27°C)



without CO<sub>2</sub> injection. Parameters observed during storage include O<sub>2</sub> uptake rate, the CO<sub>2</sub> production rate, texture, color, weight loss, water content, Total Dissolved Solids (TDS), and the physical condition of the fruit. All experiments were done triplicate and observations were made once a day.

### 3. Results and Discussion

#### 3.1. Construction of respiration chamber

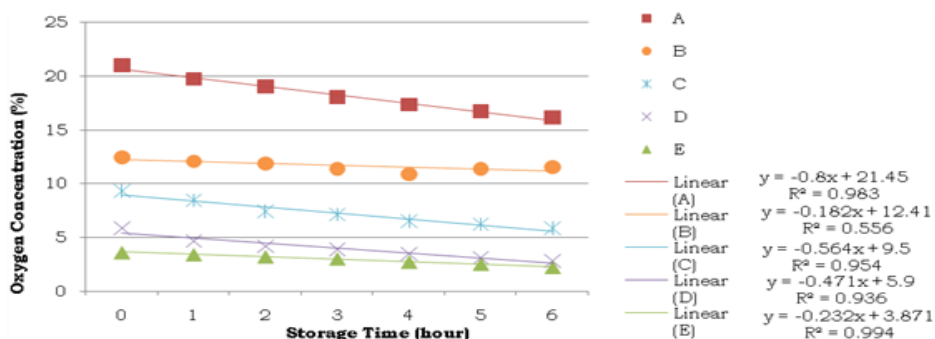
Respiration chamber was made from glass jar with closed system. The lid was modified by installed with faucets as the gas inlet and outlet. Rubber injection also installed to facilitate sampling of gas to be measured. It was also installed vacuum manometer to know the pressure in the respiration chamber.



Fig.2. Respiration Chamber

#### 3.2. O<sub>2</sub> and CO<sub>2</sub> concentration

Gas concentrations during storage were changes. O<sub>2</sub> and CO<sub>2</sub> concentrations presented graphically at Fig. 3 and 4.

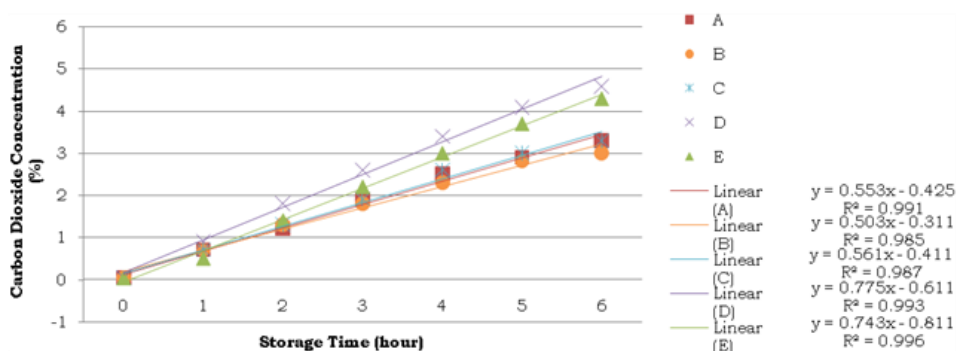


Informations: A (21% O<sub>2</sub>)                      D (5.9 – 6.1% O<sub>2</sub>)  
 B (12.4 – 12.5% O<sub>2</sub>)                    E (3.5 – 3.7% O<sub>2</sub>)  
 C (9.2 – 9.3% O<sub>2</sub>)

Fig. 3. Oxygen concentration change of Sapodilla fruits during storage at various conditions

Fig. 3 showed that during storage in 6 hours, O<sub>2</sub> concentration change of Sapodilla fruit was decreasingly occurred at all treatments. Sapodilla fruits stored at normal condition (A; 21% O<sub>2</sub>) experienced O<sub>2</sub> concentration changes faster than other treatments. Based on graphic trend line conclude that O<sub>2</sub> concentration changes at normal condition was relatively fast. It was different with other treatments graphic that showed slower even constant (E; 3.5 – 3.7% O<sub>2</sub>).

Fig. 4 showed that CO<sub>2</sub> concentration was increased in all treatments. Initial CO<sub>2</sub> concentration was 0.03% (normal atmosphere) then increased in first hour and beyond about 0.5 up to 4.6%. The graphic showed that CO<sub>2</sub> concentration change relatively occurred at the same trend line (treatment A, B, and C). While D and E showed higher CO<sub>2</sub> concentration change.



Informations: A (21% O<sub>2</sub>)                      D (5.9 – 6.1% O<sub>2</sub>)  
 B (12.4 – 12.5% O<sub>2</sub>)                    E (3.5 – 3.7% O<sub>2</sub>)  
 C (9.2 – 9.3% O<sub>2</sub>)

Fig. 4. Carbon dioxide concentration change of Sapodilla fruits during storage at various conditions

As a result of respiration process, air composition in closed system will change where O<sub>2</sub> volume decreased while volume of CO<sub>2</sub> increased against time [3].

### 3.3. Texture changes

Data observations were done triplicate then counted the standard error for each treatment that monitored. The results of texture value during storage showed at Fig. 5.

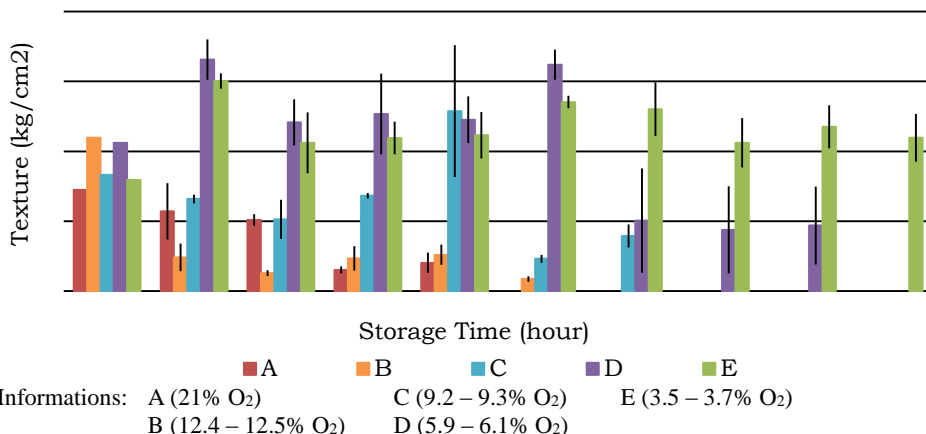


Fig. 5. Texture of Sapodilla fruits during storage at various conditions

Observation of texture value was done for 9 days, but every treatment has the different result. Sapodilla fruit stored at normal condition (A; 21% O<sub>2</sub>) has shelf life time at 4 days. At day 5, the fruit was decay. Texture value of treatment B (12.4 – 12.5% O<sub>2</sub>), C (9.2 – 9.3% O<sub>2</sub>), D (5.9 – 6.1% O<sub>2</sub>) can be observed until day 5, 6 and 8 for each. While for treatment E (3.5 – 3.7% O<sub>2</sub>) with the lowest O<sub>2</sub> concentration can be observed until the last day (day 9). But it showed that fail to ripen. Based on data collected can be known that O<sub>2</sub> concentration inside the room storage affecting Sapodilla fruit shelf life. The lower O<sub>2</sub> concentration inside the room storage can retard the fruit maturation and extend the shelf life of the fruit.

### 3.4. Weight loss of Sapodilla fruit during storage

Sapodilla fruit weight loss during storage was decreased. Naturally, fruit weight loss occurred as the effect of respiration process between O<sub>2</sub> and carbohydrates resulting CO<sub>2</sub> and water vapor released to the air.

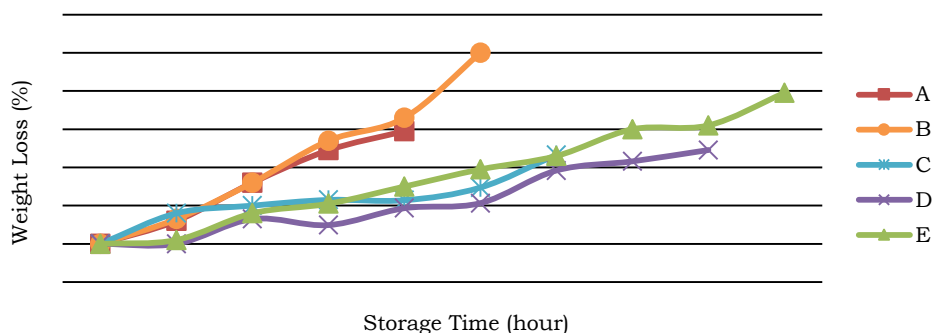


Fig. 5. Sapodilla fruit weight loss during storage at various conditions

The graphic showed that treatment C (9.2 – 9.3% O<sub>2</sub>) and D (5.9 – 6.1% O<sub>2</sub>) have the lowest weight loss than the other treatment applied with highest weight loss point at 0.47% and 0.49%. But graphic D showed that the weight loss occurred was slower than the other. While graphic E using the lowest O<sub>2</sub> concentration showed that it reach faster at the same weight loss point, so it may caused by varicosity of the fruit used in experiments. However, it can be conclude that the lower O<sub>2</sub> concentration used in storage can retard Sapodilla fruit weight loss. It was the same result as [4], exhibited that O<sub>2</sub> concentration in the modified atmosphere storage affect the retarding of respiration activity, so the breaking process of carbohydrates into volatile compounds can be retarded.

#### **4. Conclusion**

The concentration of O<sub>2</sub> inside the storage room at modified atmosphere storage methods at room temperature, affect the rate of O<sub>2</sub> uptake of Sapodilla fruit. Rate of O<sub>2</sub> uptake at respiration process was decrease comparable with the lower O<sub>2</sub> concentration used at storage room. But the concentration of O<sub>2</sub> relatively has no effect toward CO<sub>2</sub> production rate at respiration process.

Maturity time of Sapodilla fruit is affected by the amount of O<sub>2</sub> concentration in storage room. The lower O<sub>2</sub> concentration used inside storage room is able to retard maturity and extend the shelf life of Sapodilla fruit.

#### **5. References**

- [1] L.C. Hawa. 2005. Kajian susut berat dan pengembangan model laju respirasi buah sawo (*Achras zapota L.*) dalam penyimpanan hipobarik. J. of Agric. Technol. Vol. 6 No. 2.
- [2] R. Hartanto, A. Jasman. 2009. Perubahan kimia, fisika dan lama simpan buah sawo (*Achras zapota L.*) dalam penyimpanan atmosfer termodifikasi. Lokakarya Grassroot Innovation (GRI). Lampung University. Bandar Lampung
- [3] E. Sudarminto. 1992. Mempelajari pengaruh “*modified atmosphere packaging*” terhadap masa simpan alpukat (*Persea americana*, Mill). Institut Pertanian Bogor, Bogor.
- [4] A.A. Kader. 1985. Modified Atmospheres. An Indexed Reference List With Emphasis On Horticultural Commodities, Supplement No. 4. Postharvest Horticulture Series3, University of California. California.

## Heavy metals and other elements concentration in *Emilia sonchifolia* grown in topand overburden of Serpentine soil from Sorowako, Indonesia

A. Tjoa<sup>1,\*</sup>, H. Barus<sup>1</sup>

<sup>1</sup>Agriculture Faculty, Tadulako University, Indonesia

\* Corresponding author: aiye nb@yahoo.com/aiye nb@untad.ac.id

---

**Abstract** Building a phytomining field on overburden waste material without laid it with top soil is the aim of the commercial phytomining. Developing commercial phytomining on this overburden will consequently lower the operational cost. Few compositae species have a good adaptation in ultramafic sites such as *Emilia sonchifolia* in Sorowako and accumulate 190-280 mg kg<sup>-1</sup> of Ni. A pot experiment was conducted to test the efficacy of *E.sonchifolia* to acquire Ni and others elements from top and overburden soils of ultramafic (Limonitic and saprolitic Laterite) treated with and without chicken manure (w/w 1 g kg<sup>-1</sup>). Total Ni concentration in the topsoil, limonitic and saprolitic laterite were 7.051, 7.884, 10.524 mg kg<sup>-1</sup>, respectively. The shoots were collected at 50 days after transplanting, and measured for their Ni, Cr, Zn, Fe, K and Mg. *Emilia sp* produced significantly higher shoot dried biomass and contained higher Zn concentration when grown in topsoil on both treatments. But Ni, Cr and Mg concentrations and contents were higher in saprolitic laterite. Ni concentration in manure treated topsoil, limonitic and saprolitic laterite was 12.5, 30.7 and 254.5 mg kg<sup>-1</sup> and the non treated 14.7, 29.7 and 210.7 mg kg<sup>-1</sup>, respectively. Fe was the only element that reduced when chicken manure was applied. Potassium concentration and content were not different in all soils and treatments. Although *E.sonchifolia* produced 2-5 folds greater shoots when grown in topsoil and limonitic, but Ni removal rate was higher in saprolitic overburden due to much higher of Ni concentration in this soil.

**Keywords** heavy metal, top soil, overburden, ultrabasic, *Emilia sp*

---

### 1. Introduction

Ultramafics containing nickel laterites are found mainly in Central and Eastern Sulawesi, with a combined area in excess of 8,000 km<sup>2</sup>. The lateritic soils are rich in nickel and commonly strip-mined in Central Sulawesi. Globally, nickel deposits are found in either sulphide (40% of world

reserves) or lateritic (ultramafic) deposits (60% of world reserves) with some of the largest reserves in nickel laterites in Indonesia, Cuba, New Caledonia and Australia. The U.S. Geological Survey (2010) estimates the nickel reserves at 7.1 Mt for New Caledonia, 3.2 Mt for Indonesia and 26 Mt for Australia, with 2009 productions of 107,000, 189,000 and 167,000 t of nickel respectively. High-grade sulphide deposits are depleting, and as a result a higher proportion of future production is expected to come from laterite deposits [1]. Historically, nickel laterites were very difficult to process but with the development of the 'high pressure acid leach' (HPAL) technology lateritic ores have become profitable [1]. Retrieving nickel from laterites is energy intensive and produces large volumes of waste rock. In 2008, a total 86,000 t of nickel was produced from 4.7 Mt of saprolitic ore in New Caledonia [2].

Phytoremediation is an emerging technology that uses specific plants to degrade, extract, or immobilize contaminants from soil and water. This technology has been receiving increasing attention lately as an innovative, cost-effective, and alternative to the more established physical treatment methods used at hazardous waste sites. Phytoremediation approaches generally fall into four categories, one of which is phytoextraction. Phytoextraction is the use of hyperaccumulating plants to remove toxic substances such as heavy metals from the soil and store them in their shoots [3]. The interest in phytoextraction has grown significantly following the identification of metal hyperaccumulator plant species, which can contain as much as 5% metal on a dry weight base. An ability to predict the efficiency of phytoextraction from a particular soil as well as finding super hyperaccumulator plants is crucial to decide upon the commercial application of these technology.

Ultramafic soils differed from the non-ultramafic soils in texture, having a higher proportion of clay and silt. Soils derived from ultramafic bedrock have a number of extreme chemical properties that challenge plants to survive, which include a deficiency in the macronutrients phosphorus, potassium, calcium, and nitrogen, and unusually high concentrations of magnesium and nickel which may act as toxins [4, 5]. Soil profile is made up of a number of layers likewise ultramafic, including the topsoil and overburden layers. In Sorowako, topsoil layer usually about 0-15 cm contains a large store of seed and nutrients in comparison to other layers that are vital to the success of the future mine rehabilitation. The overburden layer is 30-100 cm of gravely sub-soil material sitting above the caprock. Before mining can begin, the topsoil and overburden are removed

separately. The topsoil is directly returned to areas being rehabilitated. The overburden is stockpiled and is returned in the mine pit when mining is completed.

Phytomining for Nickel (Ni) is currently an economically viable possibility, with the additional potential of the exploitation of ore bodies that previously were uneconomical to mine by current methods. Pioneering experiments in the field can further lead to a 'green' alternative to the current environmentally destructive, opencast mining practices. And the efficiency of this green technology depends on many factors; the capacity of the root system to take up and transfer metal to above-ground plant parts and the interaction with the soil with its physico-chemical characteristics, microbes and plants, and the ability to control physical environment to support growth such as wind factor, run off, and particle dispersion on plant surface. This complex interaction is affected by a variety of factors such as site-specific soil characteristics, climatic conditions, hydrology and geology, and field management. Knowledge gathered on the agronomic and practical requirements of potential plants that used for and or to support phytomining will be an additional advantage for their commercially successful application. This study was aimed to get an initial indication of the efficacy of *E.sonchifolia* to acquire Ni and other elements not only from top soil but also overburden (Limonitic and Saprolitic laterite). *Asteraceae* species such as *Emilia sonchifolia* from serpentine sites in Sorowako accumulate 190-280 mg kg<sup>-1</sup> of Ni. Its growth rate is fast, and we propose this plant as cover crop to reduce soil dispersion and transport due to run-off on a phytomining site. We investigate here its metal and non-metal translocation capacity.

## 2. Materials and Methods

*Emilia sonchifolia* seeds were collected from serpentine of Sorowako, Central Sulawesi-Indonesia, and its shoot accumulated 190-280 mg kg<sup>-1</sup> of Ni. Collected seeds were multiplied on ultramafic topsoil to produce seeds for experiments. This experiment was carried out in a controlled environment; soil for experiment was comprised of topsoil and overburden soil (Limonitic and Saprolitic laterite). The topsoil, limonitic, and saprolitic laterite were tested for their water holding capacities, and thoroughly mixed with basal fertilizers (100 mg Kg<sup>-1</sup> N (NH<sub>4</sub>NO<sub>3</sub>), 100 mg kg<sup>-1</sup> P (NaH<sub>2</sub>PO<sub>4</sub>), 100 mg kg<sup>-1</sup> K (KCl)) before planting. A half of each soil type was treated with chicken manure (1 g kg<sup>-1</sup> soil, w/w) and a half was untreated. *E. sonchifolia* seeds were pre-cultured for 3 weeks and transferred to pots. Prior to planting, pots were first filled with either 0.8 kg top *or* overburden

soils (*limonitic and saprolitic laterite*) which had been treated or untreated with chicken manure, 3 replicates in total there were 18 pots. Total Ni concentration (aqua regia extraction) of the top, limonitic and saprolitic laterite was 7.051, 7.884, 10.524 mg kg<sup>-1</sup>, and the pH<sub>H<sub>2</sub>O</sub> was 5.87, 6.52 and 7.01, respectively. The shoots were harvested at 40 days after transplanting. Shoot materials were washed thoroughly with 3% of HCl, and deionized water and dried at 65°C for 48 hours, and their dry weight recorded. Dried samples were ground before analysis. Sub samples of plant material (0.1 g) were digested with a mixture of 5 ml HNO<sub>3</sub> (65%) and 4 ml H<sub>2</sub>O<sub>2</sub> (30%), their Ni, Cr, Zn, Fe, K and Mg determined with ICP-OES. Statistical analysis was performed using SigmaStat 4.0. Means and standard deviations are presented for all data. Mean comparisons were calculated using One-Way ANOVA followed by a Duncan-test, and means marked with different letters showed significant differences (p<0.05).

### **3. Results and Discussion**

A tropical country such as Indonesia, which has many areas of ultramafic and other metalliferous soils that have seldom being investigated, is an non-explored source of novel hyperaccumulator plant species and non hyperaccumulator plant species. The success of any plant growth on metalliferous soils is significantly is affected by prevailing edaphic factors such as chemistry, drought, salinity and physical characteristics of the soils. Sorowako ultramafic soil likewise other ultramafics has extreme chemical properties as shown in Table 1, soil is very high in heavy metals concentrations but low in macronutrients. Plant species for phytoremediation (phytomining) therefore need to be selected on basis of their characteristics, such as uptake efficiency [6], the translocation of the metals from the root to the shoot, the level of accumulation in the shoots, the growth form, and the metal tolerance of the plant species or ecotype and its associated microbes [7, 8], and the ability to adapt to extreme condition. Most plant species that discovered for phytomining are slow growth, low biomass and has shallow roots. On other hand, the post mined areas are usually open, no trees left, soil contains high silt and clay causes particle dispersion during precipitation or by wind, and surface run-off. It is therefore in phytomining field, non hyperaccumulator but metal tolerance plants which are speedy in growth, are needed as cover crop to avoid soil is exported due to surface run-off, break wind, and prevent soil dispersion.



Table 1. Soil chemistry of ultramafic soils from Sorowako, Indonesia.

Parameters	Topsoil	Overburden (Laterite)	
	0-15 cm	Limonitic	Saprolitic
pH <sup>1</sup>	5.75	6.52	7.01
P total <sup>2</sup>	237.00	110.00	83.10
P extractable <sup>3</sup>	3.87	0.23	0.32
K total <sup>2</sup>	5164	4018	4138
K exch. <sup>4</sup>	0.03	0.01	0.02
CEC <sup>4</sup>	42.50	35.10	19.90
Mg exch. <sup>4</sup>	0.52	0.61	4.64
Ca exch. <sup>4</sup>	0.81	0.24	0.45
Mg:Ca	0.64	2.54	10.31
Ni total <sup>2</sup>	7051	7884	10524
Ni extractable <sup>3</sup>	7.54	20.70	30.20
Fe total <sup>2</sup>	131668	436372	240068
Co total <sup>2</sup>	57	294	536
Mn total <sup>2</sup>	1076	3053	4926
Al total <sup>2</sup>	154849	73984	35029
Cr total <sup>2</sup>	17216	11263	8595

Notes: (1) pH in H<sub>2</sub>O extract (2) hot HNO<sub>3</sub>-HCl soil digestion elemental concentrations in µg/g d.w. (3) Bray-1 extractant P in µg/g dry weight soil. (4) Extracted with 1M ammonium acetate at pH 7, concentrations in meq/100g dry weight soil. Values are average of two samples, analysed with ICP-OES

*E.sonchifolia* is abundant available at the Sorowako ultramafic site, in the field it accumulates 190-280 mg kg<sup>-1</sup> of Ni. This experiment used seeds that reproduced from collated seeds of Sorowako Ni mining area. Dry weight and metal and non-metal concentrations of shoots are presented in Table 2. Shoot production was higher when *E. sonchifolia* grown in topsoil and limonitic overburden compared to saprolitic. This strong growth inhibition on saprolitic overburden was accompanied with symptoms of toxicity as necrosis. Ultramafic is well known to have low nutrients but high in heavy metals, and for nutrients which are strongly fixed to the soil matrix like P, K and NH<sub>4</sub>, diffusion is the main pathway for transport to the root surface [9]. As consequence of this short distance transport, spatial availability is a crucial aspect for delivery of these nutrients to the roots. Spatial availability is affected by root growth, and it is strong related to soil texture.

Table 2. Shoot biomass and shoot concentrations of Ni, Fe, Cr, Zn, K and Mg of *E.sonchifolia*

Soil	Shoot	Shoot Concentration					
	D.M.	Ni	Fe	Cr	Zn	K	Mg
	(g)	(mg kg <sup>-1</sup> )				(g kg <sup>-1</sup> )	
T	1.0±0.05b	14.7±1.1c	406.8±157.4b	9.3±2.0b	28.8±0.3b	41.6±0.5a	5.7±0.5b
T1	3.6±0.28a	12.5±2.8c	40.0±8.3c	3.6±0.2b	32.2±3.2b	46.9±3.0a	3.1±3.0b

Soil	Shoot	Shoot Concentration					
	D.M.	Ni	Fe	Cr	Zn	K	Mg
	(g)	(mg kg <sup>-1</sup> )				(g kg <sup>-1</sup> )	
M	0.8±0.04b	29.7±0.8c	215.0±122.8c	10.5±0.9b	43.5±2.3a	42.9±1.6a	5.4±1.6b
M1	3.4±0.06a	30.7±5.2c	134.0±96.8c	5.8±1.5b	39.2±2.0a	44.6±1.0a	3.9±1.0b
Y	0.4±0.04d	210.7±10.1b	633.5±34.2a	28.3±2.7a	26.2±1.4c	44.0±0.7a	13.6±0.7a
Y1	0.7±0.12bc	254.7±51.5a	130.2±49.1c	34.0±10.9a	29.8±4.9b	45.2±0.8a	15.3±6.9a

Notes: T, M, Y is standing for topsoil, Limonitic laterite, Saprolitic laterite but untreated while T1, M1, Y1 was treated with chicken manure

Chicken manure application increased significantly shoots productions in all soils (T1, M1 & Y1), but less pronounced in saprolitic laterite (Y). Ultramafic is a poor soil and amendment of organic matter may play positive role. Addition of organic matters to soil may reduce potential risk of heavy metals in the environment, by reducing its mobility and availability. This reduction may be influenced by several factors, among them: nature itself and degradability of organic matter, salts contents, effect of soil pH, by the redox potential and by the type of soil [10]. The critical factor to conduct phytomining is to reduce the moving of the “crusty” (silty with high Fe) properties of limonitic and saprolitic laterite during frequent heavy rains, eliminating the burying of the germinated seedlings and the splashing of silt up on to the surface of the leaves which has proven to severely stress the young plants and reduce plant establishment. The highest uptake of Ni and Cr were found for saprolitic followed by limonitic and topsoils. This is in accordance the soils properties while saprolitic has the highest Ni plant availability concentration. The uptake of Fe was strongly influenced by the organic matter amendments. Chicken manure application significantly suppressed the Fe shoot uptake. Organic matter may interfere with the formation of stable metal precipitation, on other hand may enhance adsorption on mixed assemblages of fulvic acid and Fe oxide [11]. Differed from Fe, Zn was not influenced by application of organic matter, and was higher in shoot (Table 2) of limonitic soil. Concentration K in shoot was very similar for all soils and treatments. The saprolitic laterite has highest Mg:Ca concentration ratio (Table 1), and led to higher uptake of Mg (Table 2). Soil developed on ultramafic bedrocks share chemical peculiarities including high content of specific metals, a high of Mg:Ca concentration ratio and low concentration of macronutrients [12, 13].

#### 4. References

- [1] G.M. Mudd. 2009. Nickel Sulfide versus Laterite: The Hard Sustainability Challenge Remains. Proc. “48th Annual Conference of Metallurgists”, Canadian Metallurgical Society, Sudbury, Ontario, Canada, August 2009.

- [2] K. Salazar, M.K. McNutt. 2010. Mineral Commodity Summaries. U.S. Department of the Interior. U.S. Geological Survey. U.S. Government Printing Office, Washington. Open-File Report.
- [3] R.R. Brooks, C. Anderson, R. Stewart, B. Robinson. 1999. Phytomining: growing a crop of a metal. *Biologist* 46 (5): 201-205.
- [4] I.C. Baillie, P.M. Evangelista, N.B. Inciong. 2000. Differentiation of upland soils on the Palawan ophiolitic complex, Philippines. *Catena* 39: 283-299.
- [5] R.E. O'Dell, N. Rajakaruna. 2011. Intraspecific Variation, Adaptation, and Evolution, in S. Harrison, N. Rajakaruna (Eds). *Serpentine: The Evolution and Ecology of a Model System*, University of California Press, Berkeley and Los Angeles, California.
- [6] S. Clemens. 2006. Toxic metal accumulation, responses to exposure and mechanisms of tolerance in plants. *Biochimie* 88: 1707-1719.
- [7] W.H.O. Ernst. 1996. Bioavailability of heavy metals and decontaminations of soil by plants. *Appl. Geochem.* 11: 163-167.
- [8] M. Lasat, 2002. Phytoextraction of toxic metals: A review of biological mechanisms. *J. Environmental Quality* 31: 109-120.
- [9] H. Marschner. 1995. *Mineral Nutrition of Higher Plants*. London: Academic Press.
- [10] L.M. Shuman. 1991. Chemical forms of micronutrients in soils. In J. J. Mortvedt (Ed.). *Micronutrients in agriculture*. Soil Soc. Soc. Amer. Book Series #4. Soil Sci. Soc.Amer., Inc., Madison, WI.
- [11] D. J. Russell, G. Alberti. 1998. Effects of long-term, geogenic heavy metal contamination on soil organic matter and microarthropod communities, in particular Collembola. *Appl. Soil Ecol.* 9: 483-488.
- [12] R.R. Brooks. 1987. *Serpentine and Its Vegetation: a Multidisciplinary Approach*. Dioscorides Press, Portland, Oregon.
- [13] J. Proctor, L. Nagy. 1992. Ultramafic rocks and their vegetation: an overview. In: A.J.M. Baker, J. Proctor, R.D. Reeves (Eds.). *The Vegetation of Ultramafic (Serpentine) Soils*. Intercept Ltd, Andover, UK, pp 469-494.

## **WORKING GROUP 2: APPLIED RESEARCH AND SCALING-UP OF BIO- RESOURCE INNOVATION**

---

1. Medium thermal hydrolyzed rice straw and husk as bioherbicide at lowland rice weeds (*H. Agusta, M. Syakir, D. Guntoro, M.B. Yunindanova, B. Arifin*)
2. Potential sustainable maize-peanut production using appropriate biofertilizer technology in ultisols of Moramo district, South Konawe regency (*L. Karimuna, A. Maruf, Rahman, L.A. Sani*)
3. Evaluation of estrus synchronization with sponge vaginal and artificial insemination technologies on sheep and goat (case study at Juhut village, Karang Tanjung sub district, Pandeglang district, Banten) (*Siti Darodjah Rasad, Rangga Setiawan, Toha, Kikin Winangun*)
4. Concentrate protein albumin (probumin) from snakehead fish (*Channa striata*); local product of food supplement as cheap albumin protein source for community (*Abu Bakar Tawali, Meta Mahendradatta, Veni Hadju*)
5. Household scale environmentally friendly measures to reduce resource consumption (*Arief Sabdo Yuwono*)
6. Use of white rot fungi- and bacterial rot in decomposition of cocoa pod waste and in growth reduction of *Phytophthora palmivora* and *Lasiodiplodia theobromae* (*Tutik Kuswinanti, Ade Rosmana, Vien Sartika Dewi, Baharuddin, Jamila*)
7. Repellence test of spices (garlic, chili, and pepper) to rat (*Rattus rattus diardii* l.) (*Swastiko Priyambodo, Dewi Safitri*)
8. Growth response of dragon fruit (*Hylocereus costaricensis*) on MS medium with Gandasil and Growmore in vitro (*Faridatul Mukminah, Busroni Asnawi, Tetra Tri Novi*)
9. Effect of enriched phospho-compost application on the growth and phosphorous content of *Setaria splendida* Stapf (*R. Dianita, A. Rahman Sy, Ubaidillah*)
10. Implementation of life cycle assessment (LCA) on tempeh production in Bantul district – Yogyakarta special province – Indonesia (*Wahyu Supartono, Lina Widayari, Didik Purwadi*)
11. Study of characteristics floral and morphological hybrid rice parental lines on different seeding date (*P.N. Susilawati, M. Surahman, B.S. Purwoko, T.K. Suharsi, Satoto*)

12. Natural grass and plant residue qualities and values to support lactating cows requirement on forage at Indonesian small scale enterprise and traditional dairy farming (*Despal, Jazmi Malyadi, Yessy Destianingsih, Ayu Lestari, Hari Hartono, Luki Abdullah*)
13. Effect of seed density and nutrient source on production and quality of green house fodder as dairy cattle feed (*Idat Galih Permana, Despal, Dara Melisa*)

## Thermal hydrolyzed rice husk as bioherbicide to control sedge rice weed *Fimbristylis miliacea* (L.) Vahl

H. Agusta<sup>1,\*</sup>, M. Syakir<sup>2</sup>, D. Guntoro<sup>1</sup>, M.B. Yunindanova<sup>3</sup>, B. Arifin<sup>1</sup>,  
I.M. Suseno<sup>1</sup>

<sup>1</sup> Department of Agronomy and Horticulture, Faculty of Agriculture, Bogor Agricultural University,

Jl. Meranti, Kampus IPB Darmaga, Bogor 16680, Indonesia.

<sup>2</sup> Center of Research and Development of Estate, Ministry of Agriculture, Jl. Tentara Pelajar 1, Bogor 16111

<sup>3</sup> Faculty of Agriculture, University of 11 Maret, Surakarta, Indonesia

\* Correspondence author: agusta@gmx.at

---

**Abstract** This experiment was conducted in Bogor 2014 to test the potency of rice husk thermal hydrolysate as bioherbicide to control the growth of sedge rice weed *Fimbristylis miliacea*. In a completely randomized block, the treatment was arranged in bioassay test for rice seed germination for its adaptability, rice seedling as well as the sedge rice weed growth. The testing comprised pre emergence, early post emergence and post emergence stages. The hydrolysate had the capability to inhibit the sedge rice weed in all of its growing stages, but the growth of rice seedling was not influenced. However, in the bioassay test, rice germination was strongly inhibited.

**Keywords** Thermal hydrolysis, bioherbicide, rice waste, rice weeds, germination bioassay

---

### 1. Introduction

Rice husk as by product of rice production has a challenge to improve and increase its value added. Its lignin content mainly 26-31% (Midhun et. al, 2013). Lignin provides complex hydrocarbon that can be degraded to many kinds of organic constituents such phenolics, carboxyl and quinon groups. Actually degradation of lignin can be succeeded after the temperature of 200-600°C (Sun and Sun 2002). The hydrolyzation at 160°C for two hours degraded lignin at the level rate of less than 12% of total lignin content. Phenolic compounds as degraded product of anaerobic conditions can be toxic for living organism. The anerobic degradation process in the nature is obviously to be exposed at deep peat soil and swamp area, as well as biomass degradation at soil deeper layer, whereas the degradation process takes place in years. In a hydrothermal reactor, its degradation can be reduced by few hours. Its hydrolysate production consists of natural product

with various kinds of chemical constituents. The effectivity of the hydrolysate to control the growth of weeds at rice culture is hopefully applicable with the reasons for its sustainability i.e. high feedstuff availability, eobiotic properties and natural cycling purpose as well.

The purpose of the experiment was to test the effectivity of hydrolysate to control sedge rice weed *Fimbristylis miliacea* at pre-emergence, early post emergence dan post emergence stages and to observe the impact at the rice growth as well.

## **2. Materials and Methods**

The research was conducted at laboratory and experimental station of Bogor Agricultural University, Indonesia, in 2014. In a completely randomized block, the treatment was arranged in bioassay test for rice seed germination for its adaptability, rice seedling of cultivar IPB-4S, as well as test for *Fimbristylis miliacea* sedge rice weed growth. Control treatment was applied at all of experiment, and all of them were 4 times replicated. Each 30 mesh rice husk mill in amount of 150 mg was mixed with 1000 ml water and hydrolyzed in hydrothermal reactor at 280°C temperature, 60 bar pressure and for the duration of 30 minutes. At experiment pot with 7.5 cm diameter, the hydolysate was sprayed at the amount of 4 ml to the target plant. Percentage of inhibition was observed during 21 days for the pre-emergence and early post emergence stages and 5 days for post emergence stage. Besides weed leaves damage was also examined.

In order to identify whether the hydrolysate has long persistence in the soil, so that the rice growth could be negative influenced, a persistence experiment was conducted. A spraying of hydrolysate was directed into the soil and the soil was thereafter planted by rice seed. Rice was planted after 0-1-2-4 weeks and the seedling growth was observed until two weeks.

## **3. Results and Discussion**

Six main active substances after laboratory analyses of the hydrolysates consisted of homovanillyl alcohol, 1,4-benzenediol, 4-oxo-Pentanoic acid, 2,6-dimethoxy-Phenol, 2-Methoxy-Phenol and Phenol. Each substances had total concentration of more than 5% of total substances found in the GCMS-analyses. In the analyses of experiment it was not specially mentioned, which substance was effective for the weed control?

The hydrolysate showed a significant effect for bioherbicide after application at the sedge weed. The effect was to observed at pre-emergence and early post emergence stage, where its inhibition effect was to be noted until 3 weeks in the pre emergence stage, but only 2 weeks in the early post emergence stage (Table 1a). The sedge weed growth improved gradually after 2 weeks. Although only for 2-3 weeks, the herbicide effect bring a positive benefit, where the growth of rice is normally earlier and faster, so that the faster canopy covering can reduce the sunlight transmission for the new growing weeds.

Table 1a. The effect of hydolysate on sedge weed inhibition at pre-emergence and early post emergence stage.

-	Pre-emergence stage	% of inhibition*		
		Week-1	Week-2	Week-3
	Control	0c	0b	0b
	Rice husk 150 g l <sup>-1</sup>	68ab	52a	32a
-	Early post emergence stage	Week-1	Week-2	Week-3
	Control	12.0a	15.3a	17.3a
	Rice husk 150 g l <sup>-1</sup>	3.8bc	7.3b	11.5a

Note: Equal number index at the same column shows insignificant different values

At the post emergence stage the hydrolysate was less effective to control the height of weed growth, where its reached plant height was not to be distinguished with the control treatment. However, the leaf of the sedge weed, that was sprayed with the hydrolysate, showed a damage performance and drying at spots area due to the hydrolysate, so that the visual damage performance was to be noted (Table 1b).

Table 1b. The effect of hydolysate on sedge weed inhibition growth at post-emergence stage

a.	Post emergence stage	Plant height (cm)	Damage leaves/plant	Visual damage score
	Control	27.0a	0.0b	0b
	Rice husk 150 g l <sup>-1</sup>	29.1a	2.3a	3a

Note: Unequal number index at the same column shows significant different values

A direct spraying of the hydrolysate to the early rice germination process brought the seeds to a lethal exposure. The seeds failed to germinate by any means and the roots were not developed either. It indicates that the hydrolysate has an effective influence at the very early growing stage, hence,



at germination stage (Table 2). However, this fact is not so unfortunate, because the application for rice culture should be after transplanting stage. In this stage rice plant is less sensitive compared to at germination stage.

Table 2. Bioassay of failed rice seed germination impacted by rice husk hydrolisate

Observation time	Hours	24	36	48	90
Germinated seeds (40 seeds)	Control	0.0	38.0a	34.0a	38.0a
	Rice husk	0.0	0.0b	0.0b	0.0b
Root Length (cm)	Control	0.0	1.4a	4.3a	21.6a
	Rice husk	0.0	0.0b	0.0b	0.0b

Note: Unequal number index at the same column shows significant different values

The spraying of hydrolisate to the soil had no negative effect on the growing of rice seedling after 0-1-2-4 weeks of planting begin. Treatment of control and hydrolisate have a normal growing phase in 0-15 days (Figure 1). There was no effect of hydrolisate to the rice culture, when it was applied at the soil, where it was possible to be a toxic media for growing rice seedling.

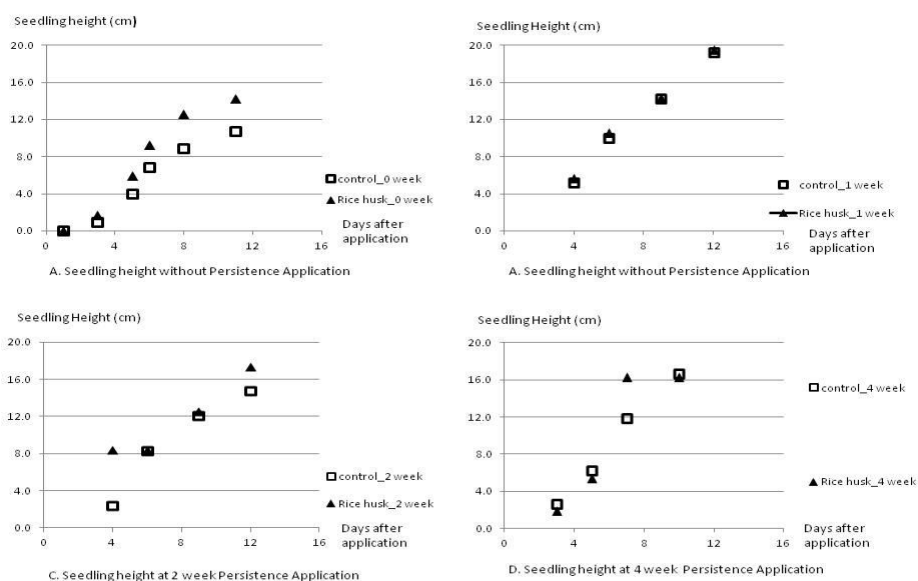


Figure 1. The effect of persistence of hydrolisate in the soil on rice seedling.

## **4. Conclusion**

Hydrolyzation at middle temperature of rice husk produced hydrolysate that has potency for bioherbicide. The hydrolysate was capable to control the growth of sedge rice weed *Fimbristylis miliacea* at pre-emergence, early post emergence dan post emergence stages. However, in the bioassay test, rice germination is strongly inhibited by the hydrolysate. There was no effect at the rice seedling and no persistence effect, when it was applied at the soil as growing media.

## **Acknowledgement**

The research was supported by KKP3N-Research Fund 2013-2014 of Indonesian Ministry of Agriculture.

## **5. References**

1. D.C.D. Midhun, P.M.S. Begum, R. Joseph, D. Joseph, P. Kumar, E.P. Ayswarya. 2013. Synthesis, characterization and application of rice husk nanosilica in natural rubber. *Int. J. Sci. Env. Tech.* 2:1027-1035.
2. R.C. Sun, X.F. Sun. 2002. Fractional separation and structural characterization of lignin and hemicelluloses by a two-stage treatment from rice straw. *Separation Sci. Tech.* 37: 2433-2458.

## **Potential sustainable maize-peanut production using appropriate biofertilizer technology in ultisols of Moramo district, South Konawe regency**

**L. Karimuna<sup>1</sup>, A. Maruf<sup>2</sup>, Rahman<sup>3</sup>, L.A. Sani<sup>3</sup>**

<sup>1</sup>The Head of Extension Services Institution, University of Halu Oleo and a Professor of Agrotechnology Department, Faculty of Agriculture, University of Halu Oleo, Kendari, Southeast Sulawesi, Indonesia

<sup>2</sup>Senior Lecturer at the Faculty of Engineering, University of Halu Oleo, Kendari, Southeast Sulawesi, Indonesia

<sup>3</sup>Senior Lecturers at the Faculty of Animal Husbandry, University of Halu Oleo, Kendari, Southeast Sulawesi, Indonesia

\*Corresponding author: lkarimuna@hotmail.com

---

**Abstract** The worldwide demand of maize for various needs has increased for the last 10 years. Farmers have planted maize in different cropping systems in order to meet adequate quantity and quality products. However, the yield of maize crops has not yet been satisfied. This was caused by the soil limiting factors derived from Ultisols with specific conditions, such as low soil nutrient contents, high acidity, and low soil organic matter. The current results of research had been carried out on seeking the most appropriate technology to not only improve crop productivity in one hand, but also to maintain soil fertility in the long run. The use of appropriate bokashi-plus fertilizer is one alternative of enhancing soil fertility and to ensure the sustainability of crop yield cultivated in Ultisols. The potential benefits for soil recuperation of using maize and peanuts organic residues had been tested and resulted a meaningful finding. Recently, the yield of intercropped maize and peanut in Ultisols has been produced amounted to about 9 t ha<sup>-1</sup> for maize and 1.78 t ha<sup>-1</sup> for peanut applying with agrobost and mulch technology during dry season. The potential use of the above biofertilizer technology is now challenging due to one of the investors interesting in using this technology on maize sustainable production in the study region for market purposes. The soil chemical properties of the site has been partially recorded and indicates the suitable soil conditions for maize intercropped with peanut in terms of nutrients and organic matter contents, but it has a limiting factor on topographical condition. The prospects of maize-peanut projects initiation are being discussed, and potential mechanization for land preparation has been settled, as well openly invited constructive comments and suggestions to have a fruitful outcome on giving strong recommendation to achieve sustainable crop production in poverty alleviation of the study region.

**Keywords** biofertilizer, maize, poverty, ultisols, Sulawesi

---

## **1. Introduction**

The high increasing world population has led to increasing worldwide demand for maize and other staple food for various needs in the last 10 years. Trend of maize yield derived from Indonesian farmers for the last five years is lower than that of maize demand for domestic needs. The government has tried to encourage the farmers in adapting appropriate technology based on the specific local conditions of region. Moreover, farmers have planted maize in different cropping systems in order to meet adequate quantity and quality products. However, the yield of maize crops has not yet been satisfied. This was caused by the soil limiting factors as the main characteristics of Ultisols. On the other hand, huge amount of biomass derived from secondary vegetation that could be used as a source of organic material were abandoned, while they contained a lot of nutrient stocks to recuperate soil fertility depletion.

Southeast Sulawesi is one of the six provinces in Sulawesi Island, situated in the eastern part of Indonesia covering the total area of 38.140 km<sup>2</sup> with various soil types found. Ultisol soil is the dominant soil type (about 60.3 percent) covered in the study region that plays an important role for the smallholding farmers to grow various crops, characterized by such limiting factors as low soil fertility, low soil organic matter, low cationic exchange capacity, shallow top soil and high acidity [1,2], which these limiting factors lead to low agriculture production earned by the farmers [3].

The current results of research had been carried out on seeking the most appropriate technology to not only improve crop productivity in one hand, but also to maintain soil fertility in the long run. The use of appropriate bokashi-plus fertilizer is one alternative of enhancing soil fertility and ensure the sustainability of crop yield cultivated in Ultisols. The potential benefits for soil recuperation of using maize and peanuts organic residues had been tested and resulted a meaningful finding. Recently, the yield of intercropped maize and peanut in Ultisols has been produced amounted to about 9 t ha<sup>-1</sup> for maize and 1.78 t ha<sup>-1</sup> for peanut applying with agrobost and mulch technology during dry season. The potential use of the above biofertilizer technology is now challenging due to one of the investors interesting in using this technology on maize sustainable production in the study region for market purposes.

The objectives of this paper were to overview the potential use of organic materials sustainably as a source of biofertilizer in proper agriculture production of intercropped maize and peanut in Ultisols, to analyze the

sustainable positive effects of bokashi fertilizer of secondary vegetation together with application of mulch technology and to determine the potential best response of those treatments on the growth and yield of maize intercropped with peanut production sustainably in Moramo district, South Konawe Regency. Having assumed that biotechnology application could be one of the appropriate alternatives to improve soil fertility using organic fertilizer after completely decomposed by effective microorganism four (EM4) and the application of mulch derived from secondary vegetation dominated by *Chromolaena odorata* L. [3], which has been recognized as a plant associated with mycorrhiza [4]. It could be formulated that the prospect of maize-peanut projects initiation is promising and potential mechanization for land preparation could be applied, as well openly invited constructive comments and suggestions to have a fruitful outcome on giving strong recommendation to achieve sustainable crop production in poverty alleviation of the study region.

## **2. Materials and Methods**

### **2.1. Place and time**

Previous research on biomass of fallow vegetation was carried out in Buke and Amasara villages, Tinanggea district as reported by [2]. Field tests on the effects of biological fertilizer treated by EM4 and mulch treatment derived from secondary vegetation on the growth and yield of intercropped maize and peanut had been carried out at the farmer's land of Abeli village, Kendari city and at the experimental garden of Animal Husbandry Faculty, University of Halu Oleo, Kendari at the elevation of about 50 m above sea level. The specific characteristic of the site was briefly figured out with surrounded by dominant shrubs vegetation from three main weed species consisting of *Chromolaena odorata* L, *Imperata cylindrica* L.Beauv, and *Colopogonium mucunoides* L. The consecutive research work on various technology of secondary vegetation had been held from 2010 to 2013. The potential application of biofertilizer bokashi plus on the growth and yield of maize and peanut in intercropping system with careful mechanization will be conducted in three villages of Moramo district, South Konawe, covering the total areas of about 500 ha, started from 2014. This best practice could be applied in another sites of Southeast Sulawesi region with similar soil and climate condition.

### **2.2. Materials and instrument**

Materials used in the field test were maize seed var. Bisi 2, peanut local variety and seed var. Gajah, bokashi fertilizer, mulch of secondary vegetation, EM4, water, sugar, label, and rope. The instrument used in the

field test were hoe, knife, balance, sprayer, oven, camera, measurement, soil thermometer and scissor. Moreover, mechanization will be applied from land preparation, especially in the flat and slight sloping area, crop management, to post harvest for the sustainable production of crops planted.

### **2.3. Data collection and analyses**

Data were collected from the results of consecutive research carried out in the secondary vegetation with different fallow ages and field tests. Then, field tests were carried out through varied experimental designs. The previous result of survey on the potential biomass and nutrient stocks to be used as the source of mulch and nutrient had been reported by [2]. The first research work was to determine the effects of bokashi fertilizer and mulch using Randomized Completely Block Design (RCBD) in factorial pattern, consisting of two factors. The second research was to study the effects of bokashi fertilizer in different planting space using split plot design, where planting time as the main plot and various doses of bokashi fertilizer as the sub plot. For the implementation of research studies in real condition of market purposes, this will be conducted in the farmers land with proper and careful integration. The results of above studies were analyzed and discussed, including the presentation of predominant variables for maize and peanut growth and yield intercropping system in Ultisols, together with the specific research design used. All variables of data recorded were tabulated using excell program and analyzed with proper statistical measures of such methods as analyses of variance (ANOVA) and others.

## **3. Results and Discussion**

### **3.1. Biomass and nutrient stocks of secondary vegetation**

The results of consecutive studies have shown the potential positive effects of biomass derived from secondary vegetation and other organic materials by using EM4 as bokashi plus on the growth and yield of intercropped maize and peanut in Ultisols. According to [2] found that biomass accumulation and nutrient stocks in 2-, 3-, 4-, 6-, 8-, and 10-yr fallow vegetation ranged from 11 to 235 t ha<sup>-1</sup> and N, P, K, Ca and Mg nutrient stocks varied considerably as shown in Table 1. Based on Table 1 showed that the biomass of the fallow vegetation correlates with the successional stages of development. Biomass of fallow vegetation determines the amount of nutrient stock in a vegetation, whereas the nutrient concentration of each species depends upon the physiological and environmental factors where a species grows. The role of biomass in nutrient storage have been discussed by [5, 6, 7, 8]. In this study, the biomass accumulation in 4- and 6-yr-old fallows was 34 and 69 t ha<sup>-1</sup>; respectively. This is similar to the study by [9].

He found that in 6-yr-old secondary vegetation produced biomass amounting to 53 t ha<sup>-1</sup>. Similarly, reported that in 4-5-yr-old fallow vegetation the total biomass produced 28 t ha<sup>-1</sup>.

Table 1. Total nutrient stocks of nitrogen, phosphorus and potassium of above-ground biomass (kg ha<sup>-1</sup>) in different ages.

Fallow age	Biomass (t ha <sup>-1</sup> )	Nutrient stocks (kg ha <sup>-1</sup> )				
		N	P	K	Ca	Mg
2	11	123	9.4	113	94,8	38,8
3	22.7	209	21.9	217	198,0	53,1
4	34.2	216	26.1	319	318,1	69,9
6	68.5	422	33.5	435	488,0	159,9
8	108	640	53.6	763	778,0	160,5
10	151	758	68.1	939	1054	209,7

Source: [2].

From the above results, if we consider the potential of plant biomass providing nutrients to the soil, it shows that maize, upland rice and other common crops can be sufficiently supplied with nutrients. Theoretically, when calculating the nitrogen, potassium, calcium, and magnesium content derived from the above-ground biomass of fallow vegetation, it is enough to supply the demand of upland rice and maize growth for 4 years of fallow.

Therefore, biomass of fallow vegetation plays important role on the recuperation of soil fertility by changing preparation from slash and burn to slash and mulch integrated with the application of EM4 as a source of biofertilizer technology.

### **3.2. Field tests**

Biomass of secondary vegetation, applied with EM4 to produce bokashi as biofertilizers, was used in all field test researches. Maize was planted in the two different mulch conditions. The vegetal matter in 3-and 7-yr old fallow was manually cut into smaller pieces and used as organic mulch spread out in the six (3 x 5 m<sup>2</sup>) plots of agricultural land. N, P and K fertilizer was applied to supply the demand of initial growth of maize plant. The results of test plant showed that the early growth of maize in 3-yr old fallow was better compared to that of 7-yr old fallow, but the further stages of maize development in 7-yr old fallow was surpassed. This indicates that organic mulch of natural vegetation which is decomposed to release nutrients can support a good growth of maize in tested field. This finding is comparable to the study by [10] for maize and cassava yield. Therefore, there is a

possibility to utilize organic material of the spontaneous vegetation as source of mulch of the region. However, this application could only be adopted if the land was managed by free-land preparation.

The effects of biofertilizer and mulch on the yield of intercropped maize and peanut in Ultisols had been conducted. Effects of various doses of mulch and bokashi fertilizer on the yield of intercropped maize and peanut were amazing that had been reported by [11], as shown in Table 2.

Table 2. The yield of maize and peanut in intercropping system treated by various doses of mulch and bokashi fertilizer in Ultisols

Treatment	Maize		Peanut	
	Seed weight of 100 grains (g)	Seed dry weight (t ha <sup>-1</sup> )	Seed weight of 100 grains (g)	Seed dry weight (t ha <sup>-1</sup> )
	Mulch (t ha <sup>-1</sup> )			
0	17.36 b	6.27	26.95	1.84 b
4	19.15 ab	7.08	27.26	2.12 ab
8	21.95 a	8.49	30.87	2.31 a
	Bokashi fertilizer (t ha <sup>-1</sup> )			
0	18.45	6.74 b	27.68	1.854 b
5	20.49	7.98 ab	28.94	2.153 ab
10	21.56	8.32 a	31.74	2.377 a

Note: Values followed by different letter at the same column (a-c) were significant differences at DMRT of 95 confidence level, as reported by [11].

The result showed that the higher, the level of mulch and bokashi fertilizer applied, the more the variables of maize and peanut produced. Table 2 showed that the highest levels of mulch treatment (8 t ha<sup>-1</sup>) and bokashi fertilizer (10 t ha<sup>-1</sup>) gave the best response for maize and peanut yield, while the application of mulch had non significant difference on seed grain weight of maize, and the treatment of bokashi fertilizer gave non significant different on seed weight of 100 grains of maize. Average production of seed dry weight of maize achieved was 8.07 t ha<sup>-1</sup>, while there was a trend of good yield of maize obtained at the mulch treatment of 8 t ha<sup>-1</sup> (8.49 t ha<sup>-1</sup>) and 10 t ha<sup>-1</sup> of bokashi fertilizer (8.32 t ha<sup>-1</sup>) that was higher compared to the potential yield of maize.

The applications of mulch and bokashi fertilizer have an effect partially or interactively on the growth and yield of maize and peanut in intercropping system. In this research work, there was an interaction effect between mulch and bokashi fertilizer on variables recorded (Table 2). The higher the level of mulch and bokashi fertilizer applied, the more the seed weight of 100



grains of maize and the dry pod weight of peanut. This finding revealed that there was a synergism effect on both factors treated, the limitation from mulch factor could be fulfilled from bokashi fertilizer. Mulch treatment plays an important role to protect a plant from high temperature and create good microclimate to support plant growth [12,13] and after mulch decomposed may contribute to increase soil fertility [14]. In addition, bokashi fertilizer provides sufficient organic material that contains macro and micro nutrients to improve soil chemical condition which then be used for plant growth and yield [15,16,17]. This research proved that mulch might increase soil permeability, develop good soil structure and maintain microclimate condition that could be considerably noted compared with the treatment without mulch [13,18,19]. Moreover, research finding also indicated that higher level of bokashi fertilizer provided sufficient nutrients and reached nutrient balance that promotes photosynthesis running in proper way, and sustain the allocation and distribution of nutrient to all parts of maize and peanut tissues. Then, the effects of much and bokashi fertilizer on plant growth of maize and peanut, and on yield of maize and peanut varied. This finding was similar to the results reported by [14,19,20,21,22].

### **3.3. Economic analyses**

One of the important factors of the success for agribusiness investment is the determination of economic analyses so that the program plan will be useful and benefit to the improvement of community welfare. The result of Cereal Research Center of Maros in 2004 reported that integrated crop system of Lamuru maize using combined organic and inorganic fertilizers might increase maize production and farmers revenue (Table 3).

Table 3. Productivity and revenue of maize farming in dryland agriculture system during dry season through integrated cropping pattern and transfer technology.

No.	Description	Farmer	IAS
1.	Productivity (t/ha)	4.81	7.87
2.	Production Value (Rp/ha)	3,281,625	5,366,250
3.	Production Budget (Rp/ha)	2,054,725	2,320,750
4.	Benefit	1,226,950	3,045,500

Source: [www.balitsereal.com](http://www.balitsereal.com), Copyright 2004 Cereal Research Center, Address: Street. Dr. Ratulangi 274 Maros South Sulawesi.

Based on the simple economic simulation with assumed that the total yield of maize and peanut might reach 9 t ha<sup>-1</sup> and 1.5 t ha<sup>-1</sup>, respectively, the result of profit analyses concluded that maize and peanut production using appropriate technology is potentially benefit, reasonable and might give a

sufficient revenue, ecologically environmentally sound, and socially acceptable. The result of profit analyses with assumption of optimal maize and peanut yield was presented in Table 4.

