ICOAAS
International Conference on Agriculture and Applied Science

E-ISSN : 2776-043X

PROCEEDING

INTERNATIONAL CONFERENCE ON AGRICULTURE AND APPLIED SCIENCE

Innovation and Application of Sustainable Agricultural Technology as a Solution for Food Security

Organized By :

Unit Research and Community Service. Politeknik Negeri Lampung

RI National Library: Catalog in publication (KDT)
E-ISSN : 2776-043X

PROCEEDINGS of the 2nd Polinela International Conference on Agriculture and Applied Sience (ICoAAS)

Theme: "**Innovation and Application of Sustainable Agricultural Technology as a Solution for Food Security**"

2021, II, 118 pp. 21,0 x 29,7cm

Editor in chief:
Dr. Dwi Desmiyeni Putri, M.Si.

Editor Technic:
Agung Adi Candra, S.Kh, M.Si.
Analianasari, S.T.P., M.T.A.
Edy Humaidi, S.P., M.Si.

Publisher
UP Politeknik Negeri Lampung
Bandar Lampung
2021

PROCEEDINGS of the 2nd Polinela International Conference on Agriculture and Applied Science (ICoAAS)

Theme: "Contribute of Applied Science and Agriculture for Social Prosperity"

Committee :

Head of Research/Community Service	: Dr. Ir. Yana Sukaryana, M.P
Chairman of Organizing Committee	: Fadila Marga Saty, S.Si., M.Si.
Editor in Chief	: Dr. Dwi Desmiyeni Putri, M.Si.
Editor Technic	: 1. Agung Adi Candra, S.K.h, M.Si. 2. Analianasari, S.T.P., M.T.A. 3. Edy Humaidi, S.P., M.Si
IT Committee Coordinator	: Dr. Septafiansyah Dwi Putra, S.T., M.T.
IT Committee Support	: 1. Oki Arifin, S.Kom., M.Cs. 2. Epro Barades, S.Pi., M.Si
Event Conference Coordinator	: 1. Desi Maulidia, S.P., M.Si. 2. Dayang Berliana, S.P., M.Si.
Publish and Financial Program	: 1. Teguh Budi Trisnanto, M.Si 2. Marlinda Apriyani, S.P., M.P.
Indeksasi, Publication and Book Program	: Yan Sukmawan, S.P., M.Si.
IT Operator Coordinator	: Septa Manhalul, A.Md.
Supporting Staff	: 1. Suharja., S.T. 2. Husna

Scientific Committee

Prof Chao-Tung Yang (Tunghai University, Taiwan)

Assoc. Prof. Dr. Mohammed N. Abdulrazaq Alskekhly (Management & Science University (MSU), Malaysia)

Prof. Dr. Ir Ainin Niswati., M.Sc. (Universitas Lampung, Indonesia)

Prof. Dr. Ir. Udin Hasanudin., M.Si. (Universitas Lampung, Indonesia)

Prof. Dr. Ir. Yusnita, M.Si. (Universitas Lampung, Indonesia)

Prof. Dr. Ir. Murhadi, M.Si (Universitas Lampung, Indonesia)

Dr. Anuraga Jayanegara, S.Pt., M.Sc. (Institut Pertanian Bogor, Indonesia)

Prof. Dr. Yuliansah., S.E., M.Acc. (Universitas Lampung, Indonesia)

Dr. Diding Suhandy, S.T.P., M.Agr. (Universitas Lampung, Indonesia)

Meinilwita Yulia, S.T.P., M.Agr. (Politeknik Negeri Lampung, Indonesia)

Dr. Ir. Arwin Datu Maya Wahyudi Sumari, S.T.. M.T., Ipm, asean.eng (Universitas Penahanan, Indonesia)

Dr. Dulbari, S.P., M.Si. (Politeknik Negeri Lampung, Indonesia)

Dr. Anung Wahyudi, S.P., M.Sc.(Politeknik Negeri Lampung, Indonesia)

Dr.T. Imam Sofi'i, S.T.P., M.Si. (Politeknik Negeri Lampung, Indonesia)

Dr. Ir. Nurbani Kalsum, M.Si. (Politeknik Negeri Lampung, Indonesia)

Dr. Ir. Sarono, M.Si. (Politeknik Negeri Lampung, Indonesia)

Dr. Oktaf Rina, S.Si., M.Si. (Politeknik Negeri Lampung, Indonesia)

Dr. Nurhayati, S.Pt., M.P. (Politeknik Negeri Lampung, Indonesia)

Dr. Dwi Desmiyeni Putri, M.Si. (Politeknik Negeri Lampung, Indonesia)

Dr. Ir. Suraya Kaffi Syahfura, M.T.A. (Politeknik Negeri Lampung, Indonesia)

Dr. Rakhmawati, S.Pi., M.Si. (Politeknik Negeri Lampung, Indonesia)

Dr. Ir. Yana Sukaryana, M.P. (Politeknik Negeri Lampung, Indonesia)

Dr. Irmayani Noer, S.P., M.Si. (Politeknik Negeri Lampung, Indonesia)

Dr. Septafiansyah Dwi Putra, S.T., M.T. (Politeknik Negeri Lampung, Indonesia)