Table 4. Profit analyses of maize and peanut yield with medium assumption of crops per year

No.	Description	Volume	Unit price (Rp.)/kg	Total (Rp.)
1.	Maize yield in ton	9x1000x500	3,200	14,400,000,000
2.	Peanut yield in ton	1.5x1000x500	7,600	5,700,000,000
Sub Total				20,100,000,000

Profit Analyses per year:

Revenue: Rp. 20,100,000,000 - Production cost = Rp. 20,025,000,000 – Rp. 5,412,500,000 = Rp. 14,687,500,000. From this simple calculation, it could be concluded that

1. Maize and peanut crops either planted in monocropping or in multiple cropping system might sustainably assure the existence of increasing agriculture production.
2. Farming system of maize and peanut for a year with two periods of planting time for the area of 100 ha (10 ha for office area): a) Getting a revenue value as Rp.146,408,333/month, and b) Total budget as Rp.511,633,333/month.
3. Result of B/C ratio analyses is 0.28 ( $B/C > 0$ ) and R/C ratio value is 1.28 ( $R/C > 1$ ). It's meant that farming system of maize intercropped with peanut is feasible and tends to have benefit.
4. Break Event Point (BEP) is as follows: a) Maize crop gets BEP when the total amount of yield reaches 897.09 ton; and normal yield is 1,800 ton, b) Sale price is Rp.1,744/kg with normal sale price is Rp.3,500/kg.
5. The value of BEP as a business capital is as follows: a) Peanut gets BEP when the total amount of peanut yield must be 406,553 ton with normal yield of 300 ton, and b) Sale price is Rp.10,299/kg with normal price of Rp.7,600/kg.

According to the above results, it could be concluded that there is no doubt that this technology of agriculture production might give multiple effects on the development of human resources and maintain the stability of human life. At the ecological aspects, soil and climate condition are suitable for the sustainable crop production, for example maize and peanut planted in intercropping system.

Selection of a crop cultivated which has high yield and adaptability to a certain area determines the sustainability of high production either planted

monocropping or intercropping. This trend is inline with the main objective of Master plan for Acceleration of Indonesian Economic Development Sulawesi Corridor as to be responded. Maize and peanut are two crops of suitable option which can be more advantageous to cultivate in intercropping system, since peanut is a legume crop that may contribute nutrient through nitrogen fixation to the soil. The arrangement of crop space for maize and peanut properly in intercropping system may increase soil efficiency [23]. It could be summarized that the application of bokashi fertilizer and mulch derived from secondary vegetation had significant effects and better responses on the improvement of maize and peanut production, and it might doubled improve maize and peanut yield compared to control.

#### **4. Conclusion and Recommendations**

Based on the results and discussions above, it could be concluded and recommended as follows:

1. The use of biofertilizers derived from secondary vegetation for the development of sustainable agriculture crop production is potential to be implemented to improve soil fertility of Ultisols as well to mitigate food scarcity and poverty alleviation.
2. Huge amount of biomass might contribute to high nutrient stocks that sufficient supply the demand of intercropped maize and peanut yield on 100 seed dry weight and yield  $t\ ha^{-1}$ . The use of local variety for maize and peanut is recommended due to high adaptability to the local condition.
3. The optimal doses of bokashi fertilizer and mulch technology gave the best response and economically benefit to 100 maize seed dry weight, amounted to 22.43 g or  $8.07\ t\ ha^{-1}$ , and for peanut, might produced up to  $2.25\ t\ ha^{-1}$  of peanut, eventhough the assumption used in simple calculation was lower.
4. In order to obtain the most reasonable result on economical analyses for business purposes, it is recommended that integrated approaches on soil condition, climate feature, technical aspect, social and economical aspects has to be considered. In view of this project analyses, potential sustainable maize-peanut production using appropriate biofertilizer technology in Ultisols of Moramo district might be achieved.

#### **5. References**

- [1] Y.B. Pasolon. 1998. Concepts and Strategies for Agriculture Development in Supporting Regional Food Stability, Upland Study Center, Institution of Research, University of Haluoleo, Kendari

- [2] L. Karimuna. 2000. Floristic Composition And Biomass Of Fallow Vegetation In Abandoned Agricultural Field Of Southeast Sulawesi. Georg - August- University Goettingen, Goettingen. Cuvillier Verlag Goettingen. 207p.
- [3] L. Karimuna. 2003. The role of organic farming on the improvement of agriculture production in Southeast Sulawesi, Indonesia. Published in Book of Abstracts Tropentag 2003, University of Goettingen, Germany, 2003.
- [4] Halim. 2008. Exploration of Weed Indigenous Micorrhyza, Faculty of Agriculture, University of Haluoleo, Kendari.
- [5] C.E. Seubert, P.A. Sanchez, and C. Valverde. 1977. Effects of land clearings methods on soil properties of an Ultisol and crop performance in the Amazon jungle of Peru, Trop. Agr. (Trinidad) 54(4): 307-321.
- [6] A.O. Aweto. 1981. Secondary succession and soil fertility restoration in South-Western Nigeria III. Soil and vegetation interrelationships. Journal of Biology, Nigeria 69-3; 957-963.
- [7] M. Denich. 1989. Untersuchungen zur Bedeutung junger Sekundärvegetation für die Nutzungssystemproduktivität im östlichen Amazonasgebiet, Brasilien. Göttinger Beiträge zur Land- und Forstwirtschaft in den Tropen und Subtropen 46. 265 p.
- [8] D.M. Burger. 1991. Land use in the Eastern Amazon region in Studies on the utilization and Conservation of soil in the Eastern Amazon region, Final report of the agreement between EMBRAPA\_CPATU-GTZ, p.69-93.
- [9] M.L. Silva Jr., K. Vielhauer, M. Denich and P.L.G. Vlek, 1998. Can tree enrichment of secondary vegetation and fire-free land preparation by cutting, chopping and mulching improve the following crops?. In Lieberei R., K. Vob, and H. Bianchi (eds), Studies on human impact on forest and floodplains in the tropics. A German – Brazilian Research Program, 110-113p.
- [10] O.R. Kato. 1998. Fire-free land preparation as an alternative to slash and burn agriculture in the Brantagina region, Eastern Amazon: Crop performance and nitrogen dynamics, George-August-University Goettingen, Goettingen Cuvillier Verlag Goettingen, 132p (Ph.D Thesis).
- [11] L. Karimuna. 2004. Succession and vegetation analyses of fallow vegetation in abandoned agricultural fields of Southeast Sulawesi, Jurnal Agriplus Edisi Mei 2004, Fakultas Pertanian Universitas Haluoleo Kendari.

- [12] G. Soepardi. 1983. Soil Characteristic and Behaviour. Bogor Agriculture University, Bogor.
- [13] N. Hakim. 1986. Introduction to Soil Science, University of Lampung, Lampung Province.
- [14] Histiani. 2005. Efficiency test of various bokashi fertilizers and SP-36 doses on the growth and yield of peanut (*Arachis hypogaea* L.) local variety from Muna, B.Sc. Thesis, Faculty of Agriculture, University of Haluoleo, Kendari.
- [15] W.J. Rinsema. 1986. Fertilizer and Fertilization Methods. Published by Bhrata Aksara. Jakarta.
- [16] L. Karimuna. 2006a. Increasing high and sustainable agricultural production through appropriate technology implementation in supporting development of agribusiness/agro-industry at Southeast Sulawesi, 19 August 2006.
- [17] L. Karimuna. 2007. Optimization use of organic fertilizer derived from secondary vegetation as bokashi in supporting National Food Security, National Seminar on Natural Resource Management of Southeast Sulawesi Region, held on 2 April 2005, Kendari,
- [18] B. Haverkort. 1992. Agriculture for the Future. Published by Kanisius. Jakarta, Indonesia.
- [19] L. Karimuna, S. Leomo, L. Indriyani. 2009. Applications of mulch technology and bokashi fertilizers derived from secondary vegetation on the growth and yield of intercropped maize and peanut in Abeli Village, Department of Agrotechnology, Faculty of Agriculture, Science and Art Technology Application Program, Institution of Extension Services, University of Haluoleo, Kendari, 34p.
- [20] D. Setyamidjaja. 1986. Fertilizer and Fertilization, Published by Simplex. Jakarta.
- [21] S. Hardjowigeno. 2003. Soil Science. Published by Akademika Pressindo. Jakarta, Indonesia.
- [22] L. Karimuna. 2006b. Study of secondary vegetation treated as bokashi on the intercropped maize and soybean of smallholding farmers land in Southeast Sulawesi, Indonesia, Tropentag 2006, October 11-13, 2006, Bonn Germany.
- [23] E. Turmudi. 2002. Studies on the growth and Crop Development of intercropped maize and four bean cultivars in various crop spacings, Agronomy Study Program, Faculty of Agriculture, University of Bengkulu, Journal of Indonesian Agriculture Sciences 4(2): 89-90.

## **Evaluation of estrus synchronization with sponge vaginal and artificial insemination technologies on sheep and goat (case study at Juhut village, Karang Tanjung sub district, Pandeglang district, Banten)**

**Siti D. Rasad<sup>1,\*</sup>, Rangga Setiawan<sup>1</sup>, Toha<sup>1</sup>, Kikin Winangun<sup>1</sup>**

<sup>1</sup>Animal Reproduction & AI Laboratory, Animal Husbandry Faculty, University of Padjadjaran, Jatinangor, Indonesia

\* Corresponding author: d447je.sdr@gmail.com

---

**Abstract** One of livestock commodities as a potential source of animal protein are sheep and goats. That livestock are a common livestock in West Java as a small scale farming, but many problem occurred by conventional management of that livestock. Resulting in the increase in sheep population on small farming in West Java is not optimal. This was due to the knowledge of the small-scale livestock concerning the reproductive aspects of sheep or goat is still not optimal, so it is of ten a delay of breeding or reproductive management of that sheep or goat. Estrus synchronization and application technology of artificial insemination can be applied as a solution to that problem. Using vaginal sponges as well as semen artificial insemination liquid (chilled semen) derived from males belongs to the farmer there, could be improve the activity and reproductive patterns of sheep or goat. 26 sheep and 5 goats with the vaginal sponges (consist of 25 mg progesterone, which were produced of Animal Reproduction & AI Laboratory, Animal Husbandry Faculty, Universitas Padjadjaran) was used and parameter of this research are percentage of estrous response and pregnancy rate. Results of this study concluded that applications of vaginal sponges can cause high estrous response, and percentage of pregnancy as a result of synchronization of estrus with vaginal sponges method showed optimal results.

**Keywords** estrus synchronization, artificial insemination, chilled semen, vaginal sponges method

---

### **1. Introduction**

One of the potential of livestock commodities as a source of animal protein are sheep and goats. Livestock is a common livestock kept by the people of West Java. The potential of sheep in West Java, difficulties, resulting in the increase of sheep population in the group of farmers in West Java is not

optimal. This is due to the knowledge of the small-scale livestock against the reproductive aspects of sheep/goat is still not optimal, so the frequent occurrence of delayed mating sheep/goats. In addition, feeding factors do not support their productive activity sheep/goat leads to lower pregnancy success obtained after mating. One of the solutions that can be applied to the farmer are efforts estrous synchronization and application technology of artificial insemination using a substance or hormone applications with low economic value that can be applied by the farmers sheep/goats. The use of vaginal sponges made in the country as well as artificial insemination semen liquid (chilled semen) derived from males belong to the farmer group is to help them to improve the activity and reproductive patterns of sheep/goats.

Research on reproductive biotechnology applications such as estrous synchronization techniques using a vaginal sponge self made Reproduction Laboratory Faculty of Animal Husbandry & AI. Furthermore, breeding is done with natural mating and AI using chilled semen from bulls that diluted with physiological saline belonging to farmers group in Juhut Village, Subdistrict Tanjung Karang, District Pandeglang Banten has been implemented. The purpose of the study was to know and evaluate the application of Estrous Synchronization and AI technologies in that area.

## **2. Materials and Methods**

This study used 26 sheep and 5 goats with age varied from 4 groups of farmers in the village of Juhut Village, Subdistrict Tanjung Karang, District Pandeglang Banten. Estrous synchronization program using vaginal sponges containing 20 mg of progesterone. The sponge is inserted into the vagina of sheep and goats for 14 days.

Artificial insemination (AI) using liquid semen from male sheep/goats belongs to group of farmers at the location of activities. Variables measured include estrous response and pregnancy percentage. Estrous response assessed from the number of estrous females of total females were synchronized. Indicators of estrous females if the uterine cervix is already open [1]. The percentage of pregnancy assessed based on the number of pregnant females and females were synchronized and mated with AI. Pregnancy determined using detection devices pregnancy (Draminsky's pregnancy detector for sheep).

### 3. Results and Discussion

Results of these research shows, as follows in (Table 1);

Table 1. Percentage of pregnancy of sheep and goat

Animal	Village	Number of Animal	Estrous Response	Pregnant	Percentage
Sheep	Kadu Salak	6	83.33	5	83.3
	Bale Ngendong	7	100	7	100.0
	Ciodeng	5	100	5	100.0
	KaduKebo	8	87.5	7	87.5
Total		26		24	92.3
Goat	Ciodeng	3	66.67	2	66.7
	KaduKebo	2	100	2	100.0
	Total	5		4	80.0

Table 1 above shows that the use of vaginal sponges to treat the onset of estrus is very effective. The vaginal sponge is one of alternative methods containing Progesterone in terms of estrus synchronization program which is now often done on sheep. According to [2] that the method commonly done now through the administration of progesterone treatment for 9-11 days using vaginal sponges (SV), which will be followed by administration of a synthetic prostaglandin 36-48 hours after removal of the SV.

This is in accordance with the opinion [3] said that the principle of estrus synchronization in female livestock are: 1) inhibits the secretion of LH; 2) shortening the life of corpus luteum (CL) and 3) shortening the onset of estrus and ovulation. This method is being done through the treatment of Progesterone preparations for a long time (long term) that would cause regression of corpus luteum. In this case progesterone would inhibit ovulation to suppress the secretion of LH, so that will give effect to lysis of the Corpus Luteum [3]. With this approach, Progesterone levels in the blood will increase. Furthermore, administration of exogenous progesterone will cause negative feedback on LH secretion immediately after regression of corpus luteum. Some researchers have suggested that the administration of the progesterone hormone can be done through intravaginal sponge method, CIDR or subcutaneous implants [4]; [5]; [6].

Using a Vaginal Sponge (that Sponge containing progesterone) around two weeks, and at the time of the removed Vaginal Sponge, Progesterone levels in the blood could decrease, and the next will occur development of the



follicle, estrous and ovulation. This manifestation occurs 2-8 days. The interval from removal of the vaginal sponge to the onset of estrus varies according to the species, for sheep and goats, estrus will occur 2-4 days after removal of the vaginal sponge.

The next procedure is mating of females who have shown estrus with natural and artificial insemination (AI). In the research that has been done, AI method around 90% on Sheep and 100% on Goat. Semen used is liquid semen from bulls that belong to group of farmers in the village Juhut. Percentage of pregnancy was 92% for sheep and 80% for goats.

#### **4. Conclusion**

From the results, it can be concluded that:

1. Application use of vaginal sponges can cause high estrous response
2. Percentage of pregnancy as a result of synchronization of estrus with vaginal sponge method showed optimal results

#### **5. References**

- [1] C.M. Kershaw, .2005. The anatomy of the sheep cervix and its influence on the transcervical passage of an inseminating pipette into the uterine lumen. *Theriogenology*. 64: 1225-1235
- [2] R.B. Rahman, Abdullah, W.E. Wan-Khadijah. 2008. Estrus synchronization and superovulation in goats: A Review. *J. of Biologic Sci*, 8: 1129-1137.
- [3] S.D. Rasad. 2004. *Teknologi Reproduksi Ternak*. Laboratorium Reproduksi Ternak, Fakultas Peternakan UNPAD (unpublish).
- [4] G. Evans, W.M.C. Maxwell. 1987. *Salamon's artificial insemination of sheep and goats*. 1<sup>st</sup>Ed. Butterworths, Sydney, Australia, ISBN: 0409491772, pp: 107-141.
- [5] A.J. Ritar, S. Salamon, P.D. Ball, P.J. O'May. 1989. Ovulation and fertility in goats after intravaginal device-PMSG treatment. *J. Small Rum*. 2: 323-331.

## **Concentrate protein albumin (probumin) from snakehead fish (*Channa striata*); local product of food supplement as cheap albuminprotein source for community**

**Abu B. Tawali<sup>1,\*</sup>, Meta Mahendradatta<sup>1</sup>, Veni Hadju<sup>2</sup>**

<sup>1</sup> Food Science and Technology Study Program, Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University, Makassar, 90245, Indonesia

<sup>2</sup> Department of Nutrition, Faculty of Public Health, Hasanuddin University, Makassar, 90245, Indonesia

\* Corresponding author: abubakar\_tawali@yahoo.com

---

**Abstract** Snakehead fish is a kind of wild fish that lives in fresh water. It has a large head somewhat flattened like a snake's head. Behind the scary appearance the snakehead fish is rich in macro and micro nutrients which are needed for health, especially albumin protein content. Traditionally, people are encouraged to consume processed fish to accelerate healing after surgery, injury, child circumcision and new mothers. Some studies showed that giving of snake head fish can improve the blood albumin value of hypoalbuminemic patients and retain the albumin value of hospitalized patients. Further, assessment of the effectiveness of that has also been done to prove that the product of snake head fish is useful as a food supplement to accelerate the healing of post-operative patients and stroke patients, to increase hemoglobin (Hb) of the elderly, as well as improving the nutritional and immune status of HIV-AIDS sufferers. To improve the effectiveness and efficiency of its use, the healthy food product from snake head fish has been developed by extracting of albumin protein and producing in the form of dispersion/emulsion, powder or in capsules or caplets with protein level between 70-85% and albumin protein of which contain between 20-60% of the total protein. The production of albumin protein concentrate in capsule has been scaled-up and standardized. The product profile was 9:29% moisture content, fat 3.65%, ash content 4:27%, protein content of 72.87% and 51.2% of the albumin-protein levels of protein. Therefore the snake head fish can be used as an alternative source of cheap albumin protein for the community in the midst of expensive commercial albumin product, Human Serum Albumin (HSA).

**Keywords** snakehead fish, albumin concentrate, food supplement

---

## **1. Introduction**

Indonesia has the most complete of the biological resources accompanied by abundant availability of raw materials. It is a small part of potential new resource that can be used to produce materials that have economic value. Snakehead fishes are found in rivers, lakes and swamps, sometimes found in low salinity brackish water, and can also live in dirty water with low oxygen levels, even resistant to drought. Snakehead fishes are found in various regions of public waters in Indonesia, including Java, Sumatra, Sulawesi, Bali, Lombok, Flores, Ambon and Maluku with a different name. This kind of fish is a voracious predator that preys on small fish, so they can spend the other small fish surroundings. Therefore, since a few years ago, this fish and some close relatives that include “snakehead fishes” wary as dangerous fish, which could threaten the survival of aquatic biota in Lake Sentani, Jayapura [1].

Nevertheless snakehead fish has high economic value because it contains protein albumin that could be an alternative source of albumin amid rising demand and high cost of pure albumin preparations. Generally the albumin used in the hospital is in form of dissolved albumin preparations. Protein albumin preparation for clinical purposes has high purity, is in form of solution that containing albumin 95%. Commercially is available the pure albumin solution of 5%, 20%, and 25%. Until now the needs of protein albumin in Indonesia for most clinical purposes are still imported at a great price. Price of commercial albumin preparations 100 ml is Rp 1,250,000 [2].

## **2. Results and Discussion**

### **2.1. Snakehead fish and its benefit**

The research of snakehead fish content has done a lot including Cavallo, who reported that the content of albumin per 100 ml snakehead fish extract was 6.224 grams by the number of calories 69 kcal, 1.7412 mg of zinc, 3,093 mg of glutamate, 1.1 mg of arginine [3]. Other research reported that fluid extracts of albumin resulting from extraction by means of vacuum extractor derived albumin of 2.62 g / dL [4]. A research result showed that by the processing of snakehead fish into meal as an albumin source, albumin level was obtained at 15.79% with water content of 8.5% [5].

### **2.2. Health benefit of snakehead fish**

Since the first snakehead fish is believed by some communities in Indonesia can accelerate the healing process. In some areas people believe that eating

snakehead fish can accelerate recovery from an illness. In South Sulawesi, snakehead fish is recommended for consumption, especially in children who recently completed on circumcision and the new mothers who gave birth were treated snakehead fish-based dishes that can be quickly recovered. People suffering from internal injuries and wounds such as burns or accidents are encouraged to consume snakehead fish so that the wound heal faster.

Clinical studies of albumin from snakehead fish have also done a lot, including the research of Suprayitno, stating that the extracts of snakehead fish has high content of albumin that can heal wounds and surgery [6]. A study has reported that supplementation of snakehead fish concentrate for 14 days in patients post-surgery in Makassar Sudirohusodo Wahidin Hospitals could increase the blood albumin levels of 0.7g/dl, beside that the patients are healing faster [7]. Supplementation of snakehead fish concentrate as supplements in stroke patients at the General Hospital Wahidin Sudirohusodo Makassar could maintain and improve the nutritional status of the patient's neurological status [8]. Furthermore a study has been conducted to see snakehead fish extract supplementation effect on nitrogen balance of stroke patients and concluded that there was a positive effect of supplementation with snakehead fish extract on the nitrogen balance of stroke patients [9].

### **2.3. Snakehead fish based foods**

In many parts of the archipelago are found a variety of dishes made from snakehead fish. In South Sulawesi, snakehead fish is processed into fish soup with broth and processed into various traditional dishes. It is believe that snakehead fish can accelerate growth, development and intelligence of children. Public trust has been scientifically proven that the fish is useful to help the growth and the intelligence of children, promote healing of the sick.

Issues facing the snakehead fish are the rancid taste and smell of mud. This has been circumvented by various processing techniques to remove odors and improve the taste of food products made from raw snakehead fish. In the community it is also known as a diversified range of processed snakehead fish. Snakehead fish processing techniques are similar with the basic techniques of fish processing generally. Some basic fish processing techniques can be classified as drying, curing, salting-boiling and fermentation. Basic processed products can be followed by further processing such as roasting, frying and sauting. Processed products with the application of the techniques mentioned above are found in several regions

in Indonesia such as salted fish, smoked fish and a couple of refined products such as shredded fish, nuggets, sausages and fish balls. However fish dishes made from snakehead fish in addition to its function as a side dish also serves to supply micro and macro nutrients, especially protein albumin are needed to maintain and improve health.

#### **2.4. Product development of albumin protein concentrate (probumin)**

Utilization of snakehead fish as source of albumin was initially applied with the use of fish extract. However, the use of fish extract was less effective both as a source for protein and albumin as a whole. Therefore, through research since 2005-2013 at the Center for Food Nutrition and Health, Hasanuddin University conducted a series of studies to obtain a wide range of products from snakehead fish. Extraction of protein from fish has been introduced by Windsor and Waldemar [10, 11]. This technique was combined with the extraction technique that performed by evaporation of the filtrate to produce the protein albumin in the form of powder which was then capsulated, so much easier to use [6]. Some researchers tried to continue the extraction process with drying to obtain a protein concentrate with high content of albumin [6]. Protein concentrate in powder form is then capsulated. Products with 12-15% of the albumin has been shown to increase levels of albumin in patients and accelerate the healing of burns, and post-operative and able to improve the nutritional status of patients.

Furthermore, to obtain protein concentrate with higher levels of albumin, the various studies to optimize the extraction process and the drying process has been carried out. The extraction of snakehead fish protein albumin comparing with some solvent to extract the albumin concentration has been optimized [12]. It was obtained that the optimal solvent was 0.1 M HCl by heating at 50-60°C for 15 minutes with 20.08% of albumin content. A research has tried to combine the extraction and vacuum drying and got the best results at 49°C vacuum dryer with 4.71% of albumin content, 15.92% of protein content; 37.21% of yield; 4.23% of water content [13]. The separation of albumin extract from other components at the isoelectric point has been conducted [14]. Optimum process obtained through solvent extraction of albumin with 0.9% of NaCl at ratio of 1: 4. The isoelectric point was best at pH 4.6 and purified products with 62.9% of albumin content, 7.8% of water content and 11.6% yield.

This product was manufactured through the stages of preparation materials includes cleaning followed by protein extraction and separation of albumin, drying, milling and capsulation. Protein extraction was performed using

0.5-1% of NaCl solution and then extracted with propyl alcohol. Separation of the protein albumin was done by adjusting the pH at pH 4-5 using acetic acid accompanied by heating to result coagulation of albumin. Drying was carried out to the protein in rise until resulting product with 8-10% of moisture content. Dried product was milled to 100 mesh. Concentrated albumin of snakehead fish in form of powder was put into capsules 0.7 grams (00 capsules). Albumin protein concentrate product named as Probumin has nutritional profile as follows: 9.29% of moisture content, 3.65% of fat content, 4.27% of ash content, 72.87% of protein content of which 51.2% was albumin. The presence of snakehead fish albumin products (probumin) causes the utilization of snakehead fish as a food supplement and source of albumin more efficient and practical.

### **Acknowledgement**

This research was funded by the Ministry of Education through the National Strategic Superior Research (Penelitian Unggulan Strategis Nasional-Ditlitabmas-Dikti). Thank you very much for the financially aid.

### **3. References**

- [1] A.B. Tawali, M. Mahendradatta, M.K. Roreng, Suryani. 2012. Difusi teknologi produksi konsentrat protein dari ikan gabus sebagai *food supplement* di Jayapura. Prosiding INSInas, Ristek 2012.
- [2] Anonim, 2005. Protein Plasma [serial online] 2005 [cited 2007 Feb 20]. Available at: [http://www.klinikku.com/pustaka/lab/hati/protein\\_darah.html](http://www.klinikku.com/pustaka/lab/hati/protein_darah.html).
- [3] C. Johanes. 1998. Studi profil asam amino albumin dan mineral Zn pada ikan Gabus (*Ophichepalus striatus*) dan ikan Tomang. Fakultas Perikanan Unibraw. Malang.
- [4] T.D. Sulistiyati. 2010. Pengaruh Suhu dan Lama Pemanasan dengan Menggunakan Ekstraktor Vakum terhadap Crude Albumin Ikan Gabus (*Ophiocephalus striatus*). Jurnal Prot. Vol.15, No. 2.
- [5] A.B. Tawali, V. Hadju, F. Attamimi. 2005. Pembuatan tepung ikan Gabus dan pemanfaatannya. Laporan Penelitian Badan Penelitian dan Pengembangan Daerah (Balitbangda) Sulawesi Selatan.
- [6] E. Suprayitno. 2003. Potensi Serum Albumin Dan Ikan Gabus (*Ophiocephalus striatus*). Fakultas Perikanan. Universitas Brawijaya, Malang.
- [7] H. Hidayanty. 2007. Pengaruh pemberian kapsul konsentrat ikan Gabus pada pasien pasca bedah di RSUD. Wahidin Sudirohusodo Makassar. Program Pascasarjana, Universitas Hasanuddin, Makassar.

- [8] Mulyati. 2007. Efek pemberian kapsul albumin ikan Gabus terhadap perubahan status gizi dan status neurologis penderita stroke di RSUP dr. Wahidin Sudirohusodo, Makassar. Tesis Program Pascasarjana Universitas Hasanuddin, Makassar.
- [9] A. Faradilla. 2011. Pengaruh suplementasi ekstrak ikan Gabus terhadap keseimbangan nitrogen pasien Stroke. Tesis, Universitas Hasanuddin, Makassar.
- [10] M.L. Windsor. 2001. Fish Protein Concentrate. Ministry of technology torry advisory note. No.39.<http://www.fao.org/wairdocs/tan/x5917E/x5917eOO.htm>. FAO in partnership with Support unit for International Fisheries and Aquatic Research, SIFAR
- [11] N. Waldemar. 2003. Processing of fish, e.g. to produce fish protein concentrate or isolate, comprises two-stage extraction of lipid with alcohol under acid to neutral conditions and then alkaline conditions, Paten DE10160042.
- [12] M. Asfar, A.B. Tawali, N. Abdullah, M. Mahendradatta. 2014. Extraction of albumin of snakehead fish (*Channa striata*) in producing the fish protein concentrate (FPC). IJSTR, Vol 3 Issue 4, pp 85-88.
- [13] D.W. Yuniarti T.D. Sulistiyati, E. Suprayitno. 2013. Pengaruh suhu pengeringan vakum terhadap kualitas serbuk albumin ikan gabus (*Ophiocephalus striatus*). THPi Student Journal Universitas Brawijaya, vol 1, no. 1, pp 1 -9.
- [14] M. Mahendradatta, N. P. Astuti, Suryani. 2012. Pengembangan produk food supplement konsentrat albumin dari ikan gabus (*Channa striata*). Laporan Penelitian Strategis Nasional, Dikti.

## **Household scale environmentally friendly measures to reduce resource consumption**

**Arief S. Yuwono<sup>1,\*</sup>**

<sup>1</sup>Dept. Civil and Environmental Engineering, Bogor Agricultural University, Bogor  
16002, Indonesia

\* Corresponding author: arief\_sabdo\_yuwono@yahoo.co.id

---

**Abstract** Local scale environmentally friendly actions can potentially be applied by Indonesian families through a number of positive measures. It deals with the consumption of water and energy as well as recycling of the generated household solid wastes. The objectives of this paper was to assess a number of positive measures to reduce the household electricity consumption, clean water consumption and management of the generated solid waste practiced in a household sample in Bogor Municipality, Indonesia. Three main objects elaborated in this assessment have been implemented during the last ten (10) years. The exploitation of solar radiation as a natural source of lighting for house rooms during daytime has been proven to substitute as much as 42% of electricity consumption for room lighting. Rainwater management by developing multipurpose five retention tanks (10.4 m<sup>3</sup>) resulted in reduction of drinking water consumption by 40 l/day which equals with 5% of total clean water consumption reduction. Solid waste management by application of small scale household composting bins and recycled trash bin showed that the organic fraction of the generated solid waste can be simply converted into qualified compost without any addition of neither biological nor chemical substances. The resulted finished compost ( $\pm 13$  kg/month) can be directly applied as growing media for ornamental plants in the household. The generated solid waste can be totally managed internally without any transportation to the local transfer station. In general, resource consumption can be significantly reduced by these environmentally friendly measures.

**Keywords** electricity, environmentally friendly measures, resource consumption, solid waste, water.

---

### **1. Introduction**

A number of positive measures can potentially be attempted by Indonesian families to reduce household resource consumption. These local scale measures include efforts to reduce household water and energy consumption as currently the drinking water services of the government owned water company (PDAM) is limited yet. The coverage of the state owned electricity company (PLN) indicated the similar condition. On the



other side, solid waste management of many Indonesian municipalities showed that due to their limited budget, the service coverage are imbalance with the daily generated solid waste volume. These are three important factors necessary to increase the awareness of the Indonesian people to reduce their household water and electricity consumption as well as to manage the household generated solid waste in such a way to avoid unhealthy environment. The general objective of the research was to assess a number of positive measures to reduce the household electricity consumption, tap water consumption and management of the generated solid waste practiced in a household sample in Bogor Municipality, Indonesia. The detail objectives of the research were as follows, (1) to introduce the construction of natural room lighting using solar radiation called transparent ceiling and to calculate its reduction of electricity consumption; (2) to reduce tap water consumption by implementing rainwater retention tanks; (3) to assess the benefit of recycling of solid waste organic fraction to produce compost.

## **2. Materials and Methods**

The important points of the research methods are presented in the following parts. Flowchart of the research is presented in Figure 1. The research was conducted in a household object located in Bogor Municipality, West Java Province, Indonesia during 2012-2014. The natural room lighting system by using solar radiation was built in 2004 whereas rainwater retention tanks have been operated since 2003. Calculation of the reduction of electrical energy consumption after implementation of the transparent ceiling was based on the number of installed lamps in the entire rooms of the object house. Reduction of tap water consumption by implementation of retention tanks was calculated based on the daily irrigation water for ornamental plants and the average tap water consumption. The tangible benefit of the composting process was assessed in terms of revenue of the finished composted resulted from the organic fraction of the generated household solid wastes.

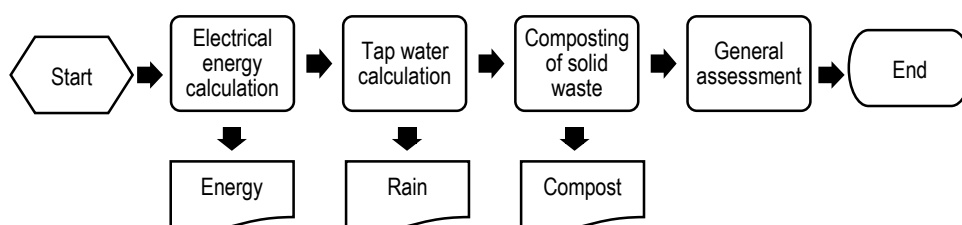


Figure 1. Flowchart of the research

### **3. Results and Discussion**

Many recent studies have focused on the use of sunlight to provide indoor lighting and save energy [1]. Use of solar radiation as a source of lighting system is a part of an integrated solar system within a building where solar energy is passively exploited. It refers to the harnessing of the sun's energy without the use of mechanical devices [2]. Here, the construction of the natural lighting system for household rooms is schematically presented in Figure 2a. The main components of such construction are local wood rods [*Meranti*; 4/6] and transparent polycarbonate sheet that were joined together to construct a rigid transparent ceiling block [40 cm width; 60 cm length]. The block was then fitted into the ceiling frame and placed under glass roofs to transmit direct solar radiation into the target room. Subsequently, the solar radiation reaches the target room without any rainwater leaks into the room. The reduction of energy consumption by implementing the transparent ceiling is presented in Table 1. It is clearly shown that the total electrical energy consumption for room lighting of the twelve rooms normally is 5.17 kWh/day. Implementation of the solar powered room lighting accounts for 2.42 kWh/day room lighting energy substitution. Therefore, the electrical energy consumption for room lighting can be reduced 48% of the normal condition.

Utilization of rainwater as a substitution of tap water supply has been introduced worldwide. In Australia rainwater tanks are being introduced into urban areas to supplement centralized potable supply systems [3]. The quality parameters such as heavy metal content, tank quality, and sediment article dynamics were investigated. It was recommended that improved tank designs that reduce sediment re-suspension and mitigate impacts on water quality should be the focus of future work. Other research conducted by Sterren et al. [4] indicated an inline idea that in rainwater tanks are increasingly adopted in Australia to reduce potable water demand and are perceived to reduce the volume of storm water discharge from developments. The reduction of household tap water consumption is due to the supply of rainwater stored in the retention tanks. There are five retention tanks (Figure 2b) with total capacity of 10.4 m<sup>3</sup>. The main function of tanks is firstly to retain the rainwater entering the house roof and, secondly, for recreation purposes such as for ornamental and food fish culture media as well as for aquatic plants growing media. According to the first function, i.e. for retention purpose, the tanks are located in five spots in house yard to enable a simple and short access to irrigate the ornamental plants grown in the yard. Consequently, transport of the irrigation water would consume minimum energy to reach the target plants. The calculation of the tap water

consumption reduction by rainwater substitution is presented in Table 2. Here, it is clearly shown that based on a long recording period [10 years] of average water consumption, the supplied rainwater has been substituting 5% of daily tap water consumption.

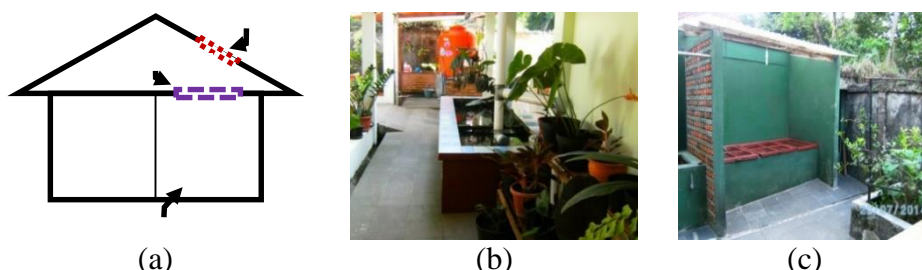


Figure 2. Scheme of transparent ceiling (a), rainwater retention tank (b) and sheltered composting bins (c)

Table 1. Reduction of electrical energy consumption after implementation of transparent ceiling

No	Object	Number of lamp [-]	Unit power [W]	Total power [W]	Working hour [h/day]	Elec. energy [kWh/day]	Solar powered time [h]	Solar powered energy [kWh/day]	Reduction [%]
1.	Front Terrace	2	14	28	24	0.67	10	0.28	42
2.	Guest room	1	20	20	17	0.34	10	0.20	59
3.	Family room	1	24	24	17	0.41	6	0.14	35
4.	Bed room	4	20	80	17	1.36	6	0.48	35
5.	Dining room	1	20	20	17	0.34	7	0.14	41
6.	Corridor	1	14	14	17	0.24	8	0.11	47
7.	Bath room	2	14	28	17	0.48	8	0.22	47
8.	Backyard terrace	2	18	36	24	0.86	10	0.36	42
9.	Kitchen	1	14	14	17	0.24	6	0.08	35
10.	Store room	1	14	14	17	0.24	6	0.08	35
	Sum	16	172	278	-	5.17	-	2.11	-
	Average	-	-	27.8	18.4	0.52	7.7	-	42

From the environmental awareness point of view, composting of household organic fraction is a simple measure to enhance environmental health. Composting has been demonstrated to be a valuable strategy for the recycling of a variety of organic residues [5]. Composting is aerobic and biological organic matter decomposition process. Stabilization and pathogen destruction of organic waste occur during composting. The process has been accepted for treating many types of industrial and agricultural organic wastes owing to above merits [6]. Benefit of composting of the household solid waste organic fraction is presented in term of monthly revenue which was based on local compost price (Table 3).

Table 2. Reduction of tap water consumption by rainwater substitution

No.	Item	Quantity	Unit
1.	Average water consumption*	789	Liter/day
2.	Rainwater supply (for irrigation)	40	Liter/day
3.	Reduction of water consumption by rainwater	5	%

Note: \* after 10 ten years record of water consumption.

Organic fraction items of the generated solid waste from household are rest food scraps and residues, garden wastes, animal (poultry) manure, as well as kitchen waste. Such composting process would result in almost no odor emission into the ambient air [7; 8]. The composting process takes place in a simple composting bin constructed basically of red brick wall with metal wire mesh cap (Figure 2c). The amount of the generated solid waste per capita is based on research series conducted by The State Ministry of Environmental Affairs (KLH, 1998) in six (6) metropolitan cities, namely Jakarta, Bandung, Semarang, Yogyakarta, Padang and Ujung Pandang (Makassar) where Indonesian daily solid waste generation is 0.765 kg/capita/day.

Table 3. Benefit of composting of household solid waste organic fraction.

No	Aspect	Quantity	Unit	Remarks
1.	Household inhabitant	4	Capita	-
2.	Solid waste generation volume*	3.1	kg/day	Standard 0.765 kg/capita/day
3.	Organic fraction	75	%	-
4.	Fully biodegradation elapse time	2	month	Stabile composting process**
5.	Bin volume	273	liter	P=70cm; L=60cm; T=65cm
6.	Volume of compost raw material	218	liter	80% of bin volume
7.	Raw compost volume (40 % initial volume)	87	liter	$\rho = 0.25$ kg/liter
		22	Kg/ month	$\rho = 0.5$ kg/liter
8.	Finished compost (uniform; ready for use)	13	Kg/month	60% of raw compost mass
9.	Revenue***	19,500	Rp/month	Price = Rp.1500/kg

Note: \* State Ministry of Environmental Affairs (1998); \*\* See: Yuwono *et al.* [9]; \*\*\* Based on compost price in Bogor Municipality (2012).

Based on the research object where the household inhabitant was 4 persons, then the produced solid waste was 3.1 kg/day and if the organic fraction of the generated solid waste 75% and the elapse time of the fully biodegradation period was 2 months, then, the average produced compost is ca. 13 kg/month. If the price of the finished compost was Rp.1,500/kg, then the revenue that could be gained was Rp.19,500 per month. The

calculation sheet indicated that the tangible benefit of the household solid waste composting is relatively small. However, from another point of view, i.e. environmental hygiene and society behavior, the intangible benefit such as family education and health as well as community patronage towards environmentally friendly behavior is paramount important since the habit of the Indonesian people partly depends on their direct and daily experience in the community where key figures role as a patron for the people in their society. Positive multiple effects could be earned from a series of well organized environmentally friendly measures carried out by those key figures.

#### **4. Conclusion**

Conclusions that can be drawn from the above elaborated study are as follows:

- a. Implementation of transparent ceiling reduces 42% of electrical energy consumption for room lighting.
- b. Rainwater retention tank intended for household irrigation water accounts for 5% reduction of tap water consumption.
- c. The composting process revenue from the organic fraction of the generated solid waste from four persons household was about Rp.19,500 per month which equals with 13 kg of compost per month.

#### **5. References**

- [1] A.J.W. Whang, K.Y. Chen, K.H. Chou, Y.Y. Chen. 2011. Refining an optical switch for the Natural Light Guiding System. *Lighting Res. Technol.* 43: 281-289.
- [2] S.H. Yusof, M.A.O. Mydin. 2014. Solar integrated energy system for green building. *Acta Tehnica Corviniensis-Bulletin of Engineering.* Tome VII [2014] Fascicule 3 [July-September]: 115-122.
- [3] M.I. Magyar, V.G. Mitchell, A.R. Ladson, C. Diaper. 2007. An investigation of rainwater tanks quality and sediment dynamics. *J. Wat Sci & Technol.* 56(9): 21-28.
- [4] M.V.D. Sterren, A. Rahman, G.R. Dennis. 2012. Implications to stormwater management as a result of lot scale rainwater tank systems: a case study in Western Sydney. *J. Aust. Wat Sci & Technol* 65(8): 1475-1482.
- [5] M.L. Cayuela, C. Mondini, H. Insam, T. Sinicco and I. Franke-Whittle. 2009. Plant and animal wastes composting: Effects of the N

- source on process performance. *J. Bioresource Technol.* 100: 3097-3106.
- [6] H.K. Ahn, T.J. Sauer, T.L. Richard, T.D. Glanville. 2009. "Determination of thermal properties of composting bulking materials". *J. Bioresource Technol.* 100: 3974-3981.
- [7] A.S. Yuwono, P.S. Lammers. 2004. Overview paper: Odour pollution in the environment and the detection instrumentation. *Agricultural Engineering International: The CIGR Journal of Scientific Research and Development. Invited Overview Paper. Vol. VI. July, 2004.*
- [8] A.S. Yuwono, P.S. Lammers, P. Boeker. 2012. Review of research development on environmental odour in the last decade. *J. of Appli Enviro and Biologic Sci*, 2(7): 304-319.
- [9] A.S. Yuwono, N. Ichwan, S.K. Saptomo. 2013. Implementasi konsep "Zero waste production management" bidang pertanian: pengomposan jerami padi organik dan pemanfaatannya. *J. Lingk. Hid "Bumi Lestari"*, 13(2): 366-373.

## Use of white rot fungi- and bacterial rot in decomposition of cocoa pod waste and in growth reduction of *Phytophthora palmivora* and *Lasiodiplodia theobromae*

Tutik Kuswinanti<sup>1,\*</sup>, Ade Rosmana<sup>1</sup>, Vien S. Dewi<sup>1</sup>, Baharuddin<sup>1</sup>,  
Jamila<sup>2</sup>

<sup>1</sup>Dept. of Plant Pests and Diseases, Hasanuddin University, Makassar, 90245, Indonesia

<sup>2</sup>Dept. of Animal Nutrition, Hasanuddin University, Makassar, 90245, Indonesia

\* Corresponding author: koeswinanti@yahoo.com

---

**Abstract** Cocoa pod husk is a major waste of cocoa plants that can be used either as an organic fertilizer or as animal feed. For 972.400 hectares of cocoa plantation, produce as much as 572.900 tons of cocoa beans, while the waste generated reached 1.8766 million tons/year. Only 94.515 tones of cocoa waste have been utilized. Given the composition of twigs, leaves and cocoa pods that contain lots of lignin and cellulose, further research is needed to find microbes that effective in decomposing of cocoa waste in field conditions, kinds of media that can enhance the growth of rot fungi and production of cellulolytic enzymes. Various isolates of white rot fungi and bacterial rot have been isolated and collected. To determine its growth rate, these isolates were grown in three different culture media and measure their colony diameter in two days interval. Isolates were then tested qualitatively for their ability to produce cellulolytic enzymes in vitro. The analysis of the cellulose, hemicellulose and lignin content in leaf and cocoa pod after treatment with fungal and bacterial isolates in vitro were conducted. The result showed that all of isolates were capable in cocoa waste degradation. Treatment with fungal isolate caused high percentage reduction of hemicelluloses components on cocoa leaf. Lignin component generally has not experienced a significant reduction in all fungal treatments. On cocoa pod, the decrease of lignin components 30 days after inoculation was still very low in all treatments. The ability of fungal and bacterial decomposer in the combination treatment has also been tested in this study. It also observed the ability of decomposer in reducing of pathogen inoculums contained in the cocoa pod husk waste (*P. palmivora* and *Lasiodiplodia theobromae*). The combination treatment proved, not only able to degrade the cocoa waste faster than a single treatment, but it also can reduce the amount of pathogen inoculums in cocoa waste. The competence to suppress the growth of the two main cocoa pathogens showed satisfactory results. Currently research for the development of microbial decomposers ready-made formulations are being conducted.

**Keywords** cocoa pod husk waste, fungal and bacterial decomposer, *P. palmivora*, *L. theobroma*

---

## 1. Introduction

White and brown rot fungi play an important role in plant litter decomposition in agriculture ecosystems through nutrient recycling and humus formation in soil [1] because they attack the lignocellulose matrix in litter that other organisms are unable to assimilate [2]. Some of the most important and well-studied white-rot fungi are *Pleurotus ostreatus*, *Phlebia radiate*, *Coriolus* (Trametes, Polyporus) *versicolor*, and *Pycnoporus cinnabarinus*. Based on the substrate utilization patterns of fungi in decomposing organic matter, Osono and Takeda [3] divided the fungi into three functional groups: lignocellulose decomposers that attack both lignin and cellulose in various proportions, cellulose decomposers that preferentially attack carbohydrates and sugar fungi that rely on soluble sugar for growth.

Cacao plant produce biomass of leaves and twigs that reach 6.85 tonnes/ha/yr for cacao without shade and 11.88 tonnes/ha/yr with shade. In addition, harvest 1kg of cacao beans will be left 10 kg of cacao pods, pulp and placenta. Mineral nutrient content of cacao pods is quite high, especially potassium and nitrogen. Abundantly cacao waste however, if not managed properly will lead to seriously problems such as environmental pollution sources (methane, CO<sub>2</sub> and NO<sub>2</sub>) and become as breeding places of plant pest organisms ie; *Phytophthora palmivora*, *Diplodia* sp and several kind of insect pests.

Nutrient content of the cacao pod waste is high, especially Potassium and Nitrogen. It reported that 61% of the total nutrient are stored in the cacao pod. Goenadi et.al [4] determined that the nutrient content of the cacao pod compost consisted of 1.81% N, 26.61 C-Organic, 0.31% P<sub>2</sub>O<sub>5</sub>, 6.08% K<sub>2</sub>O, 1, 22% CaO, 1.37% MgO and 44.85 cmol/kg CEC. Utilization of cacao pod waste as compost will increase the availability of organic fertilizer which will greatly reduced needs on chemical fertilizers. However, cacao pod husk waste has low nutrient quality if it used as animal feeds, due to high crude fiber content (40.03%), the presence of alkaloids therodromin content (0.17% - 0.22%), cellulose 36.32%, 1.14% hemicellulose, and lignin 20% - 27.95%.

There are many microorganisms both fungi and bacteria are effective in decomposing cacao pod husk waste ie. wood-rot fungus (*Pleorotus ostreatus*), *Tricoderma* sp. and some species of bacteria. Besides parse woody material, mostly bacteria and fungi produce toxic substances that can



be used to control the growth or development of other competitive microorganisms during composting process.

Fourth-fungal rot isolates that are used can be likely to inhibit the spread of the cacao fruit rot disease caused by the *Phytophthora palmivora* and *Lasiodiplodia theobromae*. Fruit rot disease is a major disease of cacao in the world, including in Indonesia. In Indonesia, the loss due of *P. palmivora* infection ranged from 32.60% - 52.99% [5].

## 2. Materials and Methods

### 2.1. Inoculation of fungal- and bacterial rot on cacao pod husk medium

These experiments using *Trichoderma* sp., *Trametes* sp.(PCK isolate), *Pleurotus ostreatus* and formulated bacteria Mikrobat (10% conc.), including the controls. Each isolate was applied singly and in combination in baglog containing cacao pod husk, so there are totally 13 treatments in this experiment. Inoculated baglog subsequently incubated at room temperature and the growth of fungal colonies were observed in interval of three days for one month (30 days). The lignocelulolytic content was analysed according to the method of Van Soest [6].

### 2.2. Dual cultures assay

All fungal isolates and 1 formulated bacteria were also screened for their antagonistic activity against *P. palmivora* and *L. theobromae* by employing the dual culture technique according to Singh et al [7]. The interaction was studied in 90-mm diameter petriplate containing V8-juice Agar. One disc of each of isolates were placed on the solidified medium at one side of plates and one of *P. palmivora* or *L. theobromae* at opposite to test isolates. Plates were incubated at  $25 \pm 2^\circ\text{C}$ . The radial growth of test pathogens in treated and control plates were recorded after 2 days until one week of incubation and the percent inhibition of mycelial growth of the pathogens was calculated using following formula:  $I = (C-T/C) \times 100$  (Singh et al [7]) where, I = Inhibition (%), C = Colony diameter in control plate and T = Colony diameter in treated plate.

## 3. Results and Discussion

All fungal- and bacterial rot isolates have different ability to degrade cellulose, hemicellulose and lignin. Hemicellulose content has highest reduction followed by lignin and cellulose (Table 1.). Decrease in lignin content is lower than cellulose and hemicellulose due to very active

cellulase enzyme. According to Akamatsu et al [8], in the white rot fungus, oxalic acid can inhibit the process of lignin degradation, due to oxalic acid inhibits several reactions that is catalyzed by the lignolytic enzymes, namely peroxidase lignolitik (LiP) and manganese peroxidase (MnP).

Table 1. Percentage of lignocellulose content of cacao pod husk and its reduction after inoculation with fungal and bacterial rot, 30 dpi (days post inoculation)

Treatments	% Cellulose		% Hemicellulose		% Lignin	
	Content	Reduction	Content	Reduction	Content	Reduction
<i>Pleurotus</i>	12.35	27.39	1.43	36.44	36.59	7.90
<i>Trichoderma</i>	15.64	8.05	2.11	6.22	31.40	20.97
Mikrobat	14.66	13.81	1.31	41.78	37.19	6.39
<i>Pleurotus</i> + <i>Trichoderma</i>	15.16	10.87	1.24	49.33	29.91	24.72
<i>Pleurotus</i> + Mikrobat	12.89	24.22	0.53	76.44	32.29	18.47
<i>Trichoderma</i> + Mikrobat	12.75	25.04	1.88	16.44	30.27	23.81
<i>Pleur.</i> + <i>Tricho</i> +Mikrobat	16.16	4.99	1.4	37.77	37.61	5.34
Control	17.01	-	2.25	-	39.73	-

Hemicellulose has low molecular weight ranging from D- xylose, D- mannanosa, D-galactose, D glucose, L- arabinose, 4-0- metal glukoronat, D- galakturonat and acid D-glukoronat which easily degraded [9]. According to Fenggel and Wenger [10] most of the hemicellulose components fast reduced because hemicellulose undergo oxidation and degradation reactions sooner than cellulose and lignin. Combined treatment with the *Trichoderma* strains had promising effects in the decomposition of organic solid waste, resulting in a greater loss of the original material than the control. Bari et al [11] reported that combined treatment was the most effective method, promoting 23% greater weight loss than the control in their experiments. Thus, the composition of the microbial culture affects the quality of the compost.

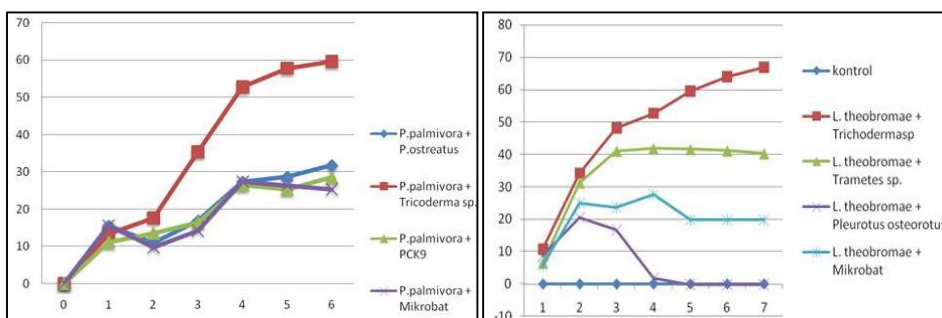


Figure 2. Growth inhibition of *L. theobromae* (left) and *P. palmivora* (right) on dual culture test with different fungal- and bacterial rot, 7 dpi.

Dual culture test demonstrated that treatment with *Trichoderma* sp. gave the highest growth inhibition against *L. theobromae* and *P. palmivora*, followed by *Trametes* sp. and mikrobat. *P. ostreatus* has no significant effect in the growth inhibition of *L. theobromae* (Figure 1). The antagonistic effect of *Trichoderma* sp. on pathogenic microorganisms is attributable to lytic enzymes produced by the fungus that degrade the cell walls of the host (mycoparasitism). Competition for nutrients also exerts a suppressing effect on phytopathogenic activity with these factors together contributing to biological control.

Cacao pod husk composting with biological agent can improve quality of compost. The combination of composting cacao pod husk on the field and the use of biofertilizers consortium is expected to increase the availability of nutrients, grain yield and reduce the use of artificial fertilizers significantly.

#### 4. References

- [2] A. Kjoller, S. Struwe. 1982. Microfungi in ecosystems: fungal occurrence and activity in litter and soil. *Oikos* 39: 391-422.
- [5] Umrah, T.J. Anggraeni, R.R. Esyanti, I. Nyoman, P. Aryantha. 2009. Antagonis dan efektivitas *Trichoderma* sp. dalam menekan perkembangan *Phytophthora palmivora* pada buah kakao. *J. Agroland*. 16 (1): 9-16.
- [6] P.J. Van Soest. 1976. New Chemical Methods for Analysis of Forages for The Purpose of Predicting Nutritive Value. Pref IX International Grassland Congress.
- [9] R.E. Quiroz-Castañeda, N. Pérez-Mejía, C. Martínez-Anaya, L. Acosta-Urdapilleta, J. Folch-Mallol. 2011. Evaluation of different lignocellulosic substrates for the production of cellulases and xylanases by the basidiomycete fungi *Bjerkandera adusta* and *Pycnoporus sanguineus*. *Biodegradation*
- [10] D. Fengel, G. Wegener. 1989. Kayu; Kimia, Ultrastruktur, Reaksi-reaksi. Terjemahan oleh Sastrohamidjojo H. Gadjah Mada University Press. Yogyakarta.
- [11] M.A. Bari, M.F. Begum, K.K. Sarker. 2007. Mode of action of *Trichoderma* spp. on organic solid waste for bioconversion. *Plant Environ Dev*. 1(1): 61-66.

## **Repellence test of spices (garlic, chili, and pepper) to rat (*Rattus rattus diardii* L.)**

**Swastiko Priyambodo<sup>1,\*</sup>, Dewi Safitri<sup>1</sup>**

<sup>1</sup>Department of Plant Protection, Faculty of Agriculture, Bogor Agricultural University

\* Corresponding author: swaspri@gmail.com

---

**Abstract** Rat is wild animal that has been associated with human life, i.e. parasitism for causing harm to people, leads to disruption and damage, being vectors of human disease. Rat population must be controlled or managed, using both chemical and non-chemical methods. Aims of the study was to determine the effectiveness of garlic, chili, and pepper and its combination as a repellent agent against house rat. Results of this research can be used as a basis for developing a system of house rat control in settlement habitat. Repellence test was conducted in two methods, i.e. in the arena and in the cage. Materials used as a repellent were garlic, chili, and pepper. Each material was tested in a single, double, and triple in combination of all spices. Test animals used were 10 head of house rats that have undergone adaptation for one day. Test in arena used 5 rats and 5 other rats in the cage. Test in arena using a rectangular arena measuring 300 cm (L) x 100 cm (W) x 50 cm (H). The base of arena is made of plywood, the sides are made of thick zinc-coated board and the top is covered by a wire ram. Cage test made of aluminum measuring 40 cm (L) x 40 cm (W) x 50 cm (H) coated wire ram. Each replicates using two cages are placed opposite each other and connected by 400 cm plastic gutter pipe with a diameter of 10 cm. Analysis of variance used a completely randomized design with 7 treatments and 5 replications. Data process performed using the SAS program for Windows (Duncan test with  $\alpha = 5\%$ ). Variables measured were daily grain consumption, the effectiveness of the repellent, and rats' body weight changes. In the arena, a mix of three ingredients was the most effective repellent, whereas in the cage garlic was the most effective. Pepper was not effective to repel rats. Body weight of rats in the cage and arena showed increased and decreased. The decrease in body weight showed that repellent treatment cause stress, even after rats were able to adapt to the environment.

**Keywords** repellent, spices, house rats

---

## **1. Introduction**

Rats are wild animals that have been associated with human life. Association of rat with human nature often parasitism cause various problems and disorders for people in a variety of fields such as: Agriculture, livestock, house hold, and health [1]. Rats have the advantageous over other mammals. It is an omnivore and have a high reproductive capacity, and can adapt to environmental changes made by humans [2]. Activity in house rats tightened their front teeth, dig a hole and make a nest cause harm because it causes damage to office buildings, factories, ware houses, and homes. Rats are also a vector for human diseases [1].

Given so many problems that can be caused by the presence of rats, then the various methods are developed to control it. Common control to rats is the use of rodenticides that probably emerge negative impacts on humans, pets, livestock, and other non-target animals. To minimize the negative impact on the use of rodenticides, it required a more secure way of control. Rats have the ability of sense that is support their activities. Among its five sensory organs, only a sense of sight is not well developed. The ability of smell and olfactory in rats can be used by human to attract or repel rats from some where. The use of repellent is one way to control which utilizes the sense of smell and olfactory of rats. Repellent material will indirectly cause the deaths and reduce the ability to survive in a population [1].

Rat repellent materials have been developed and tested in a variety of control. Some rat repellent material are sulfur, lime, carbolic acid, kerosene, oil of peppermint, n-butyl mercaptan (the active ingredient of animal smell skunk), bactericide, actidione, and sodium fluosilicate [1]. Peppermint oil which has a distinctive odor can be the basis of consideration of the use of repellent derived from spices. The information of the use of repellent using spices is very little.

Aims of this study is to determine the effectiveness of three types of spices and their combinations as repellent against to house rat (*R. rattus diardii*). Benefits of this study can be used as a basis for developing a system for rat control in habitat settlement in a practical, efficient, and does not have a negative impact to the environment.

## **2. Materials and Methods**

This research was conducted at the Laboratory of Vertebrate Pests, Department of Plant Protection, Faculty of Agriculture, Bogor Agricultural University (IPB) for three months. Test animals used are house rat (*Rattus diardii*) obtained from catching rat around campus IPB Darmaga. Pre-requisite of test animals used are: Healthy, adult, large in size, and not pregnant. The animals were adapted in the laboratory for one day with dry grain fed. After 24 hours, five rats were weighed one by one as the initial weights for the first treatment. While the other five used in the following method.

The test materials used as are pellent were chili, garlic, and pepper. Repellent was made by crushing the materials in a blender, based on the treatment being tested. In each treatment, the test material and water mixed at the ratio of 1:2 (250 g: 500 ml). Results filtered and used to test. The results are stored in a squeeze bottle in ten containers, 5 containers for repellent treatment and 5 containers for water control. Repellent and water used in each container 50 ml.

Arena used rectangular with a size of 280 cm (L) x 100 cm (W) x 50 cm (H). Base of arena were made of plywood, the sides are made of thick zinc-coated boards, and the topis covered by a wire ram. At the top of arena there were three holes in the middle, on the left and right which are used as doors for placing food and water. There were five arenas used in this study, all of the arena were covered by black plastic. At one corner of the arena placed feed grain (20 g), were paired with are pellent (50 ml). Drinking glass of water at the center of the arena. Bamboo tube where rat hide were placed near the corner of treatment. In another corner was given 20g of rice and 50 ml of water as a control. The treatment is conducted in the arena with 7 treatments with each treatment consisted of 5 replicates.

Study in the laboratory (cage) performed after in the arena was completed. Test in the laboratory using 10 pieces of aluminum cages measuring 40 cm (L) x 40 cm (W) x 50 cm (H) coated wire ram. Each replicates using two cages that are placed opposite each other and connected with modified pipes measuring 400 cm long and 10 cm in diameter. Pipe is inserted into the cage by a hole made by cutting the wire at the cage door. In the cage with the treatment, placed 20 g grain feed paired with 50 ml repellent and drinking water is always available enough. In the untreated cage, the same method but the 20 g of grain in the opposite site with water as control (50 ml).

Variables measured were daily grain consumption levels, changes in body weight of rats from the beginning to the end of the treatment, as well as the effectiveness of there pellant. The effectiveness of there pellant is calculated using the following formula:

$$LR=(CC-CR)/CC \times 100\%$$

LR: Level of repellence; CC: Consumption on control (without repellent);

CR: Consumption with repellent

The experimental design used was a completely randomized design with seven treatments and five replications. The seven treatments were: (1) chili, (2) garlic, (3) pepper, (4) chili-pepper, (5) chili-garlic, (6) garlic-pepper, and (7) chili-pepper-garlic. All treatments performed in the arena with each treatment consisted of five replicates. Each treatment takes five days of observation. The second round is done in the laboratory with seven equal treatments with each consisting of five replications. Data processing was performed using the SAS system for windows, further analysis of variance used Duncan's multiple range test at level  $\alpha= 5\%$ .

### 3. Results and discussion

Consumption of house rats (*R. rattusdiardii*) to the grain with and without repellent treatment in the arena showed significantly different results (Table 1).

Table1. Consumption (g) of house rat (*R. rattusdiardii*) to the grain with and without repellent and repellence level treated in the arena

Treatment	With repellent	Without repellent	Repellence Level (%)
Chili	2.01 b	4.88 a	58.79 a
Garlic	1.58 b	4.66 a	65.99 a
Pepper	2.17b	4.72 a	51.25 a
Chili and garlic	1.44 b	4.06 a	64.61 a
Chili and pepper	1.80 b	4.56 a	60.55 a
Garlic and pepper	1.82 b	4.32 a	57.96 a
Chili, garlic, and pepper	1.32 b	4.68 a	71.69 a

Data consumption in the same row (with and without repellent) followed by the different letter showed significantly different based on Duncan's multiple test at level  $\alpha= 5\%$

Data repelence level in the same column (repellence level) followedbythe same lettershowedno significantly different based on Duncan's multiple test at level  $\alpha = 5\%$

Table1 showed that the level of the most effective repellence row as follows: chili, garlic, pepper > garlic > chili and garlic > chili and pepper > chili >

garlic and pepper > pepper. Treatment of a mixture of three ingredients spices repellence showed the highest level of repellence (71.69%). The highest level of repellence of these mixture may be caused by: (1) Mixtures of these three materials have as strong smell that is affected the consumption pattern so rats. (2) Rat did not dare to take the risk to consume the grain fed repellent, because rat fed near the repellent feel safe for him, therefore rat prefer to eat at places that feel comfortable and secure than the perceived dangerous place [3].

A treatment of garlic and garlic-chili as are repellent material produces a high enough level of repellence (65.99 % and 64.61 %). Pepper was less effective to repel rat. It can be seen from a low-level repellence between treatments with a control that is equal to 51.25% although still significantly different between the treatment and the control. Less effective of pepper to repel rats caused by odor of pepper generated less strong repellent, lower influence the consumption patterns of rat. Repellence level of a repellent material could be measured by how much feed containing repellent is still eaten by rats [4].

Among the seven repellent treatment caused no significantly different results, as well as non-repellent treatment (control). This suggests that the level of the seventh repellence of such materials repel rats, so that rats prefer grain in areas that are not impaired. The nature of the rats were alert and suspicious of the new stuff around it causing low level consumption. Rats will avoid feed or the environment in which he considers dangerous, because of its adverse effects, so that the grain is not taken. None the less, the rats still had the courage to try less comfortable atmosphere, although only slightly and will not linger in the area. It can be seen from there mainly of grain consumed at an angle with repellent treatment, although only slightly, and the behavior of grain ruffled so scattered around the bait, and the bait upside down. Rats have a high courage so that the amount of consumption good at an angle with and without repellent were not significantly different. Consumption of house rats to the grain with and without are repellent treatment in the cage showed in Table 2.

From the data obtained in the cage tests could be seen that the effective repellent to rats is garlic, chili, and chili-garlic. Although a mixture of chili-garlic showed a higher level than garlic-pepper, but showed no significant differences with control. The mixture of garlic-pepper showed significantly different from controls. This is due to the diversity of observation data from the treatment of chili-garlic. The garlic-pepper treatment indicates



homogenous data. The four other repellent treatment showed no significantly different results and it can be concluded less effective to repel rats.

Table 2. Consumption (g) of house rat (*R. rattus diardii*) to the grain with and without are pellent and repellence level treated in the cage

Treatment	With repellent	Without repellent	Repellence Level (%)
Chili	2.10 b	5.26 a	60.04 a
Garlic	1.60 b	5.03 a	68.13 a
Pepper	4.11 a	4.38 a	6.15 a
Chili and garlic	2.73 a	5.45 a	50.00 a
Chili and pepper	2.62 a	4.79 a	45.36 a
Garlic and pepper	2.82 b	4.45 a	36.68 a
Chili, garlic, and pepper	2.88 a	4.71 a	38.81 a

Data consumption in the same row (with and without repellent) followed by the different letter showed significantly different based on Duncan's multiple stat level  $\alpha= 5\%$   
Data repellence level in the same column (repellence level) followed by the same letter showed no significantly different based on Duncan's multiple stat level  $\alpha= 5\%$

According to predictions, treatment in the cage should give significantly different results than treatment in the arena, because it is done in the laboratory by creating two places (the cages) which were connected with pipes will result in rats prefer areas untreated. Reality shows otherwise. Rats are not bothered with repellent near the grain, so that their diet remains high, both in treatment with and without repellent. The lack of effective in the four-repellent may be caused by the long enough adaptation period of rats in the laboratory (35 days). This caused the rats to recognize the area around (no stress) and also are familiar with the repellent due to the producing repellent treatment in the arena (first stage of testing) is done in the laboratory. The test animal did not feel afraid to consume close repellent grain in large quantities.

Materials chili, garlic and a mixture of both showed real different results between with and without repellent. While the other four are not effective. The effectiveness of garlic and chili in laboratory to repel rats, due to the first dan second treatment testing done. So that the rat was still afraid to approach the grain with repellent. In subsequent treatment showed a fairly high level of consumption in the cage with and without treatment, because the test animals adapted to the repellent and not be in a state of stress during treatment.

Results of cage test on a wider range can be caused by several factors supporting the existence of rats such as sound, temperature, humidity, and light. Rats in the cage did not stress by noises that can interfere with activities and conditions in the laboratory are relatively dark in the arena caused covered with black plastic, so as to adapt to the environment and consumption patterns are not disturbed eating.

Comparison of the grain consumption in with and without repellent treatment showed that chili – garlic control and chili control showed the highest consumption level of rats, on the other hand chili–garlic repellent not showed the lowest consumption. Garlic repellent showed the lowest, followed by chili repellent. Rats have to adapt to the environment, and its occurred in the chili dan garlic treatment.

The body weight of rats tested in arena showed that remained in the first week, increased in the second and third week, followed by decreased in the fourth week. Increased in the fifth week, followed with decreased in the last two weeks. The body weight of rats tested in cage showed decreased on the first two weeks, followed by an increased in the next five weeks. The decrease in body weight of the rats showed that there pellant treatment can cause stress, even after threats were able to adapt to the environment.

The behavior of rats experiencing stress could be seen from its activities in the form of ruffled feed and swirl in the arena. Aggressive behavioris thought to be one form of stressre action to the treatment given. The emergence of stress in animal is not able to adapt to the pressures cause stress that comes from outside [5]. The major changes to the size and function of some reproductive organs and behavior, occurs as a consequence of the introduction of a laboratory or experimental. In addition as a resultof stress, energy used rats during treatment is very high. Energy needs are derived from feed consumption only slightly (due to low levels of consumption), so as to meet the needs of energy reserves stored in the body un used [6]. Long treatment time (35days), the rats will lead to decreased weight during reatment [7].

#### **4. Conclusion**

Result of research conducted in the arena showed that a mixture of the three ingredients of spice (chili, garlic, and pepper) is the most effective repellent to repel rats, where as in the laboratory garlic is the most effective repellent. Pepper is not effective as a repellent to the rats. It can be seen from a low-

level repellence and showed results that were not significantly different between treatments and control, even on treatment in the cage showed a higher consumption. In effective- ness pepper to repel rats because this material does not produce a strong odor that can affect the consumption patterns of rats. The decreased in body weight of rats caused by stress of there pellent treatment, even after the rats can adapt to the environment as indicated by the increased in bodyweight.

Suggestion to the study that it should be conducted further research on the active ingredients contained in the spices that can develop more effective control measures. More over, it should be tested against the population of rats.

## **5. References**

- [1] S. Priyambodo. 2003. *Pengendalian Hama Tikus Terpadu*. Penebar Swadaya, Jakarta.
- [2] W.E. Howard. 1988. *Rodents Pest Management*. CRC Press, Florida.
- [3] W.D. Fitzwater. 1988. Non Lethal Methods in Rodent Control. In: I. Prakash, editor. *Rodent Pest Management*. CRC Press, Florida.
- [4] R.M. Timm, T.P. Salmon. 1988. Behaviour. In: I. Prakash, editor. *Rodent Pest Management*. CRC Press, Florida.
- [5] D.B. Morton, P. Townsend. 1995. Dealing with adverse effects and suffering during animal research. In: Tuffery AA, editor. *Laboratory Animals—An Introduction for Experimenters*. Second edition. John Wiley and Sons, New York.. P. 215-231.
- [6] R. Robinson. 1979. Taxonomy and genetics. In: Baker HJ, Lindsey JR, Weisbroth SH, editor. *The Laboratory Rat*. Vol 1. Academic Press. LondonInc.
- [7] S.A. Cavigelli, M.K. McClintock. 2003. Fear of novelty in infact rats predicts adult corticosterone dynamics and an early death. [serial online]. Available at: [http://www.PNAS.com/cavigelliand mcclintock 100\(26\)16131.htm](http://www.PNAS.com/cavigelliand mcclintock 100(26)16131.htm).

## Growth response of dragon fruit (*Hylocereus costaricensis*) on MS medium with Gandasil and Growmore in vitro

Faridatul Mukminah<sup>1,\*</sup>, Busroni Asnawi<sup>1</sup>, Tetra T. Novi<sup>1</sup>

<sup>1</sup> Department of Agrotecnology, Tridianti University Palembang, Palembang, 30139,  
Indonesia

\* Corresponding author: faridatulmukminah@gmail.com

---

**Abstract** This study aims to find appropriate media formulations for growing dragon fruit (*Hylocereus costaricensis*) in vitro. The experiment was conducted at the Tissue Culture Laboratory of the Faculty of Agriculture, University of Tridianti Palembang from December 2013 to March 2014. The study design used was experimental method with completely randomized design (CRD), which there were 5 (five) treatments and 5 (five) replicates as follows: H1 = MS (Without Gandasil and Growmore); H2 = MS + 2 g of Gandasil; H3 = MS + 2 g of Growmore; H4 = MS + 1 g of Growmore + 1 g of Gandasil; H5 = MS + 2 g of Growmore + 2 g of Gandasil. Each treatment had 10 (ten) bottles. Observation parameters were: time explants growing, number of roots, root length, and fresh weight of plantlets. The results showed that treatment H4 = MS + 1 g of Growmore + 1 g of Gandasil can spur the growth of dragon fruit plantlets better and show the best results on the all of parameters were investigated.

**Keywords** dragon fruit, *in vitro*, gandasil, growmore

---

### 1. Introduction

Dragon fruit (*Hylocereus costaricensis*) is also widely known as pitaya is a cactus type plant that originally came from Mexico, Central America. It is taken to Indonesia, China and Vietnam by the French around 1970, from Guyana South America, as an ornamental plant because the figure is unique and has a beautiful flower, white and red fruit shiny and finned [1].

Propagation of dragon fruit with tissue culture techniques will work well if the conditions required are fulfilled. Such techniques include the selection of explants as planting material, the use of a suitable medium, aseptic conditions, and good temperature regulation. A number of reports have shown that every genotypes (varieties) require specific media composition to support optimal growth of explants [2].

In propagation through tissue culture, the culture medium is one that determines the success in producing plantlets. So far, the media used, among others, Knudson (for development), MS (Murashige and Skoog), NP (New Phalaenopsis), and VW (Vacin and Went). The medium was made by mixing several chemicals with concentrations that have been determined, the use of these media can still be simplified through the use of compound fertilizers and organic matter complexes, to substitute the nutrients can be used Gandasil or compound fertilizers such as Growmore [3].

This study aims to find appropriate media formulations to nursery dragon fruit *in vitro*. This reserach is expected to be useful for the improvement of dragon fruit propagation through tissue culture (*in vitro*), especially in the provision of dragon fruit plants for the large-scale farmers and entrepreneurs.

## **2. Materials and Methods**

This research has been carried out in the Tissue Culture Laboratory of Agrotechnology Departement, Faculty of Agriculture, Tridinanti University Palembang from December 2013 to March 2014. The materials used were dragon fruit seeds (*Hylocereus costaricensis*), Gandasil, Growmore, to, white sugar, 70% alcohol, betadine, baycline solution (Sodium hypoklorit), formalin, spirits, sterile distilled water, detergents and other substances in a laboratory culture tissue. The experimental method was completely randomized design (CRD), with 5 (five) treatment and 5 (five) replicates. Each treatment consisted of 10 samples of the culture bottles that required as many as 250 bottles of culture.

The treatment in this study was designed as follows:

1. H1 = MS (Without Gandasil and Growmore)
2. H2 = MS + 2 g of Gandasil D
3. H3 = MS + 2 g of Growmore
4. H4 = MS + 1 g of Gandasil D + 1 g of Growmore
5. H5 = MS + 2 g of Gandasil D + 2 g of Growmore

Parameters observed in this study include: Time of explant growth, number of roots, length of roots and fresh weight.

### **3. Results and Discussion**

#### **3.1. Result**

The result of Analysis of variance of the treatments showed highly significant on the parameters: time of explant growth; root length; and fresh weight, but not significantly affected on the parameter number of roots.

##### **3.1.1. Time of explant growth (days after planting)**

Parameter observations were started when the shoots have started to emerge, followed by elongation of shoots, stems and leaf formation. Treatment H4 (MS + 1 g of Growmore + 1 g of Gandasil) affected significant on the time of formation of plantlets namely 6.13 days after planting (fastest) (Table 3.1.1).

##### **3.1.2. Root number**

Parameter root number was observed at the end of the study. The results of variance analysis showed that the treatment effect was not significant on the number of roots. Treatment H5 (MS + 2 g of Growmore + 2 g of Gandasil) was able to deliver results with the highest value namely 4.09 and H1 treatment (MS without Gandasil and growmore) returns the smallest namely 3.60

Table 3.1.1 Results of the 0.05 LSD treatment on growth parameters explants time (days after planting/dap)

Treatments	Average (dap)	LSD 0.05 = 0.75
H4	6.13	A
H5	6.53	A
H2	6.93	B
H3	7.07	B
H1	8.07	C

Remarks: The figures are followed by the same letter are not significant different states based on LSD test at 5% level.

##### **3.1.3. Root length**

Parameter observations of root length at the end of the study. The results of variance analysis showed that treatment of very significant effect on root length. Treatment H4 (MS + 1 g Growmore + 1g Gandasil) resulted in the highest root length of 2.35 cm, the treatment was significantly different from H1, H3 but not significant with the H2 and H5 (Table 3.1.3.).

Table 3.1.3. Result of the 0.05 LSD on the parameter length of root (cm)

Treatments	Average (cm)	LSD 0.05 = 0.33
H1	1.47	A
H3	1.67	A
H2	2.02	B
H5	2.15	B
H4	2.35	B

Remarks: The figures are followed by the same letter are not significant different states based on LSD test at 5% level.

### 3.1.4. Fresh weight (gram)

Fresh weight was observed at the end of the study. The results of variance analysis showed that the treatments affected significantly on fresh weight. Treatment H4 (MS + 1 g Growmore + 1 g Gandasil) produce fresh weight of plantlets heavier namely 3.53 g, is significantly different treatment to other treatments (Table 3.1.4).

Table 3.1.4. Result of the 0.05 LSD on Treatment Results on Parameter Weight Fresh plantlets

Treatments	Average (g)	LSD 0.05 = 0.31
H1	1.84	A
H3	2.43	B
H5	2.92	C
H2	2.95	C
H4	3.53	D

Remarks: The figures are followed by the same letter are not significant different states based on LSD test at 5% level.

## 3.2. Discussion

From tables 4.1.1 - 4.1.3, we can see that the combined treatment of H4 gave the significant effect on some growth parameters were observed namely the time of explant growth; root length and weight of plantlets. It is expected that addition of Gandasil and growmore to the culture medium will accelerate the growth of the plantlets, because growth driven by Gandasil and growmore includes cell division and enlargement faster. The high percentage of plantlets growth formation on H4 treatment (MS + 1g Growmore + 1g Gandasil) is probably caused Gandasil and growmore contains macro and micro nutrients. Macro nutrients contained in Gandasil and growmore ie Nitrogen, Phosphorus, Potassium, Magnesium and Sulfur [4]. The concentration of total nitrogen in H4 that is as much as 52%, The concentration of nitrogen in the media Gandasil and growmore only half of the total nitrogen in H5 media, but suspected this concentration could stimulate the growth of explants. In the vegetative phase plants need

nitrogen, since nitrogen is used for the growth of cells, tissues and organs of plants. This is in accordance with the opinion of Afriani [5].

Based on the observation parameters in Table 4.1.3 and Table 4.1.4 shows that treatment of H4 resulted in the highest root length namely 2.35 cm and the best plantlet fresh weight namely 3.53 g. It is probably caused in H4 medium containing macro and micro nutrients, glucose, vitamins and amino acids for proper growth of root length and fresh weight of plantlets, in addition to the calcium content and the type of nitrogen also affects the growth of root length and fresh weight of plantlets. It is appropriate with the opinion of Afriani [5] and Nurheldi [6] that nitrogen in the form of nitrate ( $\text{NO}_3^-$ ) is better for growth of explants. Gandasil and Growmore fertilizer containing 52% of total nitrogen and 20% of them is in the nitrate form. Besides in the form of nitrate, fertilizer and Gandasil and Growmore containing nitrogen in the form of ammonium ( $\text{NH}_4^+$ ) namely 32% of the total N.

Calcium plays a role in cell growth of plants, but it also plays a role in calcium to strengthen, organize penetrating power, and take care of the cell wall. Calcium also plays a role in the formation of roots, especially on the growing point of the root [7]. According to Kishi and Tagaki [8], nitrogen in the form of ammonium is also needed in the growth of the explants, and the availability of other nutrients in the medium with addition of fertilizer like Gandasil and Growmore can spur the growth of root length and fresh weight of plantlets.

#### **4. Conclusion**

Based on the results obtained it can be concluded that, treatment H4 = MS + 1 g of Growmore + 1 g of Gandasil can spur the growth of dragon fruit plantlets better and show the best results on the all of parameters were investigated.

#### **5. References**

- [1] S. Emil. 2011. *Untung Berlipat dari Bisnis Buah Naga Unggul*. Lily Publisher, Yogyakarta.
- [2] Basri. 2004. *Kultur Jaringan Tanaman*. Tadulako Press, Palu.
- [3] Yusnita. 2003. *Kultur Jaringan*. Agromedia Pustaka, Jakarta.
- [4] Lingga, Marsono. 2004. *Petunjuk Penggunaan Pupuk*. Agromedia, Jakarta.



- [5] A.W. Afriani.. 2006. Penggunaan Gandasil, air kelapa dan ekstrak pisang pada perbanyakkan tunas dan pembesaran *Planlet* anggrek *Dendrobium* secara *in vitro*. [skripsi]. Fakultas Pertanian Institut Pertanian Bogor. [serial online] 2006 [cited 2013 Apr 21]. Available at: [www.yunitafriani.blogspot.com](http://www.yunitafriani.blogspot.com) 21 April 2013.
- [6] A. Nurheldi. 2006. Penggunaan pupuk majemuk dan bahan organik kompleks sebagai media pertumbuhan anggrek *Dendrobium* secara *in Vitro*. [skripsi]. Fakultas Pertanian, Institut Pertanian Bogor. [serial online] 2006 [cited 2013 Apr 26]. Available at: <http://repository.ipb.ac.id> 26 April 2013.
- [7] A.N. Alamsyah. 2004. Teknologi pengolahan minyak kelapa murni terpadu. Balai Besar Litbang Pasca Panen Pertanian Bogor. [serial online] 2004 [cited 2014 Marc 18]. Available at: <http://repository.usu.ac.id> 18 Maret 2014.
- [8] F. Kishi, K. Tagaki. 1997. Analysis of medium components used for orchid tissue culture Lindieyana. [serial online] 1997 [cited 2014 Marc 18]. Available at: <http://hortikultura.litbangdeptan.go.id> 18 Maret 2014

## Effect of enriched phospho-compost application on the growth and phosphorous content of *Setaria splendida* Stapf

R. Dianita<sup>1,\*</sup>, A. Rahman Sy<sup>1</sup>, Ubaidillah<sup>1</sup>

<sup>1</sup>Faculty of Animal Science, University of Jambi, Mendalo Darat, 36361, Indonesia

\* Corresponding author: rahmi\_dianita@yahoo.com

---

**Abstract** Nutrient sources and availability from fertilizer is one of the important factors which affect fodder plant growth and production. This experiment was investigated the effect of enriched phospho-compost application on the growth and phosphorous content of *Setaria splendida* Stapf. This experiment was arranged in Completely Randomized Design (CRD) with 4 treatments and 5 replicates. The treatments were R0 = Rock Phosphate, R1 = PHOKOS (rock phosphate + rice straw + poultry manure), R2 = TRIPHOS (rock phosphate + rice straw + poultry manure + *Trichoderma harzianum*), R3 = ASPHOS (rock phosphate + rice straw + poultry manure + *Aspergillus niger*) with dosage of 7.5 t/ha. The result showed that application of compost enriched with rock phosphate and microorganisms (R1, R2 and R3) were significantly increase the growth of *Setaria splendida* Stapf in terms of plant height, shoot and root dry weight compared to R0, but it was not significantly affect phosphorous content in shoot, root and soils. Composite analyses for phosphate solubilizing fungi (PSF) in soils showed that there was PSF in R0, R1 and R2 but not in R3. It could be concluded that application of compost enriched only with rock phosphate and microorganisms resulted a better growth and P content of *Setaria splendida* Stapf rather than rock phosphate.

**Keywords** enriched phospho-compost, growth, phosphorous, phosphate solubilizing fungi (psf), *Setaria splendida* stapf

---

### 1. Introduction

*Setaria splendida* Stapf is one of potential fodder plants which had well adaptation, productivity and quality. This fodder plant could stand in unfertile soils, but very responsive with fertilization especially with nitrogen and phosphorous and sometime with potassium [1]. Cultivating this fodder plant in poor soils such as ultisol (podzolic) can be manipulated with fertilization. Nutrient sources and availability from fertilizer is one of the important factors which affect fodder plant growth and production.

Compost is one of organic fertilizer that can be made from organic materials which already decomposed by microorganisms and it can be used to improve soils physical and chemical characteristics. Generally, common compost has low essential nutrient and slow release nutrient compared to anorganic fertilizer. Addition a certain ingredient such as nutrient sources (like rock phosphate) and or microorganisms can be done to improve the nutrient content of compost. Some fungi have been well known in improving the availability of soluble phosphate among are mychorriza, *Bacillus* sp, *Trichoderma* spp and *Aspergillus niger* [2, 3, 4, 5]. The addition of *T. harzianum* and *A. niger* in phosphate-enriched compost not only help degrading the fiber of compost ingredient but also have a role as phosphate solubilizing microorganisms that will improve the quality of compost. This experiment was investigated the effect of enriched phospho-compost application on the growth and phosphorous content of *S. splendida* Stapf.

## 2. Materials and Methods

Tiller of *S. splendida* stapf and soils was collected and prepared from experimental garden of Crop and Forage Science Laboratory, the Faculty of Animal Science, University of Jambi. Soils as media were collected in a depth of 20 cm from top soils and then put in 5 kg pot. Enriched phospho-compost was prepared before the experiment started. It was consisted of main ingredients of rice straw and chicken manure with the ratio of 1 : 1 and enriched with 25% of rock phosphate. *T. harzianum* (R2) and *A. niger* (R3) fungi were added 2.5% of the total main ingredient. The compost was kept during 45 days in aerobic condition (modified from [6, 7]). The enriched phospho-compost was taken and analysed for physical and chemical properties (Table 1). Soil sample was taken and analyzed for chemical content and the results were pH 4.8, available P 3.5 ppm, P (HCl 25% ) 34.6 ppm, N 0.08% , K 0.10% and CEC 4.90.

Table 1. Physical and Chemical Parameters of Phospho-Compost \*)

	pH	Water Content (%)	Org C (%)	N (%)	C/N Ratio	Available P (%)	P <sub>2</sub> O <sub>5</sub> (%)	K <sub>2</sub> O (%)	CEC (me/100g)
R0	-	-	-	-	-	-	08.57	-	-
R1	7	22.42	27.65	1.29	21.43	5.97	15.30	2.24	40.76
R2	7	15.82	25.24	1.43	17.65	6.02	17.21	2.40	36.46
R3	7	18.46	23.49	1.49	15.76	6.72	18.16	2.84	36.85

\*) Analyses from Soil Laboratory, the Faculty of Agriculture, Bogor Agricultural University (2012)

This experiment was arranged in Completely Randomized Design with 4 treatments and 5 replicates. The treatments were: R0= Rock Phosphate (RP), R1 = PHOKOS (rock phosphate + rice straw + chicken manure), R2= TRIPHOS (rock phosphate + rice straw + chicken manure + *T. harzianum*), R3= ASPHOS (rock phosphate + rice straw + chicken manure + *A. niger*). There were 5 replicates and each replication had 2 units (pots) of experiment. Phospho-compost was applied with a dosage of 7.5 t/ha ~ 18.75 g/pot and rock phosphate with a dosage of 90 t/ha.

Each pot contained 1 tiller of *S. splendida* grass. The fertilizer was applied surrounding the tiller and covered with the soil. After grown until 40 days, the grass was harvested. It was separated between shoot and root and dried in 70°C within 2 days. It was milled and taken the sample for total P analyses as well as the soils. Composite soil sample was taken for phosphate solubilizing fungi (PSF) analyses. PSF was determined by agar-plate method. Data were analyzed by CRD design. The difference between treatments mean analyzed by Multiple Duncan Range Test [8].

### 3. Results and Discussions

The growth of *S. splendida* in Phokos (R1), Triphos (R2) and Asphos (R3) treatments was significantly different to rock phosphate (R1) treatment. The addition of *T. harzianum* and *A. niger* in phospho-compost could help releasing and providing nutrient element, particularly P for *S. Splendida*. Available nutrient element can be absorbed by plant resulted in increasing the plant growth in terms of plant height, shoot and root dry weight. Insoluble P become soluble in significant amount from both rock phosphate sources (Mussoorie rock phosphate (MP) and Hyper rock phosphate (HP)) and converted to soluble P in water, organic P and soluble P fraction during composting process [9].

Table 2. Plant Height, Shoot and Root Dry Matter of *S. splendida* Stapf at the End of Experiment

Treatments	Plant Height (cm/plant)	Shoot Dry Weight (g/plant)	Root Dry Weight (g/plant)
Rock Phosphate (RP)	54.32 b	2.36 b	0.91 c
Phokos	65.70 a	5.45 a	1.72 b
Triphos	64.73 a	4.35 a	1.90 b
Asphos	65.20 a	4.15 a	2.25 a

Means followed the same letter within the same column are not significantly different at 0.5% level by DMRT

This experiment found that there was no significant effect of treatments on phosphorous content in shoot, root and soils (Table 3). The use of *T. harzianum* and *A. niger* in phospho-compost decomposition able to solubilize more P, because *T. harzianum* and *A. niger* is an organic acid-producing organisms under aerobic conditions. P is derived from rock phosphate more soluble in acidic conditions. The mineralization of insoluble P forms by organic acids are the main advantages of composting rock phosphate [10].

**Table 3. P-Total in Shoot, Root and Soils at the End of Experiment**

Treatments	P Total		
	Shoot (%)	Root (%)	Soils (ppm)
Rock Phosphate (RP)	0.34	0.11	120.94
Phokos	0.37	0.14	123.00
Triphos	0.35	0.12	159.44
Asphos	0.34	0.13	139.84

**Table 4. P Solubilizing Fungi in soils at the End of Experiment\*)**

Treatments	P Solubilizing Fungi CFU/g
Rock Phosphate (RP)	2.0 X 10 <sup>3</sup>
Phokos	1.5 X 10 <sup>3</sup>
Triphos	3.6 X 10 <sup>4</sup>
Asphos	0

\*) Composite analyses from Soil Biotechnology Laboratory, the Faculty of Agriculture, IPB (2012)

Composite analyses for PSF in soils media at the end of experiment showed that there was PSF in RP, Phokos and Trichos treatments but not in Asphos treatment (Table 4). The amount of PSF in soils of Triphos treatment was the highest. *Trichoderma* fungi in nature favors temperatures between 15-32°C and pH in a range of 5.5 to 8.5. *Trichoderma* actively takes over a root zone and makes it difficult for pathogens to compete for space on the roots and for nutrients [11].

#### **4. Conclusion**

Application of phospho-compost with and without additional microorganism of *T. harzianum* and *A. niger* (R1, R2, R3) significantly resulted a better growth and P content of *S.splendida* than rock phosphate (R0) treatment.

## **Acknowledgement**

This experiment was funded by Operational Fund for State Higher Education with Group Research Scheme, according to letter of Agreement No. 209/UN21.6/PL/2012, date: 09 August 2012.

## **5. References**

- [1] Tropical Forage. 2014. *Setaria splendid* Stapf. [serial online] 2014 [cited 2014 July 7]. Available: <http://www.tropicalforages.info>.
- [2] R. Dianita. 2012. The study of the use of nitrogen and phosphorous in leguminous and non leguminous plant in integration system. *Dissertation*. The Faculty of Animal Science, IPB, Bogor.
- [3] S. Banik, A. Ninawe. 1988. Phosphate solubilising microorganism in water and sediments of a tropical estuary and the adjacent coastal Arabian Sea, in relation to there physicochemical properties. *J. Indian Soc. Coast. Agric.* 6: 75–83.
- [4] A. Kapri, L. Tewari. 2010. Phosphate solubilization potential and phosphatase activity of rhizospheric *Trichoderma* spp. *Braz. J. Microbiol.* vol.41 no.3
- [5] C.B. Barroso, G.T. Pereira, E. Nahas. 2006. Solubilization of cahpo4 and alpo4 by *Aspergillus niger* in culture media with different carbon and nitrogen sources. *Braz J. of Microbiol.* 37: 434-438
- [6] Biswas. 2008. Production of enriched compost. *ICAR. A Science and Technology Newsletter* 14:3, 1-2. [3]
- [7] K.C.S. Bangar, S. Shanker, K.K. Kapoor, K. Kukreja, M.M. Mishra. 1989. Preparation of nitrogen and phosphorus-enriched paddy straw compost and its effect on yield and nutrient uptake by wheat (*Triticum aestivum* L.). *Biol Fertil Soils.* 8:339-342
- [8] R.G.D. Steel, J.H. Torrie. 1995. *Principle and Procedures of Statistics: a biometric approach*. Sumantri B. Translater. Translated from: *Principles and Procedures of Satistics*. Gramedia Pustaka Utama, Jakarta.
- [9] C.P. Singh, A. Amberger. 1995. The effect of rock phosphate-enriched compost on the yield and phosphorus nutrition of rye grass. *American J. of Alter Agric.* 10: 02, pp 82-87.
- [10] S.K. Roy, R.C. Sharma, S.P. Trehan. 2001. Integrated nutrient management by using farmyard manure and fertilizers in potato-sunflower-paddy rice rotation in the Punjab. *J. of Agric. Sci.* 137: 271-278.
- [11] D. Lester. 2010. Understanding and using trichoderma fungi. *Maximum Yield Magazine*, Australia, pp 48 - 52.

## **Implementation of life cycle assessment (LCA) on tempeh production in Bantul district - Yogyakarta special province - Indonesia**

**Wahyu Supartono<sup>1,\*</sup>, Lina Widayarsi<sup>1</sup>, Didik Purwadi<sup>1</sup>**

<sup>1</sup>Department of Agroindustrial Technology, Faculty of Agricultural Technology  
Gadjah Mada University, Yogyakarta, Indonesia

\* Corresponding author: wstono@yahoo.com; wstono@ugm.ac.id

---

**Abstract** Life cycle assessment (LCA) is one part of ISO 14000 – Environmental Management System – that can identify the opportunity for minimizing usage of materials and energy and reducing the environmental effects during the life cycle of products or services. The research was conducted in tempeh industries at Bantul District. Tempeh is one of Indonesian traditional foods that gives contribution to culinary world. Tempeh is made from soybean and it was fermented between 26-48 hours before it became compact food and was ready to be cooked. The research was applied at three industries that had three different production capacity. Three producers were chosen, CHOSIM for low production capacity, NGATIJAN for middle capacity and MUCHLAR for high capacity. Aims of the research were to determine and to compare the LCA of three tempeh producers, and the effects to the environment during the tempeh production. Actually the basic calculation of the LCA is mass and energy balance. Results of the research showed that for producing tempeh from 1 kg fresh soybean it was needed 0.29607 MJ human energy, 1.2797 MJ energy from fuel (gasoline), 0.02227 MJ electricity, 0.24725 MJ combustion of woods. If kerosene was used it yielded 3.24807 MJ. Combusting gasoline released emission of CO<sub>2</sub> 0.00119 mg, NO<sub>x</sub> 0.00058 mg and SO<sub>2</sub> 0.00098 mg. Usage of woods as energy source released emission of CO<sub>2</sub> 4607.31 mg, C<sub>n</sub> H<sub>m</sub> 4194.92 mg, CO 244431.82 mg, CH<sub>4</sub> 7835, 92 mg, H<sub>2</sub> 1407.38 mg and N<sub>2</sub> 6846.19 mg. Combusting of kerosene gave emissions of CO 0.14 mg, SO<sub>2</sub> 9.52 mg, NO<sub>2</sub> 1.29 mg, HC 0.22 mg dan solid particle 1.68 mg. Solid and liquid wastes were utilized for feeds, but the pollutants gave contribution for air pollution that led to danger of human health and global warming. Finally the results could give recommendation how the industry could reduce the energy consumption during the production but still yielding the same quality of products.

**Keywords** life cycle assessment, tempeh, Yogyakarta

---

## **1. Introduction**

Environmental and global warming issues are always discussed by almost all people in the world, whether the discussions are in national and international forum. All kinds of approaches and system establishment for minimizing risks of global warming and natural damage are set up, and a lot of institutions have serious attention for taking action to reduce these risks. At the same moment Indonesia is facing a free trade area, which is covering ASEAN and Asian countries. The preparation for entering this area needs some serious activities, if Indonesia wants to compete among other countries. One of important issues in the global market is quality standard of product and or service.

Life Cycle Assessment (LCA) or ISO 14040 can be defined as macro scale approach for identifying possibilities to prevent pollution based on individual product and also to trace energy balance, raw materials and waste. This method can be used as a technique to minimize the effect of product and process on the environment. Furthermore the whole LCA system will cover also the impact on socio-economical situation.

The main purpose of LCA is the assessment to technological implementation, economical and environmental factor for raw material, processing and product, which started from creating until final product and producing waste. Some benefits can be achieved if the LCA has been implemented in the production, namely:

- a. Identification on some chances to improve the environment.
- b. Strategic planning for determining the priority of local government policy.
- c. Determining the indicators for assessing the environmental performance.
- d. Declaring the eco-labelling in the marketing strategy, etc.

Tempeh is one of Indonesian traditional foods, which is very popular in Javanese society as foods and protein source. Tempeh is produced from soybean and fermented between 24 – 48 hours by fungi *Rhizopus* sp. It has high value content of essential amino acids. In Bantul District tempeh producers vary in production capacity based on their capability, technology used and human labour. Three producers were selected as samples for this research due to their daily capacity.

This research was aimed to determine and to compare LCA among three tempeh producers. Furthermore the effects to environment during the production were evaluated.



## **2. Materials and Methods**

Objects of the research were three tempeh producers namely CHOSIM at Tegallayang, NGATIJAN at Ngoto and MUCHLAR at Nguwotan – Bantul District. Scope of research was from providing raw material, production process, marketing products and their environment.

Data collection was conducted by direct investigation at production place (primary data) and literature searching for secondary data. The primary data consisted of raw and supporting materials, equipments, production process, wastes, human labour, products, and marketing. The secondary ones found at scientific articles, internet, etc. The way to collect the datas were on-site observation, interview and literature study.

Procedure for measurement was done as follow:

- a. Mass Balance Measurement was achieved by weighing raw material as input, product output in every sub-system in processing, quantity of materials which were identified releasing emissions.
- b. Energy Balance Measurement was conducted by measuring human labour load, fuel consumption for transportation and production steps.

## **3. Results and Discussion**

The specification of tempeh producers were depicted at Table 1.

Table 1. Tempeh producer specification

	CHOSIM	NGATIJAN	MUCHLAR
Location	Tegallayang	Ngoto	Nguwotan
Product	Fresh tempeh	Fresh tempeh	Fresh tempeh
Technology	Manual	Partly Machinal	Partly Machinal
Capacity/day	50 kg	300 kg	2,500 kg
Production time	5.5 (03.30 – 09.00)	8 (05.00 – 13.00)	8 (06.30 – 14.30)
Number of labour	3	5	14
Distribution area	Local (5-7 km)	Local (5-10 km)	Local (5 – 20 km)

Based on number of labour they were classified as small scale industry, but if the technology came into account, Ngatijan was belong to middle scale and Muchlar was high scale industry.

Schematic of the research was as follow:

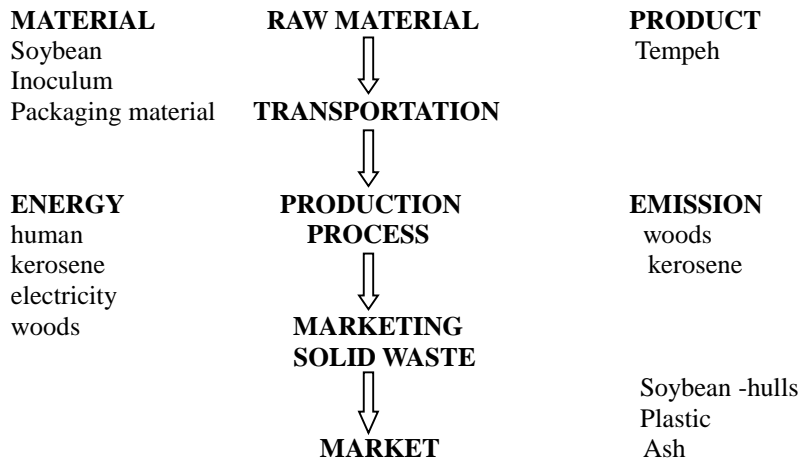


Fig. 1. Schematic research on LCA of Tempeh

Following figure showed steps for producing tempeh from dried soybean.

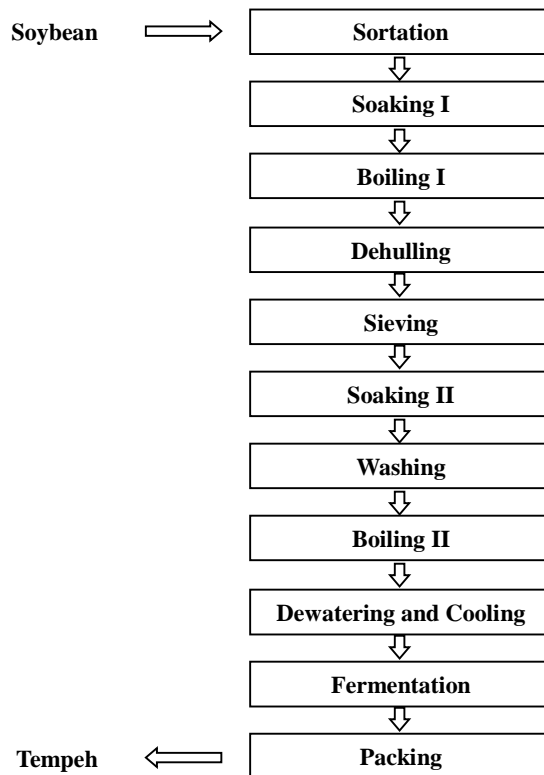


Fig.2. Tempeh processing steps

Although their processing steps were relatively similar, some modifications were done such as soaking raw soybean and boiling dehulled soybean. These modifications were designed for achieving good quality products, which were determined by each producers and consumer's need. Furthermore they could influence usage of energy for producing tempeh.

The modification led to usage of appropriate technology, which supported the processing steps by replacing human forces with some electrical equipments and the labour served only as an operator. The replacement normally occurred at medium and high scale industries, because the producers had enough capital for providing the equipments and suitable work place. It led to increase production capacity of tempeh producers. The technology helped them to do their process more efficient, because the equipment run faster and more precise than human.

In term of energy usage, most of equipments were operated by electricity, so the energy needs were lower than other energy that usually used (human and woods). For instance at boiling station, this process was to gain soft texture of soybean suitable for fermentation, to change soybean structure becoming softer, to minimize contaminants of fermentation, and to reduce trypsin inhibitor and to release iron components which was needed for growing fungi during fermentation.

Three producers used different equipment for boiling soybean namely, CHOSIM used big bowl and heated directly by woods. NGATIJAN used steam produced from water boiled in the drum using woods. The steam was transferred to the bowl using pipe and regulated with ventile. MUCHLAR utilized steam kettle with kerosene as energy source and produced hot steam to boil soybean in drum volume 508.68 dm<sup>3</sup> and 432.63 dm<sup>3</sup> respectively.

Other frequent used equipment was grinder or size-reduction machine for separating hulls from soybean for easing fermentation process. NGATIJAN and MUCHLAR used electric grinder, but CHOSIM used manual grinder which had to be moved by hand.

Table 2. LCA for tempeh production in three producers

	CHOSIM	NGATIJAN	MUCHLAR	Average
ENERGI				
Human (MJ)	0.67407	0.09585	0.11820	0.29607
Gasoline (MJ)	2.97956	0.854053	0.01901	1.2797
Electricity (MJ)	0.02928	0.01920	0.01833	0.02227
Woods (MJ)	0.19780	0.29670	-	0.24725

	CHOSIM	NGATIJAN	MUHLAR	Average
Kerosene (MJ)	-	-	3.24807	3.24807
EMISSION - GASOLINE				
CO <sub>2</sub> (mg)	0.00330	0.00028	-	0.00119
NO <sub>x</sub> (mg)	0.00138	0.00034	0.00001	0.00058
SO <sub>2</sub> (mg)	0.00219	0.00072	0.00002	0.00098
EMISSION-OTHER ENERGY SOURCES				
CO <sub>2</sub> (mg)	36858.10324	55284.51765	-	46071.31
CnHm (mg)	3356.06242	5033.78824	-	4194.92
CO (mg)	19547.65906	29320.18824	0.14000	24433.92
CH <sub>4</sub> (mg)	6268.90756	9402.94118	-	7835.92
H <sub>2</sub> (mg)	1125.93037	1688.82353	-	1407.38
N <sub>2</sub> (mg)	5477.07083	8215.31765	-	6846.19
SO <sub>2</sub> (mg)			9.52021	9.52021
NO <sub>2</sub> (mg)			1.28803	1.28803
HC (mg)			0.22400	0.22400
Pollutant Particle (mg)			1.68004	1.68004

Based on table 2. CHOSIM needed more energy for producing tempeh from 1 kg fresh soybean. It caused that CHOSIM used more gasoline and human for his production especially transportation in providing raw and supported materials. Furthermore human energy frequently used, because CHOSIM did not apply processing technology.

MUHLAR used kerosene for his production, which was as energy source for his hot steam kettle for boiling soybean. Two other producers used woods as energy source for boiling soybean. It produced more emission and pollutants to the environment.

Basically the smallest industry was not efficient in term of energy usage and releasing emission and pollutant. In this case CHOSIM depicted this phenomenon, because he produced smaller amount of tempeh and needed energy likely same with NGATIJAN. If it was calculated by per 1 kg fresh soybean for producing tempeh, the result showed inefficiency at CHOSIM industry.

#### **4. Conclusion**

1. For producing tempeh from 1 kg fresh soybean needed 0.2907 MJ human energy, 1.2797 MJ energy from fuel (gasoline), 0.02227 MJ electricity, 0.24725 MJ combustion of woods. Combusting gasoline released emission of CO 0.00119 mg, NO<sub>x</sub> 0.00058 mg, and SO<sub>2</sub> 0.00098 mg. Usage of woods (as energy source) released emission of

CO<sub>2</sub> 4607.31 mg, CnHm 4194.92 mg, CO 244431.82 mg, CH<sub>4</sub> 7835.92 mg, H<sub>2</sub> 1407.38 mg and N<sub>2</sub> 6846.19 mg. Combusting of kerosene gave emission of CO 0.14 mg, SO<sub>2</sub> 9.52 mg, NO<sub>2</sub> 1.29 mg, HC 0.22 mg and solid particle 1.68 mg.

2. The smallest industry did not use energy and material efficiently, although some exceptions occurred if the production capacity increased.
3. Waste of tempeh production was used as feed, but the usage of woods and kerosene in large amount could lead to air pollution in the production environment.

## **5. References**

- [1] Anonyme. 1999. PLCAdalam Pengelolaan Limbah Gas dan Partikulat. Handout Pelatihan Product Life Cycle Analysis. PPLH. ITB. Bandung
- [2] E. Damanhuri. 1999. PengelolaanLimbah dalam Life Cycle Analysis. Handout Pelatihan Product Life Cycle Analysis. PPLH. ITB. Bandung.
- [3] B.S. Hieronymus. 1993. *Pembuatan Tempe Kedelai*. Penerbit Kanisius. Yogyakarta.
- [4] J.W. Owens. 1997. Life Cycle Assessment: Constraint on Moving from Inventory to Impact Assessment. *Journal of Industrial Ecology* I.
- [5] Roy et al 2009. A review of life cycle assessment (LCA) on some food products. *Journal of Food Engineering* Vol. 90 Issue 1. p:1-10.
- [6] International Organization for Standardization. 2006. ISO 14040:2006 Environmental Management – Life Cycle Assessment – Principles and Framework. Geneva.

## **Study of characteristics floral and morphological hybrid rice parental lines on different seeding date**

**Pepi N. Susilawati<sup>1</sup>, Memen Surahman<sup>2,\*</sup>, Bambang S. Purwoko<sup>2</sup>,  
Tatiek K. Suharsi<sup>2</sup>, Satoto<sup>3</sup>**

<sup>1</sup> Institute for Agricultural Technology, Banten, Indonesia.

<sup>2</sup>Department of Agronomy and Horticulture, Bogor Agricultural University, Bogor  
16680, Indonesia

<sup>3</sup>Rice Research Center, Sukamandi, Indonesia

\*Corresponding author: memensurahman@yahoo.com

---

**Abstract** This research used four female inbred lines (CMS) and seven male inbred lines (restorer). The purpose was to study the flower characteristic and plant morphology of female inbred lines (CMS) and male inbred lines (restorer) of rice hybrid in relation to different planting period. This research was conducted at the Institute for Agricultural Technology, Province of Banten, Indonesia, from November 2012 to September 2013. The experiments used randomized complete block design with three replications. Each replication consisted of five plants so that the total experimental unit was 165 plants for one planting period. During this research was used four plating period namely: 1) November 2012 to February 2013, 2) January-April 2013, 3) April-July 2013 and 4) June-September 2013. The results showed that there was interaction between planting period and female inbred lines (CMS) in panicle exertion, stigma exertion, the duration of the flower opening, and the flower opening angle. The best plating period of all CMS lines is on June-September, where at the time the air temperature and the sun light duration was higher, while the relative humidity, rainfall and the number of rainy day is lower as compare to another planting period. The restorer lines were more stable as compared to CMS lines. During four times of planting period, restorer lines expressed consistently character (no variation between planting period) except in flower opening duration which influenced by the sun light duration. The pair of hybrid rice parental of Hipa 8, Hipa 5, Hipa 11 and Hipa 14 SBU showed the suitability on all observed variables.

**Keywords** rice, hybrid, characteristic, planting time

---

### **1. Introduction**

Research on flower characters and plant morphology is needed, especially in places that have never done such hybrid rice seed production in Serang

Banten. This is because the generative growth of rice plants is strongly influenced by environment, especially temperature. The results of this experiment can be used as a foundation in hybrid rice seed production further.

The purpose of this research is to study the differences in flower characters and plant morphology of female parent (CMS) and the male parent (R) of hybrid rice related to changes in the environment (different planting time).

## **2. Materials and Methods**

The study was conducted at the Experiment (KP) Singamerta, BPTP Banten. The study was conducted in four times of planting is 1) November 2012 until February 2013, 2) January to April 2013, 3) from April to July 2013 and 4) from June to September 2013.

The plant material used was 4 genotypes female parent (CMS) and 7 male parental genotypes (restorer). Female parents consists of A1 (parent of HIPA 5 Ceva and HIPA 8), A2 (parent of HIPA 6 Jete), A6 (parent of HIPA Jatim 3, HIPA 10 and HIPA 11) and A7 (parent of HIPA 14 SBU). Male parents were BR168 (HIPA 5), B8049f (HIPA 6), BP51-1 (HIPA 8), SR 88 (HIPA Jatim 3), Bio-9 (HIPA 10), IR40750 (HIPA 11) and BH33d-Mr-57 - 1-2-2 (HIPA 14 SBU). The plant material derived from the Rice Research Center, Sukamandi.

Observations by standard evaluation system for rice (SES) [1], includes the variables of female parent (CMS) and male parental lines (restorer) especially for flower characteristics.

## **3. Results and Discussion**

### **3.1. The variation of CMS character on the four time of planting**

The duration of the open flower is affected by the CMS line and by planting time. Planting time November to March resulted in the highest duration of open flower and does not vary with time of planting from June to October in line A1 and A2. Highest duration of open flower resulting in line A6 of CMS at the planting time from June to October of 101.31 minutes. Lowest duration of open flower was A1 CMS line at planting time from January to April at 43.23 minutes (Table 1).

Interaction between CMS line and planting time significantly affected the flower opening angle. In general, the time of planting from June to October

resulted in the highest opening angle on all the CMS lines (A7/2951°; A2/29.19°; A1/28.98V°) except line A6 CMS is best achieved at the time of planting from April to July 2013 (28.53°). Among lines produce different flower opening angle. A7 line produce the most wide-open angle compared to other CMS lines at all times except when planting time April. A1 line produces flower opening angle is not significantly different from line A6 at all times except at the time of planting time in June.

Table 1. Characteristics of flowering of CMS line at several different time of planting

Planting time	CMS line				Mean
	A1	A2	A6	A7	
Stigma exertion (%)*					
Nov 2012	34.0c	44.2ab	40.7abc	44.8ab	40.9
Jan 2013	40.7abc	32.0c	45.7ab	38.01bc	39.6
Apr 2013	34.7c	37.9bc	39.3abc	46.5ab	39.6
Jun 2013	48.5a	47.6ab	39.4abc	46.8ab	45.6
Average	39.5	40.4	41.3	44.1	41.3
Flower opening duration (minute)*					
Nov 2012	75.7bc	67.7bc	99.8b	50.9cd	73.5
Jan 2013	43.2e	49.6d	54.0cd	46.9de	48.5
Apr 2013	67.7b	66.1bcd	79.4bc	57.2cd	67.6
Jun 2013	62.6bcd	66.0bcd	101.3a	52.7cd	70.7
Average	62.3	62.4	83.6	51.9	65.1
Flower opening angle (°)*					
Nov 2012	28.4bc	26.3cd	26.2cd	31.9ab	28.2
Jan 2013	27.2cd	24.9d	27.7cd	28.0bc	27.0
Apr 2013	28.8ab	26.0cd	28.5bc	25.3cd	27.2
Jun 2013	29.0ab	29.2ab	27.7cd	32.2a	29.5
Average	28.4	26.6	27.5	29.4	27.9
Pollen Sterility (%)*					
Nov 2012	86.7	89.1	66.1	96.1	84.5
Jan 2013	100.0	95.5	68.8	94.6	89.7
Apr 2013	89.2	87.3	72.9	93.7	85.8
Jun 2013	91.4	96.8	65.9	90.1	86.0
Average	91.8a	92.2a	68.4b	93.6a	86.5
Spikelet number*					
Nov 2012	196.4	154.5	209.1	186.4	185.8
Jan 2013	181.7	167.5	210.6	186.6	171.6
Apr 2013	182.3	148.6	218.8	183.0	180.7
Jun 2013	217.9	170.5	206.9	187.2	188.1
Average	194.6b	160.3c	211.3a	185.8b	181.5

\* Figures followed by the same letter in each parameter are not significantly different by DMRT at level  $\alpha = 0.05$



### 3.2. The variation of restorer lines characters in four different planting times

Panicle length was not affected by planting time is also not different among lines. The mean panicle length among lines ranged 23.1 cm (PK88) to 24.9 cm (BH33d). While the average panicle length among planting time is relatively constant between 23.7-24.6 cm. Panicle lengths were stable between the times of planting. This is very advantageous because pollen transfer opportunities will be relatively the same.

The character of flower of restorer lines which include filament length, anther length and opening angle of flower only influenced by genotype lines and not influenced by time of planting. Line B8049 produces the longest filament length (8.1 mm) and no different from all other lines except with Bio-9 (6.4 mm) and IR40750 (4.6 mm). Anther length was not different for all lines except the line IR40750, the length of anthers was vary 2.0-2.3 mm. Likewise, the opening angle of flower is not different for all lines except the line Bio-9. Opening angle of flower ranging between 25.2°-30.9° (Table 2).

The duration of the open flower is influenced by time of planting and restorer lines. Between the times of planting, the duration of flowering does not different except with the time of planting from January to May 2013. Lines BP51-1 has the longest duration of open flower (63.5 minutes) and it is different with all lines except with Bio-9 (59.8 minutes), while the duration of open flower line BR168 was shortest (47 minutes).