Dr. Chandra Utami Wirawati, S.T.P., M.Si (Politeknik Negeri Lampung, Indonesia)

Dr. drh. Dwi Desmiyeni Putri, M.Si (Politeknik Negeri Lampung, Indonesia)

Dr. Fitriani, S.P., M.E.P. (Politeknik Negeri Lampung, Indonesia)

Dr. Henry Kurniawan, S.Si., M.Stat. (Politeknik Negeri Lampung, Indonesia)

Dr. Ir. Ni. Siluh Putu Nuryanti, M.P (Politeknik Negeri Lampung, Indonesia)

Dr. Ninik Purbosari, S.Pi. M.Si (Politeknik Negeri Lampung, Indonesia)

Dr. Nuning Mahmudah Noor, S.Pi. M.Si (Politeknik Negeri Lampung, Indonesia)
Dwi Eva Nirmagustina, S.P., M.Si., Ph.D (Politeknik Negeri Lampung, Indonesia)

FOREWORD

The International Conference is intended to provide technical forum and research discussion on Agriculture and Biotechnology, Agriculture Engineering, IT for Agriculture, Renewable and Novel Energy Sources. he conference will cover a series of presentations and discussions in plenary, and concurrent. It is aimed to bring researchers, academicians, scientists, students, and practitioners together to participate and present the latest research findings, developments, and applications related to various aspects.

International Conference On Agriculture and Applied Science (ICoAAS). the theme of "Innovation and Application of Sustainable Agricultural Technology as a Solution for Food Security". Was the second activity carried out by the Politeknik Negeri Lampung Unit Penelitian dan Pengabdian Kepada Masyarakat (UPPM). This conference is a gathring place from lecturers to discuss and exchange ideas in the application of research results that can be disseminated and disseminated to the public.

We hope that through this international conference Politeknik negeri Lampung can contribute to the development of science and disseminate research results to the public.

Bandar Lampung, Maret 2021

Dr. Ir. Yana Sukaryana, M.P.

TABLE OF CONTENTS

Attendance Presenter ICoAAS 2021 Report

Form : Attendance Presenter ICoAAS 2021

No	Nama	Email	Role
1	Adi Waskito,M.T	otiksawida@gmail.com	Presenter
2	Adryade Reshi Gusta	adryade@polinela.ac.id	Presenter
3	Agiska Ria Supriyatna, S.Si, M.T.I	agiskaria@polinela.ac.id	Presenter
4	Agung adi candra	adicandra@polinela.ac.id	Presenter
5	Agus Ambarwari	ambarwariagus@polinela.ac.id	Presenter
6	Agus Mulyana	mulyanaagus@apps.ipb.ac.id	Presenter
7	Akbar	akbar.mpd132@gmail.com	Presenter
8	Almara Kurniawan	almarakur@gmail.com	Presenter
9	Andy Eka Saputra, S.T., M.T.	andy.eka21@students.unila.ac.id	Presenter
10	Angela Putri Tresna Ningrum	angelaputritresna10@gmail.com	Presenter
11	Anggi Martiningtyas Januwati Saputri, S.Pd., M.Sc	anggi.saputri.ft@um.ac.id	Presenter
12	Aniessa Rinny Asnaning	aniessa.rinny@polinela.ac.id	Presenter
13	Anis Novike	anisnovike003@gmail.com	Presenter
14	Anisa Pratiwi	anisatiwi1999@gmail.com	Presenter
15	Annisya Rainy Putri S.T., B.Eng	Annisyarainy@gmail.com	Presenter
16	Anung Wahyudi, Ph.D	anung@polinela.ac.id	Presenter
17	Aprilia Syah Putri	apriliasyahputri@polinela.ac.id	Presenter
18	Ari Wahyuni, S.P., M.Si.	ariwahyuni.seed11@gmail.com	Presenter
19	Catherine Olivia Sereati	catherine.olivia@atmajaya.ac.id	Presenter
20	Chicha Zartika	zartika2906@gmail.com	Presenter
21	Clara Yolandika, S.P., M.Si.	clarayolandika@lecturer.unri.ac.id	Presenter
22	Desi Maulida	desi@polinela.ac.id	Presenter
23	Destry Faradila Nur'avisa	95destryfaradilan@gmail.com	Presenter
24	Devy Cendekia	devycendekia@polinela.ac.id	Presenter
25	Dewi Ermaya	dewi.ermaya@gmail.com	Presenter
26	Dewi Indriyana Wati, A.md.T	dewiindri1217@gmail.com	Presenter
27	Dewi Riniarti	d_riniarti@yahoo.co.id	Presenter
28	Didik Purwadi	didik@ugm.ac.id	Presenter
29	Dimas Prakoswo Widiyani, S.P., M.P.	dimaspw2@polinela.ac.id	Presenter
30	Dr. Ir. Suraya Kaffi Syahpura M.T.A.	ivisoraya@polinela.ac.id	Presenter
31	Dr. Oktaf Rina, S.Si., M.Si	oktafrina@polinela.ac.id	Presenter
32	Dr. Retno Lantarsih, S.P., M.P.	retno@janabadra.ac.id	Presenter
33	Dr.Ir. Yana Sukaryana, M. P.	yana1962@gmail.com	Presenter
34	Dulbari	dulbari@polinela.ac.id	Presenter
35	Edy Humaidi, S.P., M.Si	edyhumaidi145@polinela.ac.id	Presenter
36	Eka Irawati	ekairawati98@gmail.com	Presenter
37	Ernawita Ernawita	ernawita.ernawita@gmail.com	Presenter
38	Ervika Rahayu Novita Herawati, M. Sc.	ervika.lipi@gmail.com	Presenter
39	Esti Puji Rahayu	estipujirahayu38@gmail.com	Presenter
40	Eulis Marlina,S Pi.M.Si	eulismarlina@polinela.ac.id	Presenter
41	Evi Yuniarti, S.E., M.Si	eviyuniarti@polinela.ac.id	Presenter
42	Evi Yunita Sari, S.Pd., M.Si.	eviyunita@polinela.ac.id	Presenter
43	Fadila Marga Saty	fadila@polinela.ac.id	Presenter
44	Fitriani	fitriani@polinela.ac.id	Presenter
45	Gigih Pranandi	gigihpranandi11@gmail.com	Presenter
46	Halus Satriawan	satriawan.halus@gmail.com	Presenter
47	Hidayat Saputra	hidayat@polinela.ac.id	Presenter
48	Intan kamilia habsari, S.Pt., M.Pt.	Intankhabsari@gmail.com	Presenter
49	Ir. Dian Histifarina, M.Si	dhisti03@yahoo.com	Presenter
50	Ir. Lisa Erfa, M.Si.	lisaerfa@polinela.ac.id	Presenter
51	Ira Novita Sari, M.Sc.	iranovitasari@polinela.ac.id	Presenter
52	Irmayani Noer	Irmayani_noer@polinela.ac.id	Presenter
53	Irvan Setiadi Kartawiria	irvan.kartawiria@sgu.ac.id	Presenter
54	Istiqomah, SE., M.Sc., Ph.D	istiqomah@unsoed.ac.id	Presenter
55	Juli Nursandi	julinursandi@gmail.com	Presenter