Table 2. Characteristics of flower restorer lines in several different planting time

Planting time	Line							Mean
	BR168	B8049	PK88	BH33d	BP51-1	Bio-9	IR40750	
Filament length (mm)*								
Nov 2012	6.8	8.5	6.5	6.6	6.5	5.7	4.6	6.4
Jan 2013	7.3	8.4	7.9	7.1	7.1	6.4	5.3	7.1
Apr 2013	6.8	8.1	7.6	7.0	6.6	7.7	4.8	6.9
Jun 2013	5.7	7.3	6.8	6.9	6.3	5.7	3.8	6.1
Average	6.6ab	8.1a	7.2a	6.9ab	6.6ab	6.4b	4.6c	6.6
Anther length (mm)*								
Nov 2012	1.9	2.3	2.6	2.3	2.3	2.0	1.5	2.1
Jan 2013	2.2	2.1	2.3	2.3	2.5	2.1	1.7	2.2
Apr 2013	2.0	2.3	2.4	2.3	2.3	2.3	1.4	2.1
Jun 2013	1.8	1.9	1.7	2.1	2.0	1.8	1.5	1.8
Average	2.0ab	2.2a	2.22a	2.2a	2.3a	2.0ab	1.5b	2.1
Flower opening angle (°)*								
Nov 2012	25.9	34.8	25.0	27.9	27.3	24.5	26.1	27.4

Planting time	Line							Mean
	BR168	B8049	PK88	BH33d	BP51-1	Bio-9	IR40750	
Jan 2013	27.7	32.8	26.9	29.0	31.9	26.3	26.9	28.8
Apr 2013	27.3	29.5	28.1	30.0	30.3	26.3	27.6	28.4
Jun 2013	25.9	26.7	26.0	31.5	27.7	23.8	25.9	26.8
Average	26.7ab	30.9a	26.5ab	29.6ab	29.3ab	25.2b	26.6ab	27.8
Flower opening duration (minute)*								
Nov 2012	47.4	55.0	56.1	59.4	65.0	68.6	51.0	57.5ab
Jan 2013	43.9	48.4	51.7	59.3	53.2	49.7	56.8	51.8b
Apr 2013	44.9	53.0	57.5	48.6	71.6	57.3	56.4	55.6ab
Jun 2013	51.6	62.6	55.0	64.5	64.1	63.5	56.2	59.6a
Average	47.0c	54.7b	55.1b	57.9b	63.5a	59.8ab	55.1b	56.1

\* Figures followed by the same letter in each parameter are not significantly different by DMRT at level  $\alpha = 0.05$

#### **4. Conclusion**

1. There is interaction between the planting time and CMS line especially on variable of panicle exertion, stigma exertion, duration of flower opening and flower opening angle. The best planting time in all CMS lines is on from June to October.
2. Restorer line is more stable than CMS lines. During the time of planting four restorer lines produce consistent character (not significantly different between planting times) except for the duration of opening flower.

#### **5. References**

- [1] [IRRI] international Rice Research Institute. 2002. Standard Evaluation System of Rice (SES). IRRI, Philippines.
- [2] A. Sheeba, P. Vivekanandan, S.M. Ibrahim. 2006. Genetic variability for floral traits influencing outcrossing in the CMS lines rice. *Indian. J. Agric.* 40(4): 272-276

## **Natural grass and plant residue qualities and values to support lactating cows requirement on forage at Indonesian small scale enterprise and traditional dairy farming**

**Despal<sup>1,\*</sup>, Jazmi Malyadi<sup>1</sup>, Yessy Destianingsih<sup>1</sup>, Ayu Lestari<sup>1</sup>, Hari Hartono<sup>1</sup>, Luki Abdullah<sup>1</sup>**

<sup>1</sup>Department of Animal Nutrition and Feed Science, Faculty of Animal Science, Bogor Agricultural University, Bogor, 16680, Indonesia

\* Corresponding author: despal04@yahoo.com

---

**Abstract** Dairy farming land becomes scarce due to high land-use competition. To be survive, dairy farmer utilize locally available natural grass and agricultural by-product. Research to explore the availability of agricultural by-products, to assess their quality and to determine their values in supporting small enterprise and traditional dairy farming in Indonesia have been conducted in a 3 years serial project. The study have been conducted in small enterprise dairy estate area (KUNAK) Cibungbulang District, Bogor Regency and traditional dairy farming of KPSBU cooperative members in Lembang District, West Bandung Regency. The results showed that farmer in KUNAK only used the most available and commercially transported agricultural by-product (rice straw, cabbage plant by-product and corn stover in average percentage of 23.9, 0.6 and 0.98% out of 13.6 kg DM offered in wet seasons and 22.0, 2.77 and 0.17% out of 22 kg DM offered in drought season respectively), while farmer in Lembang used rice straw and banana leaves in wet season at percentage of 8.15 and 0.04% out of 24.34 kg DM offered and rice straw, vegetable plant byproduct, corn stover at amount of 3.2, 0.19 and 0.24% out of 23.4 kg DM offered in drought season. Although elephant grass is the major forage contributor for forage supply in both systems, however, natural grass contribution and plant by-product determined sustainability of dairy farming especially in drought season.

**Keywords** dairy, natural grass, plant by-product, traditional, small enterprise

---

### **1. Introduction**

Dairy farming is a land-based farming activity which needs land for forage supply, animal housing, waste treatment, feed storage, etc with stocking rate 2-3 livestock unit (LU)/ha (Sturaro et al., 2013) for dairy farming in Alpine mountain area to 10 LU/ha in Indonesia. Although dairy farming had been known to provide additional income for Indonesian farmers, dairy farming however was seen as landless farm activity (Riethmuller et al., 1999). Based

on Dairy National Survey (2012), average Indonesian dairy farmer cultivated only 0.44 ha of land to provide 6.07 LU cattle they kept. The land only sufficient to provide 62.7% of forage needed. Climate problem (46.3%) and lack of land (35%) have been reported to be the major limiting factor in providing sustainable good quality forage. To be survive, the farmer need to purchase or collect locally available or commercially transportable of plant residue such as rice straw, corn stover, horticulture plant residue beside collecting natural grass grown in surrounding the farm.

Contribution of the plant residue and natural grass to sufficiency of nutrient for dairy cattle in traditional and small scale dairy enterprise as well as detail information of their quality have not been explored. The study was aimed at providing information on natural grass and plant residue types and quality used by the farmer and calculating seasonal nutrient contribution in sustaining forage supply for dairy cattle.

## **2. Materials and Methods**

The study have been conducted in a small enterprise dairy estate area (KUNAK) Cibungbulang District, Bogor Regency and traditional dairy farming of KPSBU cooperative members in Lembang District, West Bandung Regency. Twenty farmers and 133 lactating cows in KUNAK and 30 farmers and 115 lactating cows in Lembang have been interviewed and observed. The type and amount of feed used have been identified, weighed and sampled. The feed were analyzed in laboratory for proximate composition (DM, ash, CP, lipid, and CF) according to Naumann and Bassler (1997) procedure, mineral contents (Ca and P) according to Reitz *et al.* (1987) preparation procedure and Taussky & Shorr (1953) procedure for P and AOAC (2003) procedure for Ca determinations. Rumen fermentability and digestibility followed one- and two-stage method of Tilley and Terry (1963). The VFA concentration have been measured using steam distillation method, while NH<sub>3</sub> concentration have been quantified using Conway micro diffusion method from General Laboratory Procedure Dept. Dairy Science Wisconsin University (1969). In vitro gas production, OMD, ME and NE<sub>l</sub> were determined using Hohenheim gas test (Close and Menke, 1986). The impact of seasons was tested using T-test, while other factors were compared using descriptive statistics.

## **3. Results and Discussions**

The type of natural grasses and plant residues offered to cows in KUNAK and KPSBU are shown in Table 1. Low quality plant residue such as rice straw was predominantly used by farmer in KUNAK both during drought

and rainy seasons. Farmer in KPSBU, however, only used the rice straw at the beginning of rainy season, when natural grass are limited and cultivated grass are still at the early stage of growth. Most of the time, cows in KPSBU were offered with high quality natural grass such as kakawatan, lameta, etc. In both location, high quality plant residue such as cabbage plant residue were only offered to limited numbers of cow due to lack of its availability. Detail quality of the natural grasses and plant residues are shown in Table 2.

**Table 1: Type of natural grasses and plant residue used**

Type of Forage	KUNAK (% cows)		KPSBU (% cows)	
	Drought	Rainy	Drought	Rainy
Natural Grasses (Local/Latin name)	4.58	10.53	-	-
Sasawuhan	-	-	16.52	14.8
Lampuyang/ <i>Panicumrepens</i>	-	-	10.43	10.4
Kakawatan/ <i>Cynodondactylon</i> Pers.	-	-	43.48	40.0
Lameta/ <i>Leersiahexandria</i>	-	-	40.00	29.6
Malela/ <i>Brachiariamutica</i>	-	-	19.13	9.6
RumputTeki/ <i>Cyperusrotundus</i> .L	-	-	6.09	-
Lamsani/ <i>Tricholaenarosea</i>	-	-	6.96	7.0
Plant residue				
Rice straw	73.28	72.93	7.83	31.3
Cabbage plant residue	32.83	6.77	4.35	-
Corn stover	8.40	2.26	2.61	-
Banana leaves	-	-	-	4.3
Blenung Leaves/ <i>Erythrina variegata</i>	-	-	5.22	-

Natural grass, rice straw and corn stover offered to cows in KUNAK contained low CP and high CF which led to low utilization by animals (low fermentability, digestibility, metabolizable and net energy). Cabbage plant residue which was high in quality lacked of its availability and had too high moisture content. Cows in KPSBU were also offered with rice straw and corn stover. However, their qualities were higher in compare to those that were offered to cows in KUNAK. It might be caused by soil fertility and light intensity (Brady and Weil, 1996). Poor quality soil combined with high light intensity produced fibrous late mature plant residue (Bazzaz, 1979). In KPSBU, the conditions were different however. Variety of natural grass and plant residues with high quality were locally available. In KUNAK, natural grasses were insignificantly contributed to total forage and ration in both seasons, but plant residues contributed to 40% of DM forage's or 25% to the total DM ration's needed. The contribution however, tent to supply high fiber but only limited CP and TDN especially during drought seasons. In opposite to KUNAK, farmer in KPSBU depended on natural grasses which contributed up to 30% to the DM forage supply or up to 16% to the DM ration and less depended on plant residue (only up to 15%).

Table 2. Quality of natural grasses and plant residues in KUNAK and KPSBU

Type of forage	Parameters													
	DM %	Ash	Fat	CP % DM	CF % DM	Ca	P	VFA mM	NH <sub>3</sub>	DMD	OMD %	TDN	ME MJ/kg DM	NEL
<b>KUNAK</b>														
Natural Grasses	24.25	8.49	2.30	5.49	26.19	0.05	0.12	96.21	3.96	37.30	36.69	69.93	6.24	3.39
Rice straw	18.52	17.89	1.33	6.72	26.27	0.04	0.10	141.75	6.95	34.08	34.34	44.18	5.93	3.17
Cabbage plant residue	6.00	11.40	1.56	19.34	12.73	0.24	0.16	135.89	15.36	83.38	84.91	75.79	10.04	6.10
Corn stover	20.18	3.33	0.75	4.63	26.33	0.05	0.15	75.27	5.75	47.25	49.63	47.86	6.93	3.91
<b>KPSBU</b>														
Sasawuhan Daman (Cibogo)	15.02	15.36	3.63	15.58	29.49	0.10	0.37	54.40	16.99	34.33	29.99	51.67	7.62	7.62
Lampuyang/ <i>Panicum repens</i>	23.32	6.60	2.09	12.72	27.02	1.35	0.09	133.65	6.77	46.21	45.32	64.81	7.84	7.20
Kakawatan/ <i>Cynodon dactylon</i> Pers.	28.05	10.77	2.01	14.05	30.02	0.09	0.22	92.26	8.92	39.14	94.40	59.08	6.88	7.90
Lameta/ <i>Leersia hexandria</i>	21.94	18.03	5.36	16.57	27.96	0.09	0.17	98.85	8.73	35.47	33.43	44.96	8.29	8.29
Malela/ <i>Brachiaria mutica</i>	22.09	12.44	1.79	11.92	26.88	0.06	0.33	130.90	14.41	58.23	56.39	61.57	8.03	8.03
Rumput Teki/ <i>Cyperus rotundus</i> .L	20.00	9.52	1.56	9.21	29.96	0.13	0.26	55.50	12.81	31.18	27.46	65.43	6.43	6.43
Lamsani/ <i>Tricholaena rosea</i>	13.16	11.26	2.05	14.67	29.43	0.13	0.27	88.33	13.34	43.11	41.10	59.24	7.18	7.18
Rice straw	34.41	16.49	1.65	8.97	29.38	0.07	0.12	44.06	13.12	27.54	28.43	50.51	5.01	3.42
Cabbage plant residue	5.92	12.30	1.92	28.17	11.67	0.09	0.16	135.89	15.36	83.38	84.91	61.58	10.04	6.10
Corn stover	22.41	15.07	2.34	13.29	22.19	0.25	0.25	131.32	11.72	45.53	44.86	57.57	5.72	5.65
Banana leaves	23.30	13.16	5.59	14.05	18.87	0.57	0.18							
Blenung Leaves/ <i>Erythrina</i> <i>variegata</i>	17.15	9.10	2.01	24.12	32.46	0.24	0.29	164.91	11.98	40.13	43.30	55.57	6.77	6.77

Table 3. Proportion and contribution of natural grass and plant residues in cows daily ration (%)

Parameters	Contribution to total forage				Contribution to total ration				
	KUNAK		KPSBU		KUNAK		KPSBU		
	drought	rainy	drought	rainy	drought	rainy	drought	rainy	
Natural grasses									
DM	2.77	5.72	28.11	15.59	1.87	3.6	15.77	11.5	
CP	3.17	5.03	26.28	22.23	1.59	1.92	15.88	13.58	
CF	2.93	5.67	27.4	19.41	2.14	3.85	20.85	18.84	
TDN	3.21	1.52	26.68	19.01	2.4	1.43	13.96	10.33	
Plant residues									
DM	38.54	48.91	5.29	14.14	24.91	25.52	3.73	8.2	
CP	18.71	38.75	5.17	7.76	10.72	18.92	3.91	4.7	
CF	39.01	47.05	5.12	15.6	27.71	29.23	4.17	11.54	
TDN	28.25	43.04	5.26	11.63	19.52	22.9	3.48	5.94	
Natural grass + Plant residues									
DM	41.31	54.63	33.4	29.73	33.4	26.78	29.12	19.5	
CP	21.88	43.78	31.45	29.99	31.45	12.31	20.84	19.79	
CF	41.94	52.72	32.52	35.01	32.52	29.85	33.08	25.02	
TDN	31.46	44.56	31.94	30.64	31.94	21.92	24.33	17.44	

In total, non-cultivated forages were contributed more than 50% to the total forages' needed in KUNAK and up to 34% in KPSBU. The forage played higher role during rainy season in KUNAK but drought season in KPSBU which showed that at higher number of animal kept and centralized area of dairy farming like in KUNAK, forage insufficiency were more significant in both seasons than in traditional smallholders dairy farmer which increase their difficulties in getting forage if the drought seasons come.

#### 4. References

- [1] [AOAC] Association of Official Analytical Chemist. 2003. *Official Method of Analysis of the Association of Official Analytical of Chemist*. Virginia (US): Association of Official Analytical Chemist Pr.
- [2] W. Close and K.H. Menke. 1986. "Selected Topics in Animal Nutrition". DSE, Stuttgart.
- [3] Dairy National Survey (2012). Dairy performance measurement as based for dairy cattle development planning in Indonesia. Collaboration between Directorate General for Livestock Service and Animal Health, Indonesian Ministry of Agriculture with Faculty of Animal Science Bogor Agricultural University.
- [4] General Laboratory Procedure. 1966. *Report of Dairy Science*. Madison (USA): University of Wisconsin.

- [5] C. Naumann and R. Bassler. 1997. VDLUFA-Methodenbuch Band III, Die chemische Untersuchung von Futtermitteln. 3rd ed. VDLUFA-Verlag, Darmstadt, Germany.
- [6] L.L. Reitz, W.H. Smith and M.P. Plumlee. 1987. Animal Science Department. West Lafayette: Purdue Univ Pr.
- [7] P.J. Riethmuller, J. Chai, D. Smith, B. Hutabarat, B. Sayaka and Y. Yusdja. 1999. The mixing ratio in the Indonesian dairy industry. *Agricultural Economics* 20(1) : 51 – 56
- [8] H.H. Taussky and E. Shorr. 1953. A micro colorimetric method for the determination of inorganic phosphorus. *J Biol Chem* (202) :675-685.
- [9] J.M.A. Tilley and R.A.Terry. 1963. A two stage technique for the *in vitro* digestion of forage crop. *J of British Grassland*. 18:104-111.
- [10] N.C. Brady and R.R. Weil. 1996. The Nature and Properties of Soils. 11<sup>th</sup> ed. Upper Saddle River, N.J. Prentice Hall.
- [11] F.A. Bazzaz. 1979. The physiological ecology of plant succession. *Ann. Rev. Ecol. Syst.* 10:351-371



## Effect of seed density and nutrient source on production and quality of green house fodder as dairy cattle feed

Idat G. Permana<sup>1,\*</sup>, Despal<sup>1</sup>, Dara Melisa<sup>1</sup>

<sup>1</sup>Department of Animal Nutrition and Feed Technology  
Faculty of Animal Science, Bogor Agricultural University, Bogor, 16680, Indonesia

\* Corresponding author: permana@ipb.ac.id

---

**Abstract** This study examined the effect of seed density and biogas bioslurry on production and quality of green house fodder. Corn grain was grown for 9 days in greenhouse under hydroponic system. The density of corn seed were D1 (350 g/tray or 36 g/100 cm<sup>2</sup>), D2 (450 g/tray or 46 g/100 cm<sup>2</sup>) and D3 (500 g/tray or 51 g/100 cm<sup>2</sup>) and the tray size was 28 x 35 cm. The nutrient solution were N1 (100% commercial nutrient solution), N2 (75% commercial nutrient solution: 25% biogas bioslurry) and N3 (50% commercial nutrient solution: 50% biogas bioslurry). This experiment used a factorial design (3x3x3) and data analyzed using ANOVA and Duncan's Multiple Range Test. The parameters studied were fresh and dry matter (DM) corn fodder production, *in vitro* dry matter digestibility (IVDMD) and *in vitro* organic matter digestibility (IVOMD). Fresh fodder production was significantly ( $p < 0.01$ ) influenced by increasing of the seed density. The seed density of D3 and D4 produced significantly ( $p < 0.05$ ) higher than D1, the fresh fodder production of D1, D2 and D3 were 715, 855 and 933 g/tray respectively. The use of 25% bioslurry (N2) as substitute the commercial nutrient solution was no significant effect on production compared with commercial nutrient solution. However, the use of 50% of bioslurry (N3) decreased the fresh fodder production. The seed density and nutrient solution were no significant effect on DM corn fodder production, however, had significant effect ( $p < 0.05$ ) on IVDMD and IVOMD of corn fodder. The highest IVDMD and IVOMD were observed in N2 (84.8 and 85.3%). Based on the results, it can be concluded that the application of 25% bioslurry as nutrient source and medium seed density (46 g/100 cm<sup>2</sup>) will improve fresh corn fodder production and digestibility.

**Keywords** bio-slurry, corn, dairy, density, hydroponics

---

### 1. Introduction

Increasing population of Indonesian resulted massive agricultural land conversion which leads to decreasing land availability for fodder productions that are needed to maintain ruminant healthy life [1]. Land intensity with vertical farming such as hydroponic system could be used as

an alternative to solve the problem. Hydroponic is a method of growing plants in nutrient solutions without soil [2]. Fodders produced from hydroponic system have better protein, highly digested and metabolizable energy [3]. One fodder that could be grown in the system is corn.

Corn is a C4 plant which well adaptive to several productions constrain [4]. The corn has advantage for fast growing and highly nutritious. The maximum corn production will be reached at optimum seed density [5] which related to the ability of the seed to compete in uptake nutrient, water and light [6]. Providing sufficient space and nutrient source will reduce the competition.

Biogas is a method to produce renewable energy from biomass such as cattle dung. The system is less popular among Indonesian smallholder dairy farmer due to lack of benefit to cost ratio. An effort to increase farmer benefit through utilizing the biogas byproduct such as bio-slurry will stimulate the farmer. Bio-slurry contained effective nitrogen and mineral that could be used as nutrient source in hydroponic system.

The research is aimed at finding corn seed density and level of bio-slurry application to produce the best corn green house fodder production for dairy cattle.

## **2. Materials and Methods**

The research has been carried out in IPB University Farm (UF) green house facilities and Dairy Nutrition Laboratory. Combination of seed density (D) and nutrient solution (N) have been studied. Factor seed density D1 (350 g/tray or 36 g/100 cm<sup>2</sup>), D2 (450 g/tray or 46 g/100 cm<sup>2</sup>) and D3 (500 g/100 cm<sup>2</sup>) and factor nutrient solution N1 = 100% commercial nutrient solution (CNS), N2 = 25% bio-slurry + 75% CNS and N3 = 50% bio-slurry + 50% CNS have been studied in a completely randomized factorial (3 x 3) design with 3 replications.

Corn seed from local market were used. The seed were washed and soaked (24 h) prior to incubation. The seed were spread in a 28 x 35 cm tray and incubated for 8 d. The trays were watered every 1 – 2 h to wet the seed surface. Plant growth was observed daily. Harvest was conducted at day 9. The fresh fodder production were weighted and dried to obtained fresh biomass and DM production. Nutrient content and utilization for animal were tested after drying the sample in a 60°C oven for 48 h. The dried

samples were ground and analyzed for proximate composition (DM, ash, CP, lipid, and CF) according to Naumann and Bassler (1997) procedure [7], rumen fermentability and digestibility followed one- and two-stage methods of Tilley and Terry (1963) [8], VFA concentration used steam distillation method, while NH<sub>3</sub> concentration followed Conway micro diffusion method from General Laboratory Procedure Dept. Dairy Science Wisconsin University (1969) [9].

The impact of seed density (D) and nutrients source (N) on parameters were tested using ANOVA followed by Duncan Multiple Range Test.

### **3. Results and Discussion**

The yield and quality of sprouts produced in hydroponic fodder system is influenced by temperature, humidity, grain quality, grain variety and treatments, soaking time, nutrient supply, depth and density of grain in troughs and the incidence of mould [10]. Corn growth, production and its nutrient content in this experiment are shown in Table 1. There was no effect of seed density on corn height. Nutrient source however, did influence the corn height. Utilization of bio-slurry for up to 25% did not significantly reduced corn height. It showed that density of seed used in this experiment gave enough space for seed to germinate and growth and no significant competition have been occurred.

In this experiment, fresh fodder productions were influenced by seed density and nutrient sources. Utilization up to 25% bio-slurry tent to increase fresh fodder weight from 884 g to 901 g but the production then significantly decreased if bio-slurry level were added. Bio-slurry is a good nutrient source for the fodder growth. However, if it is used too much, the slurry will covered leaf stomata, prevented CO<sub>2</sub> passed into internal space within the leaf and diffused into mesophyll cell which will inhibit photosynthesis. The dirt in the slurry becomes pollutant to the plant. Beside pollutant, stomata are also influenced by several environmental variables such as quantum flux density, relative humidity, temperature, carbon dioxide concentration and media moisture [11]. Decreasing CO<sub>2</sub> concentration passed into internal space within the leaf, decreased photosynthesis rate on the N3 treatment which leads to less biomass production.

Increasing seed density produced more weight on fresh fodder because more space area of the seed to absorb nutrient from media and photosynthesis conducted. Up to 51 g seed per 100 cm<sup>2</sup> were adequate and

there were no competition between seed in getting nutrient, water and light were observed by mean of decreasing biomass production and germination rate.

Table 1. Plant height, fresh and dry matter fodder production and nutrition quality

	Seed density	Nutrient source			Average $\pm$ STD
		N1	N2	N3	
Plant Height (cm)	D1	28.37 $\pm$ 6.40	29.13 $\pm$ 6.76	19.60 $\pm$ 6.26	25.72 $\pm$ 7.26
	D2	28.80 $\pm$ 4.69	24.90 $\pm$ 5.07	25.50 $\pm$ 5.07	26.40 $\pm$ 4.65
	D3	30.5.09 $\pm$ 1.75	25.70 $\pm$ 4.66	21.37 $\pm$ 1.93	25.73 $\pm$ 5.22
	AVG $\pm$ STD	29.10 $\pm$ 0.92 <sup>a</sup>	26.60 $\pm$ 2.29 <sup>a</sup>	22.16 $\pm$ 3.03 <sup>b</sup>	
Fresh fodder weight (g)	D1	674 $\pm$ 140.87	862.33 $\pm$ 127.25	610 $\pm$ 143.72	715.44 $\pm$ 164.55 <sup>b</sup>
	D2	923.67 $\pm$ 81.13	929.33 $\pm$ 159	712 $\pm$ 251.17	855 $\pm$ 187.74 <sup>a</sup>
	D3	1055.67 $\pm$ 113.17	912.33 $\pm$ 86.03	830.33 $\pm$ 39.40	932.78 $\pm$ 123.27 <sup>a</sup>
	AVG $\pm$ STD	884.44 $\pm$ 193.83 <sup>a</sup>	901.33 $\pm$ 34.83 <sup>a</sup>	717.44 $\pm$ 110.27 <sup>b</sup>	
Water contents (%)	D1	74.94 $\pm$ 0.32	70.11 $\pm$ 0.33	69.81 $\pm$ 0.18	71.62 $\pm$ 2.50
	D2	75.45 $\pm$ 0.20	69.80 $\pm$ 0.41	69.89 $\pm$ 0.26	71.72 $\pm$ 2.82
	D3	74.70 $\pm$ 0.51	70.00 $\pm$ 0.22	70.15 $\pm$ 0.19	71.62 $\pm$ 2.33
	AVG $\pm$ STD	75.03 $\pm$ 0.38 <sup>b</sup>	69.97 $\pm$ 0.16 <sup>a</sup>	69.95 $\pm$ 0.18 <sup>a</sup>	
Ash content (% DM)	D1	7.93 $\pm$ 2.89	5.11 $\pm$ 2.50	4.47 $\pm$ 0.19	5.84 $\pm$ 2.49 <sup>a</sup>
	D2	5.11 $\pm$ 3.47	5.99 $\pm$ 0.71	5.38 $\pm$ 2.36	5.49 $\pm$ 2.16 <sup>a</sup>
	D3	4.75 $\pm$ 1.46	2.77 $\pm$ 0.24	2.64 $\pm$ 0.25	3.39 $\pm$ 1.27 <sup>b</sup>
	AVG $\pm$ STD	5.93 $\pm$ 1.74	4.62 $\pm$ 1.67	4.16 $\pm$ 1.39	
Protein content (% DM)	D1	14.09 $\pm$ 1.52	12.94 $\pm$ 0.88	12.68 $\pm$ 0.91	13.24 $\pm$ 1.18
	D2	14.57 $\pm$ 1.58	13.97 $\pm$ 2.43	14.76 $\pm$ 0.40	14.43 $\pm$ 1.50
	D3	13.83 $\pm$ 0.46	14.12 $\pm$ 1.89	13.74 $\pm$ 1.39	13.90 $\pm$ 1.21
	AVG $\pm$ STD	14.16 $\pm$ 0.38	13.68 $\pm$ 0.64	13.73 $\pm$ 1.04	
Crude fibre content (% DM)	D1	3.92 $\pm$ 1.89	4.21 $\pm$ 1.63	4.69 $\pm$ 0.83	4.27 $\pm$ 1.36
	D2	5.39 $\pm$ 0.82	5.54 $\pm$ 1.13	4.97 $\pm$ 1.45	5.30 $\pm$ 1.04
	D3	4.48 $\pm$ 0.22	4.59 $\pm$ 1.61	2.84 $\pm$ 0.19	3.97 $\pm$ 1.18
	AVG $\pm$ STD	4.60 $\pm$ 0.74	4.78 $\pm$ 0.68	4.17 $\pm$ 1.16	
Crude lipid content (% DM)	D1	5.40 $\pm$ 1.45	3.36 $\pm$ 1.76	4.29 $\pm$ 0.30	4.35 $\pm$ 1.45
	D2	4.70 $\pm$ 0.18	4.47 $\pm$ 0.52	2.99 $\pm$ 1.29	4.05 $\pm$ 1.07
	D3	3.94 $\pm$ 0.31	3.80 $\pm$ 0.15	3.86 $\pm$ 0.05	3.87 $\pm$ 0.19
	AVG $\pm$ STD	4.68 $\pm$ 0.73	3.88 $\pm$ 0.56	3.72 $\pm$ 0.66	
VFA (mM)	D1	160.51 $\pm$ 27.91	147.96 $\pm$ 21.48	131.38 $\pm$ 32.16	146.62 $\pm$ 27.00
	D2	152.41 $\pm$ 23.94	132.44 $\pm$ 32.39	130.91 $\pm$ 25.08	138.59 $\pm$ 25.90
	D3	193.81 $\pm$ 74.90	153.79 $\pm$ 16.84	167.73 $\pm$ 94.24	171.78 $\pm$ 63.27
	AVG $\pm$ STD	168.91 $\pm$ 21.94	144.73 $\pm$ 11.03	143.34 $\pm$ 21.12	
NH <sub>3</sub> (mM)	D1	5.29 $\pm$ 0.37	4.23 $\pm$ 0.24	4.82 $\pm$ 0.46	4.78 $\pm$ 0.56
	D2	5.19 $\pm$ 0.99	5.21 $\pm$ 2.78	5.57 $\pm$ 2.37	5.32 $\pm$ 1.90
	D3	3.79 $\pm$ 0.22	4.70 $\pm$ 0.36	4.39 $\pm$ 2.23	4.29 $\pm$ 1.20
	AVG $\pm$ STD	4.76 $\pm$ 0.84	4.71 $\pm$ 0.49	4.93 $\pm$ 0.59	

Seed density	Nutrient source			Average $\pm$ STD	
	N1	N2	N3		
IVDMD (%)	D1	77.51 $\pm$ 2.18	85.24 $\pm$ 3.28	76.39 $\pm$ 1.28	79.71 $\pm$ 4.66 <sup>b</sup>
	D2	74.28 $\pm$ 0.55	84.62 $\pm$ 1.64	85.53 $\pm$ 2.39	81.48 $\pm$ 5.61 <sup>b</sup>
	D3	85.92 $\pm$ 2.71	84.59 $\pm$ 1.89	87.05 $\pm$ 1.16	85.86 $\pm$ 2.05 <sup>a</sup>
	AVG $\pm$ STD	79.24 $\pm$ 6.01 <sup>b</sup>	84.82 $\pm$ 0.37 <sup>a</sup>	82.99 $\pm$ 5.76 <sup>a</sup>	
IVOMD (%)	D1	78.99 $\pm$ 1.46	85.80 $\pm$ 3.23	78.58 $\pm$ 1.52	81.12 $\pm$ 4.01 <sup>b</sup>
	D2	76.54 $\pm$ 0.75	84.99 $\pm$ 1.12	85.77 $\pm$ 2.54	82.43 $\pm$ 4.66 <sup>b</sup>
	D3	86.25 $\pm$ 2.99	85.01 $\pm$ 1.63	87.48 $\pm$ 1.10	86.25 $\pm$ 2.09 <sup>a</sup>
	AVG $\pm$ STD	80.60 $\pm$ 5.05 <sup>b</sup>	85.26 $\pm$ 0.46 <sup>a</sup>	83.94 $\pm$ 4.73 <sup>a</sup>	

Water contents of corn fodder decreased by inclusion of bio-slurry (N2 and N3) but did not influence by seed density. It might caused by water content of N2 and N3 were lower than N1. It can be also seen from the cleanliness of the media solutions. AB mix solution (N1) was cleaner than bio-slurry (N2 and N3). Ash content in the green fodder was lower for higher density seed application. Which might show that the mineral content in bio-slurry contained media was less available for plant to uptake. There were no effects of treatments on protein and crude fiber contents of the fodder as well as to the fodder fermentability as have been measured from VFA and NH<sub>3</sub> parameters. The treatments influenced both IVDMD and IVOMD in the same patterns. IVDMD and IVOMD increased in line with increasing seed density and level of bio-slurry.

It can be concluded that application of corn seed at density 51 g/100 cm<sup>2</sup>tray did not produce competition between the seeds in getting nutrient, light and water. Utilization of bio-slurry however is only effective up to 25% as nutrient source to replace commercial nutrient solution ABmix.

#### 4. References

- [1] A. Sofyan. 2010. Pedomam Teknis Perluasan Areal Kebun Hijauan Makanan Ternak. (ID): Kementerian Pertanian, Jakarta.
- [2] M.R. Mugundhan, M. Soundaria, V. Maheswari, P. Santhakumari and V. Gopal. 2011. "Hydroponics"- a novel alternative for geoponic cultivation of medicinal plants and food crops. Intern. J. of Pharma and Bio Sci. 2(2): 286-296.
- [3] J. Mooney. 2002. Growing Cattle Feed Hydroponically. Australian Nuffield Farming Scholars Association. Meat and Livestock, Australia.
- [4] P.R. Goldsworthy, N. M. Fisher. 1980. Fisiologi Tanaman Budidaya Tropik. (ID): Universitas Gadjah Mada Press, Yogyakarta.

- [5] N.N.A. Mayadewi. 2007. Pengaruh jenis pupuk kandang dan jarak tanam terhadap pertumbuhan gulma dan hasil jagung manis. *Agritrop* 26 (4): 153–159.
- [6] B.E. Gonggo, Turmidi, W. Brata. 2003. Respon pertumbuhan dan hasil ubi jalar pada sistem tumpangsari ubi jalar jagung manis di lahan bekas alang-alang. *J. Ilmu-Ilmu Pertanian Indonesia*. 5(1): 34-39.
- [7] C. Naumann, R. Bassler. 1997. *VDLUFA-Methodenbuch Band III, Die chemische Untersuchung von Futtermitteln*. 3rd ed. VDLUFA-Verlag, Darmstadt, Germany.
- [8] J.M.A. Tilley and R.A.Terry. 1963. A two stage technique for the *in vitro* digestion of forage crop. *J. of. Brit. Grassland*. 18:104-111.
- [9] General Laboratory Procedure. 1966. Report of Dairy Science. University of Wisconsin, Madison.
- [10] R. Sneath, F. McIntosh. 2003. Review of Hydroponic Fodder Production for Beef Cattle. Project Report no.NBP 322. Meat & Livestock Australia Limited. Locked Bag 991 North Sydney NSW
- [11] N.C. Turner. 1991. Measurement and influence of environmental and plant factors on stomatal conductance in the field. *Agricultural and Forest Meteorology*. 54 (2 – 4): 137–154.

**WORKING GROUP 3:  
SCIENCE-POLICY INTERFACING ON BIO-  
RESOURCE CONSERVATION AND UTILIZATION**

---

1. Tropical rain forest in Kalimantan as source of medicinal plants; a case study at Dayak Meratus ethnic in South Kalimantan (*Yudi Firmanul Arifin, Siti Hamidah*)
2. Gambir development for rural economy: between policy and people aspiration (*Andy Ahmad Zaelany*)
3. Conservation of wildlife bio-resource management for livelihood (*Retno Iswarin Pujaningsih*)
4. Market integration analysis of sweetened condensed milk in Indonesia: do sweetened condensed milk prices follow the prices of imported milk and sugar? (*Venty Fitriany Nurunisa, Bonar M. Sinaga, Ratna Winandi A., Bernhard Brümmer*)
5. Trend analyses of forest and land fires towards climate change in Indonesia (*Lailan Syaufina*)
6. Agroforestry based medicinal plants and marketing partnership for community empowerment: cases in Bogor district and Sukabumi district, West Java province (*Leti Sundawati, Ninuk Purnaningsih, Edy Djauhari Purwakusumah*)
7. A survey on the community socio-economic of the district of coral reef rehabilitation and management program (COREMAP) of Sikka Flores (*Vincentius Repu*)
8. Influence of leadership style, organizational culture, and work motivation on employee performance in public company pawnshop branch office company in the Kupang city East Nusa Tenggara, Indonesia (*Fred Marthinus Dethan*)
9. Management of natural resources in tropical peat swamp forest of Indonesia (*Ujang Suwarna*)
10. Analysis of the competitiveness of pangasius fish farming in Kota Gajah sub-district, Lampung Tengah district, Lampung province (*Angga Yudhistira, Harianto, Bernhard Brümmer, Stephan Wessels, Nunung Kusnadi*)
11. The sustainability of coffee plantation in West Lampung, Lampung province, Indonesia (*Yeti Lis Purnamadewi*)

12. The importance of biodiversity conservation and livelihood of customary community approaching in national park management in Indonesia (*Nandi Kosmaryandi, Sambas Basuni, Lilik B Prasetyo, Soeryo Adiwibowo*)
  13. Competitiveness analysis of Indonesian shrimp farming, case study: PT. Surya Windu Kencana, East Java (*Siti Maryam, Bernhard Brümmer, Gabriele Hörstgen-Schwark, Rachmat Pambudy*)
  14. Competitiveness and policy impact analysis of feedlots in Lampung (*Labudda Paramecwari, Bernhard Brummer, Stefan Schwarze, Rachmat Pambudy*)
  15. The Contribution of Agricultural Sector Towards Culinary Business Development at Kupang Municipality East Nusa Tenggara Province (*Markus Bunga*)
  16. The Morphological Character of the “Bendi” Horse as Short Distance Urban Transport Modes that are Environmentally Friendly (*Sri Adiani, Dordia A. Rotinsulu, Ben J Takaendengan*)
  17. The diversity of fungi on polluted mangrove ecosystem at Belawan and Jaring Halus, North Sumatra province (*Yunasfi, Pindi Patana*)
  18. Natural products exploration in frame of tropical plant bio-resource conservation and utilization (*Enih Rosamah, Harlinda Kuspradini, Rita Khairani*)
  19. The impact of trade policy on international palm oil trade flows (*Riska Pujiati, M Firdaus, Andriyono K Adhi*)
-



## **Tropical rain forest in Kalimantan as source of medicinal plants: a case study at Dayak Meratus ethnic in South Kalimantan**

**Yudi F. Arifin<sup>1,\*</sup>, Siti Hamidah<sup>1,2</sup>**

<sup>1</sup>Faculty of Forestry, Lambung Mangkurat University, Indonesia

<sup>2</sup>Consortium for Sustainable Tropical Forest Management, Indonesia

\* Corresponding author: yudifirmanul@yahoo.com

---

**Abstract** Indonesia has high biodiversity of plants, among of them are medicinal plants. Hulu Sungai Selatan where is one of districts in South Kalimantan focused in this research. Here found the ethnic Dayak Meratus who was using many plants in forest for medicinal plants. This study investigated the potency, habitat including environmental factors which influence the distribution of medicinal plants and the using it for local people. The research based on survey method, interview and qualitative phytochemical test. Here found of 27 species medicinal plants consist of grass group, scrub, liana and tree on highland and one tree species on lowland. They distributed on habitat around the river where soil type is podsolic and altitude of 250 – 429 m asl for highland and 0-50 m asl for lowland. Most of these species grow in temperature of 27 – 31 °C, humidity of 63 – 79% and gap areas in secondary forest. The Ethnic Dayak Bukit, who use it for healing many diseases, such as diarrheal, dysentery, diabetes and so on. Result of qualitative phytochemical test was most of medicinal plants content high alkaloids, saponins, flavonoids, tannins and steroids which it can be used for antidiarrhoeal and antibacterial.

**Keywords** medicinal plants, environmental factors, plant distribution, phytochemical test

---

### **1. Introduction**

The diversity of flora in the tropical rain forest in Borneo is reflected in the plants richness, in the form of trees, bushes, shrubs, vines (lianas), epiphyt, algae, microorganisms, and fungi. A group of plant species was known as medicinal plants. It can be perceived efficacy for the locals. Actually the potency of medicinal plant species in tropical forests of Indonesia is very high, but it was not known the spreading in natural populations.

Utilization of medicinal plants for each ethnic / regional is differences both in terms of species and the composition of the medicinal plants. This is of course raises the attractiveness for the development of commercial

utilization of medicinal plants that benefit from an economic and also an opportunity for diversification of products, but the other hand stimulates the increased harvesting of medicinal plants from the forest.

The absence of accurate data for habitat and potency is one of the critical point of the effort to conserve the use of medicinal plants in Indonesia. Policies regarding these medicinal plants remain focused on its use alone, not explicitly touch the conservation efforts of medicinal plants as raw material.

## **2. Materials and Method**

### **2.1. Phase I (Inventory to determine potential)**

- a) Observations began with the introduction of the existence of medicinal plants in the study site, which is monitored through reports and information from the local community.
- b) The locations were surveyed using a transect method. At each transect plot observations made with the size of 20 x 20 m. Each transect length of 1000 meters. Observed were all known species of medicinal plants traditionally efficacious as a medicine, as well as the ecological state of the plant. Results of survey obtained the potential and ecological site of each species, as well as dissemination areas of medicinal plants in the area.
- c) Data are tabulated plants and made distribution maps, habitats and ecological conditions of each medicinal plant, as the cultivation and conservation efforts.

### **2.2. Phase II (phytochemical test)**

Qualitative phytochemical analysis was conducted to determine the content of each plant. The parameters are tested on each specimen, such as alkaloids, glycosides, saponins, flavonoids, tannins, phenolics, steroids and triterpenoid. The plant parts were sampled tested, determined based on the information from the local community about roots, leaves and bark,

## **3. Results and Discussion**

### **3.1. Results**

Result of research at Loksado Sub-District, Hulu Sungai Selatan District obtained 27 species of plants as medicinal plants, but in this paper only presented 11 dominant species, comprising; classes of grass, shrubs, lianas (climbing plants), shrubs and trees. All these plants are used for generations by Dayak Meratus Ethnic around the mountains of Meratus. In detail the

species of medicinal plants along with the potential and usability can be seen in Table 1.

**Table 1. Kinds of species dominant, potency and usefulness**

No	Botanical name	Local name	Vegetation type	Potential	Part of Morfologi-cal used	Usefulness
1	<i>Chromolaena odorata</i>	Kerinyu	Shrubs	great*)	Leaf	Stomachache & wound
2	<i>Vitex pubescens</i>	Alaban	tree	25 stems/ha	bark	stiff
3	-	Pikajar**)	grass	200 clumps/ha	leaf	increase men's stamina
4	<i>Melastoma affine</i>	Uduk uduk	shrubs	great*)	leaf	for women
5	<i>Blumea balsamifera</i>	Capa	shrubs	375 stems/ha	leaf	stomachache
6	<i>Parastemum cerophyllum</i>	Waringin	tree	50 stems/ha	leaf	headache
7	<i>Flacourtia rukam</i>	Rukam	tree	250 stems/ha	root	diabetes
8	<i>Spatholobus</i> sp.	Dibilas	liana	great*)	root	diarrhea
9	<i>Lasianthus constrictus</i>	Katubar	liana	600 stems/ha	root	vomiting & diarrhea
10	<i>Tristania maingayi</i>	Palawan	tree	175 stems/ha	water rods	thrush
11	<i>Nothaphoebe</i> spp	Gemor	tree		bark	anti-oxidant

Information: \*) It can not be calculated, but it looks very abundant and spread evenly

\*\*\*) Not Identified

Most of these plants have great potential and spread equitable, as occupying a very suitable habitat for life. Factors that affect the metabolic processes in plants are micro environmental factors which plants are located [1]. Micro environmental factors in each species above can be seen in Table 2.

**Table 2. Altitude and micro environmental factors of each plant**

No	Botanical name	Local name	Altitude (m asll)	Light intensity (Lux)	Temperature (°C)	Humidity (%)
1	<i>Chromolaena odorata</i>	Kerinyu	401,1	22800	31	63
2	<i>Vitex pubescens</i>	Alaban	267,3	480	27	76
3	-	Pikajar	250,2	1100	28	79
4	<i>Melastoma affine</i>	Uduk uduk	401,1	22800	31	63
5	<i>Blumea balsamifera</i>	Capa	401,1	22800	31	63
6	<i>Parastemum cerophyllum</i>	Waringin	401,1	22800	31	63
7	<i>Flacourtia rukam</i>	Rukam	429,3	3280	25	79
8	<i>Spatholobus</i> sp.	Dibilas	345,6	1000	28	67
9	<i>Lasianthus constrictus</i>	Katubar	250,2	1100	28	79
10	<i>Tristania maingayi</i>	Palawan	401,1	1410	27	69
11	<i>Nothaphoebe</i> spp	Gemor	0-50		21-32	88 - 99

Information: m asll: meters above sea level

The medicinal plants in Loksado Sub-District live at an altitude between 250-429 m above sea level, with varying light intensity of 480-22800 Lux. 22800 Lux is an open area without shade, whereas under the auspices of 22800 Lux means the plants need shading for live.

Growing up of plant is depend on temperatures, it will reach optimum growth rate, when the temperature is at optimum conditions [2]. Temperature is correlated with the light-harvesting, so that high light intensity causes the temperature too high. Most medicinal plants live with temperatures above 31°C or without shading, so it is appropriate development in secondary forests with the optimum temperature.

Soil temperature is closely related to water uptake by plant roots [2], soil temperature determines the proper balance of water in the growing crop. Medicinal plants above ground living at temperatures between 20-29 °C. High soil temperatures found in plants are intolerant, such as; *Chromolaena odorata*, *Melastoma* sp., *Capa*, *Parastemun cerophyllum*.

Table 3. The phytochemical content of 10 species

N o	Botanical name	Local name	Alkalo- id	Gliko- sida	Saponin	Flavo- noid	Tanin	Steroid	Fenolik	Triter- penoid
1.	<i>Urena lobata</i>	Kerinyu	++++	-	+++	++++	++++	+++	+	+
2.	<i>Vitex pubescens</i>	Alaban	++	+	++++	+	+++	-	-	++++
3.	-	Pikajar	++++	-	+++	-	-	++	+	+
4.	<i>Melastoma affine</i>	Uduk uduk	+++	+	++++	++	++	+++	+	-
5.	<i>Blumea balsamifera</i>	Capa	++++	-	-	++++	-	+++	-	-
6.	<i>Parastemun cerophyllum</i>	Waringin	++++	+	++	+	++	+++	-	++
7.	<i>Flacourtia rukam</i>	Rukam	+++	-	+++	++	-	-	+++	+++
8.	<i>Spatholobus</i> sp.	Dibilas	++++	+	++++	++++	+	++	+++	+++
9.	<i>Lasianthus constrictus</i>	Katubar	++++	+	++++	+	+	++++	++	+++
10	<i>Tristania maingayi</i>	Palawan*)								

Alkaloids, tannins, saponins, flavonoids and triterpenoids can be used as an anti-diarrheal [3, 4]. Tannins, alkaloids, saponins, flavonoids, sterols and triterpenoids can be used as an anti-diarrheal and anti-dysentery [3,4]. Flavonoids, tannins and saponins also can be used as an anti-inflammatory [5], tannins, saponins and glikosid also used for anti-microbial [6, 7]. Tannins and flavonoids can also kill the bacteria [8, 9, 4]. Most of the medicinal plants were found to have properties, such as the content contained in *C. odorata*, dibilas and katubar, according local people as an upset stomach/diarrhea and also anti-bacterial, due to content of tannins and flavonoids.

In general, medicinal plants found in the area adjacent to the river and have a tendency to cluster on a place to live. In areas that have similar environmental conditions, there is a tendency found the same species anyway. Based on observations, the intensity of light, temperature and humidity (see Table 2) is an environmental factor that affects the existence of a certain species of medicinal plants. In addition, factors altitude above sea level (see Table 2), is also a great effect for the existence of a certain species, so it should be a concern in the cultivation and conservation efforts.

### **3.2. Discussion**

Medicinal plants found in Loksado Sub-District influenced by altitude and soil types. Elevation in this district ranged between 250-464 m above sea level (asl) with podsollic soil type. Plants are known efficacious drugs by local communities (Dayak Meratus Ethnic), after testing the qualitative phytochemical study of literature, most of them are suitable with local use by the local community, although more research is still needed to quantitative content and clinical testing. Generally these plants as a potent anti-bacterial, anti-diarrhea and dysentery, and anti-virus. Most of plants have the complete content of all tested parameters, namely alkaloids, saponins, flavonoids, tannins, steroids, phenolic and triterpenoids. Tannins, alkaloid, saponins, flavonoids and triterpenoids can be used as an anti-diarrhea and dysentery [3, 4, 10, 11, 12], tannins are also useful as an anti-microbial, tannins and flavonoids can also be as anti-bacterial [8, 9, 4].

The next stage of this research is how to cultivate some plant species that is rarely found, but the properties are very well known by the local people, mostly found in secondary forest areas in the district Lokasado, Upper South River District. Almost all of these plants have the habitat near the river, by adjusting the micro-climatic conditions.

### **4. Conclusion**

- 1) Plants are believed to be local people as medicinal plants, classified in the types of grasses, lianas (climbers), parasites, shrubs, bushes and trees. While parts of plants used as medicine, such as; leaves, roots, bark and stem water.
- 2) Altitude, environmental factors (temperature, humidity, type of soil) and vegetation cover influence on the spread of medicinal plants in the forest, so the habitat of plants should receive attention in an effort to cultivation and conservation of medicinal plants.

- 3) Qualitative phytochemical test results show that the efficacy of medicinal plants used by local communities (Dayak Meratus Ethnic), most have appropriate properties based on literature research.

## **5. References**

- [1] B. Lakitan. 2004. Dasar-dasar Fisiologi Tumbuhan. PT. Raja Grafindo Persada, Jakarta.
- [2] H.J. Jumin. 2002. Agroekologi, Suatu Pendekatan Fisiologis. PT.Raja Grafindo Persada, Jakarta.
- [3] A.L. Otshudi, A. Vercruysse, A. Foriers. 2000. Contribution to the ethnobotanical, phytochemical and pharmacological studies of traditionally used medicinal plants in the treatment of dysentery and diarrhoea in Lomela area, Democratic Republic of Congo (DRC). Elsevier Science Ireland Ltd. pp 411 – 423
- [4] A.H. Atta, S.M. Mounier. 2004. Antidiarrhoeal activity of some Egyptian medicinal plant extracts. Elsevier Science Ireland Ltd. pp 303-309
- [5] H.O. Vongtau, J. Abbah, I.E. Ngazal, O.F. Kunle, Chindo, P.B. Otsapa, K.S. Gamaniel. 2003. Anti-nociceptive and anti-inflammatory activities of the methanolic extract of *Parinari polyandra* stem bark in rats and mice. Elsevier Science Ireland Ltd. pp 115 – 121.
- [6] C.N. Aguwa. 1987. Pharmacologic studies on the active principles of calliandra portoricensis leaf extracts. Elsevier Science Ireland Ltd. pp 63 -71.
- [7] R.D. Aqmol, A. Ferraz, A.P. Bernardi, D. Albring, C. Noer, L. Sarmiento, L. Lamb, M. Hass , G.V. Poser, E.E. Schapoval. 2003. Antimicrobial activity of some Hypericum species. Urban and Fischer Verlag. pp 511 – 516.
- [8] S. Süzgeç, A.H. Meric, P.J. Houghton, B. Cubukcu. 2004. Flavonoids of *Helichrysum compactum* and their antioxidant and antibacterial activity. Elsevier Science Ireland Ltd. pp 269 – 272.
- [9] K.A. Reid, A.K. Jaeger, M.E. Light, D.A. Mulholland, J.V. Staden. 2004. Phytochemical and pharmacological screening of Sterculiaceae species and isolation of antibacterial compounds. Elsevier Science Ireland Ltd. pp 285 – 291
- [10] B. Adzu, S. Amos, M.B. Amizan, K. Gamaniel. 2003. Evaluation of the antidiarrhoeal effects of *Zizyphus spinachristi* stem bark in rats. Elsevier Science Ireland Ltd. pp 245-250.

- [11] A. Geyid, D. Abebe, A. Debella, Z. Makonnen Zewdneh, F. Aberra, F. Teka, T. Kebede, K. Urga, K. Yersaw, T. Biza, B.H. Mariam, M. Guta. 2004. Screening of some medicinal plants of Ethiopia for their anti-microbial properties and chemical profiles. Elsevier Science Ireland Ltd. pp 421 – 427
- [12] M. Heindrich, H. Rimpler, N.A. Barrera. 1991. Indigeneous phytotherapy of gastrointestinal disorders in a lowland Mixe community (Oaxaca, Mexico): Ethnopharmacologic evaluation. Elsevier Science Ireland Ltd. pp 63 – 80
- [13] H. Annuk, S. Hirno, E. Tueri, M. Mikelsaar, E. Arak, T. Wadstrom. 1998. Effect of cell surface hydrophobicity and susceptibility of *Helicobacter pylory* to medicinal plant extracts. Elsevier Science Ireland Ltd. pp 41 – 45

## **Development of Gambir (*Uncaria gambir*) for rural economy: between policy and people aspiration**

**Andy A. Zaelany<sup>1,\*</sup>**

<sup>1</sup>Center for Population Research, Indonesian Institute of Sciences (LIPI), Indonesia

\* Corresponding author: andy\_az62@yahoo.com

---

**Abstract** The main lesson learned from the three-year activity (year 2010, 2011, 2012) of rural economy development program of the Office of Coordinating Minister of Economy is that rural economy development for poverty alleviation should focus not only on the increasing of plantation productivity but also on the cultivation and marketing of the products so that the community can increase their revenue not only from additional production but also could get benefit from product added value, cultivation and marketing.. Most of the people in the Lima Puluh Kota Regency, West Sumatera Province is poor and working as farmers. Gambir (*Uncaria gambir*) is one of income sources of people in Lima Puluh Kota Regency which is cultivated traditionally, so that its product quality is not standardized. Marketing of gambir is controlled by the *Tauke* (middle man), so that farmers do not receive appropriate price. To overcome these problems, a strengthening of famers' capacity should be done with the aim of building integrated marketing model of Gambir and increasing of farmer groups competitiveness so that they could build a partnership with industry with mutual benefit sharing.

**Keywords** Gambir, rural economy, policy, people aspiration

---

### **1. Introduction**

Poverty alleviation in rural areas should be based on the natural wealth owned by local area in Indonesia, which also can be used as a driver of national and regional economic growth (Rahardja, 2011). One of these is a potential plant Gambir (*Uncaria gambir*) which has been cultivated since several centuries on Sumatra, Borneo, Malaysia and the western part of Java Island. Today most of the Gambir production comes from West Sumatra and a small portion of South Sumatra and Bengkulu. Lima Puluh Kota district, which is the focus of this study, is the largest Gambir producer in Indonesia, even in the world. There are about 80 per cent of Gambir in Indonesia comes from this district (Edward,tt; Hasbullah, 2001).



The agribusiness development strategy for Gambir can be in form of institutional strengthening patterns based on local communities / farmers. Agribusiness development can be done, for example, through a *partnership pattern* that integrate with industrial companies both in regional and national scale or with other social and economic institutions. Indeed, the market demand opportunities of Gambir as a raw material is very open, accompanied by the tendency for people to 'back to nature', which can be seen as one alternative way to increase the household income of farmers at the local farmers' level (Sundawati, et.al, 2012; Widodo et al, 2013; Zaelany, 2011).

Marketing orientation of Gambir is directed at the domestic market and overseas market. For the present time, domestic marketing becomes a major preference related to the efforts to raise the price of Gambir. The model suggested is *interaction networking* as many as the number of stakeholders through institutional strengthening that play an active role in marketing institutions, which involves not only the industry, but also requires the participation of the government (both central and local) as a facilitator, mediator or a companion for farmers (Glover and Kusterer, 1990; Sundawati et al., 2012; Warsana, 2009).

There are a number of problems faced by the households of Gambir farmers in their agribusiness effort. First, farmers face obstacles in the form of limited skills mastery and knowledge, lack of referral sources for the cultivation and processing of Gambir products, as well as the lack of sufficient production supporting institutions and the crucial cultural problem is the traders controlled market (monopsonistic price). Secondly, farmers face a number of obstacles such as economic morality (economy moral) as well as the perspective of the selected product. This cultural dimensions is what have led to farmer's low preference on Gambir crop selection as their principal commodities (Zaelany, 2011).

To overcome the above matters, partnership and institutional capacity building of farmers are selected as the main approach in an attempt to 'open' Gambir market network for farmers (Sundawati et al., 2012). Network partnership and cooperation of the farmers (in this case the Farmers Group Association/*Gabungan Kelompok Tani*) with industry is the approach priority taken, by including the role of the government. The process of strengthening institutional capacity and partnerships should be done continuously until one day they are able to develop agribusiness system independently (Dharmawan and Toni, 2005; Widodo et al., 2013; Zaelany, 2011).

The general objective to be achieved is the establishment of an integrated marketing model of Gambir and the establishment of Gambir farmers groups which is competitive so that it can partner with industry (as a model of partnership) with mutual benefit.

## **2. From Science to Policy**

Gambir and its benefits to this day has not been widely recognized by the public. There has been quite a lot of research done on this plant. Gambir is better known as a term for the dried leaves extract of the plant. This extract contains *catechins* (provides delicious sweet taste), *catechu tannic acid* (gives a bitter taste) and *juercetine* (yellow dye). *Catechin hydrate* (in form of d, L and dL) has the melting point of 93 degrees Celsius and forms an *anhydride* thereof has a higher melting point, at 174 ~ 175 degrees Celsius. *Catechins* are soluble in boiling water and cold alcohol. Gambir has long been used as one of the ingredients in the betel-chewing in some groups in Indonesian society. In addition, Gambir is also used as astringent, antiseptic, stomachache medicine and cosmetics mixing ingredients, breweries' raw water purifier, giving the beer a bitter taste and tanner ingredients. For medicine ingredients, West Germany importer requires 40-60% *catechine* levels Gambir and the company Ciba Geigy requires a minimum of 60.5% *catechine*. For tanneries, leather processing company Cuirplastek R. Bisset and Cie require tannin content of 40% (Meeting Document March 15, 2012; Hasbullah, 2001; Edward, tt).

Gambir plant in the Lima Puluh Kota Regency can be harvested after 1-1.5 years planted. The leaves are harvested along with twigs of the plants which contains *catechin*. Harvesting is done by cutting the branches and twigs of the plant. Each year, the harvest can be 2-4 times depending on the growth of plants. Gambir plants can be harvested continuously for 15 years since the first harvest is done (Meeting Document February 27, 2011).

Lima Puluh Kota district is the largest supplier of Gambir nationally and worldwide. Just unfortunately, up to now the results of this commodity is still not able to improve the life of the Gambir farming community, because the selling price is low and fluctuating. Actually, there are quite a lot of domestic markets for the use of Gambir to increase farmers' income, unfortunately no one has been willing to utilize Gambir for raw material production and no investor who is interested in building industrial raw material Gambir. Indonesia until now is known only as the Gambir seller but not producing its derivatives.

The direction of government policies that can be utilized for the development of Gambir, is the government's policy plan to cut up to 20% of the total import dependence by encouraging the production of substitution pharmaceutical raw materials, by building pharmaceutical raw materials industry in the country, ranging from the chemical industry, industrial raw materials and the provision of technology. Especially when considering that the total value of imports of raw materials that are very large and tend to increase steadily. In 2011 the value of imports of raw materials for drugs has reached Rp 9.59 trillion and are expected to increase in 2012 amounted to IDR 11.4 trillion (8.5%). Marketing opportunities also shows a great advantage when worked in earnest. According to the data from IMS Health, in 2011 the national pharmaceutical market was for Rp 43.08 trillion, and is expected to increase in 2012 became Rp 48.61 trillion (an increase of 13%) (Meeting Document March 15, 2012). Therefore, incentive facilities from the government are required, such as Tax Holiday, Collateral duties and others.

### **3. Gambir Development**

The main problem in the development Gambir in Lima Puluh Kota District is that its selling price is low and fluctuating. Gambir trades are controlled by *tauke* (middle man) who often act as a patron or rather as moneylenders. Dependence on *tauke*'s help and ignorance make the *taukes* can play with Gambir prices freely. Usually a *tauke* mention that Gambir prices in India had been the cause of the fluctuating production price. In addition, the low quality of production also referred to by them as the reason why the price of cheap. There are two reasons of Gambir low quality. First, Gambir cultivation is not done in a good way, so the quality is not good enough. Second, the existing Gambir production is considered unclean since averagely it is mixed other impurities, such as sand and gravel.

Therefore, residents expect that the policy to be constructed by various parties (stakeholders) should promote the production of added value, not just selling the raw materials. Gambir sales in the form of raw material led to easily manipulated prices by traders. Gambir development strategies here include: 1) Developing the capacity of production and household economy of Gambir farmers with different production technologies and post-harvest technology in the Lima Puluh Kota district of West Sumatra province, 2) Developing models and institutional marketing in order to empower Gambir farmers, which in this case involving industry and other Government agencies, 3) Developing other ventures which is a multiplier effect of the

presence of the Gambir business in the Lima Puluh Kota district, for example, culinary services, transportation, and even agro-tourism, and others.

There are at least 6 (six) Gambir processing methods that can be pursued for the domestic market, namely i) tannery industry, ii) dye batik industry, iii) wood preservative industry, iv) plywood glue industry, v) election ink industry, and vi) food preservatives industry. Simple form of processing can be done to support the marketing efforts of Gambir. However, supports in the form of regulation (regulation, legislation, etc.) and capital should be provided by local governments and economic institutions such as banks. The required regulation is for example obligate the use Gambir as materials that are safer and more environmentally friendly in the industry activities. For instance, for the tannery industry should use it rather than chromium which is chemical. Same thing with the general election ink industry that can cause irritation to the skin and uses imported materials, can be substituted by Gambir that does not cause adverse effects to health (Meeting Document February 27, 2011).

In the long term, Gambir development can be done in the industry of pharmaceuticals raw materials (for example a *catechins* factory) and cosmetic raw materials industry. By developing Gambir, Indonesian economy can be revived through Gambir based industry results export, meet domestic demand while improve the welfare of the community because of Gambir's nature which has multiplier effect to revive other sectors.

#### **4. Conclusion**

Efforts to develop Gambir in Lima Puluh Kota district is a series of activities that must be supported by the various parties and is hard to be achieved if is only done by the farmers alone. There are several things that can be inferred from Gambir development. First, the establishment of competitive farmer association (Association of Farmers Group/ *Gabungan Kelompok Tani*) so as to produce product with appropriate raw materials standards needed by the users. In this case Gapoktan is the institution that buys the products of farmers in collaboration with industry. Secondly, the establishment of a strategic partnership between Gambir stakeholders which is interdependent, supportive and mutually beneficial (among industries / investors, government, academia, society, Gambir farmers, merchants). Third, increasing the welfare of the community with the emergence of other ventures due to the Gambir development activities, such as transportation,

tourism, provision of food services, and establishment of industries that produces Gambir derivatives.

## **5. References**

- [1] A.H. Dharmawan and F. Tony. 2005. Interaksi dan Relasi antara Kelembagaan Petani Tingkat Internasional dan Nasional
- [2] Edward, Zulkarnain. *The Function Utilization of Gambier (Uncaria gambier) as the Hepatoprotector*.
- [3] D. Glover and K. Kusterer. 1990. *Small Farmers Big Business: Contract Farming and Rural Development*. Macmillan. Basingstoke and London
- [4] Hasbullah. 2001. *Teknologi Tepat Guna Agroindustri Kecil Sumatera Barat*. Dewan Ilmu Pengetahuan, Teknologi dan Industri Sumatera Barat (editor Esti, Sarwedi)
- [5] Raharja, Sjamsu. 2011. Pengembangan Komoditi Unggulan. Dalam Majalah *Lionmag*, Jakarta
- [6] L. Sundawati, N. Purnaningsih and E.D. Purwakusumah, E. Djauhari 2012. *Pengembangan*
- [7] Model Kemitraan dan Pemasaran terpadu Biofarmaka dalam rangka pemberdayaan Masyarakat sekitar hutan di Kabupaten Sukabumi, Provinsi Jawa Barat. Bogor, Institut Pertanian Bogor
- [8] Warsana. 2009. Pemantapan Kelembagaan pada Gapoktan. Dimuat di Tabloid Sinar Tani.
- [9] <http://www.litbang.pertanian.go.id/artikel/one/249/pdf/pemantapan20Kelembagaan%20Pada%20Gapoktan.pdf>
- [10] Widodo dkk. 2013, *Pemberdayaan Tenaga Kerja Pedesaan dalam Sistem Pertanian Organik*. Yogyakarta, Penerbit Indonesia Pintar Publishing
- [11] Zaelany, Andy Ahmad. 2011. Menuju ke Pertanian Terpadu: Kebijakan Separuh Hati. Dalam: *Menuju Pertanian Berkelanjutan*, Ngadi (ed.). Yogyakarta, Penerbit Impulsif
- [12] Gambir Meeting at the office of Coordinating Minister of Economy February 27, 2011
- [13] Gambir meeting at the office of Coordinating Minister of Economy March 15, 2012

## **Conservation of wildlife bio-resource management for livelihood**

**Retno I. Pujaningsih<sup>1, \*</sup>**

<sup>1</sup>Departement of Animal and Agriculture, Diponegoro University, Semarang, 50275,  
Indonesia

\* Corresponding author: retno.marwoto@gmail.com

---

**Abstract** The world's biological resources continue to be lost at an alarming rate, and particularly in developing countries where many of the remaining resources are concentrated. Biodiversity management and local livelihoods are integrated, complex and locally-specific. The case referred to the conservation of anoa, gembrong goat and deer showed that bio-resources play a critical role in the livelihood systems of the poor, even in highly modified or degraded landscapes. Understanding relationships in different situations is central to the design and implementation of rural development, poverty alleviation and biodiversity conservation initiatives. Concluding thoughts: (1) The use-values of biodiversity to local people, including the very poor, are often neglected; (2) Conservation and development strategies must move away from simplistic assumptions that conservation and development are always mutually supportive; (3) Biodiversity management in developing countries is not something that can be left solely to protected areas and high profile species as it has major implications for livelihoods more generally. This paper offers a framework for assisting in the planning of policies and interventions using a problem-centered and stakeholder approach for assembling and analyzing information and developing a vision and plan for action. The approach needs to be tested and adapted to local situations and applied research in this area is urgently required.

**Keywords** wildlife conservation, bio-resources management, poverty alleviation

---

### **1. Introduction**

Bioresources means resources from biological origin or the total biological variation manifested as individuals such as animals, plants and their gene pools which can be taken by man for use in drug, food, live stocked, construction materials for shelter, environment protection etc. It is also used in the development of improved crops and animals for higher yields and tolerance to biotic and abiotic stresses [1]. The loss of bioresources due to

developmental activities such as hydroelectric projects, road laying, urbanization and changes in agricultural practices. Over-grazing and changes in land-use pattern are taking heavy toll on biodiversity available in the wild species. Globalization and market demand are also contributing indirectly to the loss of biodiversity, particularly of minor and neglected crops. The most important point to remember is once these species are vanished, that knowledge along with the potential benefits is also lost. In other words, once these genes are lost, there is absolutely no chance of bringing them back at any cost. Conservation of bioresources creates innovative mechanisms for sustainable development that encompasses the interface between health and the environment [2, 1]. Therefore, exploration, conservation and preservation of bioresources are the centre of attention around the world. The latest advancement in biotechnology play an important role to create awareness, conservation and sustainable utilization of immense biodiversity. Biotechnology tools perform a significant role in creating effective *ex-situ* and *in-situ* conservation strategies, groupings of bioresources through molecular lineages, identify useful genes through gene maps and develop a genetically modify bioresources [2].

## **2. Results and Discussion**

### **2.1. Conservation of Gembrong Goat, Anoa and Deer**

Since the new Indonesia's Laws, Acts, and Orders Law No.22 year 1999 and Government Regulation No. 25 year 2000 were declared the provincial level could have an independency in determination of the importance of the role of specific animals, in terms of economical values, better income for the farmers and properties of their society [3]. This approach refer to the reason of their suitability to the local environment and its proud local community, which is associated with specific socio-cultural conditions, the economical value of its contribution, which are limited due to the use of specific local resources.

**Gembrong Goat.** Gembrong goat are very unique. Goats are used to a lot of lives in coastal areas in Karangasem regency, Bali. Fishermen often cut a long fur and attached to a hook to catch fish. Without food, fishermen can easily get fish. This method has been known for a long time and is still used by local fishermen. The extinction of this goat's increasingly thought to be caused by many things. There is indigenous knowledge of fishermen who believes that if the goats are often mated with a female goat will cause the fur to fall out. They tried to prevent the female goat to copulate to remains dense fur. They try to get the fur because it's very expensive, even up to IDR

400.000 per kilogram. As a result gembrong goat regeneration is very slow. Its population is less than 50 goats in Indonesia [4]. The extinction of goats is also caused by economic pressure. The fishermen, who were generally poor, easily sell the goat to the butcher for living. Another things that triggers the goat's extinction is the dense fur which cover the head. Goats have the difficulty to eat as the dense fur covering the face, eyes and mouth. Because they do not get appropriate nutrition then goats are susceptible to disease and easily death. In addition, most of the surviving goats reared by poor farmers or fishermen. Efforts to preserve gembrong goats need to be done seriously. Outreach efforts continue to be done, however there are still people who believe in the belief that complicates the goats conservation efforts.

**Anoa.** This species is considered eendangered because its population is estimated to be less than 2,500 mature individuals, its rate of decline is believed to be greater than 20% over two generations (14 to 18 years), and no subpopulation is believed to number more than 250 mature individuals. Hunting for food is considered to be a threat to this species. There is also a trade in live animals and in body parts (presumably for medicine), but this is not thought to constitute a threat. A number of Lowland Anoa is in captivity, but the breeding program has been greatly hindered by the difficulties of assigning captive anoa to appropriate taxa. The captive population doubled in size in the 1990s, with around 125 individuals in zoos as of 1998 [8]. This species requires the following conservation actions: (1) protection from hunting, (2) prevention of habitat loss at key sites, (3) complete genetic studies to better determine the taxonomy of this species, and (4) determination of the status of remaining populations [1,5,6]. This species, as it is confined mainly to lowland areas, requires well established protected areas with protection from hunting a major priority. Law enforcement combined with education should be employed to reduce hunting pressure [7].

**Deer.** Deer (*Cervus* sp) is an animal that is protected under the laws of the Ordinance and the Wild Animals Protection Regulations 1931 No. 134 and 266. Then Minister of Agriculture Decree No. 362/KPTS/TN/12/V/1990 dated May 20, 1990, include the deer into the various groups of cattle that can be cultivated like other animals, including regulations of business license. Law No. 18 of 2009 on livestock and animal health states that wildlife both in natural habitats and breeding results can be utilized in the cultivation to produce the pet in accordance with the provisions of Law on wildlife conservation. Reindeer husbandry has a good prospect, because the



venison has great potential to be marketed with low fat content specifications, distinctive flavor and is believed to improve health, and stamina. Besides, the deer antlers, testicles, tails and others can be used as an ingredient of traditional Chinese medicine and has the potential to be marketed locally and even export. Seeing this potential, deer farm has interesting prospects to develop as a new commodity in the region of Borneo, Java, and Papua in the field of animal husbandry then be sought in the direction of agribusiness and agro-industries even very possible to be developed in the direction of the development of agro-tourism as one of the new attractions.

## **2. 2. A frame work for bio-resources management**

It is needed to find the justification among conservation on biodiversity, local wisdom and agriculture aspect. The last aspect refers to the effort of domesticating this endemic animal [1, 5]. Figure 1 presents a generic framework to assist in the planning of policies and interventions that incorporate the ideas discussed in this paper. It can be used in helping to prepare specific local actions working from broadly stated strategic goals. An essential feature of this framework is the adoption of a problem-centred stakeholder approach that incorporates early analysis of the perspectives and economic interests of different stakeholders, and the representation of these interests in intervention design. The approach comprises three stages: (1) Analysing the system; (2) Developing a vision and plan for action; (3) Action planning, iteration and feedback.

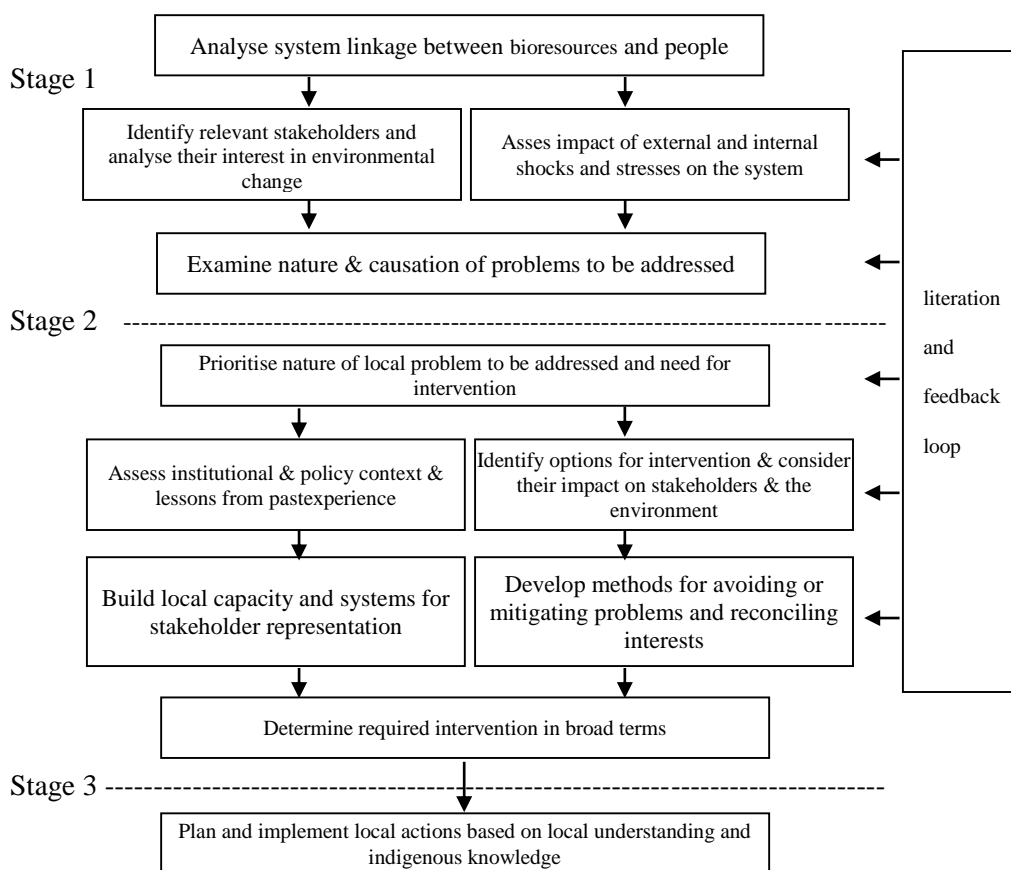


Figure 1. A framework for preparing bio-resources management [2,3]

### 3. Concluding thoughts.

- The use-values of biodiversity to local people, including the very poor, are often neglected. Understanding these, how they are accessed and by whom is central to the design and implementation of interventions.
- Conservation and development strategies must move away from simplistic assumptions that conservation and development are always mutually supportive. Where environmental change or conservation is involved there will also always be winners and losers.
- Biodiversity management in developing countries is not something that can be left solely to protected areas and high profile species as it has major implications for livelihoods more generally.

#### 4. References

- [1] R.I. Pujaningsih. 2009. Managing biodiversity towards bioregional management (a case study on anoa conservation programs). International Conference on Research for Development in Agriculture and Forestry, Food and Natural Resource Management. Department of Biology, University of Hamburg. October 6–8, 2009. The list of all presented abstracts, four-page-versions and posters of Tropentag 2009. Available on <http://www.tropentag.de/>.
- [2] R.K. Patidar, S. Debashish, K.M. Singh, R.C. Shakywar. 2013. Biotechnological tools for conservation of bioresources. *Inter. J. of Agric. Envir and Biotechol*: 6(2): 223-232.
- [3] G. Robin, L. Martyn. 2002. Biodiversity Management and Local Livelihoods: Rio Plus 10. The Overseas Development Institute, 111 Westminster Bridge Road, London SE1 7JD, UK.
- [4] FAO. 2003. National Report On Animal Genetic Resources Indonesia: A Strategic Policy Document. Rome.
- [5] R.I. Pujaningsih, C.I. Sutrisno. 2011. Sustaining anoa (*Bubalus sp.*) as prospective meat resources by using feeding technology processing in the *ex situ* area. ISSAAS (The International Society for Southeast ASIAN Agricultural Scientist) Indonesia Chapter. November, 7-10, 2011.
- [6] G. Semiadi, B. Mannullang, J. Burton, A. Schreiber, A.H. Mustari, the IUCN SSC AsianWild Cattle Specialist Group. 2008. *Bubalus depressicornis*. The IUCN Red List of Threatened Species. Version 2014.2.
- [7] R.I. Pujaningsih, C.I. Sutrisno, Y. Supriondho. 2010. Study on Anoa's feed form preference towards *ex situ* conservation and cultivation. *J.of. anim. Prod. UNSOED*, volume 12 No 3 -September, 2010. pp. 150-155.

## **Market integration analysis of sweetened condensed milk in Indonesia: do sweetened condensed milk prices follow the prices of imported milk and sugar?**

**Venty F. Nurunisa<sup>1,\*</sup>, Bonar M. Sinaga<sup>2</sup>, Ratna Winandi A.<sup>1</sup>,  
Bernhard Brümmer<sup>3</sup>**

<sup>1</sup>Department of Agribusiness, Graduate School of Bogor Agricultural University, Bogor, 16680 Indonesia

<sup>2</sup>Department of Agricultural Economics, Graduate School of Bogor Agricultural University, Bogor, 16680 Indonesia

<sup>3</sup>Department of Agricultural Economics and Rural Development, Georg August University, Germany

\* Corresponding author: venty.fitriany.nurunisa@gmail.com

---

**Abstract** The recent escalation of Indonesia's import dependence for milk and sugar is expected as one of the free trade implementation effect. The condition is also affected by the increasing needs of these goods from the milk processing industry in Indonesia. Sweetened Condensed Milk (SCM) production whose mainly consumed by the low income family is produced by using skim milk (imported from New Zealand) and refined sugar (imported from Thailand). This study examines the market integration between the SCM price and its ingredients; imported skim milk and sugar. Monthly prices of SCM, imported skim milk, and imported refined sugar from January 2000 to July 2013 were used as sample data in analysing the market integration analysis. The methods used were the Augmented Dickey Fuller test, Johansen Cointegration test, Gregory and Hansen test, and Vector Error Correction Model. The result indicates that: all variables are stationary in the first difference; together all variables are proven to be co-integrated with structural break on year 2009. Further, the VECM results indicate evidence of integration in the long run. In the long run, SCM prices are mostly influenced by the imported sugar prices. Changes in sugar prices give bigger magnitude than changes in milk prices. Every 1% increase in imported sugar prices could decrease the SCM prices by 1.373%. The result is strengthened by the loading vector coefficient of sugar price as the only significant coefficient, which indicates the long run response to disequilibrium. Based on this situation, some recommended strategies to minimize the price risks are: i) concern the provision of company's budget buffer, ii) search for the alternative milk and sugar suppliers and iii) concern the future trade system to be applied in the company.

**Keywords** sweetened condensed milk, sugar, market integration

---

## **1. Introduction**

Trade liberalization is a concept where two countries or more agree to reduce the trade borders through the settlement of lower tariff and/or non-tariff barriers and/or even totally erase them from the trade activity [1]. In the developing country, poor infrastructure becomes one important factor which affects the market function even often hinder the full information transmission to occur. Some primary goods in Indonesia are indicated as import dependency including dairy and sugar commodities. Sweetened Condensed Milk (SCM) is one of Indonesia's dairy products which mostly consume by the low middle income family. Unfortunately, the milk processing companies in Indonesia are still importing the main ingredients of SCM; Skim Milk Powder from New Zealand and refined sugar from Thailand. This study is aimed to examine the market integration between the Skim Milk Powder price and the SCM price.

## **2. Results and Discussion**

The SCM production in Indonesia is supported by the availability of its main ingredients. Skim milk powder and sugar are two main ingredients which support the production. The imported refined sugar is about 40% of the total composition, while SMP covered about 25% of the SCM product. Figure 8 illustrates the price movement from all variables used in this study (in log version). The price data were generated from value of export/import divided by the export/import quantity (kg/US\$). The price transmission analysis is performed to answer the issue of international and vertical market integration. The international market integration examines the price relationship between export/import of SMP and sugar from New Zealand and Thailand, respectively. The vertical price transmission observes the relationship between input and output prices, in this case, skim milk powder and sugar paired with the prices of sweetened condensed milk prices.

### **2.1. Stationarity test through augmented *Dickey Fuller Test* (ADF Test)**

Stationarity is an important aspect in time series analysis since a non-stationary data can lead the results into a bias estimation. Stationarity is tested by checking the existence of unit root in the variables. Basically, there are some important steps that should be considered before. First, is to set the maximum lags; second, is to choose the lags criterion; third, is to determine the assumption of an intercept, trend or both of them do exist in the observation. This study assumes that maximum applied lags are 13 lags, which is generated from the Schwert Criteria [2]:

$$I_{12} = 12 \times \left(\frac{T}{100}\right)^{1/4}$$

by assuming T is the total observations (163 observations). The Akaike Information Criterion (AIC) is used in this study as a basis in determining the lags. Table 1 shows the results of unit root tests for all variables.

**Table 1 Unit Root Test Using Augmented Dickey Fuller (ADF)**

No	Variable	Constant			
		Lags	T-statistics (Level)	Lags	T-statistics (First Difference)
1	Imported Sugar	1	-1.3567	0	-16.3550
2	Imported Milk	3	-1.8127	1	-6.5721
3	SCM	3	-1.0104	1	-9.2936

Lags criteria: Akaike Information Criterion (AIC)

Max Lags: 13

Test with Constant

Critical value: -3.43 (1%), -2.86 (5%) and -2.57 (10%)

Processed by Jmulti

The ADF test result shows that on the level, all variables show a higher t-statistics than the critical value (1%, 5% and 10%). This means, on the level, all of the variables are accepting the null hypothesis of not stationary or having unit root. However, if the variables are indicated stationary on the first difference and further they are proved to have a cointegration relationship, they might have a meaningful interpretation on the long run. Table 1 also shows the result of unit root test for the first difference data which resulting together all variables are rejecting the null hypothesis in their first difference (indicated by all t-statistics are having a lower value than the critical value). Economically, stationarity in the time series data explains the influence from the past price to the present or even the future price. Economic data often found to be not stationary because there are some points in the previous period which are influence the price determination in the present day.

## **2.2. Cointegration test**

Gregory and Hansen [3] presented cointegration test which allows the probability of any regime shifts or breaks to be existed. The null hypothesis of Gregory Hansen test is no cointegration between variables, against the alternative hypothesis of cointegration between variables in the presence of a possible break. Table 2 presents the result of all tests: ADF, Za and Zf. The result shows interesting result where t-statistics are lower than the critical value. Through 163 observations, cointegration relationship with structural break is detected together with changes in the intercept and trend. The result leads to a conclusion of structural break on the 119<sup>th</sup> data or on

November 2009. Gregory Hansen test finally assumes that there is evidence of cointegration relationship with structural break between the prices of import sugar, import milk and SCM.

Table 2. Cointegration Test with Structural Break Using Gregory Hansen Test (1996)

	Test Statistic	Breakpoint	Date	Asymptotic Critical Values		
				1 %	5 %	10 %
ADF	-5.63	119	2009m11	-5.80	-5.29	-5.03
Zt	-5.80	119	2009m11	-5.80	-5.29	-5.03
Za	-57.75	119	2009m11	-64.77	-53.92	-48.94

Model = Change in Level and Trend

Number of observations = 163

Maximum Lags = 13

Lags = 0 chosen by Akaike Information Criterion

Processed by Stata

Furthermore, to check the rank of cointegration, Johansen test is performed. The result of cointegration test with structural break is presented on Table 3. The test is performed by considering the structural break which is detected on November 2009 as a dummy variable. The p-value is being accepted on cointegration rank=0, which means that there is not enough evidence to conclude there is no cointegration between related variables. Meanwhile, the p-value on rank 1 and 2 indicate a higher value than 0.1, which means that statistics support the conclusion of there are at most two cointegration relationship between related variables.

Table 3 Cointegration Test with Structural Breaks Using Structural Breaks

Variable	Cointegration Result (P-Value)		
	Lags	Rank ( <i>r</i> )	Johannsen
Import Sugar	3	0	0.0741
Import Milk		1	0.1060
SCM		2	0.1527

Lags criteria: Akaike Information Criterion (AIC)

Max Lags: 13

Test with Constant and Trend

During 2007-2009, the milk prices show a rebound trend. This is expected as an impact of the global crisis in 2007-2009 which hit many countries worldwide at that time. Specifically on the milk case, a global increase in feed prices on those periods affected the dairy stock at that moment. The USA and Europe hit by difficulties in fulfilling their domestic demand. The international dairy supply was distracted, which also stimulated the falling prices in 2009. The falling international milk price was responded by the import tariff adjustment for dairy product by the Indonesian government at

that time. The import tariff was adjusted, especially the tariff which is used for the industrial purposes. The government through the Finance Ministry issued a new import tariff for industrial purposes milk in Ministry Decree No. 101/PMK.011/2009. The decree replaced the previous policy of allowing null import tariff (No. 19/PMK. 011/2009) for dairy product for industrial purposes with the new tariff of 5%.

### **2.3. Market integration of sweetened condensed milk**

Finally, the VEC model was generated to analyze the relationship between consumer price of SCM and input prices for milk and sugar. Based on the Gregory Hansen test [3] in the previous section, the analysis also concludes structural break in late 2009. The shift and the trend shift which generally reflect the break is applied in the model. The lag used is two as it suggested by AIC. Table 4 presents the result of the calculation with one cointegration rank.

The long run equation indicates that 1% raise in milk and sugar import price decrease the SCM price by 0.550% and 1.373%, respectively. The result gives evidence that in the long run changes in sugar import price gives a bigger magnitude than changes in milk import price. The relevant reason underlies this finding is supposed to be caused by a larger composition of the sugar in SCM product. However, changes in sugar price give double effect in comparison to changes in the price of imported milk. The long run equation also shows that shift and trend shift are matter, this finding is in line with the previous error correction result using two ranks cointegration.

**Table 4. Error Correction Model of SCM Price and the Input Prices**

Long Run Equation:			
1.422 - 0.550 $\text{impmilk\_log}(t-1)^*$ - 1.373 $\text{impsugar\_log}(t-1)^*$ - 3.432 $\text{shift}(t-1)^*$ + 0.023 $\text{trendshift}^*$ + 0.003 $\text{trend}$			
Short Run Equation			
Variable	$d(\text{scm\_log})$	$d(\text{impmilk\_log})$	$d(\text{impsugar\_log})$
$d(\text{scm\_log})(t-1)$	0.209*	-0.244*	0.034
$d(\text{impmilk\_log})(t-1)$	0.020	0.078	0.175
$d(\text{impsugar\_log})(t-1)$	0.065*	0.028	-0.189*
$d(\text{scm\_log})(t-2)$	-0.140*	0.155	0.139
$d(\text{impmilk\_log})(t-2)$	0.021	0.292*	-0.073
$d(\text{impsugar\_log})(t-2)$	0.008	0.065	-0.016
Loading Vector Coefficient			
$\text{EC}(t-1)$	-0.029*	-0.017	-0.117*

\* significant P-Value

Lags criteria: Akaike Information Criterion (AIC); Max Lags: 13

Test with Constant, Trend, Shift and Trend Shift

Processed by Jmulti



In the short run, SCM price tends to be influenced by its previous price (lags 1 and 2) and also with the sugar price. Milk import price is likely to be influenced by the previous price of SCM and also by its own previous price (lags 2). Later, sugar import price indicates that the price is only influenced by the previous price, and no influence from other prices. Further, the significant coefficient of the error correction term gives evidence that sugar import and SCM are becoming two variables that adjust to the equilibrium in the long run. It means that these variables are responding to changes in the long run, therefore they will move from disequilibrium to an equilibrium condition with the speed of adjustment equals to -0.117 for sugar import and -0.029 for SCM price. Further, the coefficient also shows that the import sugar adjustment to disequilibrium is relatively faster than the SCM.

### **3. Conclusion**

In 2009, international milk price fell, while sugar price from Thailand rose due to drought that struck the country. Indonesian government sets the new import tariff responding the price changes. Milk tariff was increased from 0% to 5%, while sugar was reduced from Rp 700 to Rp 400. The shift is expected to be caused by the new applied regulations, while the trend shift was expected to be caused by the appreciation of Indonesian currency at that time. Finally, the evidence from this study has led to a result that the SCM price in Indonesia is mostly influenced by the sugar import price. The sugar import price gives a bigger magnitude than the milk import price, shown that 1% increase in sugar import price could decrease the price of SCM by 1.373%. The error correction coefficient shows that import milk price does not give any response into the long run equilibrium, while SCM and sugar import price is likely to react to the disequilibrium. Based on this situation, some recommended strategies to minimize the price risks are: i) concern the provision of company's budget buffer, ii) search for the alternative milk and sugar suppliers and iii) concern the future trade system to be applied in the company.

### **4. References**

- [1] [Kemendag] Kementerian Perdagangan Republik Indonesia. 2014. Free Trade Agreement. Kementerian Perdagangan Republik Indonesia. [serial online] 2014 [cited 2014 Jan]. Available at: <http://www.kemendag.go.id/id/faq#h-1>.
- [2] G.W. Schwert. 1989. Tests for unit roots: a Monte Carlo investigation. *J. of. Bus and Econom Stat.* Volume 7, No.2.

- [3] A.W. Gregory, B.E. Hansen. 1996. Residual-Based Tests for Cointegration in Models with Regime Shifts. *J. of. Econometrics*. Volume 70, page 99-126.

## **Trend analyses of forest and land fires towards climate change in Indonesia**

**Lailan Syauffina<sup>1,\*</sup>**

<sup>1</sup>Department of Silviculture, Faculty of Forestry, Bogor Agricultural University, 16680, Indonesia

\* Corresponding author: [syaufinalailan@gmail.com](mailto:syaufinalailan@gmail.com)

---

**Abstract** Forest and land fire in Indonesia has been an important environmental issue since the last four decades as the impacts have been locally as well as regionally and globally scales. Though the fires caused by human factors intentionally and unintentionally, climatic factors plays very important role to determine the level of fire danger and fire severity. Besides, fire season is also influenced by climate variability occurred in a region. In climate change era which indicates changes in seasonal variability and weather anomaly, fire season and frequency are undoubtedly changed. To predict fire occurrence in the future, trend analyses was conducted on fire data which is indicated by hotspot and climatic data represented by rainfall and temperature in the period of 20 years. Correlation analysis has also been done to determine the relationship between fire occurrence and climate, particularly weather anomaly indicated by Keetch Byram Drought Index (KBDI). The study revealed that the most influence factor to fire occurrence in Indonesia is rainfall, where decreasing of rainfall causes decreasing of fuel moisture content and increasing fuel availability quantitatively and qualitatively. However, temperature influences evaporation and transpiration. Trend analyses shows that fires in Indonesia has nonlinear characteristics and influenced by weather anomaly, especially the shifting of rainfall decrease from normal condition and dry season increase as indicated by the increasing of chance of KBDI to extreme level. Beside that, increasing of fire severity from vegetation and soil aspects has also been increased. Therefore, fire prevention program is the most determine factor to anticipate and minimize fire occurrence in Indonesia now and in the future.

**Keywords** trend analyses, forest and land fires, climate change, drought index, fire severity

---

## **1. Introduction**

Forest and land fires are among the important environmental issues in Indonesia, which cause a great impacts in local, regional as well as global level. The significant impacts of the fires has been appeared since 1997/1998 when between 10 and 11,7 million ha area burned in Indonesia [1,2], the number of people affected by smoke haze and fire were 75 million, and the total economic cost to the region was as much as US\$ 3.5 – 9.7 billion [3,1]. Since then transboundary haze pollution in ASEAN region become prominent and recurrent until now. The most recent phenomenon is the haze from fire occurrence in Riau province in 2014 that blanketed the province as well as other neighboring countries. No doubt, greenhouse gas emission from the fires may contribute to global warming.

On the other hand, climate play very important role to fire occurrences in three ways: 1) affecting fuel availability, 2) determining fire season, and 3) determining fire severity. Climatic factors have strong influence on forest fire occurrences and behaviour, particularly the occurrences of drought which are coincided with the ENSO (El Nino Southern Oscillation) phenomenon [4]. Moreover, several studies [5-8] found that climatic factors influence fire behaviour strongly in terms of ignition, flame development, fire spread and smoke. Among the climatic factors, rainfall is the most important influencing factor to fire in Indonesia. The rainfall may contribute to the fuel moisture content [9] which is the most critical factor to fire. Most large fires occur during El Nino years in which is strongly related to drought, such as in 1982/1983, 1987, 1991/1992, 1993/1994, 1997/1998, 2000, 2002, 2004, 2006, 2013, and 2014.

The objective of the study is to analyze the trend of hotspot distribution in relation with climate change phenomenon in Indonesia.

## **2. Materials and Methods**

Data used in the study was hotspot data as indicator for forest and land fires from Ministry of Forestry for the period of 1997-2014. The data was then analysed using trend analyses and simple descriptive analyses to indicate annual and monthly hotspot distribution. Meanwhile, climate change in Indonesia was referred to data and information from BMKG (Agency for Meteorology, Climatology, and Geophysics). Besides, literature studies on climate change, climate change scenario in Indonesia and the impacts of climate change on forest fire have strengthened the analyses.

### 3. Results and Discussions

#### 3.1. Status of forest and land fires in Indonesia

Forest and land fires in Indonesia are human-induced disaster which occur every year. Since 1997/1998, the forest and land fires have been part of important environmental issue, especially in Sumatera and Kalimantan islands. Based on hotspot monitoring conducted by Ministry of Forestry for period of 2006-2012, fires in Indonesia mostly occurred outside forest area (69.1%) compared to fires in forest area (29.9%). It is related to land use changes for plantation and other non forestry uses. To date, fire is still used as land preparation tool for plantation and other farming activities, as it is considered to be the cheapest, easiest and most efficient tool [11].

Hotspot as forest and land fires indicator are found in all Indonesia region, particularly in Sumatera and Kalimantan (Fig.1). In the period 1997-2013, the highest hotspot found in Riau Province, which is followed by Central Kalimantan, West Kalimantan, and South Kalimantan. Moreover, the occurrence of hotspot has strongly correlated with peatland area with coefficient correlation of 85 % [10]. The higher the peatland area the higher the number of hotspot. It means that the presence of peatland area contribute to the occurrence of peat fire [11].

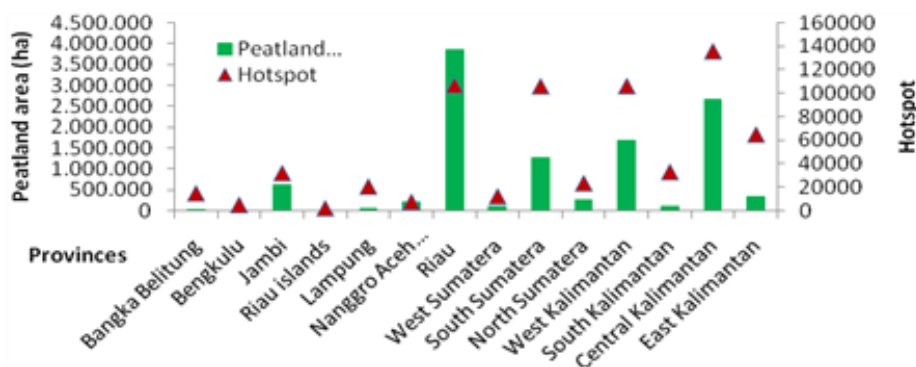


Figure 1. Distribution of hotspot and peatlands area in various provinces in Sumatera and Kalimantan in the period of 1997-2013.

#### 3.2. Seasonal distribution of fire season

Forest and land fire occurrences in Indonesia correspond to dry period in a year. As a tropical maritime country, Indonesia's climate condition is influenced by a monsoon wind circulation system comprising of dry and wet seasons. Climate condition in Indonesia is also influenced by global ocean-atmosphere dynamics which has consequences in climate variability.

Hence, the rain characteristic for a given month can vary greatly from year to year. The most significant inter-annual (with the period of occurrence between 2 and 5 years) climate variability phenomena in Indonesia is associated with ENSO (El Nino Southern Oscillation) in the Pacific Ocean and, more recently found, IOD (Indian Ocean Dipole) in the Indian Ocean.

Forest and land fire occurrences are significantly influenced by rainfall and reach the peak in dry season in which fuel moisture content has been decreased and hence become vulnerable to fire. In the period of 2009-2014, the peak fire season mostly occur in June to September (Fig. 2). However, it seems that the fire season has been shifted during that period. Since 2007, the fire season has been indicated earlier (June), particularly in 2014 when fire occurred extremely uncontrolled and come much earlier than before, namely in February-March.

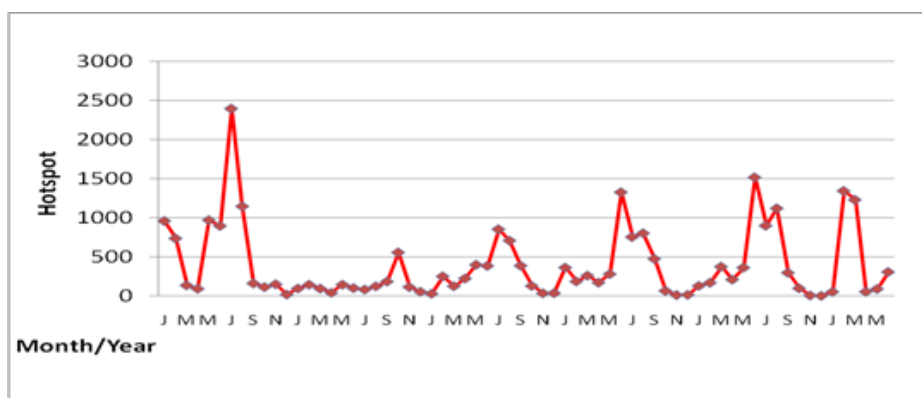


Figure 2. Monthly distribution of hotspot in 2009-2014 period

It is in line with finding of [12] that explained a shift in the seasonality of precipitation (wet and dry seasons); in the southern regions of Indonesia the wet season rainfall has increased while the dry season rainfall has decreased, whereas opposite pattern was observed in the northern regions of Indonesia.

### **3.3. Trend analyses of forest and land fires towards climate change**

The occurrence of forest and land fires in Indonesia fluctuated by year. The analyses indicated that fire tend to increase in the future in non linear manner (Fig.2). Particularly, fire in 2014 has resulted in significant impacts to the environment. Transboundary haze pollution has blanketed the Asean region. Though, there was a significant reduction of hotspot in Indonesia during 1997-2011 period. Hotspot decreased significantly in linear trend, from 1997-2006 period by 44.8 %, from 1997-2011 period by 85 % and from 2006-2011 period by 72.8 % respectively [10].

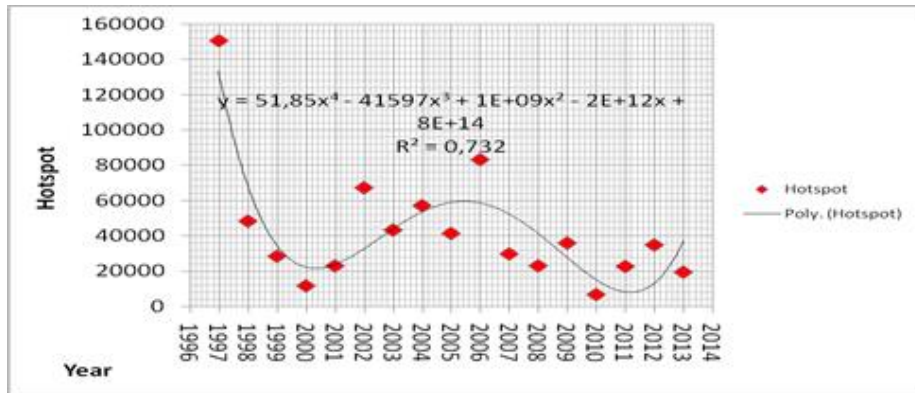


Figure 3. Hotspot distribution trend based on 1997-2014 data period

On the other hand, significant spatial variability has been found in rainfall distribution; there has been a decline in annual rainfall in the southern regions of Indonesia (e.g., Java, Lampung, South Sumatra, South Sulawesi, and Nusa Tenggara) and an increase in precipitation in the northern regions of Indonesia (e.g., most of Kalimantan, North Sulawesi) [12]. It is in line with the prediction by the Meteorology, Climatology and Geophysical Agency (BMKG) that indicates an increase of rainfall during dry season in Sumatera, part of Kalimantan and Papua except in Java, Nusa Tenggara, some parts of Sulawesi and the mountainous regions of Papua. By referring to the future of climatic condition in Indonesia, it seems that forest and land fire risk is on increasing trend. Therefore, forest and land fire prevention is a must if fire occurrences need to be minimized.

#### 4. Conclusions

1. Fire occurrences as indicated by hotspot show a non linear trend as they are mostly caused by human activities, particularly in land preparation.
2. Climate change in Indonesia has influenced forest and land fire season by shifting the peak and seems to increase fire risk in the future.

#### 5. References

- [1] L. Tacconi. 2003. Forest fire in Indonesia: Causes, Cost and Policy Implication. CIFOR. Pp Vi + 28
- [2] Bappenas-ADB. 1999. Causes, Extent, Impact and Costs of 1997/1998 Fires and Drought. Final Report, Annex 1 and 2. Planning for Fire Prevention and Drought Management Project. Asian Development Bank TA 2999-INO. National Development Planning Agency (BAPPENAS) and Asian Development Bank, Jakarta.
- [3] C. Barber and J. Schweithelm. 2000. Trial by Fire: Forest Fires and

- Forest Policy in Indonesia's Era of Crisis and Reform, report of World Resources Institute, Forest Frontiers Initiative, in collaboration with WWF Indonesia and Telapak Indonesia Foundation.
- [4] B. Lee, M. Brady, A. Sasitawarih and H. Sandhu. 2000. Wildland fires as a source of air pollution: recent experience in Southeast Asia. In *Proceedings of Forests and Society: the Role of Research*. Poster Abstracts Vol. III. XXI
- [5] A. Buckley Jr. 1992. Fire behaviour and fuel reduction burning: Bemm River Wildfire, October 1998. *Aust. For.*, 55: 135-147
- [6] D.R. Weise and G.S. Biging. 1996. Effect of wind velocity and slope on flame properties. *Can. J. For. Res.* 26: 1849-1858
- [7] T. Mori, T. Toma, Hastaniah and D.I. Ghozali. 1999. Forest fire and meteorological condition in Bukit Soeharto Education Forest, East Kalimantan in 1998: comparative study on the cases in 1997 and 1998. In H. Suhartoyo and T. Toma eds., *Proceedings 3<sup>rd</sup> International Symposium on Asia Tropical Forest Management*. Samarinda, Indonesia. September 20-23, 1999. Pusrehut special publication No. 8. Tropical Forest Research Center, Mulawarman University and Japan International Agency. Indonesia. p. 72-80.
- [8] J.A. Gomez-Tejedor, M.J. Estrela and M.M. Millan. 2000. A mesoscale model application to fire weather winds. *Int. J. Wildland Fire* 9 (4): 255-265.
- [9] L. Syaufina., A.N. Ainuddin, B. Jamaluddin, F. See, Lai and M.Y. Mohd. Rashid. 2004. The effects of climatic variations on peat swamp forest conditions and fire behaviour. *Trop. For. Manage. Journal* X (2):1-14.
- [10] L. Syaufina. 2013. The Implementation of ASEAN Peatland Management Strategy (APMS) in Indonesia in relation with Peat Fire Reduction: A Review. *Proceedings of the International Symposium on Tropical Forest Ecosystem, Science and Management 2013*, Bintulu, Sarawak, Malaysia.
- [11] Samsuri, I.N.S. Jaya and L. Syaufina. 2012. Spatial Model of Land and Forest Fire Risk Index, Case Study in Central Kalimantan Province (*in Indonesian*). *FORESTA Indonesian Journal of Forestry* I (1) 2012: 12-18.
- [12] R. Boer and A. Faqih. 2004. Current and Future Rainfall Variability in Indonesia. In *An Integrated Assessment of Climate Change Impacts, Adaptation and Vulnerability in Watershed Areas and Communities in Southeast Asia*. Report from AIACC Project No. AS21. International START Secretariat. Washington, DC.



## **Agroforestry based medicinal plants and marketing partnership for community empowerment: cases in Bogor district and Sukabumi district, West Java province**

**Leti Sundawati<sup>1\*</sup>, Ninuk Purnaningsih<sup>2</sup>, Edyi Purwakusumah<sup>3</sup>, Yudi F. Sitepu<sup>4</sup>**

<sup>1,4</sup>Department of Forest Management, Bogor agricultural University, Bogor, 16680, Indonesia

<sup>2</sup>Department of Communication Science and Community Development, Bogor agricultural University, Bogor, 16680, Indonesia

<sup>3</sup>Department of Bio-chemical, Bogor agricultural University, Bogor, 16680, Indonesia

<sup>1,2,3</sup>Biopharmaca Research Center, Bogor agricultural University, Bogor, 16680, Indonesia

\*Corresponding author: lsundawati@gmail.com

---

**Abstract** Indonesia has a very rich biodiversity among any others is medicinal plants or biopharmaca plants. Demand on medicinal plants as raw material of herbal medicine tends to increase in last decade, so that it becomes an opportunity for farmers to increase their income. But most of farmers including farmers at Sukaluyu Village, Nanggung Sub-district, Bogor District and farmers at Mekarjaya Village, Ciemas Subdistrict, Sukabumi District has not yet cultivated medicinal plants according to standard operating procedure and even never conducted post-harvest processing. As a result, they received low product price because its quality is same as spices not as raw material of herbal medicine. Agroforestry has been known as a land use system which integrated woody perennial plants with crops and or animal, and has been considered to have ecological, economic and social benefits. Agroforestry based medicinal plants, in which medicinal plants such as *temulawak* (*Curcuma shantoriza*) planted under Jabon tree stands and *kapolaga* (*Amomum cardomum*) integrated with mangosteen fruit tress, has been introduced to the farmers in Mekarjaya Village, Sukabumi District and in Sukaluyu Village, Bogor District respectively. Through comparative study, training on cultivation and post-harvest processing of medicinal plants member of farmer group and women farmer group Lamping from Sukaluyu Village have increased their knowledge and skill on standardized cultivation of medicinal plant, processing of medicinal plant products into simplisia and instant herbal drink. While members of Srijaya Farmer Groups Association (FGA) at Mekarjaya Village in Sukabumi District were also trained on cultivation, post harvesting and facilitation of farmer group institution. Agribusiness networking and partnership is built through memorandum of understanding

on marketing between FGA and herbal medicine company.

**Keywords** agroforestry, medicinal plant, empowerment, marketing, partnership

---

## **1. Introduction**

Demand of bio-resources as raw material for traditional medicine, pharmacy, and cosmetic industries increased every year in Indonesia as well as at international market due to the trend of “back to nature”. In Indonesia, demand on ginger (*Zingiber officinale* Roxb.) reached about 5,000 ton/year, cardamom (*Ammomum cardamomum* Auct.) and turmeric (*Curcuma domestica* Val.) reached the same amount i.e. about 3,000 ton/year. Supply of those bio-resources comes from national production which is mostly extracted from their habitats (mostly from forest area) and only about 15% comes from cultivation by farmers. Until now, there is a very big shortage on supply of medicinal plants (*biopharmaca*) in Indonesia as well as international market. For example the demand of dried cardamom from China reached about 400 ton/month, but Indonesia could only export about 40 ton/month or only about 10 % [1].

The high demand on biopharmaca plants becomes a very good opportunity for farmer to cultivate biopharmaca plants and to increase their household income. Farmers at Sukaluyu Village, Bogor District already cultivated some biopharmaca plants such as ginger (*Zingiber officinale*) and temulawak (*Curcuma xanthorrhiza*) introduced by local government program [2], but the cultivation is still in traditional way or not comply with Good Agriculture Practices that required for production of medicinal plants as raw material for medicine, because development of bio-medicine must comply with principles of safety, quality and efficacy from provision of raw material until final product processing.

Farmers at Sukaluyu Village sold then their products in fresh form without post-harvest and/or processed them. They also always get low price for their products, because its quality is not suitable as raw material for medicine industry. So they sold the product as spices to middle men or to traditional market. As consequence, farmer income from their biopharmaca products is low as well as their prosperity.

How to increase income and prosperity of farmers at Sukaluyu Village, Bogor District? To answer that question, an action research has been conducted in Sukaluyu Village, Bogor District in 2013 funded by Ministry

of National Education through schema of Community Empowerment. The objectives of the action research were (1) to improve farmer knowledge and skill on medicinal plant cultivation through introduction of agroforestry based medicinal plant, and (2) to improve farmer skill on post-harvesting and processing of medicinal plant products.

## 2. Materials and Methods

This action research was conducted at Sukaluyu Village, Bogor District, West Java Province in 2013. The action research use method of diffusion of innovation and acceleration of technology transfer. Existing condition of farmers and research location was assessed using structured interview to 30 famer households who are member of farmer group at Lamping Hamlet, Sukaluyu Village. Farmers were then empowered through training on medicinal plant cultivation, post harvesting and processing.

## 3. Results and Discussion

### 3.1. Development of agroforestry based medicinal plan

Result of survey on existing condition showed that medicinal plants (ginger and lemon grass) that traditionally practiced by farmers contributed only less than 10% to the household income at Sukaluyu Village (Table 1).

Table 1. Average annual farmer household income from various sources at Sukaluyu village

Income Source	Income (Rp/ year)	Persentase (%)
1. Agroforestry:		
a. Wood	5,279,333	27.90
b. Medicinal plants	1,559,233	8.24
c. Food crops	3,226,200	17.04
2. Paddy field	2,916,666	15.42
3. Non agriculture	5,940,566	31.40
Total	18,921,998	100.00

Improving farmer knowledge and skill on medicinal plant cultivation was conducted through introduction of agroforestry based medicinal plant at Sukaluyu Village, Bogor District is aimed not only to increase productivity but more important to improve the product quality. As raw material for medicine and cosmetic, medicinal plants must free of dangerous chemical content and have high content of active compound.

Training on cultivation of cardamom (*Ammomum cardamomum* Auct.) combined with woody trees (*Maesopsis eminii*) and mangosten fruit trees

(*Garcinia mangostana*) (see Figure 1), farmers were also encourage to become a seed breeder, because the increasing of demand on medicinal plant products has increase the demand on high quality of seed. Because until now, there are very few research institutions in Indonesia that are dealing with research on medicinal plant breeding. So, most of seed that used by farmers come from their own production that certainly has not very good quality which affect the productivity of medicinal plants cultivated by farmers.



Figure 1. Establishment of demonstration plot of agroforestry based medicinal plant that combined cardamom (*Ammomum cardamomum*) with woody trees (*Maesopsis eminii*) and mangosten fruit trees (*Garcinia mangostana*) at Sukaluyu Village.

Agroforestry is a colective name for land use systems and technologies where woody perennials (trees, shrubs, palms, bamboos etc) are deliberately used on the same land management units as agricultural crops and or animals, in some form of spatial management or temporal squence [3]. Results of various researches have been proved that agroforestry is suitable for optimizing land-use especially for poor farmers with small land ownership, increasing biodiversity of agriculture land and improving soil fertility [4, 5, 6].

Agroforestry has been practiced at various countries including Indonesia since a long time ago. But agroforestry is barely recognized by Indonesian government. So there is no high level regulation recommended agroforestry as sustainable and environmental friendly cultivation practice. Agroforestry is suitable for shade tolerant medicinal plants, such as cardamom (*Ammomum cardamomum* Auct.). Medicinal plants that light demanding could be planted in agroforestry system through suitable planting space arrangement

### 3.2. Improving knowledge and skill on post harvesting and processing of medicinal plants

Knowledge and skill on post harvesting is important for farmers who cultivated medicinal plants. Most medicinal plants especially which produce tuber such as ginger, turmeric, curcuma, etc. could be only harvested once a year, while the demand of the products throughout the year. Through post-harvest handling, such as making *simplisia* from tuber through slicing and drying, farmers could sell their products later when the price is good, not during the peak season when the price is low due to oversupply (Figure 2). So that, farmers will get added value from conducting post-harvest handling. Processing medicinal plant products is aimed to add the value to the products, so that farmers could get additional income and also for farmer family consumption and health.



Figure 2: Women farmers at Sukaluyu Village participated on training of post-harvesting (making *simplisia* or dried medicinal plants) and processing of instant herbal drink

## 4. Conclusion

1. Agroforestry based medicinal plants system could improve quality of medicinal plant products.
2. Economic benefit as well as family health could be derived from post-harvest and processing of medicinal plants by farmers.
3. Government should also develop and support more research institutions on medicinal plant breeding to increase the provision of high quality of seed.

## 5. References

- [1] Masyhari. 2013. Negeri Jamu: Analisis Faktor-faktor yang Mempengaruhi Pengembangan Industri Jamu Traditional. PT Harfa Media Komunika.

- [2] Agromedika Hambaro. 2008. Profil Kebun Agromedika di Desa Hambaro, Kabupaten Bogor. Dinas Pertanian dan Kehutanan Kabupaten Bogor.
- [3] B. Lungreen. 1987. Institutional aspects of agroforestry research and development. In: Agroforestry Decade of Development. ICRAF Nairobi.
- [4] L. Sundawati. 1993. The Dayak forest gardens in Sanggau district, West Kalimantan: an agroforestry system. Thesis of Master of Forestry Sciences. Georg-August University of Goettingen. Germany.
- [5] J. Kartasubrata. 2003. Social Forestry and Agroforestry in Asia. Fakultas Kehutanan IPB, Bogor.
- [6] D. Suharjito, L. Sundawati, S.R. Utami, Suyanto. 2003. Aspek Sosial Ekonomi dan Budaya Agroforestry. World Agroforestry Centre (ICRAF) Southeast Asia, Bogor.