56	Kamarani	satriawan_80@yahoo.co.id	Presenter
57	Kamsia Dorliana Sitanggang	Kamsiasitanggang@gmail.com	Presenter
58	Kelik Istanto	kelik@polinela.ac.id	Presenter
59	Kresna Shifa Usodri, S.P., M.Si.	kresna@polinela.ac.id	Presenter
60	Kukuh Setiawan	kukuhsetiawan38@gmail.com	Presenter
61	Kurnia Rimadhanti Ningtyas	ningtyas@polinela.ac.id	Presenter
62	Le Van Dang MSc	lvdang@ctu.edu.vn	Presenter
63	Lidia Virgianti, SP.MT	aralidiavirgianti@yahoo.com	Presenter
64	Lina Budiarti	linabudiarti@polinela.ac.id	Presenter
65	Lina Budiarti, S.P., M.Si	linabudiarti@polinela.ac.id	Presenter
66	M. Khalifatul Ardhi	khalifatulardhi@mail.ugm.ac.id	Presenter
67	Made Same	madesame@polinela.ac.id	Presenter
68	Maria Viva Rini	maria.vivarini@fp.unila.ac.id	Presenter
69	Maryanti	maryanti@polinela.ac.id	Presenter
70	Meyliana Astriyantika, S.Hut., M.Si	meylianaastri@gmail.com	Presenter
71	Muhammad Hatta	moehammadhatta1881@gmail.com	Presenter
72	Nani Irwani	naniirwani@polinela.ac.id	Presenter
73	Neko Riffandi	nekoriffandi@polinela.ac.id	Presenter
74	Nelsy Dian Permatasari	nelsypolteq@gmail.com	Presenter
75	Nindyo Cahyo Kresnanto	nindyo_ck@janabadra.ac.id	Presenter
76	Nuni Anggraini	nuni.anggraini@polinela.ac.id	Presenter
77	Nur Indariyanti,S.Pi.,M.Si	nurindariyanti@polinela.ac.id	Presenter
78	Onny Chrisna Pandu Pradana	onnypradana@polinela.ac.id	Presenter
79	Ovy Erfandari, S. P, M. Si.	ovyerfandari@polinela.ac.id	Presenter
80	Prof. Dr. Ir. Setyo Dwi Utomo, M.Sc.	setyo.dwiutomo@fp.unila.ac.id	Presenter
81	Rahmadi Aziz	rahmadiaziz@polinela.ac.id	Presenter
82	Rakhmawati	rakhmawati@polinela.ac.id	Presenter
83	Refdi Akmal, M.Pd	refdi@polinela.ac.id	Presenter
84	Reny Mita Sari, S.P., M.Si.	renymita@polinela.ac.id	Presenter
85	Restu Paresta	restuparesta06@gmail.com	Presenter
86	Rianida Taisa, S.P., M.Si.	rianidataisa@polinela.ac.id	Presenter
87	Rima Maulini, S. Kom., M. Kom	rima_maulini@polinela.ac.id	Presenter
88	Rizka Novi Sesanti, S.P., M.P.	rizka@polinela.ac.id	Presenter
89	Rusdi Evizal	rusdi.evizal@fp.unila.ac.id	Presenter
90	Shintawati	shintawati@polinela.ac.id	Presenter
91	Siti Hartati Yusida Saragih, SP.,M.Si	yusida90.shys@gmail.com	Presenter
92	Siti Novridha Andini, S.P., M.P.	sitinovridaandini@polinela.ac.id	Presenter
93	Soenar Soeko Pitojo	soenar.soekopitojo.ft@um.ac.id	Presenter
94	Sri Astuti, SE.,MM	astuti@polinela.ac.id	Presenter
95	Sri Rahayu	srirahayu@unmer-madiun.ac.id	Presenter
96	Sudiyo, S.S.I, M.A.	sudiyo@polinela.ac.id	Presenter
97	Sutarman	sutarman@umsida.ac.id	Presenter
98	Sutarni, S.P., M.E.P.	sutarniagripol@gmail.com	Presenter
99	Syukron Abdillah	syukronabdillah18@gmail.com	Presenter
100	Tri Sandhika Jaya	sandi@polinela.ac.id	Presenter
101	Triana Setyawardani	triana.setyawardani@unsoed.ac.id	Presenter
102	Trias Sitaresmi, SP. M.Si	triassitaresmi@gmail.com	Presenter
103	Veronica Sri Lestari	veronicasrilestari@yahoo.com	Presenter
104	Vida Elsyana, S.Pd., M.Si.	vida@polinela.ac.id	Presenter
105	WAHYUDI	wahyudingawi25@gmail.com	Presenter
106	Wardika	wardika@polindra.ac.id	Presenter
107	Widia Rini Hartari, S.T.P., M.Si.	widiarini@polinela.ac.id	Presenter
108	Widya Lestari, S. Si., M. Si	widyalestari1688@gmail.com	Presenter
109	Wiwiek Rabiatul Adawiyah	wiwiek.adawiyah@unsoed.ac.id	Presenter
110	Yan Sukmawan	ysukmawan@polinela.ac.id	Presenter
111	Yoga Sabela Parmadi	yogisabela12@gmail.com	Presenter
112	Yusep Windhu Ari Wibowo	yusep.windu@polinela.ac.id	Presenter
113	Zainal Mutaqin	hidayat88saputra@gmail.com	Presenter
114	Zairiful	adicandra@polinela.ac.id	Presenter