## **A survey on the community socio-economic of the district of coral reef rehabilitation and management program (COREMAP) of Sikka, Flores**

**Vincentius Repu<sup>1,\*</sup>**

<sup>1</sup>Faculty of Economics of Widya Mandira Catholic University, Kupang, 85225 Indonesia

\*Corresponding author: vincentiusr@yahoo.com

---

**Abstract** This study aims to collect baseline data on the social, cultural and economic of the community with regard to the utilization of marine resources. In a more specific purpose is to give a general picture of the location of Coremap, human resources conditions, the community welfare and income levels as well as the factors that influence it. This study was conducted in Sikka District. There were eight Villages of the district that were taken as samples, i.e Wuring, Wolomarang, Lewomada, Parumaan, Kojadoi, Sikka, Mbengu and Pruda. Study results revealed that Sikka region has a fairly wide expanse of reefs, which are scattered in the southern territorial waters and in the waters of the northern region of the district (Gulf Maumere). In the northern region, most of the stretch of coral reefs have been damaged, especially during the last 10 years. The coral reefs damage was caused by natural disasters and human being. Natural disasters that destroy coral reefs is the earthquake and tsunami that occurred on December 12, 1992, while the damage caused by human include: catching marine resources by using bombs and poisons, the use of fishing gear that is not environmentally friendly (trawling) and forest clearing. Most of the population of the sample villages are fishermen (fish catch and cultivation fishermen). During the last 10 years the catch has been perceived decline as a result of the destruction of the coral reef ecosystem. Due to a decrease of the catch, most fishermen in the region of small islands in the 2000s have switched from catch fishermen to fishing cultivation. Most of them are on the business of seaweed. While other fishermen switch in to other businesses that not related to fishing, such as trading and public transportation. The shift of occupation from from fishing to seaweed cultivation is due to potentials of seaweed of the region. The fishermen have the skills to do the seaweed business. The seaweed business is growing due to good transportation and the market is quite promising. Most of the population are traditional fishermen with modest fleet (canoes without motors) and limited access to capital resources. Until now the production of the seaweed is still low. This leads to the low level of the people welfare. The per capita income of the sample villages is Rp 509,013 per month which is below the average per capita income of the district, i.e. Rp 2,274,653. While the minimum income per capita per month is Rp 108,333 and the maximum income per capita per month is Rp 21,716,667. This shows a quite wide gap

of income amongst the fishermen. The maximum household income is Rp 21,716,667 which is above the World Bank's limit. The low income of the fishermen is due to the limited access to capital resources, traditionally-run fishing, limited catchment area, and limited number of catch. Seasonal factors also result in limited catch location as well as months to go fishing in a year. To increase the fishermen household income it is recommended to facilitate the fishermen with easy access to capital resources and production factors, and provision of training on fishing skills.

**Keywords** coral reef, marine resource, socio-economic

---

## **1. Introduction**

In the early 2000s Indonesian government has launched a program called COREMAP (*Coral Reef Rehabilitation and Management Program*) to overcome the problem of coral reefs damage. The program intended to drive and improve business management and rehabilitation of coral reefs so that marine resources can be exploited for the community sustainable increasing income and welfare, especially the coastal communities of Indonesia. Coremap program is based on community participation (*community-based management*).

Indicators that can be used to measure the achievement of the objectives are both biophysical and socio-economic aspects. From the biophysical aspects it is expected that an increase in coral cover at least 5 percent per year to achieve the same level with the areas that have been managed well or *pristine area* (area of a pristine coral reef/untapped). While the socio-economic aspects are: (1) the increase of 10 percent of the income and the number of people who receive income from the economic activity based on coral reefs and other related economic activities; and (2) at least 70 percent of the fishing community (*beneficiary*) in the district feel the positive impact of Coremap program [1].

One of the Coremap areas is District Sikka, East Nusa Tenggara. The whole stretch of coral reefs in Sikka district reaches approximately 14,500.4 hectares. There is about 60 percent of coral reefs are still in good condition.

The research objectives are:

- a. To provide an overview of geography, infrastructure, natural resources, especially marine resources and their utilization patterns of the Coremap location.



- b. To describe education condition and economic activities of the community, especially coral reef-based economic activities.
- c. To figure out the income and social welfare especially the ownership of assets (production and non-production) and the condition of housing and environmental sanitation.
- d. To identify factors influencing the level of income of the people.

## **2. Materials and Methods**

### **2. 1. The choice of location**

This research was conducted in Sikka district, while the sample villages were Wuring, Wolomarang, Lewomada, Parumaan, Kojadoi, Sikka, Mbengu and Pruda.

### **2. 2. Data collection**

There are two types of data collected, the quantitative and qualitative data. Quantitative data were collected through surveys. While the qualitative data were collected through in depth interviews, focus group discussions (FGD), field observations and photo documentation. Respondents are heads of the households or one of the members of the families. The respondents were purposively selected.

### **2. 3. Data analysis**

The analysis used is *descriptive analysis* and *content analysis*. Data collected from questionnaires were analyzed descriptively using frequency tabulation in order to see the spread of the category or variation. Also, the cross-tabulation is used to see the relationship between variables. Then the qualitative data obtained from in-depth interviews, focus group discussions were analyzed using *content analysis techniques*.

## **3. Results and Discussion**

### **3.1. Socio-demographic profile of the population**

#### **3.1.1. Education of the population**

Table 2 shows that the educational level of the population is still low. Most people, 42 percent, is still in the group of not completed primary school. This is very alarming because people who complete primary school only 31%. While people who have been able to enjoy junior and senior high school is only 27%.

Table 2. Distribution of Population Aged 7 Years and above by Education and Gender East Nusa Tenggara Province, Sikka District, 2012

Education attained	Man		Female		Male + Female	
	Number	Percentage	Number	Percentage	Number	Percentage
Not / no school	24	7.36	21	7.05	45	7.21
Not / did not complete primary school	112	34.36	102	34.23	214	34.29
Elementary school graduation	96	29.45	100	33.56	196	31.41
Junior graduate	54	16.56	33	11.07	87	13.94
High school graduation to the top	40	12.27	42	14.09	82	13.14
Total	326	100.00	298	100.00	624	100.00

Sources: Primary data, processed 2012

### 3.1.2. Skills of the residents

The skills of the population are fused with natural conditions or natural potential. In villages located in small islands, Kojadoi, Pemanan, and Kojagete, the skills of the population are related to fishing activities. In land areas of the research area, which are geographically closed to urban areas, the types of skills tend to be more diverse.

### 3.1.3. Employment

Fishery jobs dominate the district employment structure, amounting to 57.62 percent. Other jobs are services (18.1 percent), agricultural sector amounted to 16.67%, followed by trade sector totaled 4.76 percent and processing industry by 1.90%. The rest is only 1 percent (Table 3).

Table 3. The Distribution of Population Aged 10 Years and above According to Major Employment and Sex East Nusa Tenggara Province, Sikka District, 2012

Jobs	Man		Female		Male + Female	
	Number	Percentage	Number	Percentage	Number	Percentage
Fishery	115	65.34	6	17.65	121	57.62
Agriculture	28	15.91	7	20.59	35	16.67
Trade	6	3.41	4	11.76	10	4.76
Livestock	1	0.57	0	0.00	1	0.48
Social service	25	14.20	13	38.24	38	18.10
RT Industry/Processing	0	0.00	4	11.76	4	1.90
Other	1	0.57	0	0.00	1	0.48
Total	176	100.00	34	100.00	210	100.00

Sources: Primary data, processed 2012

### 3.1 4. Welfare

#### 3.1.4.1. Ownership and control of productive assets means and sea fishing gear

In general, data shows that the types of fishing fleets in the sample villages are ship/boat motors, outboard motor boats and canoes without motors. Most of the fleets are boats without motors.

#### 3.1.4.2. Living conditions

*Residential tenure.* In general, most houses are of 20 to 50 square meters.

*Ownership of Productive Land.* There is nearly 65 percent of the people of the villages located in the small islands do not have productive yard. This is due to the rocky islands. While households that want to open the land have to go to big island. This is in contrast with the Villages Pemana and Kojagete whose locations are on islands located on the waterfront. In these two villages people can plant banana and other vegetation.

#### 3.1.4.3. Problems in the management of marine resources

One of the problems in relation to the management of coastal and marine resources is that the local government has not passed local legislation on management of coastal and marine resources.

## 3.2. Income per capita and household income

Table 5 shows that the people earn only about Rp 509,013 per month, or approximately Rp 16.967,- per day. This is below the poverty line stated by World Bank. World Bank states that the poor spends US \$ 2 or less per day (with US \$ 1= Rp 9,000, - then the poor spends Rp. 18,000, -/day). It shows that the people are poor.

Table 5. Statistics of Per Month Household Income East Nusa Tenggara Province, Sikka District, in 2012

Income	Number
Average	2,274,653
Per capita	509.013
Minimal	108.333
Maximum	21,716,667
Median	10,912,500

Sources: Primary data, processed 2012

#### 3.2.1. Revenue by income group

By income group, the majority (76 percent) of households in the sampled villages are under Rp 1.500.000,- per month (Table 6). This is due to such several factors as traditional technology of fishing fleets (canoes) and

simple fishing equipment; fishing is the only source of household income; and the small size of seaweed cultivation.

Table 6. Distribution of Households by per Month Income Group East Nusa Tenggara Province, Sikka District, 2012

Income (Thousands rupiahs)	The number (n)	Percentage (n)
0 s / d 499	62	38.75
500 s / d 999	33	20.63
1000 s / d 1499	27	16.88
1500 s / d 1999	5	3.13
2,000 s / d 2,499	5	3.13
2500 s / d 2999	8	5.00
3000 s / d 3499	5	3.13
3,500 and above	15	9.38
Number (N)	160	100.00

Sources: Primary data, processed 2012

### 3.2.2. Revenue by employment

Table 7 shows that most of the sampled households (65.36 percent) are involved in the field of fishing. While in agriculture is only 18.30 percent and social service is in the third. However, people that are involved in social service enjoy the highest income, followed by livestock and fishery.

Table 7. Average per Month Household Income According to the Household Head Job East Nusa Tenggara Province, Sikka District, 2012

Field Work	Average Revenue	Number (n)	Percentage
Fishery	1.057.923	100	65.36
Agriculture	637.994	28	18.30
Trade	1.858.000	5	3.27
Livestock	2.620.000	1	0.65
Social service	2.462.500	18	11.76
Other	1,000,000	1	0.65

Sources: Primary data, processed 2012

### 3.2.3. Fishermen revenue according to season

In a strong wave season, income distribution pattern is very different from the other seasons. In a strong wave season, the number of households proved highly concentrated in the lowest income group (under Rp 500,000.00). It is interesting that the number of households turns out to be 90.09 per cent. The research results show that there is no single one household whose income lies in the group up to Rp 2,500,000 (Table 8).

Table 8. Statistics of per month Household Income of Fishermen According to Season East Nusa Tenggara Province, Sikka District, 2012

Income	Season		
	Strong waves	Transition period	Weak waves
Average	230.411	443.998	1.002.669
Minimum	10,000	7,500	25,000
Maximum	2.437.500	5.625.000	9,800,000
Median	1223750	2816250	4.912.500

Sources: Primary data, processed 2012

### 3.2.4. Fishermen income according to season and income group

*The distribution pattern of the income In the transition seasons is different from that in the calm waves of the season.* The proportion of households in the upper middle income group tends to decline. In fact, there is not even a single household on the income group of Rp 2,500,000 - Rp 3,000,000. The number of households in the income group of Rp 3 millions and above is likely to decline. While the number of households in the income group under Rp 1 million increases significantly. The decrease in revenue is due to the decline of number of days of fishing activity (Table 9).

Table 9. The Distribution of Fishermen Household by per Month Income Group and Season East Nusa Tenggara Province, Sikka District, 2012

Income (Thousands of dollars)	Strong waves		Transition period		Weak waves	
	The number (n)	Percentage (n)	The number (n)	Percentage (n)	The number (n)	Percentage (n)
0 - 499	100	90.09	86	77.48	45	40.54
500 - 999	9	8.11	16	14.41	36	32.43
1000 - 1499	0	0.00	3	2.70	14	12.61
1500 - 1999	1	0.90	3	2.70	2	1.80
2,000 - 2,499	1	0.90	0	0.00	5	4.50
2500 - 2999	0	0.00	0	0.00	5	4.50
3000 - 3499	0	0.00	1	0.90	0	0.00
3,500 and above	0	0.00	2	1.80	4	3.60
Number (N)	111	100.00	111	100.00	111	100.00

Sources: Primary data, processed 2012

## 4. Conclusion and Recommendation

### 4.1. Conclusion

Most population are fishermen, but the catch of marine resources has been diminishing over the last 15 years due to the coral reef ecosystem damage.

In 2000s most fishermen in the region of small islands (primarily in the village of Kojadoi) moved to seaweed cultivation and traders. The shift is due to suitable and potential areas, increasing employment for household members, more stable income and seasonal affect avoidance to the income. Although the majority of the population has low level of education (primary school to down), many fishermen possess the skills of seaweed cultivation. This is supported by Coremap program, increasingly smooth access to transportation and promising market of seaweed production.

Most of the people are traditional fishermen with modest fleet (canoes without motors) and tiny catch. The aquaculture development still needs capital and seed production costs. Most of the homes in the research area are owned by the residents but the houses are not permanent buildings. Source of clean water for the majority of the population in the two study areas is still a problem.

The per capita income in the sampled villages is only about Rp 509,013 per month, or approximately Rp 16.967,- per day. This is below the poverty line stated by World Bank. It shows that the people are categorized poor.

#### **4.2. Recommendation**

- a. To increase the fishermen household income it is recommended that the government facilitate the fishermen with easy access to capital resources and production factors.
- b. It is also recommended to provide training in relation to the fishing skills and seaweed cultivation.

#### **5. References**

- [1] BAPPEDA Sikka. 2009. Database Sikka, Sikka District Profile Family Based Indicators on Food, Clothing, Board, Food Security, Land Ownership, Education and Health.
- [2] BAPPEDA Sikka. 2010. *Sikka Regional Economic Profile*, Maumere: Bappeda Sikka regency.
- [3] BPS Sikka. 2010. *Welfare Indicators Sikka regency in 2010*, Maumere: BPS Sikka regency.
- [4] BPS Sikka. 2007. *Population Sikka 2007*, Maumere: CPM district. Sikka.
- [5] BPS Sikka. 2007. *The District Kewapante In 2007 figures*, Maumere: CPM district. Sikka

- [6] BPS Sikka. 2008. Sikka District in Figures 2008, Maumere: CPM district. Sikka
- [7] COREMAP – AusAID. 2003. Six Monthly Report of NTT Pilot Sub-Project
- [8] Daliyo and S. Bandiyono. 2002. Social Aspects of Data Base Indonesian Coral Reefs: A Case Study Boni Village, District of North Waigeo Sorong Regency, Papua Province , Jakarta: LIPI COREMAP.
- [9] Hidayati, Deny and L. Rachmawati. 2002. Data Association Indonesian Social Aspects of Coral Reefs: A Case Study of North Mola village, Wangi-Wangi Subdistrict, Buton, Southeast Sulawesi , Jakarta: LIPI COREMAP .
- [10] Jones, W. Gavin and Y. Raharjo. 1998. *Population, Land And Sea Challenges of Development in Eastern Indonesia*, Jakarta: Pustaka Sinar Harapan.

## **Influence of leadership style, organizational culture, and work motivation on employee performance in public company pawn shop branch office in Kupang City, East Nusa Tenggara, Indonesia**

**Fred M. Dethan<sup>1</sup>, \***

<sup>1</sup>Faculty of Social and Political Science, University of Nusa Cendana, Kupang, Indonesia

\* Corresponding author: fmdethan@yahoo.co.id

---

**Abstract** Success or failure of the management of an organization, regardless of its form, be it a private organization, community or government cannot be separated from the role of human resources or a leader. Any sophisticated organization, as well as any management system, will be halting perhaps even use less if no one is able to lead to move or control the organization. In the management of the organization should pay attention to the style of leadership, organizational culture, motivation, and performance of the people who work with in the organization. In general, this study aims to explain the influence of leadership style, organizational culture and work motivation on employee performance in Public Company Pawn shop Branch Office in the Kupang City. The study was conducted using a questionnaire that was sent to 92 employees at Public Company Pawn shops Branch Office in the Kupang City. The data collected were analyzed using SPSS version 16. The result of the analysis shows that the leadership style and organizational culture significantly affect the performance of employees. While the motivation to work, although not optimally implemented, but also significantly affect the performance of the employees at the Public Company Pawn shop Branch Office in the Kupang City, because it was developed by means of creating an atmosphere of dialogue in a variety of containers.

**Keywords** leadership style, organizational culture, work motivation, employee performance

---

### **1. Introduction**

Success or failure of the management of an organization, regardless of its form, be it a private organization, community or government can not be separated from the role of human resources or a leader. Any sophisticated organization, and as good as any semi-modern management system, will be halting perhaps even useless if no one is able to lead to move or control the



organization. Keep in mind that the function of leadership and management functions requires otherwise requires leadership function of management functions. Human resources (human resources) is the most important asset for the company because of its role as the subject of implementing the policy and operational activities in order to realize the vision and mission of the company in accordance with the company's long-term plan (corporate plan).

### **Literature review**

According to Robbins [1], Leadership is the ability to influence group members to work toward goals and objectives. Being a leader can not happen instantaneously, but need not be a short trip.

The theory states that the behavior of the main issues in leadership is to make an effective leader or leadership style best. Bennis in Hitts [2] provides a view of leadership, he said that the process of becoming a leader synonymous with the process of becoming fully human.

According to Harris in Heidjrahman and Husnan [3] there are basically three (3) categories of leadership styles namely; the autocratic leader. The participative leader, and the free-rein leader.

Changes in the world situation, organizations can adopt to face the challenges of organizational culture that is not only flexible but also must be sensitive to cultural perbedaan. The number, variety, status and role of the organization in the process of transformation of society raises some fundamental questions, whether that be the foundation of social culture is still able to serve as a frame of reference in the transformation of society and bring benefits to the desired changes. All organizations have a culture that depend on strength. Culture can have a significant influence on the attitudes and behavior of members of the organization [4].

In simple terms, culture can be defined as a way of doing things in the organization. Culture is an artifact, rules, values, principles, and assumptions that guide the behavior of the organization. According to Schein [5], culture is the assumption that the pattern is found, researched, and developed by a group within the organization. Culture helps groups learn to overcome the problems of external adaptation and internal integration, and enables all tasks are considered valid to be taught to new members as the proper way to perceive, think, and feel the problems encountered. Schein definition illustrates that culture involves assumptions, adaptation, perception, and learning.

According to Koontz, O Donnell and Wehrich [6], motivation is a combination of encouragement, wants, needs, expectations and similar powers possessed by each individual. When a leader motivate subordinates, it means the leader to make every effort that is expected to provide impetus and desire sarta cause the subordinates do the work desired by the leader.

Motivation for each leader has a special meaning, because the role of the leader himself is closely related to subordinates. Every leader should always cooperate with subordinates, because it requires the ability to motivate subordinate.

A leader can see motivation as a system that includes individual characteristics, work and situation as well as understand the relationship between intensive, motivation and productivity, they will be able to predict the behavior of subordinates. Only managers know this by knowing how to apply can expect the realization of increased productivity of employees [7].

Thus, the appropriate leadership style to be set. With an employee-oriented leader (a follower contered leadership orentation), a manager can treat employees humanely, more than just a resource that can be exploited. Leadership and motivation to have a great effect, because the motivation of subordinates a manager can lead leadership look good or bad [8].

Manulang [9] defines the performance is the result of the quantity and quality of work achieved an employee in carrying out their duties in accordance responsibility given to him. The performance assessment is a very important activity because it can be used as a measure of the success of an organization in achieving its mission.

### **Objectives of the study**

In accordance with the description of the background of the above problems, the formulation of the problem can be stated as follows: "How Influence Leadership, Corporate Culture, and Work Motivation on Employee Performance in Public Company Pawnshops Branch Office in the Kupang City"?

In general, this study aims to explain the performance of employees in the branch office in Public Company Pawnshops Branch Office in the Kupang City, along with the factors of leadership, organizational culture and work motivation that influence it. The purpose of the study described in some special cases, among others:

- To determine the performance of the employees at the Public Company Pawnshops Branch Office in the Kupang City.
- To find leadership, corporate culture, motivation and performance of employees at the Public Company Pawnshops Branch Office in the Kupang City.
- To test and analyze the significance of the influence of leadership, corporate culture and work motivation on employee performance at the Public Company Pawnshops Branch Office in the Kupang City.
- To describe the model of the influence of leadership, corporate culture and work motivation on employee performance at the Public Company Pawnshops Branch Office in the Kupang City

### **Hypothesis**

Hypothesis is a conjecture or statement of truth while still weak, so it is necessary to test the hypothesis. In this case will be faced with two options, namely a conclusion to accept or reject the hypothesis, for easy and detail required by the abbreviated alternative hypothesis  $H_a$  as a working hypothesis or research hypothesis stated that tends to positive statements and null hypothesis  $H_0$  abbreviated expressed with a negative statement .

Hypothesis 1: there is the influence of leadership style on the employees performance in Public Company Pawnshop Branch Office Company in the Kupang City

Hypothesis 2: there is influence between organizational cultures to the employees performance in Public Company Pawnshop Branch Office Company in the Kupang City

Hypothesis 3: there is influence between work motivations on the employees performance in Public Company Pawnshop Branch Office Company in the Kupang City.

## **2. Materials and Methods**

The population in this study were all managers or general company Public Company Pawnshops Branch Office in the Kupang City, amounting to 92 people. The sampling method of this study using probability sampling method that provides equal opportunity for every member of the population to be elected as members of the sample. While the techniques used are proportionate stratified random sampling because the population has elements that are not homogeneous and stratified proportionally.

In determining the category questionnaire scores and is based on an interval scale, where every question will be given a score of 1 to 5 using the highest and lowest values. In the questions in this questionnaire is positive questions with alternative answers and scores as follows: Never = skor1, score 2 = Rarely, Sometimes = score of 3, Often = a score of 4, and a score of 5 = Very often.

### **3. Results and Discussion**

#### **3.1. Results**

Leadership has four indicators that reflect the identity of the leadership at the Public Company Pawnshops Branch Office in the Kupang City, namely belief, practice leadership, innovation, and mindset, Results of analysis that the results represent the highest leadership is trust ( $\lambda$  0.76, t 9.83), followed by the practice of leadership ( $\lambda$  0.60, t 7.72), and innovation ( $\lambda$  0:58, t 7.60), and the lowest is the mindset ( $\lambda$  0:49, 6:35 t). These values indicate that the meaningfulness of leadership variables are: degree of freedom (2), chi-square (0.74), goodness of fit index (1.00), the root mean square of the residuals (0:01), significant probability (0.69) with the level of reliability (0.61).

Organizational culture has four indicators that reflect the values and norms of behavior which the employee is working at the Public Company Pawnshops Branch Office in the Kupang City, the character, the relationship between members, work environment, and an opportunity or chance. Results of analysis that the results represent the highest leadership is character ( $\lambda$  0.71, t 9.63), followed by the relationship between members ( $\lambda$  0.62, t 7.76), work environment ( $\lambda$  0:57, t 7.70), and the chance or opportunity ( $\lambda$  0:45, 6:25 t). These values indicate that the significance of corporate culture variables are: degree of freedom (12), chi-square (0.74), goodness of fit index (0.98), the root mean square of the residuals (0:03), significant probability (0.69) with the level of reliability (0.82).

Work motivation has five indicators that describe the underlying reasons for the employees working at the Public Company Pawnshops Branch Office in the Kupang City, namely career, responsibility, respect, participation from, and job satisfaction. Results of analysis that the results represent the highest work motivation is career ( $\lambda$  0.74, t 9.85), followed responsibility ( $\lambda$  0.60, t 7.72), participation ( $\lambda$  0:59, t 7.70), job satisfaction ( $\lambda$  0:53, t 6.82), and the is the lowest award ( $\lambda$  0:49, not 5:33). These values indicate that the meaningfulness of work motivation variables are: degree of freedom (5),

chi-square (4.74), goodness of fit index (0.99), the root mean square of the residuals (0:04), significant probability (00:04) with the level of reliability (0.80).

### **3.2. Discussion**

The results of analysis of the results showed that leadership influence on the performance of employees at the Public Company Pawnshops Branch Office in the Kupang City, because the company is considered a leader in the organization as a central domination, move, coordinating existing resources within the organization. The leader of the organization is needed as a locomotive company, the leader determines the survival and development of the organization.

Organizational culture significantly influence the performance of the employees at the Public Company Pawnshops Branch Office in the Kupang City, due to the organization of the company in carrying out his ministry always develop good teamwork on the basis of the system and working mechanism prevailing in the organization of the company, and is always seeking the creation of good communication among fellow employees.

Employee motivation significantly affect the performance of the employees at the Public Company Pawnshops Branch Office in the Kupang City, because motivation is an encouragement needs and desires of goal-directed employees to obtain satisfaction of what is needed and every employee will be stimulated when given responsibility.

## **4. Conclusion and Recommendation**

### **4.1 Conclusions**

Leadership style needs to be improved by taking into account the provision of compensation, incentives, bonuses, or awards to employees who have worked well. Employees need to be involved in solving the problems of the company, as this has a significant and positive effect in increasing the motivation and performance of employees.

Organizational culture at the Public Company Pawnshops Branch Office in the Kupang City can not be separated from the environment in which the company runs its service activities. The quality of the company's interaction with the company's internal environment is quite high and is based on the reality that the problems of coordination between sections or relationships between co-workers or the boss can be established.

Public Company Pawnshops Branch Office in the Kupang City should provide the opportunity or freedom as possible to employees in order to improve motivation, ability, ideas, and develop its potential. With the opportunity or freedom, it will be able to create and support positive development of all activities performed by employees in order to produce a better performance.

The role of leadership is to provide a good environment conducive so that employees can improve performance through factors that can motivate the employees or subordinates. In other words, things that can determine whether the poor employee motivation is how the efforts of leaders using the style of leadership in giving encouragement to his subordinates, namely by providing support and guidance tailored to the situation and conditions of subordinates so that they can be motivated to work properly.

#### **4.2 Recommendation**

Public Company Pawnshops Branch Office in the Kupang City need to increase employee motivation, satisfaction above includes salary or wages received, work performed, the relationship between co-workers or the boss, promotions, and a good working environment.

Public Company Pawnshops Branch Office in the Kupang City can improve employee motivation by giving encouragement to employees to stay motivated to work, and it is to be instilled in the employees that it is a necessity. This needs to be reflected within the employees who influence and control others and responsible to him, so employees put themselves as the leader of the group's activities to control others

### **5. References**

- [4] S. Robbins. 2006. *Organizational Behavior*. Gramedia, Jakarta.
- [5] E. Schein. 2004. *Organisational Culture and Leadership*, 2nd ed. Josey-Bass Publishers, Fransisco.

## **Management of natural resources in tropical peat swamp forest of Indonesia**

**Ujang Suwarna<sup>1,\*</sup>**

<sup>1</sup>Department of Forest Management, Faculty of Forestry, Bogor Agricultural University, 16680, Indonesia

\* Corresponding author: usuwarn@yahoo.com

---

**Abstract** Tropical peat swamp forest in Indonesia has important functions that consisted all aspects of hydrology, ecology, economic, and social. Meanwhile, timber harvesting activities could potentially reduce some functions of the tropical peat swamp forest. Measurement and calculation of natural resources in the tropical peat swamp forest should be done accurately to evaluate implementation of timber harvesting activities in the tropical peat swamp forest and also to estimate biomass and carbon stock. The objective of the study was to know changes of natural resources in order to evaluate implementation of timber harvesting activities in the tropical peat swamp forest. The study was conducted in the forest concession area of PT. Diamond Raya Timber, Riau Province, Indonesia. The study found out that timber harvesting activities in the tropical peat swamp forest has reduced about 29% of standing trees and also decrease 23% of forest biomass and forest carbon stock. It indicated that implementation of timber harvesting activities in the tropical peat swamp forest should be improved through best forest management and advanced timber harvesting techniques.

**Keywords** tropical peat swamp forest, natural resources, forest management, timber harvesting

---

### **1. Introduction**

Tropical forest was important agent in global climate change mitigation through absorption and storage of carbon in form of biomass. One of forest ecosystem type that has potential to absorb and store carbon was tropical peat swamp forest. Tropical peat swamp forest should be managed through best forest management practices because it has very important functions that consisted all aspects of hydrology, ecology, economic, and social. Based on data in 2006, Indonesia had 21 million ha of tropical peat land that consisted 9 million ha (43%) of non forest area and 12 million ha (57%) of tropical peat forest area [1]. The tropical peat forest area was used as conservation function (28%) and production function (72%). Timber

harvesting activities can reduce potentially some functions of tropical peat swamp forest. So, implementation of timber harvesting in tropical peat swamp forest should be improved through best forest management practices and advanced timber harvesting techniques. In this study, measurement and calculation of natural resources in tropical peat swamp forest were done accurately to evaluate implementation of timber harvesting. The study also estimated total biomass and carbon storage in the three conditions of the forest. The objective of the study was to measure and to know changes of natural resources in order to evaluate implementation of timber harvesting in tropical peat swamp forest.

## **2. Materials and Methods**

The study was carried out in forest concession area of PT Diamond Raya Timber in Riau Province, Indonesia. The object of study was focused on three forest conditions: (1) forest area before harvesting as well as primary forest; (2) forest area after harvesting as well as log over area; and (3) degraded forest area. Stand density and species composition was measured in the field by using 8 sampling plots with area 1 ha of each sampling plot. The sampling woods were analyzed in laboratory by using testing method to know woods chemical and physical characteristics. Biomass and carbon content were estimated by using direct measurement with destructive sampling technique. Those samples were tested and analyzed by using carbonization method. Then, an allometric equation was produced by using regression method. Forest biomass and carbon stock were divided in two types of vegetation. First was non trees vegetation such as grass, shrubs, and herbs. Second was tree vegetation such as seedlings, saplings, poles, and trees. Total biomass and carbon stock of non tree vegetation in each plot were estimated by using direct measurement with destructive sampling techniques. Total biomass and carbon stock of tree vegetation in each plot were estimated by using allometric equations from Suwarna *et.al.* [2]. as following: Biomass (W) =  $0,204 \text{ DBH}^{2.393}$  and Carbon (C) =  $0.087 \text{ DBH}^{2.470}$ .

## **3. Results and Discussion**

### **3.1. Forest management and timber harvesting in tropical peat swamp forest**

The concession area had total area of 90,956 ha. It was managed by propotional land use and divided into an effective production area (77%) and a protected area (23%). The peat soil had a high moisture content consisting 898%-1042% of fibrik peat and 861%-1065% of hemik peat with



the average 979%. It indicated that the hydrological function of the area had been well managed. Timber harvesting had been done only in the effective production area, with the average felling area of 2000 ha each year. The felling area divided into two harvesting techniques. First area consisting 70% of total area implemented a manual harvesting by using kuda-kuda system and reduced impact logging techniques. In the manual harvesting, tree felling used chainsaw and logs skidding used people power and ongkak tools. Second area consisting 30% of total area implemented a mechanical harvesting by using logfisher system and conventional techniques. In the mechanical harvesting, tree felling used chainsaw and logs skidding used logfisher. Logfisher system provided higher residual stand damage than kuda-kuda system.

### **3.2. Species composition and stand density in tropical peat swamp forest**

Species composition of grass was dominated by *Imperata cylindrica*. Species composition of shrubs was dominated by *Liana* sp. Species composition of herbs was dominated by *Licuala spinosa*. Species composition of tree vegetation was dominated by *Eugenia* sp., *Knema cinerea*, and *Urandra secundiflora*. The study showed that total number of tree species was 33 species. Istomo [3] said that primary peat swamp forest had 45 species totally. Its difference was caused by various peat thickness. Table 1 showed that species number of poles and trees decreased 7% and 15% because of timber harvesting activities. The forest degradation reduced species number of seedlings 30%, saplings 40%, poles 75%, and trees 100%.

Table 1. Species composition and stand density in the three conditions of forest area

No	Forest conditions	Species composition (spesies/ha)				Stand density (individu/ha)				Total
		Seedlings	Saplings	Poles	Trees	Seedlings	Saplings	Poles	Trees	
1	Before harvesting	23	21	28	33	8000	1088	548	251	9887
2	After harvesting	23	21	26	28	5900	592	316	200	7008
3	Degraded forest	16	13	7	0	2000	3728	32	0	5760

Table 1 showed that stand density of seedling, saplings, poles, and trees decreased 29% after timber harvesting activities. The activities of forest degradation reduced 42% of stand density of seedlings, saplings, poles, and trees. Those results indicated that the harvesting techniques should be improved and the best management practices must be implemented in order to maintain the species composition and stand density in the tropical peat swamp forest.

### **3.3. Biomass of vegetation in tropical peat swamp forest**

Biomass number of non-tree vegetation before timber harvesting activities was dominated by herbs (90%). It indicated that the primary forest had high biodiversity of herbs before timber harvesting activities. Biomass number of non-tree vegetation after timber harvesting activities was dominated by grass (77%). Table 2 showed that biomass number of non-tree vegetation decreased 70% caused by timber harvesting activities. The forest degradation decreased 70% of biomass number of herbs, but it increased 85% of biomass number of grass and shrubs.

Table 2. Biomass of tree and non-tree vegetation (ton/ha) in the three conditions of forest area

No	Forest conditions	Biomass of non tree (ton/ha)				Biomass of tree (ton/ha)				
		Grass	Shrubs	Herbs	Total	Seedlings	Saplings	Poles	Trees	Total
1	Before harvesting	1.51	0.61	18.53	20.65	0.17	1.63	15.61	160.04	177.45
2	After harvesting	4.82	1.44	0	6.26	0.24	1.20	9.96	124.96	136.36
3	Degraded forest	10.79	3.13	5.61	19.53	0.11	1.04	0.60	0	1.75

Table 2 showed that biomass number of tree vegetation decreased 23% because of timber harvesting activities. The activities of forest degradation decreased 99% of biomass number of tree vegetation in the tropical peat swamp forest. Istomo *et.al.* [4] Stated that tree biomass totally 247.50 ton/ha in the primary forest, 111.40 ton/ha in the log over area, and 6.95 ton/ha in the opening area. The different number of biomass might be caused by different conditions of the research areas such as peat thickness and human activities. Those results indicated that the harvesting techniques should be improved and the best management practices must be implemented in order to maintain the biomass number in the tropical peat swamp forest.

### **3.4. Carbon stock of vegetation in tropical peat swamp forest**

Carbon stock of non-tree vegetation before timber harvesting activities was dominated by herbs (91%). It indicated that the primary forest had high carbon stock of herbs before timber harvesting activities. Carbon stock of non-tree vegetation after timber harvesting activities was dominated by grass (74%). Table 3 showed that carbon stock of non-tree vegetation decreased 70% caused by timber harvesting activities. The forest degradation decreased 91% of carbon stock of herbs, but it increased 86% of carbon stock of grass and shrubs.

Table 3. Carbon stock of non-tree vegetation (tonC/ha) in the three conditions of forest area

No	Forest conditions	Carbon stock of non tree (tonC/ha)				Carbon stock of tree (tonC/ha)				
		Grass	Shrubs	Herbs	Total	Seedlings	Saplings	Poles	Trees	Total
1	Before harvesting	0.46	0.15	6.40	7.01	0.06	0.72	7.17	95.91	103.86
2	After harvesting	1.54	0.54	0	2.08	0.08	0.52	4.57	74.33	79.50
3	Degraded forest	3.28	0.93	0.57	4.78	0.01	0.44	0.27	0	0.72

Table 3 showed that carbon stock of tree vegetation decreased 23% caused by timber harvesting activities. The activities of forest degradation decreased 99% of carbon stock of tree vegetation in the tropical peat swamp forest. Ludang and Jaya [5] said that primary peat swamp forest had carbon stock totally 351.33 tonC/ha. There was 173.33 tonC/ha in the log over area and 143.33 tonC/ha in the area after burning. The different number of carbon stock might be caused by different conditions of the research areas such as peat thickness and human activities. Those results indicated that the harvesting techniques should be improved and the best management practices must be implemented in order to maintain the carbon stock in the tropical peat swamp forest.

#### 4. Conclusion

Tropical peat swamp forest had high biodiversity both tree and non-tree vegetation. Timber harvesting activities in the tropical peat swamp forest had reduced 29% of standing trees and decrease 23% of forest biomass and forest carbon stock. Those indicated that implementation of timber harvesting in the tropical peat swamp forest should be improved by implementation of best forest management practices and advanced timber harvesting techniques.

#### 5. References

- [1] Badan Perencanaan Pembangunan Nasional (BAPPENAS). 2009. Reducing carbon emissions from Indonesia's peat lands. Interm report of a multi-disciplinary study. Paper was presented at wetlands international side event 11 December 2009. COP 15 Copenhagen, Denmark.
- [2] U. Suwarna, Elias, D. Darusman, Istomo. 2012. Estimation of total carbon stocks in soil and vegetation of tropical peat forest in Indonesia. *J. of. Trop. Foresy. Manag.* 12(3):40-57.

- [3] Istomo. 2006. Content of fosfor and calsium in soil and biomass of peat swamp forest. *J. of Trop. Foresy. Manag.* 12(3):40-57.
- [4] Istomo, C. Wibowo, I.T.C. Wibisono. 2009. Plant diversity and biomass content in relation to wise use of tropical peat land. In: *Proceeding of Bogor symposium and workshop on tropical peat land management 14-15 July 2009.* Page: 57-66.
- [5] Y. Ludang, H.P. Jaya. 2007. Biomass and carbon content in tropical forest of Central Kalimantan. *J. of. Appl. Sci. in Envir. Sanit.* 2(1):7-12.

## **Analysis of the competitiveness of pangasius fish farming in Kota Gajah Sub-district, Lampung Tengah District, Lampung Province**

**Angga Yudhistira<sup>1,\*</sup>, Harianto<sup>2</sup>, Nunung Kusnadi<sup>2</sup>, Stephan Wessels<sup>3</sup>,  
Bernhard Brümmer<sup>3</sup>**

<sup>1</sup> Sustainable International Agriculture, Joint Degree Program: Bogor Agricultural  
University & Göttingen University

<sup>2</sup> Department of Agribusiness, Bogor Agricultural University, Bogor, 16680, Indonesia

<sup>3</sup> Department of Agricultural Economics and Rural Development, Göttingen University,  
Göttingen, 37073, Germany

\* Corresponding author: [anggayudhistira42@gmail.com](mailto:anggayudhistira42@gmail.com)

---

**Abstract** The study examined data on pangasius fish grow-out business as practiced through earthen pond aquaculture system in Kota Gajah Sub-District, Lampung Tengah District, Lampung Province, Indonesia. Kota Gajah is famous in the utilization of local resources as cheap and sustainable input for pangasius fish farming business. The study estimated the competitive and comparative advantages of the pangasius fish farming business using the Policy Analysis Matrix (PAM) method to determine the Private Cost Ratio (PCR) and Domestic Resource Cost Ratio (DRC). Sensitivity analysis was performed to measure the responsiveness of the PCR and DRC to the changes of key parameters in pangasius fish farming. The result shows that pangasius fish farming in Kota Gajah has competitive and comparative advantage, as confirmed by PCR and DRC that less than 1. Strong trade policy on output has given the local pangasius fish farmer competitive and comparative advantages. Policy on inputs is not really providing protection to the pangasius fish farmers. Policy on inputs allows the farmers to buy input prices only 1% lower than their world market prices. Government needs to give more protection on the inputs of pangasius fish farming. Comparative advantage of pangasius fish farming in KoGa is sensitive to the changes in pangasius fish fillet FOB price, alternative feed prices (rice bran and dried salted fish prices), and the official exchange rate (OER). Whilst the competitive advantage is sensitive only to the change in alternative feed prices.

**Keywords** pangasius fish, competitive advantage, comparative advantage

---

## **1. Introduction**

### **1.1. Background**

Demand for fisheries commodities is expected to increase. In 2008, aquaculture production was 56.48% of the total volume of fisheries production and increased to 62.40% in 2012 [1]. The increased production of aquaculture could be achieved because of the government support through Minapolitan and Fisheries Industrialization programs. In 2007, pangasius production was 36,755 MT and increased to 347,000 MT in 2012. Although pangasius fish production is increasing, but it has not been able to meet its domestic demand and has to be fulfilled by import which is mainly from Vietnam. In 2011, selling price of local pangasius fish was 17,000.00 IDR/kg while pangasius fish from Vietnam was 9,000.00 IDR/kg [2]. In order to prioritize the local pangasius fish farmer, Indonesian government stopped importing pangasius fish fillet through Regulation of the Minister of Marine Affairs and Fisheries PERMEN-KP No.15/MEN/2011 about "Quality Control and Safety of Fisheries Product Entry into the Republic of Indonesia". Kota Gajah (KoGa) is famous in the utilization of local resources as cheap and sustainable input for pangasius fish farming business [3].

### **1.2. Problem statement**

Some government programs and policies are conducted in KoGa which include subsidy in capital such as feed pellet machines subsidy, Best Aquaculture Practices (BAP) training and counseling, etc [4]. But some policies are distorting such as value added tax on input. Efficiency is needed in order to compete with imported pangasius fish. Does pangasius fish farming in KoGa have comparative and competitive advantages? Do government's policies on pangasius fish farming in KoGa have a positive effect to the competitive advantage?

### **1.3. Objectives and benefits of the study**

The objectives of the study are: (1) To analyze the level of comparative and competitive advantages; (2) To analyze the impact of government policy; and (3) To identify the effect of changes in key factor affecting comparative and competitive advantages of pangasius fish farming business. The benefits of this study are: (1) As reference and consideration in setting policy; (2) As an information in order to improve production efficiency; and (3) As reference and information for further study in competitiveness of pangasius fish farming business.

## **2. Materials and Methods**

### **2.1. Types and sources of data**

This research was conducted in Kota Gajah Sub-District. Cross section data were used in this study with 2012 as the base year. The primary data were collected by surveyor in September 2013 through deep interviews with primary resources, namely the chairman of The Joint-Group of Fish Farmers Karya Mina Manunggal and the fisheries instructor of Agricultural, Fishery, and Forestry Agricultural Extension Centers (BP3K) Kota Gajah Sub-District. The data collected are farm budget and policies related to the pangasius fish grow-out business in the earthen pond system. Secondary data are sourced from the Minister of Marine Affairs and Fisheries; BP3K Kota Gajah Sub-District; Statistics Indonesia; Directorate General of Customs and Excise; UN COMTRADE; Foreign Agricultural Service USDA; World Bank; and a number of publications.

### **2.2. Empirical analysis**

The analysis used in this study is the Policy Analysis Matrix (PAM) [5, 6]. The Analysis stage is described as follows: (1) Identification of input and output in the pangasius fish farming business; (2) Construction of private farm budget; (3) Determination of input into tradable and non-tradable inputs; (4) Calculation of the input and output shadow prices; (5) Construction of social farm budget; (6) Construction of Policy Analysis Matrix; and (7) Analysis of the identities of Policy Analysis Matrix to measures the competitive and comparative advantages.

### **2.3. Policy analysis matrix**

Policy analysis matrix is a method which provides information and analysis of agricultural policy. PAM analysis consists of double entry of farm budget, which is the farm budget at actual market prices (measures of competitive advantage) and farm budget at economic efficiency prices (measures of comparative advantage) [5].

Table 1. Policy analysis matrix

	Revenue	Costs of tradable input	Costs of domestic factor	Profits
Private prices	A	B	C	D
Social prices	E	F	G	H
Divergences	I	J	K	L

Where: (A) private revenue; (B) tradable input in private price; (C) domestic factor in private price; (D) private profit; (E) social revenue; (F) tradable input in social price; (G) domestic factor in social price; (H) social profit;

(I) output transfer; (J) input transfer; (K) factor transfer; and (L) net transfer. Here are the identities and ratios of PAM analysis [5]:

Private profitability [ $D = A - (B + C)$ ] is a measure of competitiveness of the agricultural business system at certain technologies, output prices, input costs, and applied policies. Social profitability [ $H = E - (F + G)$ ] is a measure of efficiency or comparative advantages in prices that reflect scarcity values or social opportunity costs (efficiency price). Thus if  $D$  and  $H > 0$ , then the pangasius fish farming business is profitable in private and social prices respectively. Private cost ratio [ $PCR = C/(A - B)$ ] and domestic resource cost ratio [ $DRC = G/(E - F)$ ] are used to compare the competitiveness and comparativeness of other agricultural systems that produce unlike outputs respectively. Private cost ratio and domestic resource cost ratio show how much the system can afford to pay domestic factors and still remain competitive in its private and social prices respectively. Thus if PCR and DRC is less than 1, then the pangasius fish farming business has competitive and comparative advantages respectively. Nominal protection coefficient on outputs [ $NPCO = A/E$ ] and inputs [ $NPCI = B/F$ ] can be used to compare the output and input protection of other agricultural system respectively. Thus, if  $NPCO > 1$  and  $NPCO < 1$  then the output and input in the pangasius fish farming business receiving protection.

#### **2.4. Input and output social price determination**

*Output.* Social price of fresh pangasius fish is approximated from the FOB price of frozen pangasius fish fillets from Vietnam to US. *Tradable input.* Social prices of pangasius fish fingerlings; rice bran; dried salted fish; vitamin and mineral; and dolomite are estimated from their actual market prices subtracted by their policy or regulation which is attached to them such as value added tax. This can be performed because they are produced locally in the vicinity area and traded in a perfect competitive market. The social price of fuel is estimated from its economical prices released by the Ministry of Energy and Mineral Resources of Republic Indonesia. The social price of urea and salt are estimated from their FOB and CIF price respectively. *Non-tradable input.* Social price of land, capital and labor are predicted through the observations on their rural factor markets. Capital includes the feed pellet machine, feed warehouse, drying floor, and equipment. The value of capital in the private prices was determined from its depreciation costs. Feed pellet machine was fully subsidized by the government as an act of support from the government. Thus, its private price was zero and its social prices equaled to its depreciation costs. The social



prices of labor could be approached by its opportunity costs. The use of labor was divided into three types of role, namely fish keeping, feed pelleting, and fish harvesting. The labor is classified as unskilled labor, thus in the smallholder agriculture, policies on labor were unenforced. Therefore, those could be ignored [6]. *Shadow exchange rate*. Shadow exchange rate (SER) is given as  $SER = OER/SCF$  where official exchange rate (OER) and SER are in IDR/USD [7]. Standard conversion factor (SCF) is given as  $SCF = (M + X)/[(M + Tm) + (X - Tx)]$  where  $M$ ,  $X$ ,  $Tm$  and  $Tx$  (total imports, total exports, import taxes and export taxes respectively) are in USD [8].

### 2.5. Sensitivity analysis

The sensitivity analysis was performed to measure the responsiveness of the PCR and DRC due to the changes of key parameters. The key parameters were the pangasius fish fillet FOB price, alternative feed price, and exchange rate. The changes of PCR and DRC in sensitivity analysis were measured by comparing the percentage change of PCR and DRC if the key parameters were increased by 1%.

## 3. Results and Discussion

Pangasius fish grow-out in KoGa was conducted in earthen pond. Pangasius fish needs 6 month to reach its marketable size of 2-3 fish/kg. Survival rate in average was 90% which is yielding 36,000 kg pangasius fish per ha per cycle. Sold at 15,000.00 IDR/kg, farmers can gain revenue as much as 540,000,000.00 IDR/ha/cycle. Total cost in this business was 312,188,000.00 IDR/ha/cycle.

Table 2. Policy analysis matrix analysis (IDR per ha per cycle)

	Revenues	Costs of tradable inputs	Costs of domestic factors	Profit
Private prices	540,000,000	249,996,000	40,442,060	249,561,940
Social prices	416,596,631	251,971,417	41,542,060	123,083,154
Divergences	123,403,369	-1,975,417	-1,100,000	126,478,786

Table 2 shows that both private and social prices generated positive profits (D and H >0) which means it is profitable in its social and private prices. PCR value is 0.14 (PCR<1) and DRC value is 0.25 (DRC<1) which means in order to get value added as much as one unit, it is required additional domestic factor cost as much as 0.14 units and 0.25 units in its private and social prices respectively. It indicates that the pangasius fish grow-out business in KoGa has strong competitive and comparative advantages.

NPCO value is 1.30 ( $NPCO > 1$ ) and NPCI value is 0.99 ( $NPCI < 1$ ) which means output produced and input used in this business receive protection which then allow pangasius fish farmers to sell their product 30% higher and buy their input price 1% lower than the world market prices.

Table 3. PAM sensitivity analysis results

Percentage change	Pangasius fish fillet FOB price	Alternative feed price	Official exchange rate
PCR (%)	-	0.73	-
DRC (%)	-2.54	1.30	-2.54

As seen in Table 3, the percentage change of DRC with respect to the change in the pangasius fish fillet FOB price is -2.54%, implying that the comparative advantage is improved by 2.54% whilst the competitive advantage remains the same. The percentage change of PCR and DRC with respect to the change in the alternative feed price is 0.73% and 1.30% respectively. Those mean that the competitive advantage is getting worse by 0.73% and the comparative advantage is getting worse by 1.30%. The percentage change of DRC with respect to the change in the official exchange rate is -2.54%, implying that the comparative advantage is improved by 2.54% whilst the competitive advantage remains the same.

#### **4. Conclusion**

Pangasius fish grow-out business in KoGa has strong competitive and comparative advantages. Trade policy on output, especially policy on controlling the imported pangasius fish, has improved the local pangasius fish farmer competitive and comparative advantages. Policy on inputs is not really providing protection to the pangasius fish farmers since their input price was only 1% lower than the world market prices. Divergences in domestic factors are limited to feed pellet machine subsidy which helps the farmer to produce low cost fish feed with local and sustainable ingredients. Comparative advantage of pangasius fish farming in KoGa is sensitive to the changes in pangasius fish fillet FOB price, alternative feed price, and the official exchange rate whilst the competitive advantage is sensitive only to the changes in alternative feed price.

#### **5. References**

- [1] KKP. 2012. Marine and Fisheries Statistics Book 2012. Data Statistics and Information. Ministry of Marine Affairs and Fisheries, Jakarta.

- [2] DJPB. 2011. Patin Vietnam: Unggul tapi Bukan Tanpa Kelemahan. Directorate General of Aquaculture. Ministry of Marine Affairs and Fisheries, Jakarta.
- [3] DJPB. 2013. Panen Patin di Lampung Tengah. Directorate General of Aquaculture. Ministry of Marine Affairs and Fisheries, Jakarta.
- [4] BP3K. 2012. Programa Penyuluhan Perikanan. Balai Penyuluhan Pertanian, Perikanan dan Kehutanan (BP3K) Kecamatan Kota Gajah, Lampung.
- [5] E.A. Monke, S.R. Pearson. 1989. The Policy Analysis Matrix for Agricultural Development. Stanford University. Stanford, California.
- [6] S. Pearson, C. Gotsch, S. Bahri. 2003. Applications of the Policy Analysis Matrix in Indonesian Agriculture. Stanford University. Stanford, California.
- [7] J.P. Gittinger. 1984. Economic Analysis of Agricultural Projects. Economic Development Institute. The World Bank.
- [8] A. Lagman, Martin. 2004. Shadow Exchange Rates for Project Economic Analysis: Toward Improving Practice at the Asian Development Bank. Economic and Research Development - Technical Note Series No. 11 February 2004. Asian Development Bank.

## **The sustainability of coffee plantation in West Lampung, Lampung province, Indonesia**

**Yeti L. Purnamadewi<sup>1,\*</sup>, Lina Marlina<sup>2</sup>**

<sup>1</sup> Department of Economics, Bogor Agricultural University, Bogor, 16680, Indonesia

<sup>2</sup> Department of Agribusiness, Lampung University, Bandar Lampung, Indonesia

\* Corresponding author: yetilispurnama@yahoo.com

---

**Abstract** By considering the development of coffee processing industry and global trends as well as the domestic demand for coffee continues to increase, the prospects for future marketing of coffee to be getting better. In 2009-2013, the growth rate of per capita coffee consumption in Indonesia is 5.4 percent per year. Never the less, with the opening of international trade in this era of globalization, the competition between the world's coffee producers is becoming increasingly strong, while Robusta coffee price tend to fluctuate. Thus the sustainability of the coffee plantations will be determined by the competitiveness of the commodity. Therefore, this study aimed to assess the sustainability of the coffee plantations in the production center, West Lampung. The study shows that the level of sustainability of small holder plantations in Lampung is quite worrying, because the efficiency of coffee plantation at the farm level are relatively small due to the relatively old age of the plant so that the productivity is relatively low; in adequate post-harvest technologies so that coffee quality are relatively low; marketing efficiency are relatively low due to institutional at the farm level has not been functioning well and the market structure is not perfectly competitive so that the farmer is a price taker and also the ability of farmers to invest are relatively low.

**Keywords** Sustainability, coffee plantation, farm and marketing efficiency

---

### **1. Introduction**

#### **1.1. Background and problems of the study**

Coffee is one of the important agricultural commodities in Indonesia. Coffee is the most traded commodity in the world after petroleum and Indonesia is the third-world coffee producer after Brazil and Vietnam so that Indonesia is one of the world's major exporters of coffee. More than 90 percent of the land area of coffee plantations in Indonesia is cultivated by smallholder farmers [1].

Viewed from the development of the coffee processing industry which more vary and trend of world and domestic coffee demand which continues to

increase, the future prospects of the coffee marketing seems to be getting better. The growth rate of per capita coffee consumption in Indonesia in the period 2009-2013 was 5.4 percent per year [2]. However, in line with the opening of trade between countries in the era of globalization, the competition between producing countries will be stronger.

Lampung is a center of coffee production in Indonesia, in addition to Bengkulu, South Sumatra, North Sumatra and East Java. West Lampung is the main production centers in Lampung province in terms of land area and production [3]. Correspondingly with the national coffee condition, in general both land area and coffee production in West Lampung in the last five years (2007-2011) so do not change significantly, slightly fluctuate because productivity is also likely to remain [4]. Therefore, Indonesia's coffee exports, both nationally and regionally, especially in the provinces of Lampung also fluctuates. Meanwhile, robusta coffee in particular, where this type is the largest of the coffee grown in Indonesia also in West Lampung, in the last five years the price is always lower than the price of Arabica coffee and also fluctuates [2]. In the west Lampung, coffee productivity is only about 1 ton per hectare, much lower than coffee productivity in other producing countries such as Vietnam, which has reached about 2.5 tons per hectare. This is possible partly because of the whole coffee plantation in West Lampung cultivated by small-scale farmers, which typically have limited access to capital and technology as well as having multiple livelihood.

Scale and productivity of farming is usually significantly influence the levels of farm efficiency which in turn will affect the sustainability of the farming. Thus, the big question to be answered in this study is the extent to which the sustainability of smallholder coffee farms in terms of the efficiency and economic role in the household farmers.

## **1.2. Objectives of the Study**

Based on the background and the problems that have been mentioned, the general purpose of this study is to assess the sustainability of the coffee plantations in West Lampung on the terms of the efficiency of farm and household economic conditions. In particular, the purposes of this study are:

- a) To analyze the efficiency of smallholder coffee plantations both in terms of marketing and in terms of farming
- b) To analyze the role of coffee plantation in the household economy of the farmer.

## **2. Materials and Methods**

### **2.1. Location of the study**

The study was conducted in West Lampung, Lampung province. Lampung is a center of coffee production in Indonesia and West Lampung is the center of the main coffee production in the province

### **2.2. Types, sources and methods of data collection**

The main data used in this study are primary data. Primary data were collected through interviews using a questionnaire to the respondent sample farmers and marketing institutions. While the secondary data is obtained from various literature sources and references, as well as relevant agencies through the study of literature

### **2.3. Method of sampling**

The sample in this study is the head of household coffee farmer and marketing institutions. The sample of farmers that includes small, medium and large farmers is determined purposively (unprobability sampling). The number of samples is 60 coffee farmers in each category is determined proportionally. For the samples of any marketing institutions involved in the coffee marketing chain is determined by the method of snowbowling.

### **2.4. Method of analysis**

In assessing the sustainability of smallholder coffee farms in the west Lampung regency is used methods of descriptive and quantitative analysis. Quantitative analysis is mainly used to analyze the efficiency of coffee plantations and coffee plantations role in the household economy. In this case are used of analysis of farm and marketing efficiency, analysis of revenue and expenditure structure of households. Descriptive analysis is mainly used to assess the sustainability of smallholders coffee plantation principally based on the analysis of bussiness efficiency and the role of coffee plantation in the household economy.

## **3. Results and Discussion**

### **3.1. Effeciency analysis of smallholders coffee plantation**

#### **3.1.1. Marketing efficiency**

In general there are three marketing channels used by farmers in marketing of coffee sold in the form of coffee beans, this coffee is not processed as shown in Figure 1. It is seen that there are several marketing institutions

which are involved in the marketing of coffee that middlemen (PP), traders village (PPD), sub-district collectors (KDP) or wholesalers and exporters (EKS)

In general there are three marketing channels used by farmers in marketing of coffee sold in the form of coffee beans, this coffee is not processed as shown in Figure 1. It is seen that there are several marketing institutions which are involved in the marketing of coffee. These are middlemen, village traders, sub-district collectors or wholesalers and exporters.

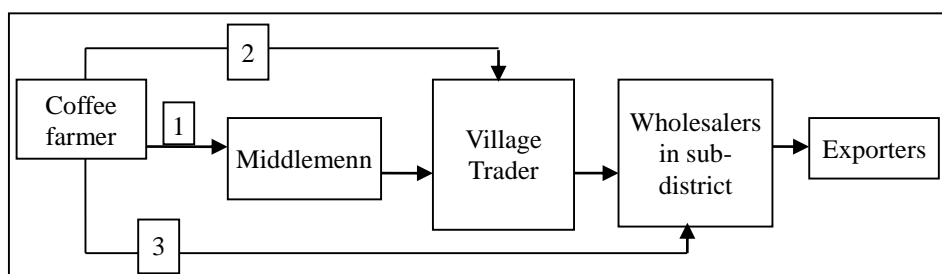


Figure 1. Chanel of coffee marketing in West Lampung

Most farmers choose the coffee marketing channels two in selling coffee considering the price received by farmers is not much different either sold to middlemen, village traders and wholesalers (Figure 1). This is because the farmers sell their coffee to traders anywhere are always in the form of seed drying and stripping results without sorting or grading. Selection of channel marketing by farmers is based on proximity, economic ties, and kinship. While village traders and wholesalers, not only do the transaction function, but also conduct other marketing functions. Traders Village performs selection/sorting and wholesalers conduct grading and standardization in which both the marketing functions can increase the value-added products so that can then be sold to the next trader with a higher price. A small percentage of farmers also sell their coffee to Women Farmers Group which process coffee beans into coffee powder but in a very small scale so that-called "home industry".