115	Zukryandry, S.T., M.Si.	zukryandry@polinela.ac.id	Presenter
116	Zulkifli	kiflianwar69@gmail.com	Presenter

Attendance Participants ICoAAS 2021 Report

Form : Attendance Participants Openeing ICoAAS 2021

No	Nama	Email	Role
1	Achmad rifaldi	Achmadmobile42@gmail.com	Participants
2	Achmad Zulfikar	ahmadfikar3@gmail.com	Participants
3	Adam Riski Pratama	adrizpratama70@gmail.com	Participants
4	Adam Suhandi	adamsuhandi996@gmail.com	Participants
5	Adani Dholifun Nafsi Subadra	adani.eka45@gmail.com	Participants
6	Addinul ihsan bakhtiar	Adinul.ihsan.b@gmail.com	Participants
7	Ade gilang kertagana	gilangkertagana2111@gmail.com	Participants
8	Ade irma	Irmaadee26@gmail.com	Participants
10	Adelia Septiana	adeliasptn292@gmail.com	Participants
11	Adhitya wijaya	adhityawijaya30@gmail.com	Participants
12	Adi Candra Saputra	adichandra437@gmail.com	Participants
13	Adi Susanto	adi.susanto220401@gmail.com	Participants
14	Adi wibowo	Adiw18811@gmail.com	Participants
15	Adinda amartalia	Adindaamartalia@gmail.com	Participants
16	Adinda Salshabella	Salshabellaadinda@gmail.com	Participants
18	Aditya Budi Setiawan	Skate.adit@gmail.com	Participants
19	Adni Oktaviana	adni_zein@polinela.ac.id	Participants
21	Afeby Ade Habibansyah	Afebykk77@gmail.com	Participants
22	Agestina Tri Lestari	agestinatrilestari08@gmail.com	Participants
23	Agil Wicaksono	agilwicak035@gmail.com	Participants
24	Agis Widyanti	agiswidyanti12@gmail.com	Participants
26	Angga azan fajar	Anggafajar987@gmail.com	Participants
28	Ahmad Fadel Muzaki	ahmadfadelmuzaki@gmail.com	Participants
29	Ahmad Fahrori Al Hasani	ahmadfahrorialhasani@gmail.com	Participants
30	Ahmad Maulana	ahmatmaul4@gmail.com	Participants
31	Aidhan Syahara Mukti	aidhanmukti@gmail.com	Participants
32	Alan tri buono	alantribuono011298@gmail.com	Participants
33	Albi Yusnidar	albiyusnidar05oktober2001@gmail.com	Participants
34	Aldi Huda Verdian, S.Pi., M.Si.	aldihudaverdian@polinela.ac.id	Participants
35	Alfiana Afiah	Alfiananutz@gmail.com	Participants
36	Alfiel Apriansyah	putraaditiya0503@gmail.com	Participants
37	Alfina Handayani	alfinahandayani90@gmail.com	Participants
39	Alief Maulana	maulanaalief18@gmail.com	Participants
40	Aliya Citra Damayanti	aliyaacitra14@gmail.com	Participants
41	Almara Kurniawan	almarakur@gmail.com	Participants
42	Alvina Handayati	alvinahandati@gmail.com	Participants
43	Alvina Novaisyah Putri	alvinanovaisyahputri@gmail.com	Participants
44	Amalia Puspita	amaliaamel920@gmail.com	Participants
45	Aminnullah	aminnullah39@gmail.com	Participants
46	ananda ghafiqi suripto	anandaghafiqi@gmail.com	Participants
47	Andreansyah saputra	Andreansyahsaputra622@gmail.com	Participants
49	Angga Surmana	anggasurmanasembiring@gmail.com	Participants
50	Anggit Wijayanto	anggitwijayanto337@gmail.com	Participants
51	Anggun Kurnia Wati	anggunkurniawati59@gmail.com	Participants
52	Anggun Nurmayasari	anggunnurmayasari2002@gmail.com	Participants
53	Anita Puja Kusuma	anitapuja09@gmail.com	Participants
55	Annisa Dwi Cahya Novilia	annisadwicahyanovilia@gmail.com	Participants
56	Annisa Putri Januarti	annisaputrijanuarti@gmail.com	Participants
57	Apriana Megasari	apriannapelangi@gmail.com	Participants
59	Ardiansyah Purba	ardiansyahpurba23@gmail.com	Participants
61	Arif Irawan	Arifirawan752@gmail.com	Participants
63	Arifin Prabowo	arifinprabowo418@gmail.com	Participants
64	Ariq Fadhlurrahman	afr.ariqfadhlurrahman@gmail.com	Participants
65	Armanda firmansyah	armanda.firman92@gmail.com	Participants
66	Arya Wiratama	aawiratam4@gmail.com	Participants
67	Aulia Ismiyani Mubariqoh	auliaismiyanimubariqoh@gmail.com	Participants
68	Aulia Marta Anwar Rodzia	auliamartaaa@gmail.com	Participants
69	Aulia Ulfa Silaen	auliaulfasilaen06@gmail.com	Participants
70	Bagus Sanjaya	sanjayabagus020@gmail.com	Participants
72	Bangkit Sigiharto	bangkitsugiharto91@gmail.com	Participants

73	Bawon mahhendra	mahhendrabawon@gmail.com	Participants
74	Bayu Aji Nurrahmadhan	baayu27@gmail.com	Participants
75	Chicha Cristi Monica	chichacristi@gmail.com	Participants
76	Choirunisa	icha70182@gmail.com	Participants
77	Cindi Lutfiani	cindilutffiani@gmail.com	Participants
78	Cindy Avita	sindyavita02@gmail.com	Participants
79	CINDY DEVIA RAHMADANI	deviacindy207@gmail.com	Participants
80	cindy kaliana tantri	Cindykalianatantri10@gmail.com	Participants
81	Danang Sendi Budi Antoro	danangsendi19390@gmail.com	Participants
82	Dani triyadi	dhany.2410@gmail.com	Participants
83	Debora Yunita Manurung	deborayunitamanurung1@gmail.com	Participants
84	DEDE ARTHA KENCANA	arthabandot@gmail.com	Participants
85	Dede Artha kencana	arthabandot@gmail.com	Participants
86	Dede Hidayat	hidayatdede0312@gmail.com	Participants
87	Dela Agustina	delaagustiana566@gmail.com	Participants
88	Delta Atika Chamalia	deltachamalia@gmail.com	Participants
89	Deni Haposan Sihombing	denihaposan31@gmail.com	Participants
90	Desca Adhitya Megantoro	descaadhityamegantoro@gmail.com	Participants
91	Desta Sanjaya	destasanjaya2001@gmail.com	Participants
92	Destia Pentiana,S.E.M.Si.	destiapentiana@polinela.ac.id	Participants
93	Destieka Ahyuni	destieka@polinela.ac.id	Participants
94	Devara Levisa	devaralevisa123@gmail.com	Participants
95	devi natalia	devinatalia282000@gmail.com	Participants
96	Devi Nofiana	devinofiana26@gmail.com	Participants
97	Devy Cendekia	devycendekia@polinela.ac.id	Participants
98	Dewi Apriyanti	deewiapr@gmail.com	Participants
101	Dhani setya wibawa	dhaniwibawa330@gmail.com	Participants
102	Diah Riski Amelia	diahriskiamelia01@gmail.com	Participants
104	Diana Sari Dj, S.Si.,M.T	dianasaridj@gmail.com	Participants
105	Dimas Eka Firmansyah	firmansyahekadimas@gmail.com	Participants
106	Dimas Habiyudanto	dimashabby2@gmail.com	Participants
107	Dimas Novian Sardi	dimassardi321@gmail.com	Participants
109	Dimas Wahyu Nur Hidayah	wdimas388@gmail.com	Participants
110	Dita Tamara	ditatamara65@gmail.com	Participants
111	Ditya Pratiwi	Dityaapratiwisantoso@gmail.com	Participants
112	Dodi Busadi	dodibusadi1504@gamil.com	Participants
113	Dr. Asih Mulyaningsih, SP.,M.Si	asihmulya@ymail.com	Participants
115	Dr. Henry Kurniawan, S.Si., M.Stat.	henry_stk@polinela.ac.id	Participants
120	Dr. Nasir, S.Pd., M,Pd	nasir_melinda@unulampung.ac.id	Participants
122	Dwi anang saputra	anangsaputra.das@gmail.com	Participants
124	Dwi Nita Yusmalida	yusmalidanita@gmail.com	Participants
125	Dwi Suryati Antaqo	antago.dwi@gmail.com	Participants
126	Dwi Wahyu Ningsih	dwiwahyuningsih019@gmail.com	Participants
128	Eka Septiana	ekaseptiana15313@gmail.com	Participants
130	Ela Sri Melyana	elasrimelyn@gmail.com	Participants
132	Endang Nahalana.NH	endangnahalana@gmail.com	Participants
133	Endi Luki Putra	endi.luki93@gmail.com	Participants
134	Epro Barades, S.Pi., M.Si.	eprobarades@polinela.ac.id	Participants
135	Erla Margaretta br Ginting	erlamargaretta@gmail.com	Participants
136	Erna Widyanti	ernawidyanti372@gmail.com	Participants
137	Errisha Ardhia Pramesthye	errishaardhia12@gmail.com	Participants
138	Esti Hayu Pertiwi	estihayu1201@gmal.com	Participants
139	Eva Rosdiana, S.P., M.P	eva_rosdiana@polije.ac.id	Participants
140	Evana, M.Sc.	evana3009@gmail.com	Participants
141	Evi Yunita Sari, S.Pd., M.Si.	eviyunitasari26@gmail.com	Participants
142	Fadil Bima Praditya	bimapraditya06@gmail.com	Participants
143	Fadilla Azzahra	azahrafadilla654@gmail.com	Participants
144	Fahri Ali, S.P., M.P	fahrialiagro@gmail.com	Participants
145	Fajar Cahyo Bawono	fajarbawono3010@gmail.com	Participants
146	Fajar Rachmat	fajar10031999@gmail.com	Participants
147	Faldiniyus Mukti	undigaming170379@gmail.com	Participants
148	Fani Setiawan	fanisetiawan823@gmail.com	Participants
149	Farid Abdul Aziz	farid210301@gmail.com	Participants
151	Farra Viona Cinta Fanaria	farraviona468@gmail.com	Participants