Table 1. Farmer Share, Selling Price, Purchase Peice and Benefit-Cost Ratio in Each Marketing Institutions

Institutions and Marketing Margin	Channel 1	Channel 2	Channel 3
1. Coffe Farmer			
a. Selling Price(Rp/kg)	16000	16000	16000
b. Farmer share (%)	75	75	75

Institutions and Marketing Margin	Channel 1	Channel 2	Channel 3
2. Middlemaen			
a. Selling Price (Rp/kg)	16200		
b. B/C Ratio	2.64		
3. Villlage Traders			
a. Selling Price (Rp/kg)	16649	16649	
b. B/C Ratio	0.62	1.34	
4. Wholesalers			
a. Selling Price (Rp/kg)	18800	18800	18800
b. B/C Ratio	2.32	2.32	3.33
5. Exporters			
a. Selling Price (Rp/kg)	21300	21300	21300

Referring to the ratio of the price/revenue to the cost or the ratio of benefit to the cost occurred in each marketing institutions, marketing coffee has not run efficiently (Table 1). Farmer share is relatively small (Farmer share received by farmers in Vietnam, approximately 90%) and the benefit-cost ratio of each marketing institution is unequal distributed. Farmer share is relatively small because the market structure is more oligopsony, farmer groups have not been functioning well and the quality of the coffee is relatively low.

### 3.1.2. Efficiency of coffee farming

Farm efficiency is indicated by the value of the revenue-cost ratio or benefit-cost ratio, if the value of the revenue-cost ratio is greater than one or the benefit-cost ratio is greater than zero then the farm is profitable or efficient. Table 2 shows that coffee farming in all sizes either small, medium or broad is profitable or efficient. In general, the level of Coffee farming efficiency is low when it is compared to the benefit-cost ratio of coffee in the other countries. This is mainly due to the relatively low productivity which is generally less than 2 tons per hectare. It appears that for the medium farmers, their farming have the highest benefit-cost ratio which means the most efficient farming. This is because that farming also have the largest productivity, about 1.6 tons per hectare and the cost is relatively small

Table 2. Analysis of coffee farming efficiency according to the scale farming

No. Kategori Lahan	Revenue	Cost	Benefit	R/C	B/C
1. Small	26,616,667	11,343,945	15,272,722	2.35	1.35
2. Medium	27,268,617	10,889,658	16,378,959	2.50	1.50
3. Large	21,220,344	9,668,075	11,552,269	2.19	1.19



### 3.2. Analysis of coffee farming role to household economy

In general, both the small, medium and large farmer households run multiple livelihood to meet the needs of their household (Table 3). For all type of the farmer households, coffee farming has an important role to the household income. Income from coffee farms provide the largest contribution (> 50%) to the household income of coffee farmers. In contrast to the large farmer households, for both small and medium farmers households, the second major source of income is from non-agricultural sector; while for the large farmer households, the second-largest source of income is from agriculture non coffee.

Table 3. Income stucture of coffee farmer household according to the scale farming

No	Household Income	Small	%	Medium	%	Large	%
1	On farm Coffee	9,071,972	59	22,660,040	56	41,206,236,6	64.43
2	On farm non Coffee	2,634,067	17	7,250,471	18	17,874,850,00	27.95
3	Off farm	200,000	1	305,882	1	316,000,00	0.49
4	Non Farm	3,500,000	23	9,996,206	25	4,555,000,00	7.12
Total Income		15,406,039	100	40,212,599	100	63,952,087	100.00
Net Income		-6,872,794.5		11,477,799.03		21,800,911.65	

With these their income, the small farmer household can not meet all the household expenses so that the annual net income is negative and does not have the ability to invest. Therefore, according to welfare standards of the World Bank, a small farmer households in the category of poor household. The opposite to the small farmer, medium and large farmer households have a positive net income. However, only about 25 percent of these household that are able to make investments that are usually in the form of investments in land and the fingerlings.

Providing different results when using expenditure indicators, based on indicators such spending, not only small farmer households are included in category of poor household but also the medium farmers households are. As seen in Table 4. In the structure of household expenditures, only large farmer households who have the biggest expenditure for tertiary needs and not to meet the primary needs. While in pattern of household expenditure of small and the medium farmers, the biggest households expenses is to meet the needs of primary

Tabel 4. Average Expenditure of Coffee Farming Household per Year  
According to the Scale Farming

No	Household Expenditure	Small (Rp)	%	Medium (Rp)	%	Large (Rp)	%
1	Primary	8,489,833.33	38.16	11,715,623.53	41.07	12,584,075.00	32.82
2	Secunder	7,422,333.33	33.37	9,819,323.53	34.43	10,120,850.00	26.39
3	Tersier	6,333,333.33	28.47	6,988,088.24	24.50	15,639,750.00	40.79
Jumlah		22,245,500.00	100.00	28,523,035.29	100.00	38,344,675.00	100.00

#### **4. Conclusion and Policy Implication**

The level of sustainability of coffee plantation in Lampung quite worry considering the efficiency of coffee plantation at the farm level are relatively small due to the relatively old age of the plant so that the productivity is relatively low; inadequate post-harvest technologies so that coffee quality are relatively low; marketing efficiency are relatively low due to institutional at the farm level has not been functioning well and the market structure is not perfectly competitive so that the farmer is a price taker and also the ability of farmers to invest are relatively low.

By considering the conclusion, there are some recommendation to encourage the sustainability of the coffee plantation in West Lampung:

- a. increase the accesibility of the coffee farmer to the cheaper credit especially for using teh replanting op the coffee trees
- b. empowerment the farmer group (cooperative) to increase the bargaining position of the farmer in the price determination;
- c. doing the training to increase the knowledge and skill of the coffee in post harvesting to get the value added

#### **5. References**

- [1] [AEKI] Asosiasi Eksportir Kopi Indonesia. 2014. *Industri Kopi Indonesia*. [serial online] 2014 [cited 2014 Mey 16]. Available at: <http://www.aeki-aice.org/page/industri-kopi/id>.
- [3] [BPS Kabupaten Lampung Barat] Badan Pusat Statistik Lampung Barat. 2013. *Lampung Barat Dalam Angka*. Lampung Barat (ID): BPS Kabupaten Lampung Barat.

## **The importance of biodiversity conservation and livelihood of customary community approaching in national park management in Indonesia**

**Nandi Kosmaryandi<sup>1</sup>, Sambas Basuni<sup>2</sup>, Lilik B. Prasetyo<sup>3</sup>, Soeryo Adiwibowo<sup>4</sup>**

<sup>1,2,3</sup> Faculty of Forestry, Bogor Agricultural University, Bogor, 16680, Indonesia

<sup>4</sup> Faculty of Human Ecology, Bogor Agricultural University, Bogor, 16680, Indonesia

\*Corresponding author: nandi\_k@ipb.ac.id

---

**Abstract** Criteria for the establishment of National Park in Indonesia are aimed at benefiting the purpose of ecological sustainability of the area on scientific basis. But the establishment of national park in Indonesia often neglected the sociocultural aspects. This phenomenon causes overlapping between national park territory and customary territory that creates social due to disharmony of criteria in the zonation pattern and spatial pattern of traditional community. Three important findings are found through an approaching the importance of biodiversity conservation and livelihood of customary community. First, the sustainable use of natural resource would be in place where customary community still keeps their traditional way of life particularly that in relations to conservation. Second, the park zonation policy does not take into account the values, norms and livelihoods of the customary community. Third, the regulations and criteria for park zonation hinder the traditional access and control of customary community over national park. The last two mentioned factors could potentially create conflicts between customary community and the park management.

**Keywords** biodiversity conservation, customary community, national park

---

### **1. Introduction**

Indonesia has stipulated about 23% (28 million of hectares) of its forest areas as conservation (protected) areas. Establishment of these areas was implemented on forests which have significance in biodiversity conservation. Therefore, criteria on ecological condition and natural phenomena were used as based to select location of protected areas. These criteria have caused sociocultural negligence, so that forest areas were considered as empty from human settlement. This has caused problems in protected areas management. Borrini-Feyerabend et al [1] mentioned that many protected areas were established on region and resources that become

community common property and stated by the government as nobody's property (*terra nullius*).

Approximately 57% of all protected areas in Indonesia are managed as national parks. National park is protected area with natural ecosystem, managed on zoning system and use for research, science, education, supporting cultivation, tourism, and recreation (Act No. 5/1990 concerning Conservation of Biological Resources and Its Ecosystem, and Government Regulation No. 28/2011 concerning Management of Nature Reserve Area and Nature Preservation Area). Based on this definition, forms of utilization space allocation implemented is designed for communities outside national parks, such as scientists or tourists. Therefore, space necessity of the people living and day to day interacted with natural resources in the forests areas was not defined.

Problems in the establishment and management of protected areas with regard to communities have been acknowledged by international community. The International Union for Conservation of Nature (IUCN) in the fifth World Park Congress/WPC on September 2003 in Durban, South Africa, resulted in the Durban Accord that related with rights acknowledgement of indigenous, traditional, and mobile people who reside in the protected areas [2]. The problem was negligence of existence and rights of customary communities as the "owner" of areas that has been passed by generations. In fact, based on the historical chronology of the protected areas, the protected areas came later than utilization of the same areas as livelihood sources of the customary communities, where locations were called as customary forests (*hutan adat*), customary land (*tanah ulayat*) or customary territory (*wilayah adat*).

The objectives of this research is to analyse of the importance of biodiversity conservation and livelihood of customary community to achieve effectiveness national park management where located in customary territory.

## **2. Materials and Methods**

Two national parks in Indonesia i.e. the Wasur National Park (WNP) and the Kayan Mentarang National Park (KMNP) that have overlapping areas with customary territories were studied. The field research was carried out during period of October 2008 to July 2011 in relation with participatory planning activities for park zonation. Literature review, in-depth interviews,

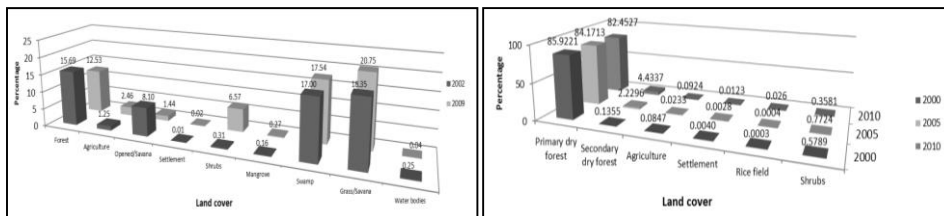
field observations, as well as participatory observations during park zonation process were field methods applied for data collections, and spatial analysis was used to understand the compatibility of spatial patterns.

### **3. Results and Discussion**

#### **3.1. Sustainable utilization of forest resources in the customary community system**

Customary community believes that human is an integral part of the nature, so that nature become unity that cannot be separated from human life. Therefore, customary community have a view that nature is something they must protect, both the sustainability and balance. This view become the base for traditional/indigenous knowledge development that later resulted in the emergent of traditional wisdom behavior. Kleden et al [3] mentioned that the importance of conserving customary territory, its resources and boundary was reflected in the regulation and policy so that customary community has planned how their customary territory was utilized. Ecological condition of WNP and KMNP until today are mostly in natural ecosystem condition, although dwelled and utilized by several generations of customary communities. This indicated that customary communities have wisdom in utilizing natural resources, so that utilization of natural resources was not causing overexploitation.

Based on landsat imagery analysis of year 2002 and 2009 in WNP, natural ecosystem coverage was 59.86% and 59.14%, consisted of forests land use, open land/savanna, shrub, mangrove, swamp, grass/savanna, and water body (Figure 1). The decline of 0.72% of natural land uses happened on the increment of 169.54% population (population data on 2006-2010). In KMNP, traditional use of land was 70.67% from customary territory. However, result of landsat TM7 (2000 and 2005) and Alos Palsar (2010) image interpretation showed this was not causing significant change of natural ecosystem, so that almost all areas are in the form of forests (Figure 1). Forests are maintained as forests by customary communities, because forests keep the fertility of the *kebun* and *ladang* and provide animal for hunting as well as hydrological protection, especially river the nerve of customary communities' livelihood. Data on land cover change dynamic showed the most obvious average change was on the secondary dry land forest and shrubs that mostly happened on the land used for daily activities and *ex-ladang* (shifting cultivation).



Source: Landsat image 2002 and 2009  
Remark: cloud cover correction was conducted; extent of area after cloud cover correction was 38.38%

Source: Landsat image map (2000 and 2005) and Alos Palsar (2010)  
Remark: cloud cover correction was conducted; extent of area after cloud cover correction was 13.27%.

Figure 1. Extent of ecosystem type change in Wasur National Park (left) and in Kayan Mentarang National Park (right)

Explanation above showed that natural resources were considered as community property. Ostrom (1990) mentioned that management of resources by community property regimes will avoid tragedy of the common, because in social institution of customary communities there have been common agreement in the form of customary law that honored by all community members. The absence of formal acknowledgement on the existence of customary territory and customary community rights to have management authority has caused customary community who have managed those regions by generation only has limited control on their natural resources. Meanwhile, the State ability to manage resources is limited, both human resources and fund, and therefore open access situation happened. Besides, control of the State on the natural resources caused the State can decide to allocate exploitation rights or establish protected areas without consent from customary community.

### 3.2. National park management policy is still neglecting sociocultural significance

Based on regulation, an area can be designated as national park when fulfilling the following requirements: a) have relatively enough extent to ensure natural ecological processes; b) having specific and unique natural resources, both plant and animal species and their ecosystems as well as natural phenomena that is intact and natural; c) having one or several intact ecosystems; d) having original and natural condition of nature to be developed as natural tourism; and e) an area that can be divided into core zone, utilization zone, wilderness zone, and other zones that based on the area's significances for rehabilitation, dependency of local community on the area, and in order to support living natural resources and their ecosystem can be established as independent zone. Those criteria showed that national

park establishment in Indonesia was done to fulfill natural resources conservation significance that in the utilization was aimed at science and tourism importance. Meanwhile, socioculture aspect was not part of establishment consideration. Communities have been considered as dwelling the fringe of the areas, not inside the areas. Therefore, at least 24 (twenty four) of 50 (fifty) national park have been established, their areas have been overlapping the customary territory or related with customary community. Such condition is shown in KMNP and WNP (Figure 3).

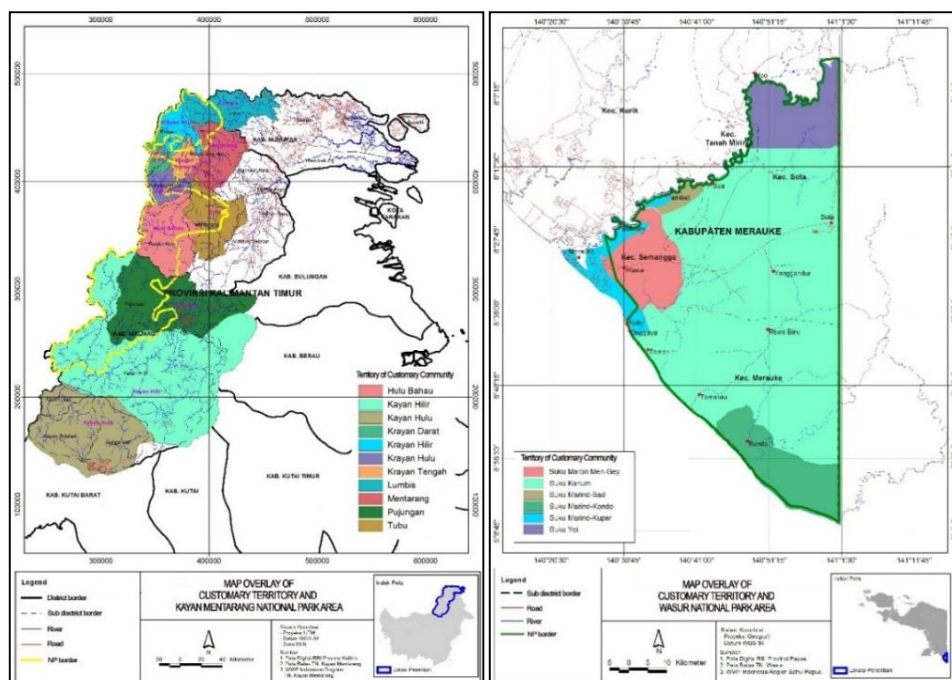


Figure 3. Overlapping of areas in national parks

Results of participatory mapping that was collaborated with national park and WWF Indonesia in 1993-1998 at KMNP and in 2006 at WNP showed overlapping based on region as follow:

1. KMNP was overlapping with 10 (ten) customary territories of Dayak Ethnics, namely at customary territory of Apokayan (Kayan Hulu); Pujungan; Hulu Bahau; Tubu; Mentarang; Krayan Hulu; Krayan Tengah; Krayan Darat; Krayan Hilir dan Lumbis Hulu. At all regions, overlapping happened on part of customary territory.
2. WNP was overlapping with customary territory of Malind-anim that covered six customary territories (ethnics), namely Kanum, Marori Mengey, Yei, Malind-Kondo, Marind-Bad, and Marind-Kuper. Customary territory of Kanum Ethnic was the vastest. Only part of Yei

(Yeinan) and Marind-Kuper Ethnics' customary territory became national park areas.

Negligence of sociocultural aspect is clearly observed in the consideration of national park establishment written in the establishment letter. Customary communities whose areas were designated as national park were not informed previously, although they are said to be involved in the establishment of the national park. Study on the content of national parks' establishment letters/designation decree letters showed that only one national park that clearly stated that customary community existence as one of consideration for its establishment, namely Bukit Dua Belas NP. For KMNP, existence of customary community as consideration was because of impact from customary community's resistance on the establishment of Kayan Mentarang Nature Reserve on their customary territory, so that the government change the status/function to national park. Colchester [4] stated that in Indonesia, though the State law recognizes customary rights and acknowledge common property (*hak ulayat*), the government interpreted it as forest product collection rights on government lands that is weak before law, so that customary community rights was not guaranteed and considered as neglected subject.

The establishment of national park in customary territory had aroused conflict, since it had not incorporate traditional management system in its management system. Therefore, policy change on national park management in customary territory need to be done. Various international agreements in conservation area management related to customary communities and customary communities' capabilities that factually could implement conservation actions become appropriate reasons to develop national park governance with customary community perspectives. Through this policy, systems which available in the customary communities become main guide in national park management policies and actions. Of course, this become important basic capital for the achievement of biodiversity mandate in national park management and for customary communities' livelihood.

The significance of customary community in the protected area management was clearly stated as the results of the fifth World Park Congress. One of its declarations stated that all protected area, both currently exist and will be established, must be developed and managed by honoring rights of customary communities, adopt customary systems and pay for the restitution from the utilization of natural resources used. Each



country must start identification of customary community and regulation related with protected area management and its customary communities. In this declaration, honor to customary communities' rights through free, prior and informed consent/FPIC on all actions which affect land, territory, and their natural resources was considered as important tools in achieving social and environmental sustainability. Honoring the rights by conservation institution must end conflicts that suffer customary communities. By honoring customary community's right, and especially right on FPIC, the future protected area can be formed in the customary territory so far there is agreement on the management techniques on these areas, based on recognizing customary community rights to own and control the land and territory.

Beyond that, in Durban declaration it is stated that customary forests, lands, or customary lands that was taken over by the government for establishment of protected areas without consent in the past, must be returned to the customary communities. Observation on the customary communities' rights for FPIC must also ensure that development schemes can only be implemented in their territories if impact on customary communities has been answered until the customary communities themselves sure that such projects will benefit them in the long period. Honor to right to say "NO" must be stopping development schemes that are pushy and destroy cultures. Therefore, contributed to utilization and conservation of natural resources sustainably.

### **3.3. The regulations and criteria for park zonation hinder the traditional access and control of customary community**

Criteria of zones is regulated in the the Indonesia Minister of Forestry Regulation No. P.56/Kpts-II/2006 concerning the Guidelines of National Park's Zone Establishment. The regulation requires a minimum of three zones in national park management system, namely the core zone, wilderness zone, and the use zone, as well as other zone based on management needed. Because of policy that neglected sociocultural aspect, criteria to establish zones in national park has not yet designed with mindset of equality and mutual benefit with customary community. Such condition has caused criteria unconformity between spatial use pattern implemented by the government (zones) and traditional spatial use pattern in customary community. Facts in the field showed that criteria to establish zones which regulated in the regulation could not be fulfilled. In example, in the establishment of core zone, the criteria is intact forest ecosystem and no human intervention. In fact, in a customary territory, most of the area has

been managed, so that it is difficult to find intact forest ecosystem as requirement to establish core zone. Even if there is such area, it will be a very small part of the designed national park (Figure 4). If the government consequent with the regulation, in fact national park establishment is null and void by law.

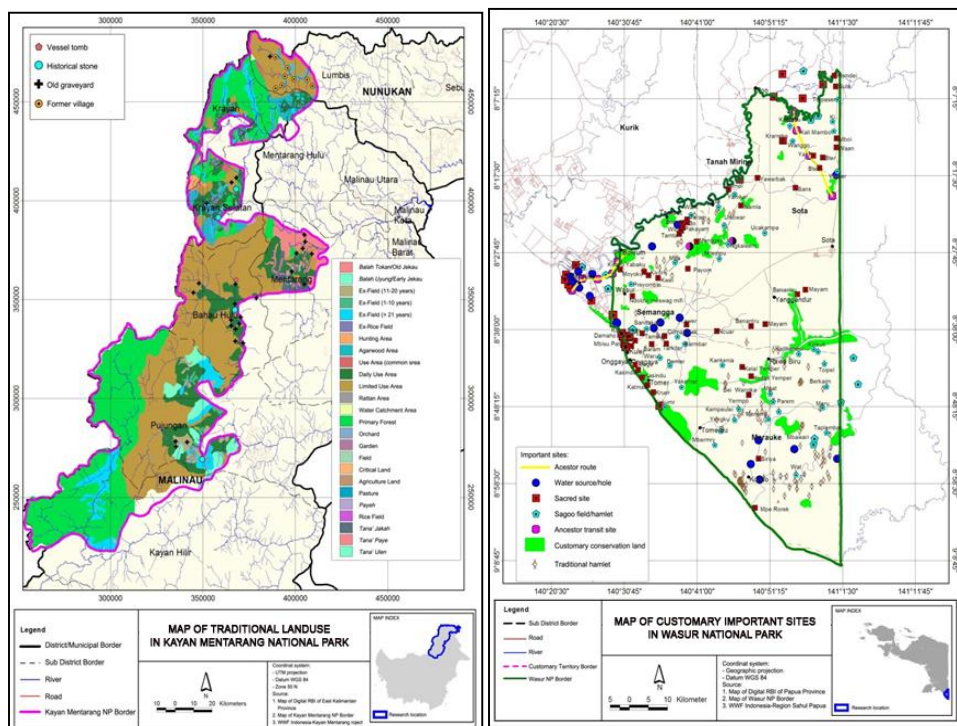


Figure 4. Overlapping traditional spatial use pattern with national park area

Mindset and policies have been used by the government so far showed facts of management complexities and zoning conflict in the management of national park that are within customary territory. Formal conservation policies have caused implementation gap, because of inappropriate policy target. In such national park, modern science principles cannot be fully implemented as management basis, because there are customary communities that position themselves as integral part Mindset and policies have been used by the government so far showed facts of management complexities and zoning conflict in the management of national park that are within customary territory. Formal conservation policies have caused implementation gap, because of inappropriate policy target. In such national park, modern science principles cannot be fully implemented as management of existing ecosystem and natural resources at multidimensional value of their livelihood, as economic, social, ecological,

and religious values.

#### **4. Conclusion**

1. Adaptation was needed toward the prevailing science-based ecologically-oriented regulation on zoning plan, so it would incorporate the customary community in order to achieve effective management of national park.
2. Zones in national parks which were established on customary territory should be directed to accommodate the traditional knowledge of land use. Adaptation, to reach compatible and applicable zone, was carried out through: 1) Change of logical framework from managing customary community in perspective of national park to managing national park in perspective of customary community livelihood; 2) Zoning policy of national park areas established in customary territory should aim at reaching national park function instead of fulfillment of zoning requirements; 3) Adaptation of the form and criteria of national park zones with traditional land use, since the function of traditional land use could contain the form and functions needed in national park zones, and 4) Adoption of traditional knowledge in the mandate of national park management since it would provide management effectiveness.

#### **5. References**

- [1] F.G. Borrini, K. Ashish, O. Gonzalo. 2004. Indigenous and Local Communities and Protected Areas: Towards Equity and Enhanced Conservation. Best Practice Protected Area Guidelines Series No. 11. IUCN, Gland, Switzerland and Cambridge, UK.
- [2] [IUCN] International Union for Conservation of Nature. 2003. The Durban Action Plan. [serial online] 2003 [cited 2009]. Available at: [http://www.iucn.org/about/work/programmes/pa/pa\\_event/wcpa\\_wpc/](http://www.iucn.org/about/work/programmes/pa/pa_event/wcpa_wpc/).
- [4] M. Colchester. 2008. Beyond Tenure: Rights-Based Approaches to Peoples and Forests Some lessons from the Forest Peoples Programme. Rights and Resources Initiative, Washington DC.

## **Competitiveness analysis of Indonesian shrimp farming, case study: PT. Surya Windu Kencana (SWK), East Java**

**Siti Maryam<sup>1,3,\*</sup>, Gabriele H. Schwark<sup>2</sup>, Rachmat Pambudy<sup>3</sup>**

<sup>1</sup> Department of Agricultural Economics and Rural Development, Göttingen University,  
Göttingen, 37075, Germany

<sup>2</sup> Department of Animal Sciences, Göttingen University, Göttingen, 37075, Germany

<sup>3</sup> Magister Science of Agribusiness, Bogor Agricultural University, Bogor, 16680,  
Indonesia

\* Corresponding author: s.maryam87@gmail.com

---

**Abstract** In spite of having domestic resources which lead to competitiveness, several problems have been faced by Indonesian shrimp farmers. However, implementation of government policies is likely to have two contrasting effects; to promote and to hinder domestic production of shrimp. This study assesses the level of competitiveness and policy impact on the white-leg shrimp farming in PT. Surya Windu Kencana (SWK), East Java, through Policy Analysis Matrix (PAM) approach. The results show that PT SWK has both competitive and comparative advantages in producing shrimp, as shown in the value of Private cost ratio (PCR) and domestic resource cost (DRC), those are 0.234 and 0.678, respectively. Indicators of policy impact to input and output indicate that government interventions are effective in protecting the domestic production of white-leg shrimp farming in PT. SWK. Nevertheless, the shrimp business is still has dependence on imported input. Therefore, implementation of policy regarding imported input is needed to enhance the competitiveness of the shrimp farming.

**Keywords** policy analysis matrix, competitiveness, shrimp farming, Indonesia

---

### **1. Introduction**

Development of shrimp farming in Indonesia has started since the eye-stalk ablation in 1980 with black tiger shrimp as the main species cultured. The production then keeps growing through technology improvement in hatchery, feed, and pond management [1]. Moreover, introduction of *Litopenaeus vannamei* or white leg shrimp in 2001 has given positive impact on national production of shrimp with East Java as one of the biggest *L. vannamei* production province [2].

Despite of suffering from depreciation of IDR and high input price, Indonesia is still found to have competitiveness in shrimp farming due to its potency of natural resources which is followed by the high demand for cultured shrimp in the world market [3, 4]. Furthermore, government intervention is also considered to play a crucial role in improving the shrimp farming business. Yet, another policy, such as import duty of 20% for imported wheat flour (shrimp feed ingredient) is likely to hinder the domestic production and the shrimp culture competitiveness later. Thus, objectives of this study are to analyze the level of competitiveness and the impact of government policies on shrimp farming activities through policy analysis matrix.

## 2. Materials and methods

The Policy Analysis Matrix is an approach covering a complete analysis on the impact of policy on competitiveness and farm level profits (which measured at actual market price), the influence of investment policy on economic efficiency and comparative advantage (which measured at efficiency price or social price), and the effects of agricultural research policy on changing technology. As shown in Table 1, the PAM structure consists of four columns reflecting profitability identity and three rows depicting the divergences or transfers identity [1, 2].

Table 1. Policy analysis matrix

Description	Revenue	Costs		Profit
		Tradable Input	Domestic Factor	
Private Prices	A	B	C	D
Social Prices	E	F	G	H
Transfers	I	J	K	L

Where:

A : Private revenue	G : Social price of domestic factor
B : Private price of tradable input	H : Social profit (E-F-G)
C : Private price of domestic factor	I : Transfer of output (A-E)
D : Private profit (A-B-C)	J : Transfer of input (B-F)
E : Social revenue	K : Factor transfer (C-G)
F : Social price of tradable input	L : Net transfer (I-J-K)

Moreover, ratios are also used and classified into two analyses, namely competitiveness (private profit, private benefit-cost ratio or PBCR, private cost ratio or PCR, social profit, social benefit-cost ratio or SBCR, and domestic resources cost or DRC) and policy implications (output transfer or OT, nominal protection coefficient output or NPCO, input transfer or IT, nominal protection coefficient input or NPCI, factor transfer or FT, effective

protection coefficient or EPC, net transfer or NT, and subsidy ratio to producer or SRP).

The study was conducted in PT. Surya Windu Kencana (SWK), a shrimp farming firm located in East Java, Indonesia with 2013 as the base year. Primary data were collected by internship students of Aquaculture Department, Bogor Agricultural University, Indonesia. Furthermore, secondary data were collected from several sources, i.e. UNCOMTRADE, FAO, Ministry of Marine Affairs and Fisheries, Ministry of Trade, Bank of Indonesia, National Electricity Company (PLN), and other related institutions.

Comparable world prices, those are import and export prices, are used to determine social prices for tradable output and inputs. Import prices are represented by CIF prices while export prices are represented by FOB prices [4, 6]. Moreover, social valuation for non-tradable inputs is approached by the private price since domestic factors are mostly determined by domestic supply and demand [4]. Shadow prices calculated in this study are for exchange rate, tradable inputs (feed, fertilizer, dolomite, and fuel), non-tradable inputs (fry, labor, electricity, capital, and rent), and output (shrimp).

### **3. Results and Discussion**

This part illustrates the overview of shrimp farming in PT. SWK, including the business analysis, policy analysis matrix, and benefit-cost ratio analysis, followed by the analysis of competitiveness and analysis of policy impact to shrimp farming.

#### **3.1. Overview of PT.SWK shrimp farming**

PT. SWK consists of five different shrimp farming located in different areas. This farm is characterized as intensive system of shrimp culture in medium scale tambak (or pond) due to the size of production area (17 ha) and the number of pond used (49 tambak). The average value of stocking density and survival rate (SR) respectively are 101 fry/m<sup>2</sup> and 60 percent. Fry and feed used, which contributed for 10.5 % and 70 % of the total cost, respectively, were obtained from domestic production. Yet, feed ingredients for the feed production are still imported. Moreover, shrimp production was 12,500 kg/ha. After one cycle (culture period), shrimp were harvested in the size 60 shrimp/kg at price 51,600 IDR/kg. Table 2 shows that the shrimp farming gained profits both in its private and social price. Positive private profit means that the business is profitable and competitive, while positive

social profit signifies that the shrimp farming business is efficient [4, 5]. Higher private profit than social profit shows that applied policies in the shrimp farming gave positive impact to the business.

**Table 2. Policy analysis matrix for PT.SWK shrimp farming (IDR/ha/cycle)**

Description	Revenue	Costs		Profit
		Tradable	Non-Tradable	
Private price	631,836,735	242,668,910	90,986,498	298,181,327
Social price	378,972,301	236,725,883	96,430,844	45,815,574
Transfers	252,864,434	5,943,027	-5,444,346	252,365,078

### 3.2. Analysis of competitiveness

The benefit-cost ratio is applied to compare the profitability and the cost used in the shrimp farming business. Greater than one value of PBCR and SBCR means that the business is profitable both at its actual market price and social price. The PCR value (0.234), which reflects the affordability of the business system to pay domestic factors, also depicts the business stability to remain competitive. Moreover, DRC is the ratio of domestic factor cost to the value added created by the same resources, both are valued at social prices. Comparative advantage which is reflected by the small value of DRC, which is 0.678, is also obtained by the shrimp farming. The higher DRC value than the PCR value indicates that implementation of government policies in the shrimp farming business, such as input subsidy for fertilizer, fuel, and electricity, play a crucial role (Table 3).

**Table 3. Indicators of competitiveness of PT. SWK shrimp farming**

PBCR	SBCR	PCR	DRC
1.894	1.138	0.234	0.678

### 3.3. Analysis of policy impact

Policy implementation in the shrimp culture impacts on output, input, and both input and output (Table 4). Indicator of policy impact to output can be seen in the value of OT and NPCO. Positive OT value (252,864,434) indicates that to some extents, output of the shrimp culture was subsidized. Moreover, the NPCO value (1.667) depicts that the domestic market price is higher than the world price. By this condition, producer is able to increase domestic production then it results in an increase in the export quantity.

**Table 4. Indicators of policy impact of PT. SWK shrimp farming**

Impact to output		Impact to input			Impact to input and output			
OT (IDR)	NPCO	IT (IDR)	NPCI	FT (IDR)	EPC	NT (IDR)	PC	SRP
252,864,434	1.667	5,943,027	1.025	-5,444,346	2.736	252,365,753	6.508	0.666

Indicators portraying the policy impact to input in the shrimp farming business are IT, NPCI, and FT. Positive IT value (5,943,027) shows that taxes are applied in the shrimp farming business. However, the NPCI value (1.025) explains that government intervention protects the tradable input in the shrimp farming business. Moreover, negative FT value (-5,444,346) indicates that non-tradable inputs are subsidized. Indicators of policy impact to input and output are EPC, NT, PC, and SRP. Those indicators reflect whether the government intervention protects or hampers the shrimp farming business. The value of EPC (2.340) reflects that government policies are effective in protecting the domestic shrimp farming business. Positive value of NT (252,365,753) indicates that there was producer surplus arose due to the government intervention. Moreover, the PC value that is greater than one (6.508) indicates that overall policies give incentives to the domestic business. SRP value shows to what extent an agricultural system is being subsidized. Thus, the value of SRP (0.666) indicates that the government intervention had made the domestic producer to spend less of private costs than its social costs in conducting the shrimp farming.

#### **4. Conclusion and recommendation**

Shrimp farming business of PT. SWK have competitive and comparative advantages in respect of the small value of PCR and DRC. Government intervention in the shrimp culture impacts both on the output and input of the shrimp farming business. Overall implementation of policies gave incentives to the shrimp farming business. Therefore, government intervention regarding the technical and economical aspect in enhancing and improving domestic shrimp production is continuously to be done.

#### **5. 5. References**

- [1] O. Juarno. 2012. Daya saing dan strategi peningkatan ekspor udang Indonesia di pasar internasional. PhD Dissertation, Graduate School, Bogor Agricultural University, Bogor.
- [2] Ministry of Marine Affairs and Fisheries. 2013. Capaian produksi perikanan budidaya. Unpublished presentation. Ministry of Marine Affairs and Fisheries Republic of Indonesia.
- [3] Tajerin, M. Noor. 2004. Daya saing udang Indonesia di pasar internasional: sebuah analisis dengan pendekatan pangsa pasar dengan menggunakan model ekonometrika. *Economic J. of Emerg. Mark.* 9 (2): 177-191.



- [4] A. Zaini, H. Sa'diyah, B.D. Kusumo. 2003. Is cultured shrimp production in West Nusa Tenggara still profitable. In: S. Pearson, C. Gotsch and S. Bahri. Applications of the policy analysis matrix in Indonesian agriculture part two: case studies. University of California. Yayasan Obor Indonesia.
- [5] E.A. Monke, S.R. Pearson. 1989. The Policy Analysis Matrix For Agricultural Development. Cornell University Press, Ithaca.
- [6] N.T. Kiet, Z.M. Sumalde. 2008. Comparative and competitive advantage of the shrimp industry in Mekong River Delta, Vietnam. Asian J. of Agric and Develop. vol. 5 No.1: 57-80.

## **Competitiveness and policy impact analysis of feedlots in Lampung**

**Labudda Paramecwari<sup>1, \*</sup>, Rachmat Pambudy<sup>2</sup>, Nunung Kusnadi<sup>2</sup>**

<sup>1</sup>Master candidate at Master Science of Agribusiness, Bogor Agricultural University, Indonesia

<sup>2</sup> Master Science of Agribusiness, Bogor Agricultural University, Indonesia

\*Corresponding author: labudda.paramecwari@gmail.com

---

**Abstract** Perceiving the importance of beef and cattle as high-valued commodities and the concern of sustaining under market liberalization, many countries stimulate massive production and improve competitiveness, particularly Indonesia. Government put efforts which focused in the production center such as Lampung through intervening the input and output sectors. However, it is arguable whether these interventions are encouraged or discouraged competitiveness. The study assesses the competitiveness level and the policy implication to feedlots in Lampung by employing Policy Analysis Matrix (PAM). Feedlots in Lampung are shown to have comparative and competitive advantage according to Private Cost Ratio (PCR) and Domestic Resource Cost (DRC) ratio of 0.53 and 0.77, respectively. Further, government efforts are proved to promote competitiveness.

**Keywords** competitiveness, feedlot, policy analysis, beef

---

### **1. Introduction**

The trade of valuable commodities such as beef and cattle gives an important contribution to the agricultural sector. Although the impact of market liberalization remains unknown and unclear, many developed and developing countries are prepare to have a gain in international arena. For this reason, many countries enthusiast to encourage production activities and at the same time, improve competitiveness.

Indonesia, as one of the net importing countries, has the same motivation, interpreted as the beef-self-sufficiency program, in order to be less reliant on imported product. Although the import trend for the past 5 years shows a different direction, Indonesia still have the potential to improve its productivity by looking at the adequate natural resources and supportive government intervention to promote competitiveness.

Lampung is one of the targeted area of beef-self-sufficiency program. Benefited with their location near to the market (i.e. Java island and Jakarta), establishment of many feedlot firms, and huge cattle numbers has made Lampung to be the major beef producing province in Indonesia. Despite these excellences, feedlots in Lampung are facing constraint to accelerate beef production regarding continuity of cattle supply and the below-standard cattle-weight from the local farmers. Therefore, to overcome these difficulties, government design policy in the form of tax and subsidy to output and input component in beef production activities and other beef-production-improvement program. However, it is still arguable whether this policy are really improve profitability of firms and thus, also improve competitiveness. According to the explanation above, this study aims to:

1. Assess the level of competitiveness of feedlots in Lampung
2. Analyse the impact of government policy to the competitiveness of feedlots in Lampung

## **2. Materials and Methods**

The study covers the aggregate measurement of 7 feedlots performance with the total of 89.603 cattle in Lampung which operate in 2011. All data, input and output information, as well as the policy evaluation will be associated with that year. The primary data consist of all expenditure on input and revenue of firms which obtained from the bureau of statistic. The secondary data consist of the trade-related information such as import price and exchange rate.

The research is focused on the assesment of competitiveness and policy impact of feedlot firms in Lampung. To address the issues, Policy Analysis Matrix (PAM) is employed as analytical tool because it provides indirect estimation for comparative and competitive advantage. Further, impact of policy to output, input, and both, can also be evaluated from the matrix. Table 1 shows the PAM structure which consist of three columns and three rows, reflecting the revenue, cost, and profit, measured at private and social price. Moreover, the last row reflects the effect of divergences occurred due to policy intervention.

**Table 1. Structure of PAM**

Description	Revenues (Rev)	Cost of Inputs		Profits ( $\Pi$ )
		Tradable (T)	Domestic Factors (DF)	
Private Price (p)	$Rev_p$	$C_{Tp}$	$C_{DFp}$	$\Pi_p$
Social price (s)	$Rev_s$	$C_{Ts}$	$C_{DFs}$	$\Pi_s$
Transfers (t)	$Rev_t$	$C_{Tt}$	$C_{DFt}$	$\Pi_t$

Source: Monke & Pearson [1]

The competitiveness analysis consist of the assessment competitive and comparative advantage. Competitive advantage could be determine from the information in the first row, through comparing the domestic factor private costs with private revenue and tradable input private cost difference, written as Private Cost Ratio (PCR) as shown below:

If  $PCR < 1$ : Feedlot in Lampung has competitive advantage

$PCR > 1$ : Feedlot in Lampung has competitive disadvantage

On the other hand, comparative advantage could be determine from the information in the second row, written as Domestic Resource Cost (DRC), which obtained from the ratio of domestic factor social cost with the difference between social revenue and tradable input social cost, as shown below:

If  $DRC < 1$ : Feedlot in Lampung has comparative advantage

$DRC > 1$ : Feedlot in Lampung has comparative disadvantage

The policy impact analysis divided into three parts; to output, to input, and both. The policy to be evaluated were the import tariff to beef, cattle, medicine, and non-tariff requirement such as the import quota, SPS-related restriction, and cattle specification.

### **3. Results and Discussion**

The entries of budget information are inserted to the PAM. The revenue obtained from the output value while costs of input are attained from the disaggregated input component. PAM of feedlots in Lampung is shown on Table 2.

Table 2. Policy analysis matrix of feedlot in Lampung in 2011

Province (IDR/cattle)	Revenue	Cost of Input		Profit
		Tradable	Domestic Factor	
Private Price	8.949.854	2.006.918	3.679.454	3.263.481
Social Price	9.285.720	2.640.220	5.143.977	1.501.523
Transfer	-335.866	-633.302	-1.464.522	1.761.958

#### **3.1. Profitability**

The private profitability of 3.263.481 IDR per cattle is the indicator of competitiveness under existing input, technology, and policy. It implies that feedlots in Lampung has competitive advantage at the actual market price and have the ability to expand its production.

Investation to feedlots in Lampung is promising, looking at the Private

Benefit Cost Ratio (PBCR) value of 1.57. It illustrates that 1.57 unit of private revenue is gained from a unit spent on cost.

The social profitability of 1,501,523 IDR per cattle is the indicator of efficiency of commodity when all policies are abolished. It implies that feedlots in Lampung operate efficiently without any government intervention. The Social Benefit Cost Ratio (SBCR) value indicates that Lampung would have 1.19 unit of social revenue from a unit of cost it has invested.

### **3.2. Competitiveness**

The PCR value of 0.53 implies that feedlots in Lampung have a competitive advantage. The value indicates that 0.53 additional unit of domestic factors would result to an additional unit of added value in Lampung. It means that a feedlot could gain profit because it could pay the domestic factor cost at the actual market price.

On the other hand, the DRC ratio of 0.77 shows that Lampung has a comparative advantage. The value indicates that to gain an additional unit of value added in Lampung, additional 0.77 unit of domestic factors are required. In other words, feedlots could operate efficiently even without government intervention.

The factors which made a feedlot in Lampung have a comparative advantage is because of the low cost of water, electricity, machinery and equipment. It accounted for 115,806 IDR per cattle.

### **3.3. Policy impact to output**

Impact of policy to output can be analysed through the value of Output Transfer (OT) and Net Protection Coefficient (NPCO). The output transfer of -335,866 IDR per cattle is equal to the difference between revenue measured at private and social price, shown at the second column last row at table 2. It reflects the government policy to beef or finisher cattle is applied and is made the domestic price of beef to be different from the world price. The negative output transfer implies that the feedlots received a lower beef price than it used to without government intervention. The magnitude of difference between the domestic and world price is reflected by the NPCO value. NPCO of 0.96 implies that the feedlot industry in Lampung sells the beef with 4 percent lower price than the world price.

The related policy to beef is fuel subsidy. Feedlots in Lampung pay gasoline for 6.130 IDR/L. Further, 5 percent import tariff on beef at the border push up the parity price to be higher than the domestic price. The parity price were 23.215 IDR per kg live weight while the domestic price is 22.375 IDR per kg live weight.

### **3.4. Policy impact to input**

Impact of policy to input can be assessed through the value of Input Transfer (IT), Net Protection Coefficient to Input (NPCI) and Factor Transfer (FT). Table 2 presents that feedlot in Lampung have negative IT of -633.302 IDR per cattle, which indicated that firms received subsidy to tradable input. NPCI reflect the magnitude of difference between the tradable input domestic prices with the world price as the effect of policy. The NPCI value of 0.76 implies that the domestic price of tradable input in Lampung is 24 percent lower than the world price because of subsidy applied to tradable input. Similarly, the negative FT of -1.464.522 IDR per cattle suggested that feedlots received subsidy to domestic factor.

Lampung was one of the provinces which prioritize for combine breeding (using artificial insemination and natural breeding). This program would impact to the improvement on supply ability from farmers, as the cattle population will increase. Wanti [2] has stated that competitiveness index increase in the prioritized province for artificial inseminations, compare to those who was not receiving the program, although, not all areas in Indonesia could be developed for beef sector. Other types of intervention were applied for the imported feeder cattle, for instance, the weight must not exceeds 350 kg per cattle.

### **3.5. Policy impact to output-input**

The impact of policy to input and output can be measured with the value of Net Transfer (NT), Effective Protection Coefficient (EPC), Profitability Coefficient (PC) and Subsidy Ratio to Producers (SRP). NT is the sums of OT, IT, and FT. Feedlots in Lampung have negative OT (tax on output component) and negative IT and FT (subsidy on input component). As a result, NT in Lampung is positive which implies that government subsidy to input wipe off the impact of tax in the output sectors.

EPC of 1.04 are obtained from the ratio between value added measured at the private and social price. It indicated that the overall policy to output and input in Lampung have running effectively to protect producers in value added process.

PC is the extension of EPC which take into account the domestic factor cost, thus it is the comparison of profit measured at private and social costs. It indicates that Lampung could gain 2.17 times greater private profit than its social profit with the net transfers of IDR 1.761.958 without policy.

SRP measures the amount of social revenue needed if single subsidy or tax substituted all the set of policy [3]. It obtained from the ratio of profit transfers ( $\Pi_i$ ) with its social revenue ( $Rev_s$ ). Lampung showed an SRP of 0.19 which indicate that the transfer would have increased the revenues by 19 percent.

#### **4. Conclusion**

From this study, it conclude that:

1. Feedlot in Lampung has comparative and competitive advantage.
2. The government policy influence the competitiveness of feedlot.

#### **5. References**

- [1] E.A. Monke, S.R. Pearson. 1989. The Policy Analysis Matrix for Agricultural Development. Cornell University Press, Ithaca.
- [2] Wanti, P.I. Nugroho. 2013. Analisis Daya Saing Industri Penggemukan Sapi Potong Lokal di Indonesia. Institut Pertanian Bogor, Bogor.
- [3] M.L. Tothova, H. Goodwin. 1999. Production Distortion in the Slovakian Grain Sector Resulting from Agricultural subsidies. Tennessee.

## **The Contribution of Agricultural Sector Towards Culinary Business Development at Kupang Municipality East Nusa Tenggara Province**

**Markus Bunga<sup>1,\*</sup>**

<sup>1</sup>Department of Business Administration, Nusa Cendana, Kupang, 82555, Indonesia

\* Corresponding author: markusbunga@yahoo.co.uk

---

**Abstract** The culinary business in Kupang City was growth significantly. It is presumed that increasing in population has been the factor for its growth. The growing number of people being involved in this business is an indicator of changing in society consumption behaviour. The major contribution to the expansion of the business is agricultural sector. But to what extent the sector support this Culinary Business and how the business contribute to provide job opportunity are among the challenging questions to be explored. The research's main objectives were to know to what extent the contribution of agricultural sector towards culinary business development; and to deeply explore and identify the characteristics and the impact of culinary business. This is an exploratory study utilizing purposive sampling for chosen area and snowball sampling for respondent. The number of respondent was not be restricted until the requirement information fulfilled. Qualitative descriptive with simple statistic was utilized in analyzing the result. It was found that major part of culinary business was done by migrant from: Java, South Sulawesi, West and North Sumatera. The rest was from Kupang, where mostly conducting by Chinese ethnic, especially for restaurant. Most of Kupang people involved in providing special traditional food: se'i, porch, RW (dog meat). What was interesting is the existence of culinary business has attract more people to engage in agricultural and animal husbandry business. The number of farmers, chicken and pig raiser had grown significantly in the last five years. Even all the Kupang agriculture output was marketed around Kupang City but still a number of raw material needed were supplied from outside such as districts in Timor Island, Java, South Sulawesi and West Nusa Tenggara. So, it is said that culinary business has a great impact on the local economy in terms of providing job opportunity and increasing local people income. So, for the years to come government has to be creative in looking for prospective business in order to giving more chance to be participated in local development.

**Key words:** Agricultural sectors, culinary business

---



## **1. Introduction**

Nowadays, *resource based development paradigm* is viewed as an irrelevant approach in the era of the advanced of science and technology which becomes the basis of *knowledge based development paradigm*. Nevertheless, it is not totally true for there are still high variation in potencies and level of development of each region, as found in the context of Indonesia. The central government has launched a strategic policy in the frame of *economic cluster development* which is known as MP3EI to speed up the progress of less developed regions. East Nusa Tenggara Province is being included in corridor 5- along with Bali and West Nusa Tenggara, which focus on tourism, animal husbandry and marine/fisheries. This policy has taken into account the factual conditions of this province which is characterized by high level of variety in all aspects of life.

There were some prime mover of NTT economic development for the years to come are: (1) tourism; (2) Fisheries and Marine; (3) Plantation/ Agriculture; and (4) Animal Husbandry. Tourism may be the only sectors having the greatest multiplier effects because of its global characterization. It can be the locomotive for others economic sectors within a certain territory or even to pull of global resources to the national/regional market, as indicated of culinary business development in Kupang City, where its level of growth was significantly increased. It was presumed that some factors has contributed this conditions, i.e: (1) increasing in population; (2) changing of society consumption behaviour; (3) increasing of tourism itself. The growth of culinary business has brought positive impact to low level income society (grass root) especially for those whose passion in farming, breeding, and fishing.

There were some challenging question to be explored: (1) to what extend agricultural sector contributed to culinary business development in Kupang Municipality; (2) what the characteristic and contribution of culinary business towards the economy of the city

The objectives of the research were (1) to know to what extend the contribution of agricultural sector towards culinary business development; (2) to deeply explore and indentify the characteristics and contribution of culinary business towards the economy of the city

## **2. Materials and Methods**

The study was conducted in Kupang City as an exploratory study. Purposive sampling used for sampling area by looking on culinary business concentration. Snowball method applied for determined number of respondent whether to up stream or down stream market in order to get a clear picture of the raised problems. The study used primary and secondary data. Guide line interview and observastion were used to collect primary data from farmers, breeders, culinary businessmen and other relevant informan. While secondary data was gathered from government institutions. Qualitative descriptive analysis with simple statistic was used to analyzing the result.

## **3. Results and Discussion**

### **3.1. Profile of Kupang city**

As the Capital of East NusaTenggara, Kupang City is the autonomous region which consists of 6 sub districts. The City covers an area of 18.027 ha, where 310 ha of that is an agricultural area. The city is characterized by a number of distinctive flora and fauna such as palm sugar and gewang. The highest rainfall reached 851.1 m3 and the average temperature is 29°C.

### **3.2. Profile of agricultural sector of Kupang city**

#### **3.2.1. Types and number of agriculture business units**

Farmers and breeders were limited to those who conducting the activities for market purpose (market orientation). From this point of view, it was found that the number of people being involved in agriculture, animal husbandry and fisheries increased significantly in the last five years (Figure 1). It was interesting to know that those who engaged in farming activities were local people which most of them grew various vegetables and short term fruits. On the other hand, the breeders were mostly from Java. The location used to breeding was hired from local people. Breeding business was conducted in the form of self-managed and partnership

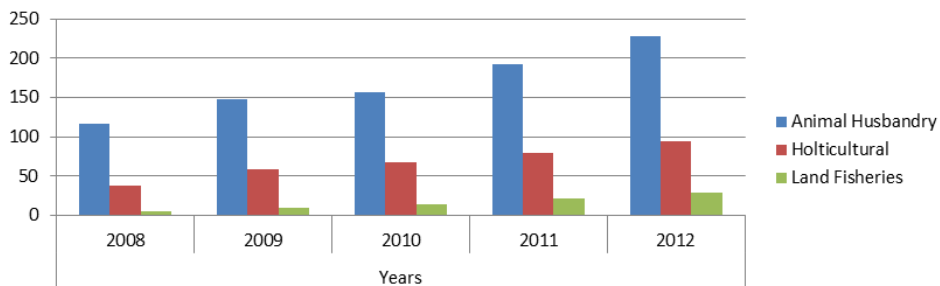
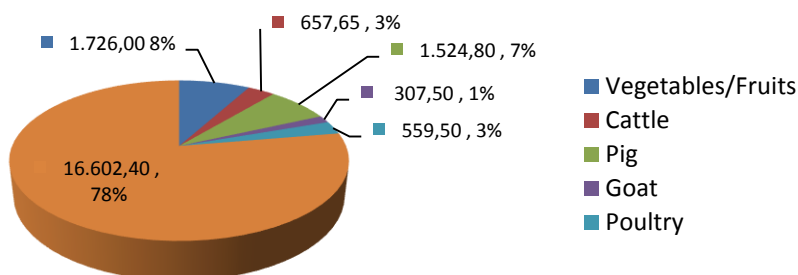


Figure 1. Number and Category of Agriculture Business Unit

### 3.2.2. Annual amount of production

The increasing number of household engaging in farming, animal husbandry and land fisheries was limited to certain commodities, such as: spinach, mustard green, cabbage, tomatoes, chili, cucumber, banana, papaya, catfish, goldfish, poultry, pig, goat and cattle (Figure 2). The main target of these products was to fulfill the needs of local people including culinary business as well. However, due to limited produces and commodities originating from this region then it could not satisfy the whole demand for food consumption, which means the other products had been imported from other districts or provinces.



Source: Statistic office of Kupang city

Figure 2. Production of vegetables/fruits and meat (tonnage) 2012

### 3.2.3. Distribution model of Agriculture products

Although the products were locally produced, the flow of them went through some channels before reaching the end consumers (Figure 3). The way taken in this process, of course, bring along more opportunities for people talking part in this process of business, which means creating more jobs. Even both crop produces and meat were the same model of channel, but the way they move were different. The produces were usually brought by the owners themselves to the market while in the case of meat whole seller and retailer took them directly from the farmers gate.

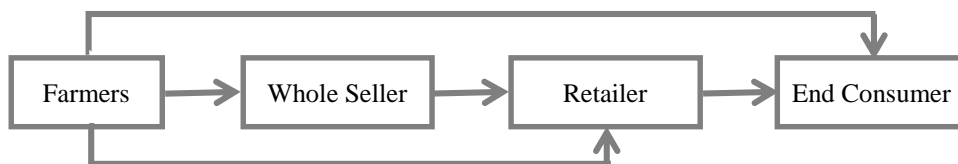


Figure 3. Distribution Model

### 3.3. Profile of culinary business

#### 3.3.1. Origin and education level of culinary businessman

Culinary business in Kupang City was done in form of restaurant, stall, stroller or even selling in pedestrian part of main venue which just using mats for its customer. It was also found that culinary business was mainly done by migrants from: Java, South Sulawesi, and West Sumatera. The rest was from Kupang, where mostly conducting by china's ethnic, especially for restaurant Figure4).

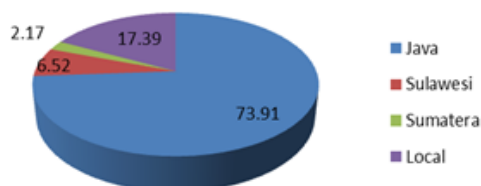


Figure 4. Region of origin of people doing culinary business (%)

In most cases, the business was run by those whose level of education just up to junior high school and only by very small percentage with university/college back ground (Figure 5). It is interesting to see that people engaging in culinary business was those whom level of education just up to junior high school (50%). On the other hand, the business itse If has contributed towards providing job opportunities in significantly number, where between 1-3 assistants were employed by individual culinary business unit without mentioning number of job opportunities relating to this business, parking attendants for instance.

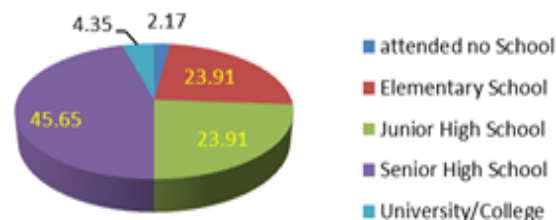


Figure 5. Educational level of culinary business person (%)

### 3.3.2. Types and amount of raw material consumed

Types and amount of daily raw material consumed by each culinary business unit were varies according to their product sold. The average absorb by individual business according to its category product was: 7.6 kg of Vegetables, 11- 15 kg of fish and 16.3 kg of meat. Part of these products were Kupang's Agriculture production. Because other products such as garlics, red onion, eggs, potatoes, carrot, and spices, rice were still being imported from other region/provinces. Most of local culinary business provided special food like porch and RW (dog meat). While those from other provinces provided more variation food such fried chicken, sate (cattle/goat), ice fruit and fish. It meant that the target market of the first one is narrower than the last one.