152	Faruq Al Askhary	faruqalaskhary19@gmail.com	Participants
153	Fathur Rahman	frahmancr7@gmail.com	Participants
154	Febri Kurnia Sari	febrikurnias27@gmail.com	Participants
156	Ferdy Dwi Mulyana	ferdydwimulyana@gmail.com	Participants
157	Ferdy Gaza Assidiq	ferdigazaassidiq11711@gmail.com	Participants
158	Fetri Pristi Prasinta	fetripristi07@gmail.com	Participants
159	Figo Sheva Ramadhan	tulussd45@gmail.com	Participants
160	Franciska Aidha Martha	fransiskaaaidha28@gmail.com	Participants
161	Gazzing Arkhan Rizky Gustiwan	Gazzingggustiwan26@gmail.com	Participants
162	Giannis Aji Deksono	gianisaji2000@gmail.com	Participants
163	Gigih Pranandi	Gigihpranandi11@gmail.com	Participants
164	Gilang Allantama	gilangallan19@gmail.com	Participants
165	Gilang Saufa Yardho	gilangsaufayardho@gmail.com	Participants
166	Gusma Gama Maradon, S.Pt., M.Si.	gusma@polinela.ac.id	Participants
167	Habib Rahman	habibr0098@gmail.com	Participants
168	Haditya Wahyu	hadityawhy20@gmail.com	Participants
169	Hafid Andre Permana	andrediender777@gmail.com	Participants
170	Hafid nur holis	holishfd@gmail.com	Participants
171	Hafli Chensa Prabu	haflichensa4567@gmail.com	Participants
172	Halimah Alifia	halimahalifia12@gmail.com	Participants
173	Hanifah Annabila	hanifahannabila31@gmail.com	Participants
174	Hari aldo novendra	harianovendra11@gmail.com	Participants
175	Harun Surya Ramadhan	harunsuryani912@gmail.com	Participants
176	Helda Monica	heldamonica.12.s2@gmail.com	Participants
177	Hendi Karunia Ramadhani	hendikarunia808@gmail.com	Participants
179	Heriawankhafid	Heriawankhafid405@gmail.com	Participants
180	heru Prabowo Aji	timbolsitepu@gmail.com	Participants
181	Hety Sundari	hetysundari81@gmail.com	Participants
183	Holidi	holidi@fpunmura.ac.id	Participants
185	I Made Ari Dharma Yasa	Dharmaari79@gmail.com	Participants
186	I Made Darma Saputra	Madedarma745@gmail.com	Participants
187	I Wayan Yudha swp	wayanyudha009@gmail.com	Participants
188	Ibnu Fajar Alifa	Ibnufajaralifa067@gmail.com	Participants
189	Ica Maulina	Ichamaulina57@gmail.com	Participants
190	Iis Nursafitri	nursafitriis36@gmail.com	Participants
191	Ika Rodhatul Auliya	ikaauliya867@gmail.com	Participants
192	Ikke Rossa Damayanti	ikkerossa@gmail.com	Participants
193	Ilham Hadi Kurniawan	ilhamajja615@gmail.com	Participants
195	Imelda Panjaitan	Imelpolinela27@gmail.com	Participants
196	Indra Kurniawan	ik074064@gmail.com	Participants
197	Indri Syafiqa Lusiana	indrisyafiqa23@gmail.com	Participants
198	Ine Ratu Herlina	ineherlina20@gmail.com	Participants
199	Intan Kamilia Habsari, S.Pt., M.Pt.	intankhabsari@gmail.com	Participants
203	Ir. Hilman Hidayat M.Si	hilmantasik27@gmail.com	Participants
205	Ir. Indriyani, S.T., M.Si.	indryinthan@gmail.com	Participants
207	Ir. Raida Kartina, M.P.	raidakartina@polinela.ac.id	Participants
208	Ir. Yun Sondang, M.P.	silitongayun27@gmail.com	Participants
209	Ir. Yusanto, m.si	yusanto@polinela.ac.id	Participants
211	Ismail Wahyudi	yudimail55@gmail.com	Participants
212	Ita Kartika	itakartika148@gmail.com	Participants
213	Iva aulia rahman	Ivaaulia53520@gmail.com	Participants
214	Jerry elza kusuma	jerryelza17@gmail.com	Participants
215	Joko Wiranto	joko14u@gmail.com	Participants
216	Joni Setiawan	jonesmkj46@gmail.com	Participants
217	Joyfunny Amazing Pangemanan	joy270901@gmail.com	Participants
219	Julia Wulandari	juliawulandari57@gmail.com	Participants
220	Julian Aria Dwiva	Juliandwiva@gmail.com	Participants
221	Kadek Dwi Serena	kadekserena2909@gmail.com	Participants
222	Karunia maghfiroh	maghfiroh.karunia@gmail.com	Participants
223	Kemas M Segentar Alam	segentaralam12@gmail.com	Participants
224	Ketut Widiawati	ketutwidiawati92@gmail.com	Participants
225	Khoirul Huda	kunruel58@gmail.com	Participants
227	Kusmaria, S.P., M.Si.	kusmaria@polinela.ac.id	Participants
228	Laila Ambar Wulandari	lailaambar27@gmail.com	Participants

230	Lina Budiarti, S.P., M.Si	budiarti46@gmail.com	Participants
231	Lina Wati	lina731.wati@gmail.com	Participants
232	Livia Rhea Alvita, S.Si., M.Si.	liviarhea@gmail.com	Participants
233	Liyanda Rahmadani	liyandarahmadani645@gmail.com	Participants
234	Lutvia Putri Rahmawati	lutviaputriwati@gmail.com	Participants
235	M Ihsan Pratama	ihsanprtma@gmail.com	Participants
236	M Yoga Armanto	yogamuhammad907@gmail.com	Participants
237	M. Amirul Ikhsan	amirullikhasan@gmail.com	Participants
238	M.Muhayin A Sidik	masayin88@polinela.ac.id	Participants
239	M.Oki Leriansyah	okileriansyah2@gmail.com	Participants
240	M. Zacky Auzan	mzackyauzan@gmail.com	Participants
241	Marin Sinta Syahputri	syahmarin@gmail.com	Participants
244	Mega Marantika	megamarantika018@gmail.com	Participants
245	Meidaliyantisyah	meida.garna@gmail.com	Participants
247	Melda Aritonang	aritonangmelda33@gmail.com	Participants
248	Melia Diana Safitri	meliadianasafitri77@gmail.com	Participants
249	Meriermia	ermia0405@gmail.com	Participants
251	Merry Oktaviani	Merryoktaviani06@gmail.com	Participants
252	Mia Puspa Safitri	miapuspa24@gmail.com	Participants
253	Miana Dwi Astuti	miana6599@gmail.com	Participants
255	Mila Hamita Rohimah	hamitamila2002@gmail.com	Participants
257	Moh. Rizki Ananda	m.rizkiananda71@gmail.com	Participants
258	Muhamad Fajar Irawan	fajarmuhamad642@gmail.com	Participants
259	Muhamad Tohari	muhamadtohari2712@gmail.com	Participants
260	Muhammad hafiz Relindranata	hapispis129@gmail.com	Participants
261	Muhammad Lutfi Basith	m.lutfimobile@gmail.com	Participants
262	Muhammad Novan Aditia Saputra	novanadityasyaputra@gmail.com	Participants
263	Muhammad Rizal Ramli	ramlirizal622@gmail.com	Participants
264	Muhammad Rizky	mrizky894@gmail.com	Participants
265	Muhammad Syahrul Fadillah	msyahrulfadillah990@gmail.com	Participants
266	Murhadi	murhadiburcik@gmail.com	Participants
267	Nabilla Ananta	nabillaananta5@gmail.com	Participants
268	Nada Hisanah Syifa Fadiyah	nadahisanahsyifa@gmail.com	Participants
269	Naila salsabilah	nailasalsabilah4@gmail.com	Participants
270	Nanang Heru Setiawan	nanangheru08@gmail.com	Participants
271	Nani Irwani, S.Pt., M.S	naniirwani@polinela.ac.id	Participants
273	Niken Kristiani	nikencristiani2@gmail.com	Participants
274	Niko Andalas Joko S	nikosap89035@gmail.com	Participants
275	nousya nabila	nosyan6@gmail.com	Participants
276	Novi Irma yani	noviirma@gmail.com	Participants
277	Novita, S.P., M.P.	novitasp10@gmail.com	Participants
279	Nuning Mahmudah Noor	nuning@polinela.ac.id	Participants
282	Nurul Hasanah	nurulhasanah3032@gmail.com	Participants
284	Okta Dwi Akbar	oktadwiakbar09@gmail.com	Participants
285	Oktavia Istiani	oktaviaistiani99@gmail.com	Participants
288	Panca Omega	pancaomega2000@gmail.com	Participants
290	Pratama Mulya Hadi Saputra	pratamaputra10112001@gmail.com	Participants
291	Putri Fina Puspita	putrifinapuspita@gmail.com	Participants
292	R.A Ajeng Sekarwati	Ajengsekarwati630@gmail.com	Participants
293	Rafli Ramadhani	Ainunmahya7777@gmail.com	Participants
294	Rahmad Mahkomul Amin	rahmadmahkomul@gmail.com	Participants
295	Rahmadi Aziz	rahmadiaziz@polinela.ac.id	Participants
296	Rahmat hidayatullah	rh811604@gmail.com	Participants
297	Raima Rafidah	raimarafidah21@gmail.com	Participants
299	Rakhmiati	rahmiradik@gmail.com	Participants
300	Rama Agus Mulyadi	rama0401polinela@polinela.ac.id	Participants
301	Rama Destama Andaluna	rama.damarpunya13@gmail.com	Participants
302	Ramadani	ramaadanii20@gmail.com	Participants
303	Ramadhona Rosalia	Dhonarosalia91@gmail.com	Participants
304	Ranadiva Khairani	ranadivakhairani01@gmail.com	Participants
305	Rani Agustina	renianns@gmail.com	Participants
308	Renita Asmara Ningsih	renita210401@gmail.com	Participants
309	Reny Mita Sari, S.P., M.Si.	renymita@polinela.ac.id	Participants
310	Reza Aldo Saputra	rezaaldobagas30@gmail.com	Participants