## 4. Conclusion and Recommendation

### 4.1. Conclusion

- (1) The production of agricultural sectors of Kupang City has contributed significantly towards culinary business activities in the region in terms of meat and fish. However it still many to be exported from outside because of the limitation of production or even they were not produced locally.
- (2) The present of culinary business bring significant contribution towards the eagerness of local people to engage in utilizing the potency of local bio resources or things relating to that. So, it made a great meaning in terms of providing job opportunities in a situation where government could not provide more jobs for the people.
- (3) It seems that culinary business and agriculture will go along (mutual symbiosis) with the tendency of changing behavior of society in terms of eating habits i.e. from home eating habits to outside eating habits

### 4.2. Recommendations

Government has to pay more attention to both kind of businesses because of their multiplier effect in society aspect of life in terms of providing job opportunities and supporting the government policy which has put NTT as one of main destination of tourism as stated in MP3EI.

## 5. References

- [1] B. Arifin. 2007. *Ekonomi Pertanian dalam Era Revitalisasi Pertanian: Harmonisme Mikro Usahatani dengan Makro Kebijakan. Mungkinkah Petani Sejahtera?* Prosiding Komperensi Nasional XV

- Perhimpunan Ekonomi Pertanian Indonesia (PERHEPI) Surakarta, 3-4 Agustus 2007. Penerbit Brighten Press.
- [2] A. Aryanto and Y. Hafizrianda. 2010. *Model-Model Kuantitatif Untuk Perencanaan Pembangunan Ekonomi Daerah. Konsep dan Aplikasi*. Penerbit IPB Press.
- [3] V. Gaspersz. 2002: *Perencanaan SDM Makro NTT*
- [4] <http://bappedakotakupang.info/warta-bappeda-kota-kupang/245-profil-kota-kupang.html>
- [5] Y. Patnasari. 2005. Implikasi Liberalisasi Perdagangan Terhadap Daya Saing Ekspor Produk Pertanian Indonesia ke Amerika Serikat, *Jurnal Ekonomi dan Bisnis*, Volume 7 No. 2, Juni 2005. FE Uniba, Surabaya.
- [6] B. Saragih. 1998. *Agribisnis, Paradigma Baru Pembangunan Ekonomi Berbasis Pertanian*. Pusat Studi Pembangunan IPB, Bogor.
- [7] U. Silalhi. 2010. *Metodologi Penelitian Sosial*. Penerbit Refika Aditama Bandung.

## **The Morphological Character of the “Bendi” Horse as Short Distance Urban Transport Modes that are Environmentally Friendly**

**Sri Adiani<sup>1</sup>, Dordia A. Rotinsulu<sup>2</sup>, Ben J Takaendengan<sup>1</sup>**

<sup>1</sup>Department of Animal Production and Breeding Technology, Faculty of Animal Science, Sam Ratulangi University, Manado, Manado 95115, Indonesia.

<sup>2</sup>Veterinary Technician Vocational Program, Bogor Agricultural University, Bogor, Indonesia.

Corresponding author: sri\_adiani@yahoo.com

---

**Abstract** The purpose of this study was to search for and compare to the morphological characteristics of the minahasa horse which serves as a means of urban transport close range. Body measurements and live-weight were taken on 90 Minahasa horses (32 mares and 58 stallions). A multivariate approach was adopted to provide description of both body shape and body size of two Minahasa local horse populations, i.e. Manado and South Minahasa (Minsel). Statistical methods employed in this study were test of the difference between two means square and T student. The results showed that the average of body weight and body measurements, for example such as heart girth, chest width, chest depth, wither height, hip height, hip width, body length, thigh circumference and face width of the horse population in the two areas were not significantly different ( $P < 0.05$ ). Meanwhile character of the head length and neck length of the horse population in the two regions were significantly different ( $P > 0.05$ ), with the horses in Manado has a neck and head size is longer than the horses in South Minahasa. These results indicate that the population of horses in both regions have similarities in weight and body measurements, but have slight differences in the length of the neck and head were allegedly due to the dominating influence of gender differences in the two populations in the area.

**Keywords** morphological indices, local horses, function

---

### **1. Introduction**

Characterization of local breeds is very important in maintaining animal genetic resources [1]. Despite the modernization of agriculture, Minahasa local horse, in North Sulawesi plays an important role in the rural area. The horses are mainly used in agriculture, light traction, riding and leisure activities. In order to differentiate variation in both size and shape, body

measurements of animals were used to describe morphological differentiation in large animals [2, 3].

Nowadays body weight and body measurements are indispensable in the suspect animal breeds that have been able to adapt to the environment which would be characteristic of the animal. Obviously the necessary assessment of the properties of body size and body weight on the horse population in the city of Manado and South Minahasa Regency is to get an accurate picture about the type and what kind of horse that can work well and fit the surroundings.

## **2. Materials and Methods**

### **2.1. Materials**

City of Manado and Minahasa District is two coastal cities still take the horse as a mode of transport from downtown to the settlement in the range of 5 to 10 kilometers. A number of local horse called 'Bendi' randomly selected in this study were 32 mares and 58 stallions. Age was ranged between two and seven years old. The unhealthy and pregnant ones were excluded. Age was primarily determined by dentition as described by Owen and Bullock [4].

### **2.2. Methods**

Eleven different body measurements were taken on each horse population. These include: wither height, body length, chest width, chest depth, heart girth, hip height, hip width, head length, collar length and face width. Height measurements were assessed by using a graduated measuring stick, the length and circumference used a flexible tape, meanwhile calibrated wooden caliper was used for the width measurements. The procedure and anatomical reference points for the respective body measurements with fewer modifications described elsewhere by Salako and Ngere [5]. Pregnant horse data were excluded as sample due to anatomical changes (thoracic size) which can mislead the measurement. Measurements were done by the same person to avoid from human error.

### **2.3. Statistic Analysis**

The descriptive analysis such as mean, standard deviation and coefficient of variability of each body measurement were estimated using PROCMEANS procedure of the SAS package [6]. Test comparison of two means with unbalanced use of data and continued with the T test.



### 3. Results and Discussion

#### 3.1. Results

Result of the descriptive analyses of live weight and body measurements of the Minahasa local horse for both sexes are presented in Table 1. It's showed that the Manado horses were slightly heavier than Minsel horses but T test result showed that the two populations have a body weight that is not significantly different ( $P < 0.05$ ). The same phenomena were found for heart girth, chest width, chest depth, wither height, hip height, hip width, body length, thigh circumference and face width measurements respectively. Considering quite a few measurements, the horse from Manado and South Minahasa has similar body size measurement except the head length and neck length.

Table 1. Descriptive statistics and morphological indices of the quantitative traits of Bendi horse

Variable (cm)	District	
	Manado (N=57)	Minsel (N=33)
Life Weight (kg)	201.26±40.44 <sup>a</sup>	191.09±20.40 <sup>a</sup>
Heart Girth	136.72±8.74 <sup>a</sup>	136.58±4.87 <sup>a</sup>
Chest Width	25.63±2.48 <sup>a</sup>	26.64±1.69 <sup>a</sup>
Chest Depth	50.63±3.95 <sup>a</sup>	52.03±2.97 <sup>a</sup>
Wither Height	116.54±6.12 <sup>a</sup>	116.06±4.56 <sup>a</sup>
Hip Height	117.49±6.47 <sup>a</sup>	117.64±4.63 <sup>a</sup>
Hip Width	33.91±5.17 <sup>a</sup>	38.55±2.03 <sup>c</sup>
Body Length	113.80±4.91 <sup>a</sup>	115.78±3.16 <sup>ac</sup>
Thigh Circumference	36.60±2.87 <sup>a</sup>	38.21±1.87 <sup>ac</sup>
Collar Length	53.68±4.25 <sup>a</sup>	50.61±4.50 <sup>b</sup>
Face Width	19.54±1.12 <sup>a</sup>	19.42±0.75 <sup>a</sup>
Head Length	47.26±3.07 <sup>a</sup>	45.00±1.84 <sup>c</sup>

Means in the same rows with different superscript differ significantly ( $P < 0.05$ ); (\*) = significantly different ( $P < 0.05$ ); LW= live weight; HG= heart girth; CW= chest width; CD= chest depth; WH= wither height; RH= rump height; HW= hip width; BL= body length; RL= rump length; CL= collar length; FW=face width; FL= face length.



Figure 1. Right= Manado horse and Left= South Minahasa horse.

### **3.2. Discussion**

The size is almost similar to the body size of pony breeds at the same age. However, some local horse populations in Minahasa were speculated that they are originated from the crossing of many breeds for centuries. Noor [7] affirmed that the adaptation to environment which yielded a fertilized offspring were good to develop as indigenous breeds since the ability to adapt to specific environmental pressure.

Size of body measurement variation indicates the existence of selection, and could be due to the influence of same environment. Although there is a noticeable difference in the length of the head and neck of the horse in the two populations but according Takaendengan [8] in particular, variations in length of head very slightly due to its close association with the bones of the skull. The possibility that the differences due to the influence of gender, where the most population of horses in Manado are male and the reverse in South Minahasa.

The high variability shown by the large standard deviation values associated with the measurements can also be a reflection of wide disparity among the sample size which can not identified yet. Similarities between the body measurements of males and females have been reported in cattle [5].

### **4. Conclusion**

Based on this study concluded that the morphological characters of 'Bendi' horses in the city of Manado and South Minahasa Regency has the same size with a pony and suitable for use as a mode of short-distance transport of air pollution-free and environmentally friendly.

## **5. References**

- [1] M.R. Lanari, H. Taddeo, E. Domingo, M.P. Centeno, L. Gallo. 2003. Phenotypic differentiation of exterior traits in local Criollo goat population in Patagonia (Argentina). *Arch. Tierz Dummerstorf.* 46:347-356.
- [2] R.P. Gilbert, D.R.C. Bailey, N.H. Shannon. 1993. Linear body measurements of cattle before and after 20 years of selection for post-weaning gain when fed two different diets. *J. Anim Sci.* 71:1712-1720.
- [3] K.A. Shahin, A.M. Soliman, A.E. Moukhtar. 1995 Sources of shared variability for the Egyptian cattle body shape (conformation). *Indian J. Anim. Sci.* 65:759-764.
- [4] R. Owen, J. Bullock. 2002. *Complete Book of The Horse and Rider.* Hamlyn Pub. Ltd. England.
- [5] A.E. Salako, L.O. Ngere. 2002. Application of multifactorial discriminant analysis in the morphometric structural differentiation of the WAD and Yankasa sheep in the humid southwest Nigeria. *Nig. J. Anim. Prod.* 29:163-167.
- [6] [SAS] Statistical Analysis System. 2000. *SAS User's Guide.* SAS Inst. Inc, North Carolina.
- [7] R.R. Noor. 2008. *Genetika Ternak.* Edisi ke-4. Penebar Swadaya, Jakarta.
- [8] B.J. Takaendengan, R.R. Noor, S. Adiani. 2011. Morphometric Characterization of Minahasa Horse Its Breeding and Conservation. *J. Med. pet J.* 34-2:99-104

## The diversity of fungi on polluted mangrove ecosystem at Belawan and Jaring Halus, North Sumatra province

Yunasfi<sup>1,\*</sup>, Pindi Patana<sup>1,\*</sup>

<sup>1</sup>Study program of forestry, faculty of agricultural, University of Sumatera Utara, Medan,  
20154, Indonesia

\*Corresponding author: [yunasfijamhar@yahoo.co.id](mailto:yunasfijamhar@yahoo.co.id)

---

**Abstract** Fungi is one of important microorganism in litter decomposition process of mangrove ecosystem. Several environmental factors such as salinity, pH, and condition of polluted aquatic environment will influence to the living of fungi. High level of heavy metal will influence ecosystem sustainability and microorganism activities. Microorganism such as fungi can grow in polluted mangrove ecosystem, but it needs stronger adaptation process than unpolluted ecosystem. Mangrove ecosystem at Belawan was predicted containing more industrial pollution throughout Deli River, while Jaring Halus was less. This research was conducted to compare diversity of fungi in both mangrove ecosystem with different level of pollution. Sample of fungi isolation was mud and water planted with *Avicennia marina*. Sampling for isolated fungi was randomized at six points of each research sample. This research measured heavy metals Cu and Pb in mud and water which was the same origin with the six points of isolated fungi. It resulted that diversity index of fungi in mud (1.45) and water (1.71) at Belawan mangrove ecosystem was less than at Jaring Halus mangrove ecosystem (1.78 in mud and 1.94 water). The level of heavy metal Cu and Pb at growth location of *A. marina* at mangrove ecosystem of Belawan was higher than at Jaring Halus.

**Keywords** *Avicennia marina*, diversity, fungi, heavy metal, mangrove

---

### 1. Introduction

Many mangrove ecosystem at coastal areas currently is halting place for any industrial waste from upstream to downstream. The existence of industrial waste at this ecosystem can degrade environmental quality. It made vary organism at mangrove ecosystem weren't able to survive. Industry without water treatment installation can produce polluted waste containing hydragyrum (Hg), ferrum (Fe), mangan (Mn), cuprum (Cu), plumbum (Pb), zinc (Zn), chromium (Cr), and nikel (Ni). One of mangrove vegetation which has adaptive variation to the polluted environment such as heavy

metals is *Avicennia marina* as it's halophyte facultative [1,2]. The most accumulated heavy metals is occurred on root [3, 4]. This fact shows that roots have important rule as barrier heavy metal translocation and protect sensitive part of vegetation from heavy metals contamination [5]. *Avicennia marina* is pioneer mangrove species that takes the role as determinant factor of mangrove ecosystem survival in accumulating heavy metals on roots, stems and leaves. Mangrove ecosystem has the capacity as sink or buffer and removes, immobilization heavy metals before reaching closed aquatic ecosystem [6].

There are many organic material at mangrove habitat that are from leaves, branches, twigs or water and soil. These organic materials will be decomposed by vary organism and microorganism. Fungi is one of many microorganism groups which plays important role in decomposing process of litter. Other decomposers from microorganism or organism such as bacteria, worms, crabs, etc and environmental factor also take part in that decomposing process. Symbiosis between fungi and bacteria in mangrove ecosystem will make littering process faster [7]. Fungi is main decomposer of mangrove leaves due to the ability to decompose lignin and cellulose. The existence of vary fungi is influenced by the existence of vary heavy metals, it means how survive fungi to grow and develop on polluted mangrove ecosystem of heavy metals as it could be a bioindicator to determine the level of pollution.

## **2. Materials and Methods**

Determination of population and spesies of fungi in mud and water at site of *A. marina* was conducted at Laboratory of Soil Microbiology, Faculty of Agriculture North Sumatera University. Mud and water sample to isolate fungi was from the site of *A. marina* grew at river estuary of Belawan where it's suspected as polluted area of heavy metals and mangrove forest at Jarung Halus as unpolluted area (control). This research was conducted in June till October 2013.

### **2.1. Materials**

Materials used were leaves litter of *A. marina* that's collected with net and cut leaves of tree with senescence category, PDA (*Potato Dextrose Agar*), MEA (*Malt Extract Agar*), alcohol 96%, sterile water, alumunium foil, spiritus, and plastic bag. Field equipment materials used are litter's bag of nylon with mesh size 2 mm, nylon rope to bundle litter's bag, bamboo stick, permanent board ink, written tools, etc, Equipments used were

*handrefractometer* to measure salinity, microscope, autoclave, reaction tube, object glass, petri dish, pinset, culture box, slide box, Erlenmeyer tube, measured glass, digital camera, etc.

## **2.2. Methods**

### **2.2.1. Fungi isolation of leaves litter *A. marina***

Fungi determination was conducted by using dilution method with series of sample suspension. Soil dilution and fungi isolation on media in petri dish was done by following steps such as below:

- a. 10 gr of mud sample dissolved was put into erlenmeyer glass 250 ml, added water from mangrove ecosystem that had been sterlized up to 100 ml. After litter dilution of *A. Marina* reached optimum level ( $10^{-5}$ ), then 0,1 ml of dilution suspension took from each dilution level. Further, suspension was cultured in petri dish with PDA media using antibiotic kemicitine 0.1 g/l and put in room temperature. For each dilution level, it's repeated twice.
- b. Colony observation was done 1 till 12 days after incubation time. For counting fungi population per ml litter sample of *A. marina* leaves by counting the number of colony timed to dilution factor.

### **2.2.2. Identification of fungi**

Pure cultivated fungi was replicated in PDA media, and incubated for 5-7 days at room temperature. Fungi isolate which had grown on media, identified macroscopic characteristic, such as colony type including hype, colour and colony diameter and colour of spore and conidia. Fungi isolates were also cultivated on slide culture by putting the cutting part of agar with dimension 4 x 4 x 2 mm which had been covered by fungi on slide culture, then closed with slide. Isolate on slide culture put on platic box with dimension 30 x 20 x 6 cm, by giving wet cotton. Fungi isolate on slide culture was on that for several days at room condition till fungi isolate grew well. When fungi isolate grew enough, it was seperated with agar. Further, the ex-cutting part of agar was added by 1 drop of Lactofenol to make permanent culture. Then, fungi isolates were observed by using electron microscope to identify its character such as hype, conidiopore, conidiogenesis and the size of spore. The characteristic was tabulated, then it's checked with identification key of fungi [8, 9, 10, 11, 12, 13, 14, 15, 16]. After identification, it's counted the number and population at mangrove mud. This activities were done for each sample point.

### 3. Results and Discussion

#### 3.1. Diversity of fungi at Belawan

There were 4 species of fungi found at Belawan mangrove mud, those are *Aspergillus* sp. 1 ( $21 \times 10^2$  cfu/ml), *Aspergillus* sp. 2 ( $6 \times 10^2$  cfu/ml), *Aspergillus* sp. 3 ( $6 \times 10^2$  cfu/ml) and *Trichoderma* sp.1 ( $5 \times 10^2$  cfu/ml) with species diversity index 1.45. While on water with *A. Marina* overgrown, there were 6 species of fungi consisted of *Aspergillus* sp. 1 ( $23 \times 10^2$  cfu/ml), *Aspergillus* sp. 2 ( $15 \times 10^2$  cfu/ml), *Aspergillus* sp. 3 ( $14 \times 10^2$  cfu/ml), *Trichoderma* sp. 1( $22 \times 10^2$  cfu/ml), *Trichoderma* sp. 2( $12 \times 10^2$  cfu/ml) and *Aspergillus* sp. 4 ( $5 \times 10^2$  cfu/ml). The species diversity index of fungi in water is 1.72.

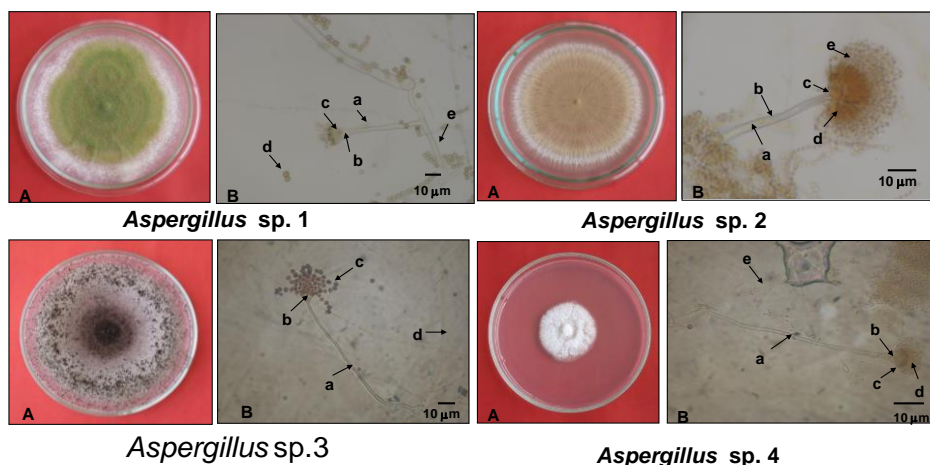


Fig 1. Diversity of fungi *Aspergillus* spp.

#### 3.2. Diversity of fungi at Jaring Halus

There were 6 species of fungi found at Jaring Halus mangrove mud, those are *Aspergillus* sp. 1( $23 \times 10^2$  cfu/ml), *Aspergillus* sp. 3 ( $30 \times 10^2$  cfu/ml), *Trichoderma* sp. 3 ( $24 \times 10^2$  cfu/ml), *Penicillium* sp. ( $19 \times 10^2$  cfu/ml), *Fusarium* sp.( $22 \times 10^2$  cfu/ml) and *Trichoderma* sp.4 ( $22 \times 10^2$  cfu/ml). Diversity index of fungi in mud is 1.78. While in water with *A. marina* overgrown, there were 7 species fungi consisted of *Aspergillus* sp. 1( $33 \times 10^2$  cfu/ml), *Aspergillus* sp. 2 ( $28 \times 10^2$  cfu/ml), *Aspergillus* sp. 3( $27 \times 10^2$  cfu/ml) *Trichoderma* sp. 3 ( $24 \times 10^2$  cfu/ml), *Penicillium* sp. ( $23 \times 10^2$  cfu/ml) , *Fusarium* sp. ( $22 \times 10^2$  cfu/ml) and *Trichoderma* sp.4 ( $24 \times 10^2$  cfu/ml). Diversity index of fungi in water is 1.94.

Mangrove ecosystem at Belawan actually is an estuary of River Deli where this river is congested with industrial companies. It's predicted that this

industry contributed to many heavy metal throw away the river without good waste processing management. Data from Government Environmental Agency of North Sumater BAPEDALDASU [17] released that there were 57 industries along River Deli and 22 along River Belawan. Several types of industry were cooking oil, plywood, metal processing, plastic, textil, tin, dry battery, dolomit fertilizer, metal layering, etc. Diversity index of fungi in mud and water at surrounding *A. Marina* of Belawan mangrove ecosyatem is less than Jaring Halus mangrove ecosystem. If it's connected with the assessment of heavy metal concentrate of Cu and Pb on mud and water, it can be explained that there's correlation in between species diversity of fungi influenced by heavy metal concentrate of Cu and Pb. According to Doelman *et. al.* [18], pollution caused by heavy metal could contribute to negative impact of micro rganism community of decomposer. Beside that Leita *et. al.* [19] stated that heavy metal influenced growth, morphology, metabolism of microorganism through barriers or disturbances such as protein denaturation, destruction of cell membranes, etc.

Species of fungi at Jaring Halus mangrove ecosystem is more diverse than Belawan both in mud and water. There are 3 species *Aspergillus* and 2 species *Trichoderma* in mud and water of Belawan mangrove ecosystem, while at Jaring Halus there are 3 species *Aspergillus*, 2 species *Trichoderma*, 2 species *Fusarium*, and 1species *Penicillium*. Halim *et. al.* [20] stated that fungi *Aspergillus*, *Penicillium*, *Fusarium*, and *Trichoderma* are tolerant fungi to heavy metal Pb on his research at West and East coastal Malaysia 33% and 25% for each. Further, Halim *et. al.* [20] stated that these fungi could be used as biosorban that was expected to be able to absorb heavy metal of environmental pollution. Yunasfi [21] researched on litter decomposition process at different level of salinity also found *Aspegillus*, *Fusarium* and *Penicillium* which those were available for each observation every two weeks and had dense population compared to others.

#### **4. Conclusion**

Diversity of fungi in mud and water at surrounding *A. Marina* of Belawan mangrove ecosyatem is less than Jaring Halus mangrove ecosystem which is predicted as an effect of heavy metal existence of Cu and Pb at Belawan is higher than Jaring Halus. Species of fungi *Aspergillus*, *Fusarium* and *Penicillium* are types of fungi that are tolerant to heavy metals and be expected to be bioindicator of heavy metal pollution at coastal areas.



## 5. References

- [1] P. Hutching, P. Saenger. 1987. The Ecology of Mangroves. University of Queensland. Queensland Press, St Lucia.
- [2] Y. Waisel, A. Ethel, M. Sagami. 1986. Salt tolerance of leaves of mangrove *Avicennia marina*. *Physiol. Plantarum*. 67: 67-72.
- [3] C.A.R. Silva, L.D. Lacerda, C.E. Rezende. 1990. Heavy metal reservoirs in red mangrove forest. *J. Biotrop*. 22: 339-345.
- [4] C.Y. Chiu, C.H. Chou. 1991. The distribution and influence of heavy metals in mangrove forests of the Tamushi estuary in Taiwan. *J. Soil Sci and Plant nutr*. 37: 659-669.
- [5] F.Y.T. Nora, S.W. Yuk. 1997. Accumulation and distribution of heavy metal in a simulated mangrove system treated with sewage. *J. Hydrobiol*. 352: 67-75.
- [6] E.C. Peter, N.J. Gasman, J.C. Firman, R.H. Richmond, E.A. Power. 1997. Ecotoxicology of Tropical marine Ecosystems. *J. Enviro Toxicol and Chem*. 16: 12-40.
- [7] J.W. Fell, R.C. Cefalu, I.M. Masters and A.S. Tallman. 1975. Microbial Activities in the Mangrove (*Rhizophora mangle* L.) Leaf Detrital Systems. Hlm. 661 – 679 in Proceedings of the International Symposium on Biology and Management of Mangroves. G.E. Walsh, S. C. Snedaker dan H. J. Teas (Peny.). Univ. Florida, Gainesville.
- [8] M.A. Rifai. 1969. A revision of the genus *Trichoderma* .Hlm. 1-56 dalam Mycological Papers No. 116. Herbarium Bogoriense, Bogor.
- [9] W. Gams, J. Lacey. 1972. *Cephalosporium*-like hyphomycetes: two species of *Acremonium* from heated substrates. *J. Trans. Br. Mycol. Soc*. 59: 519-522.
- [10] W. Gams. 1975. *Cephalosporium*-like hyphomycetes: some tropical species. *J. Trans. Br. Mycol. Soc*. 64: 389-404.
- [11] G.J. Samuels. 1976. Perfect states of *Acremonium* the genera *Nectria*, *Actiniopsis*, *Ijuhya*, *Neohenningsia*, *Ophiodictyon* and *Peristomialis*. *New Zeal. J. of. Bot*. 14: 231-260.
- [12] B.C. Sutton. 1980. The Coelomycetes Fungi Imperfecti with Pycnidia Acervuli and Stomata. Commonwealth Mycological Institute. Kew, Surrey, England.
- [13] J.R. White. 1987. Endophyte-host associations in forage grasses. X. cultural studies on some species of *Acremonium* Sect. *albo-lanosa*, including a new species, *A. starrii*. *Mycotaxon*. 30: 87-95.
- [14] K. Singh, J.C. Frisvad, U. Thrane, S.B. Mathur. 1991. An Illustrated Manual on Identification of some Seed-Borne Aspergilli, Fusaria, Penicillia and their Mycotoxins. AiO Tryk as Odense, Denmark.

- [15] M.B. Ellis. 1993. Dematiaceous Hyphomycetes. CAB International. England, United Kingdom.
- [16] R. Lowen. 1995. *Acremonium* Section *Lichenoidea* section nov. and *Pronectria Oligospora* Species nov. J. Mycotaxon. 53: 81–95.
- [17] Badan Pengendalian Dampak Lingkungan Daerah Provinsi Sumatera Utara (BAPEDALDASU). 2007. Laporan Status Lingkungan Hidup Daerah Provinsi Sumatera Utara Tahun 2007. <http://www.bapedalda.go.id>.
- [18] P. Doelman, E. Jansen, M. Michels, M. Van Til. 1994. Effects of heavy metals in soil on microbial diversity and activity as shown by the sensitivity-resistance index, an ecologically relevant parameters. J. Biol. Fertiliz. Soil. 17: 177-184.
- [19] L. Leita, M. Denobili, G. Muhlbachova, C. Mondini, L. Marchiol, G. Zerbi. 1995. Bioavailability and effects of heavy metals on soil microbial biomass survival during laboratory incubation Soil. J. Biol. And. Fert. of. Soils. 19: 103-108.
- [20] H. Halim, S.A. Alias, G. Redzwan. 2012. Metal tolerance of selected marine fungi isolated from metal polluted mangrove surfaces sediment in West and East Coast of Malaysia.
- [21] S. Yunasfi, C. Hadi, L.I. Kusmana, Sudirman, B. Tjahjono. 2006. Dekomposisi serasah daun *A. marina* oleh bakteri dan fungi pada berbagai tingkat salinitas. (Disertasi). Sekolah Pascasarjana Institut Pertanian Bogor, Bogor.

## Natural products exploration in frame of tropical plant bio-resource conservation and utilization

Enih Rosamah<sup>1,\*</sup>, Harlinda Kuspradini<sup>1</sup>, Rita Khairani<sup>2</sup>

<sup>1</sup> Department of Forestry Science, Faculty of Forestry, Mulawarman University, Samarinda, 75119, Indonesia

<sup>2</sup> Department of Chemistry, Faculty of Mathematic and Natural Science, Mulawarman University, Samarinda, 75119, Indonesia

\* Corresponding author: enihros@yahoo.com

---

**Abstract** The extracts and raw materials from mangroves have been used by coastal communities for natural medicines, one of these is Api-Api (*Avicennia lanata* Ridley) leaves. In this research, phytochemical screening, total phenolic content analysis, toxicity test, and antioxidant activity test of methanol crude extract, *n*-hexane fraction, ethyl acetate fraction and methanol-H<sub>2</sub>O fraction of *A. lanata* leaves have been done. Total phenolic content was analyzed by Folin-Ciocalteu method. Based on this analysis was known that the total phenolic content on crude methanol extract, ethyl acetate fraction and methanol-H<sub>2</sub>O fraction of *A. lanata* leaves are 3.27; 5.35 and 7.59 mg GAE/g sample, respectively. On toxicity test by using Brine Shrimp Lethality Test (BSLT) method, was obtained the LC<sub>50</sub> values of crude methanol extract, *n*-hexane fraction, ethyl acetate fraction and methanol-H<sub>2</sub>O fraction of *A. lanata* leaves are 104.79; 128.69; 268.33 and 324.70 ppm, respectively. The antioxidant activity test was carried out by radical scavenging using 2,2-diphenyl-1-picrylhydrazyl (DPPH) which act as free radical DPPH was reduced by antioxidants of extract samples. The IC<sub>50</sub> values obtained for the crude methanol extract, *n*-hexane fraction, ethyl acetate fraction and methanol-H<sub>2</sub>O fraction of *A. lanata* leaves were 37.89; 172.12; 51.71 and 39.00 µg/mL, respectively. Based on the IC<sub>50</sub> values could be known that the crude methanol extract, ethyl acetate fraction and methanol-H<sub>2</sub>O fraction of *A. lanata* leaves were belonging to the extracts that had a very strong antioxidant activity, while *n*-hexane fraction relatively had a weak antioxidant activity.

**Keywords** Antioxidant, *Avicennia*, phenolic, toxicity

---

### 1. Introduction

Indonesia has the second largest tropical forest in the world rich in biodiversity. The bio diversity of natural resources in Indonesia, one of which, is the source of secondary metabolites compounds. A movement back to nature has led to the increasing in the usage of natural products as

natural medicine. For example, medicinal herbs currently widely used either as a remedy alternative and for the maintenance of health. Some medicinal plants are distributed in Mangrove forest. Mangrove Forest in Indonesia is the highest in the world ( $\pm 42.550 \text{ km}^2$  with  $\pm 45$  species) [1]. Mangrove forest plays role as ecological function, food resources, and natural medicine (*Sonneratia*, *Avicennia*) based on local wisdom.

## **2. Material and Methods**

In this research were conducted phytochemical screening [2], total phenolic content analysis [3], toxicity test, and antioxidant activity test of methanol crude extract, *n*-hexane fraction, ethyl acetate fraction and methanol-H<sub>2</sub>O fraction of *A. lanata* leaves. Total phenolic content was analyzed by Folin-Ciocalteu method. This analysis was carried out by using spectrophotometer UV-Vis at 765 nm wavelength and gallic acid as standard. The toxicity test by using Brine Shrimp Lethality Test (BSLT) method [4]. The antioxidant activity test was carried out by radical scavenging using 2,2-diphenyl-1-picrylhydrazyl (DPPH) which act as free radical DPPH was reduced by antioxidants of extract samples. The absorbancies were measured by Vis spectrophotometer at the maximum wavelength ( $\lambda = 517 \text{ nm}$ ) [5].

## **3. Results and Discussion**

Based on phytochemical screening was known the secondary metabolites content in extract *A. lanata* leaves. In crude methanol extract was found alkaloid, steroid, saponin, flavonoid and phenolic compounds. In *n*-hexane fraction was found alkaloid and steroid compounds. In ethyl acetate fraction was found alkaloid, steroid, saponin, flavonoid and phenolic compounds. In methanol-H<sub>2</sub>O fraction was found saponin, flavonoid and phenolic compounds.

Total phenolic content was analyzed by Folin-Ciocalteu method. This analysis was carried out by using spectrophotometer UV-Vis at 765 nm wavelength and gallic acid as standard. Based on this analysis was known that the total phenolic content on crude methanol extract, ethyl acetate fraction and methanol-H<sub>2</sub>O fraction of *A. lanata* leaves are 3.27; 5.35 and 7.59 mg GAE/g sample, respectively.

Testing of Brine Shrimp Lethality Test (BSLT) test revealed the methanolic crude extract is the most toxic compared to the fractions from leaves of *A. lanata* LC<sub>50</sub>, because it has the smallest LC<sub>50</sub> value of 104.79 ppm (table

1).

Table 1. LC<sub>50</sub> values from extracts and fractions of *A. lanata* leaves

Extracts and Fractions	LC <sub>50</sub> (ppm)
Crude methanolic extracts	104,79
<i>n</i> -hexane fraction	128,69
Ethyl acetate fraction	268,33
Methanol-H <sub>2</sub> O fraction	324,70

Dealing with the classification level of the toxicity (table 2), based on this test was known that the most toxic extract is crude methanol extract because it has the lowest LC<sub>50</sub> value.

Table 2. The classification level of the toxicity of an extract based on LC<sub>50</sub> value

Range of LC <sub>50</sub> value	Remark
LC <sub>50</sub> ≤ 30 ppm	Very toxic
30 ppm < LC <sub>50</sub> ≤ 1000 ppm	Toxic
LC <sub>50</sub> > 1000 ppm	No toxic

Crude methanol extracts at concentration range of 6 – 100 µg/mL revealed an antioxidant activity with the DPPH radical scavenging in range of 22.84 – 90.73% with the scavenging average value of 50,64%. The fraction of *n*-hexane have antioxidant activity with the DPPH radical scavenging in range of 4.74 - 28% with average value of radical scavenging of 14.25%. The fraction of ethyl acetate gave an antioxidant activity with the DPPH radical scavenging in range of 6.47 – 86.21% with the average value of 39,83%. Fraction methanol-H<sub>2</sub>O has an antioxidant activity with the DPPH radical scavenging percentage in range of of 20.91 – 90.30% with the average value of radical scavenging of 49.83%. Whereas, in vitamin C, DPPH radical scavenging revealed in value of 35,42 - 97,99% with the average value of scavenging of 61,97% .

The assay of antioxidant activity carried out with the DPPH radical scavenging methods. The DPPH free radical scavenging activities of crude methanolic extract and each fraction from *A. lanata* leaves extracts as well as vitamin C revealed the inhibitory concentration 50 (IC<sub>50</sub>) values, as shown in the following table 3.

Table 3. The value of IC<sub>50</sub> of *A. lanata* Leaves extracts measured by spectrophotometer at a maximum wavelength of 517 nm

Extracts and fraction of <i>A. lanata</i> Leaves	IC <sub>50</sub> (μg/mL)
Crude methanolic extracts	37,89
n-hexane fraction	172,12
Ethyl acetate fraction	51,71
Methanol-H <sub>2</sub> O fraction	39
Vit C	19,83

The concentration level of IC<sub>50</sub> indicated an antioxidant substance is needed to inhibit 50% free radical DPPH. Antioxidant substances that have high antioxidant activity will have the low IC<sub>50</sub> values. Specifically, the strength of antioxidant activity of a compound according to Mardawati [6] can be classified based on the values of IC<sub>50</sub> as presented on the table 4.

Table 4. Classification of antioxidant activity strength of a compound

Nr.	Range value of IC <sub>50</sub>	Remark
1.	IC <sub>50</sub> ≤ 50 μg/mL	Very strong
2.	50 μg/mL < IC <sub>50</sub> < 100 μg/mL	Strong
3.	100 μg/mL ≤ IC <sub>50</sub> ≤ 150 μg/mL	Medium
4.	151 μg/mL ≤ IC <sub>50</sub> ≤ 200 μg/mL	Weak

Based on the classification of the strength of the antioxidant activity can be known that crude methanolic extract, ethyl acetate and methanol-H<sub>2</sub>O fractions are classified as having a very strong antioxidant activity, whereas the n-hexane fraction belongs to the weak antioxidant activity. From the results it can be estimated that the secondary metabolite compounds such as flavonoids and phenolic extracts contained in crude methanolic extract and ethyl acetate- and methanol-H<sub>2</sub>O fraction have antioxidant activity. In addition, alkaloids compound contained in crude methanol extracts, the fraction of ethyl acetate and n-hexane fraction also have antioxidant activity.

#### 4. Conclusion

The crude methanolic extract is the most toxic compared to the other fractions of *A. lanata* leaves. The crude methanolic extracts, ethyl acetate-, and methanol-H<sub>2</sub>O fractions are classified as having a very strong antioxidant activity, whereas the n-hexane fraction belongs to the weak antioxidant activity. The methanol-H<sub>2</sub>O fraction is recommended to be developed its utilization as an antioxidant.

## 5. References

- [1] H. Purnobasuki. 2004. Potensi Mangrove Sebagai Tanaman Obat. *Biota, Jurnal Ilmiah Ilmu-ilmu Hayati*. IX (2): 125–126.
- [2] D. Darwis. 2000. Uji Kandungan Fitokimia Metabolit Sekunder: Metode Lapangan dan Laboratorium. Workshop Pengembangan Sumber Daya Manusia Dalam Bidang Kimia Organik Bahan Alam Hayati. h 9–14. DITJEN DIKTI DEPDIKNAS, Padang.
- [3] R. Andayani, Y. Lisawati, Maimunah. 2008. Penentuan aktivitas antioksidan, kadar fenolat total dan likopen pada buah tomat (*Solanum lycopersicum* L). *J. Sains dan Teknol. Farm*, Vol.13 No.1.
- [4] B.N. Meyer, J.E. Ferrigni, L.B. Putnam, D.E. Jacobsen, D.E. Nicholas, J.L. McLaughlin. 1982. Brine shrimp: a convenient general bioassay for active plant constituents. *J. Plant. Medic.* 45:4-31.
- [5] F. Aryani. 2009. Eksplorasi bioaktivitas dan pengembangan produk herbal rambai sungai (*Sonneratia caseolaris* L. Engl). Tesis Program Studi Magister Ilmu Kehutanan Universitas Mulawarman, Samarinda.
- [6] E. Mardawati, C.S. Achyar, H. Marta. 2008. Kajian Aktivitas Antioksidan Ekstrak Kulit Manggis (*Garcinia mangostana* L.) Dalam Rangka Pemanfaatan Limbah Kulit Manggis Di Kecamatan Puspahiang Kabupaten Tasikmalaya. Laporan Akhir Akhir Penelitian, Penelitian Peneliti Muda (Litmud), Fakultas Teknologi Industri Pertanian, Universitas Padjajaran, Bandung.

## **The impact of trade policy on international palm oil trade flows**

**Riska Pujiati<sup>1,3,\*</sup>, M Firdaus<sup>2</sup>, Andriyono K Adhi<sup>3</sup>**

<sup>1</sup> Department of Agricultural Economics and Rural Development, Göttingen University, Göttingen, 37075, Germany

<sup>1,2,3</sup> Master Science of Agribusiness, Bogor Agricultural University, Bogor, 16680, Indonesia

\* Corresponding author: r.pujiati@gmail.com

---

**Abstract** International agriculture trade is important for developing countries. Southeast Asia is a region that consists of middle income developing economies, with two countries contributing as the region major exporters, they are Indonesia and Malaysia. Palm oil counted as strategic sector in international vegetable oil market. The change of trade flow of palm oil in worldwide trade caused by the proliferation of regional trade agreement (RTA) in the Southeast Asia region. The objective of this study is to examine the impact of the establishment of RTA on the Indonesia and Malaysia's palm oil trade flows. The effect analyzed quantitatively by gravity model on trade. The result show the different impact for both countries.

**Keywords** Palm oil, International Trade Policy, Gravity Model.

---

### **1. Introduction**

Agriculture plays an important role for developing countries as a primary source of income [1]. Southeast Asia is a region that consists of middle income developing economies, with two countries contributing as the region's major exporters, Indonesia and Malaysia. The major commodity which contributes to the high value of export is vegetable oil initially originated from palm oil which is exported as two main form: crude and refined. Furthermore, there are more than 100 countries listed as the destination of Indonesian and Malaysian palm oil. Latest development of international trade for Indonesia and Malaysia is the establishment of regional free trade agreement. As two of the largest producers, joining the AFTA become an opportunity for Indonesia and Malaysia to promote trade because of the reduction in trade barriers. Although Indonesia and Malaysia produce similar products, involvement in the RTA will give different results in the flow of goods. Based on the description above, the objective of this research is to analyze the impact of the establishment of regional trade agreements on Indonesia and Malaysia's palm oil trade flows.



## 2. Materials and Methods

### 2.1. Data types and sources

This study uses secondary data available from various sources. The bilateral trade of palm oil annual data from the period between 1991 and 2011 has been generated from the United Nations Commodity Trade Statistic Database (UN COMTRADE) and further incorporated with the World Integrated Trade Solution (WITS) software. The data consists of a nominal value of bilateral trade from Indonesia and Malaysia to 77 partner countries that have conducted trade more than ten times within the 21 year period.

The total palm oil and its fraction which has Harmonized System (HS) code: 1511, divided into crude palm oil (HS code: 151110) and refined palm oil but not chemically modified (HS code: 151190). The geographical distance between countries was obtained from the *Centre d'Etudes Prospectives et d'Informations Internationales* (CEPII), the importer's GDP and the exchange rate of Purchasing Power Parity (PPP) data came from the World Bank, along with FTA information from the Asia Regional Integration Centre (ARIC). The value of palm oil production is generated from the FAO.

### 2.2. The gravity estimation analysis (PPML estimation)

The gravity model estimation is utilized to analyze whether the regional trade agreement influences trade flow or not. This study uses Poisson Pseudo Maximum Likelihood (PPML) in order to handle zero trade data and heteroskedasticity. PPML method is commonly used for the count data model [2]. The result from the PPML estimation will provide better results by including the zero value rather than truncating OLS [3]. The PPML is consistent and performs well in the presence of over dispersion (the conditional variance is not equal to the conditional mean) and excess zero values [4].

The application of PPML is superior to the OLS result in order to estimate the effect of FTAs with disaggregated data for agriculture commodities [4]. The empirical model is specified as:

$$Y_{ijt} = \exp\{\beta_0 + \ln \text{Prod}_{it} + \beta_2 \ln \text{GDP}_{jt} + \beta_3 \ln D_{ij} + \beta_4 \text{FTAs\_early}_{ijt} + \beta_5 \text{FTAs\_after\_2000}_{ijt} + \beta_7 \text{FTAs\_early\_IDN}_{ijt} + \beta_8 \text{FTAs\_after\_2000\_IDN}_{ijt} + \beta_9 \ln \text{ppp\_cnvrt}_{jt} + \pi_{ij} + \delta_i + \varphi_j + \gamma_t + \varepsilon_{ijt}\}$$

Where  $Y_{ijt}$  denotes the palm oil export value from country  $i$  to  $j$  at time  $t$  (US\$),  $\text{Prod}_{it}$  is annual palm oil production value of  $i$  at year  $t$  (US\$);

$GDP_{jt}$  represents annual GDP of importer country (j) at year t (US\$),  $D_{ij}$  denotes bilateral distance between countries (km),  $FTA\_early_{ijt}$  = Dummy variable for FTAs before year 2000, 1 if exporters and importers have signed agreement at time t, otherwise 0,  $FTA\_after\_2000_{ijt}$  = Dummy variable for FTAs after year 2000, 1 if exporters and importers have signed agreement at time t, otherwise 0,  $FTA\_early\_IDN_{ijt}$  = Dummy variable for FTAs before year 2000, 1 if Indonesia as an exporter and have signed agreement with importer country (j) at time t, otherwise 0,  $FTA\_after\_2000\_IDN_{ijt}$  = Dummy variable for FTAs after year 2000, 1 if Indonesia as an exporter and have signed an agreement with importer country (j) at time t, otherwise 0,  $\delta_i$  stands for the fixed effect of country i (exporter fixed effect),  $\varphi_j$  represent the fixed effect of country j (importer fixed effect),  $\pi_{ij}$  denotes the country pair fixed effect, and  $\gamma_t$  refers to the time effect.

### **3. Results and Discussion**

The result of the PPML estimation for different palm oil export type can be seen in Table 2. A positive sign was also determined for refined palm oil (HS 151190), with the average export value increasing by about 0.58 percent when the production value increases by one percent, *cp*. The increasing of palm oil export is supported by the increase in the plantation area of palm oil trees. In contrast, the coefficient for the palm oil production variable has a negative sign and is significant for crude palm oil (HS151110), this means that when the production value increases by one percent, the average crude palm oil export will fall by 0.64 percent *cp*. The reason behind the declining of crude palm oil export is that the majority of palm oil are exported had passed the refining process. The GDP coefficient has a positive influence on the palm oil export, the GDP variable was not influential on the palm oil export and is statistically insignificant for all types of palm oil export. The distance coefficient has positive signs for crude and refined palm oil and is statistically significant at one percent level for refined palm oil. This contrary result indicates that for high value product (refined palm oil), the distance does not influenced trade. Furthermore, the trade flow experiences different changes for Indonesia and Malaysia due to the establishment of trade agreements. The average export of Indonesian palm oil increased by 64.71 percent after the establishment of the FTA from 2001 to 2011. For crude palm oil, the average export decreased by 3.73 percent while for refined palm oil, the average changes of export was 99.57 percent higher than export without FTA, *c.p*.

Table 1. PPML Estimation Result for HS1511, HS151110, and HS151190

VARIABLES	(1)	(2)	(3)
	HS1511 (total palm oil and its fraction)	HS151110 (crude palm oil)	HS151190 (refined palm oil)
ln_Prod_val	0.391* (0.206)	-0.638*(0.381)	0.578*** (0.163)
ln_GDP	0.00272 (0.0109)	1.150(0.787)	0.00170(0.0235)
ln_PPP_cnvrt	0.588*** (0.109)	-0.588(0.810)	0.713*** (0.233)
ln_dist	-13.08*** (1.700)	0.758(0.518)	10.44*** (0.905)
fta_early	-1.616*** (0.234)	-1.991*** (0.706)	-1.493*** (0.314)
fta_after_2000	-0.225** (0.0891)	0.481* (0.279)	-0.143 (0.169)
fta_early_IDN	2.312*** (0.299)	1.993*** (0.490)	3.796*** (0.363)
fta_after_2000_IDN	0.724*** (0.135)	-0.519*** (0.187)	0.691** (0.349)
Constant	101.7*** (12.53)	-6.267 (24.63)	-81.23*** (8.576)
Observations	3,234	3,234	3,234
R-squared	0.921	0.966	0.884

Note : standard errors (SE) in parentheses, \* p<0.1, \*\* p<0.05, \*\*\* p<0.01

Source : Author's estimation

The use of crude palm oil for domestic consumption may become the reason why the change in export of crude palm oil is different than the change in refined palm oil. In fact, Indonesia also counted as the largest consumer of cooking oil which originated from palm oil. The increase in Indonesia's refined palm oil export after the establishment of AFTA could be influenced by the higher demand of palm oil in the international market. The rapid economic growth of countries in the southeast Asia region have become the primary factor for the increased consumption of palm oil, thus, Indonesia's palm oil exports have shifted their destinations to other FTA member countries. In contrast, the FTA after year 2000 negatively impacted the total value of Malaysia's palm oil export. The establishment of FTA after year 2000 caused the average export value decrease by 20.15 percent. The opposite effect applied to HS 151110 (crude palm oil), where the average export of crude palm oil increased by 61.77 percent compared to export without FTA, c.p. The reason for the higher export volumes of crude palm oil is due to the establishment of bilateral trade agreements with China, India and Myanmar.

Table 2. The change of palm oil export due to FTA establishment (%)

Palm oil HS	Indonesia (%)		Malaysia (%)	
	Before 2000 <sup>1</sup>	After 2000 <sup>2</sup>	Before 2000 <sup>3</sup>	Before 2000 <sup>4</sup>
HS1511	100.57	64.71	-80.13	-20.15
HS151110 (crude)	0.20	-3.73	-86.34	61.77
HS151190 (refined)	900.41	99.57	-77.53	-13.32

<sup>1</sup> The effect of FTA before 2000 for Indonesia is the summation of fta\_early coefficient and fta\_early\_IDN coefficient, then calculated by  $\{[\exp^{(\beta)}-1] \times 100\}$ ,

<sup>2</sup> The effect of FTA after 2000 for Indonesia is summation of fta\_after\_2000 coefficient and fta\_after\_2000\_IDN coefficient, then calculated by  $\{[\exp^{(\beta)}-1] \times 100\}$ ,

<sup>3</sup> The effect of FTA before 2000 for Malaysia is similar with fta\_early coefficient, then calculated by  $\{[\exp^{(\beta)}-1] \times 100\}$ ,

<sup>4</sup> The effect of FTA after for Malaysia with fta\_after\_2000 coefficient, then calculated by  $\{[\exp^{(\beta)}-1] \times 100\}$ ,

In fact, the market share of Malaysian palm oil in China's market has reached 61 percent, while the Indonesian share in China's market only reaches 39 percent. Moreover, the Malaysian company has built a refinery in China by doing a joint venture mechanism with a China's company in the beginning 1995. Taking this into consideration, along with the FTA establishment, Malaysia has additional opportunities to process refined palm oil into downstream products such as oleochemicals [5]. This is one of the examples of the dynamic effect that has occurred due to the establishment of RTAs, the investment creation effect. For refined palm oil, the FTA after year 2000 has a negative sign, this means that the average export of Malaysia's refined palm oil decreased by 13.32 percent after the FTA was established, *c.p.* This result is correlated with the increased export of crude palm oil, as mentioned previously. Furthermore, the Malaysian export oriented policy has pushed the development of refineries in Malaysia itself, the refined palm oil is then exported to fulfill the demand for countries outside of the Asian region. Since the year 1990, Malaysian palm oil has acquired the oleochemical industries in several developed countries such as the Netherlands, Germany, Switzerland and the United States.

#### **4. Conclusion and Policy Recommendation**

In summary, the flow of exports is not only influenced by the trade agreement itself, but also by the government policies that are put into effect. The Malaysian government's focus on the production of high value palm oil is the critical difference between the policies established in Malaysia and Indonesia. The Malaysian government has also further utilized free trade agreements by investing in the downstream opportunities of the palm oil industry in other FTA membership countries, especially with China. This is one of the most sufficient pieces of evidence for the positive dynamic effect of FTAs.

For further research, it is recommended that the researcher should focus not only on palm oil commodities, but also in the derivatives of palm oil products. Also, the potential use of other techniques on gravity estimation,

such as the Heckman Estimation Model, can likely give a more satisfying result.

## **5. References**

- [1] M.A. Aksoy, J.C. Beghin. 2004. Global agricultural trade and developing countries. Washington, DC: The World Bank.
- [2] C. Gourieroux, A. Monfort, A. Trognon. 1984. Pseudo maximum likelihood methods: application to poisson models. *J. Econometrica*. 53(3), 701–720.
- [3] J.S. Silva, S. Tenreiro. 2006. The log of gravity. *Review of economics and statistics*. *J. Econ. Lett.* 88(4): 641–658.
- [4] J.S. Silva, S. Tenreiro. 2011. Further simulation evidence on the performance of the Poisson pseudo-maximum likelihood estimator. *J. Econ. Lett.* 112(2): 220–222.
- [5] A.M. Nor. 2012. Internationalisation of malaysian palm oil-based multinationals. *Oil Palm Indus. Econ. J.* 12(1): 8–13.

## LIST OF PARTICIPANTS

No.	Name	Institution
1	Uwe Muuss	University of Goettingen, Germany
2	Ronald F. Kuehne	University of Goettingen, Germany
3	Rahmi Dianita	University of Jambi
4	Bambang Irawan	University of Jambi
5	Enih Rosamah	University of Mulawarman
6	Condro Wibowo	Jenderal Soedirman University
7	Wahyu Supartono	Gajah Mada University
8	Yudi Firmanul Arifin	Lambung Mangkurat University
9	Tutik Koeswinanti	Hasanuddin University
10	Bahar Baharuddin	Hasanuddin University
11	Faridatul Mukminah	University of Tridianti Palembang
12	Siti Darodjah	Padjadjaran University Bandung
13	Agung Karuniawan	Padjadjaran University Bandung
14	La Karimuna	University of Halu Oleo
15	Retno Iswarin P.	Diponegoro University
16	Iqbar	Syiah Kuala University
17	T. Samadi	Syiah Kuala University
18	Muh. Ikhsan Sulaiman	Syiah Kuala University
19	Asabul Anhar	Syiah Kuala University
20	Pindi Patana	University of North Sumatera
21	Arinafril	Sriwijaya University
22	Meta Mahendradatta	Sriwijaya University
23	Aiyen B. Tjoa	Tadulako University
24	Vincentius Repu	Widya Mandira Catholic University
25	Fred Dethan	University of Nusa Cendana
26	Bambang Susilo	Universiti of Brawijaya
27	Luki Abdullah	Bogor Agricultural University
28	Gunawan Djajakirana	Bogor Agricultural University
29	Iskandar Z. Siregar	Bogor Agricultural University
30	Dodik Ridho Nurrochmat	Bogor Agricultural University
31	Anuraga Jayanegara	Bogor Agricultural University
32	Dordia	Bogor Agricultural University
33	Swastika Priyambodo	Bogor Agricultural University
34	Wakhid Nurdin	Bogor Agricultural University
35	Didik B. Purwanto	Bogor Agricultural University
36	Suharno	Bogor Agricultural University

No.	Name	Institution
37	Jaenal Effendi	Bogor Agricultural University
38	Mahrus Aryadi	Bogor Agricultural University
39	Herman Prayudi	Bogor Agricultural University
40	Abdul Munif	Bogor Agricultural University
41	Suryo Wiyono	Bogor Agricultural University
42	Heri Ahmad Sukria	Bogor Agricultural University
43	Yeti Lis Purnamadewi	Bogor Agricultural University
44	Widyanti Octoriani	Bogor Agricultural University
45	Despal	Bogor Agricultural University
46	Arief Sabdo	Bogor Agricultural University
47	Bambang Pontjo	Bogor Agricultural University
48	Agus Setiadi	Bogor Agricultural University
49	Azbas Taurusman	Bogor Agricultural University
50	Bonny Soekarno	Bogor Agricultural University
51	Leti Sundawati	Bogor Agricultural University
52	Andy Ahmad Zaelany	Bogor Agricultural University
53	Lukman M. Baga	Bogor Agricultural University
54	Itjhe Wientarsih	Bogor Agricultural University
55	Hizir Sofyan	Bogor Agricultural University
56	Meti Restiekayani	Bogor Agricultural University
57	Lailan Saufina	Bogor Agricultural University
58	Memem Surahman	Bogor Agricultural University
59	Herdhata Agusta	Bogor Agricultural University
60	Lina Karlina	Bogor Agricultural University
61	Syarifah Iis Aisyah	Bogor Agricultural University
62	Iskandar	Bogor Agricultural University
63	Yayat	Bogor Agricultural University
64	Slamet Rosyadi	Bogor Agricultural University
65	Husnileili Yusran	Bogor Agricultural University
66	Raafqi Ranasasmita	Bogor Agricultural University
67	Agus Setiadi	Bogor Agricultural University
68	Ujang Suwarna	Bogor Agricultural University
69	Angga	Bogor Agricultural University
70	Evi Arida	Bogor Agricultural University
71	Ventri F.	Bogor Agricultural University
72	Puspi Eko Wiranthi	Bogor Agricultural University
73	Siti Maryam Latief	Bogor Agricultural University
74	Nandi	Bogor Agricultural University
75	Ida	Bogor Agricultural University

No.	Name	Institution
76	Zulfahmi	Bogor Agricultural University
77	M. Baihaqi	Bogor Agricultural University
78	Israr Albar	Bogor Agricultural University
79	Markus Bunga	Nusa Cendana University
80	Sri Adiani	Sam Ratulangi University
81	Marhawati Mappatoba	Tadulako University
82	Adam Malik	Tadulako University
83	Jane	Sam Ratulangi University



## **COMMITTEE**

---

### **Steering Committee**

- Prof. Dr. Anas M. Fauzi (Vice Rector for Research and Collaboration IPB)
- Prof. Dr. Iskandar Z. Siregar (Director for Research and Innovation IPB)
- Dr. Nandi Kosmaryandi
- Dr. Dodik R. Nurrochmat
- Dr. Leti Sundawati

### **Organizing Committee**

- Head : Dr. Ir. Syarifah Iis Aisyah
- Scientific Conference : Dr. Anuraga Jayanegara  
Nita Nurhayani, S.Si
- Secretary : Lia Septiani  
Nur Fajri Rahmawati, SP
- Treasurer : Firmansyah, A.Md  
Ramdani
- Excursion : Dewi Kuraesin, S.Pt  
Ahmad Nakib, S.Pd
- Accomodation : Dewi Kuraesin, S.Pt  
Abdul Ghofur
- Promotion : Ahmad Bagwi Rifa'i  
Rusnadi
- Registration : Nadia Nur Soraya, S.KPm
- Logistics : Wahyudin  
M.Soleh



**DAAD**  
Deutscher Akademischer Austauschdienst  
German Academic Exchange Service



---

**International Workshop**

**IPB International Convention Center**

**ISBN : 978-602-98410-1-5**