311	Reza Fadilla	Rezafadilla263@gmail.com	Participants
312	Reza Imelda Puspita	rezaimelda65@gmail.com	Participants
313	Ria Agustina	riaa94630@gmail.com	Participants
314	Ria Latipah	rlatifah08@gmail.com	Participants
315	Ria Putri, S.P., M.Si.	riaputri@polinela.ac.id	Participants
316	Riana Jumawati	riana31@polinela.ac.id	Participants
318	Ridwan Riky Saputra	ridwanriky72@gmail.com	Participants
319	Ridwan Syaifulloh	dewiridwan7@gmail.com	Participants
321	Riliano Andre Putra	rilianoandre@gmail.com	Participants
323	Rini Desfaryani, S.P., M.Si	desfaryanirini@gmail.com	Participants
324	Rini Dwi Yanti	rinidwiyanti92@gmail.com	Participants
325	Rio Anggara	rioanggara46548@gmail.com	Participants
326	Rio Yusufi Subhan	Rioysubhan@polinela.ac.id	Participants
327	Riski Ayu Marisma	Ayumarisma31@gmail.com	Participants
328	Rizka Novi Sesanti, S.P., M.P.	rizka@polinela.ac.id	Participants
329	Rizki Baroto	rizkibaroto03@gmail.com	Participants
330	Rizki Gilang Kusuma	rizkiglng02@gmail.com	Participants
331	Rizki Perdana	perdanarizky970@gmail.com	Participants
332	Rizky Bagus Kurniawan	rizkybk1800@gmail.com	Participants
333	Rizky Matfiansyah	riskymatfiansyah@gmail.com	Participants
334	Rizky Nur Iqbal	Nuriqbalrizky@gamil.com	Participants
335	Rofi Nurhalim	Rofinurhalim29@gmail.com	Participants
336	Romi Saputra	romisaputra9898@gmail.com	Participants
337	Ronal muahirin	ronaldmuahirin1210@gmail.com	Participants
340	Sabila Putri	sabila99bila@gmail.com	Participants
341	Safitri Embun Oktavi	safitriembuno@gmail.com	Participants
342	Samuel Pandinata	samuelsinaga2209@gmail.com	Participants
345	Sandiyah	sandiasmanstar@gmail.com	Participants
346	Satria Tri Putra	strtrptr1222@gmail.com	Participants
347	Savika Intan Mutiara Putri	Savikaintan78@gmail.com	Participants
348	Scaesar Rosa Amanda	scaesaramanda11@gmail.com	Participants
349	Sekar Ayu Anindiarani	sekaranndrn@gmail.com	Participants
350	Sekar Mustika Arum	Sekarkari12@gmail.com	Participants
351	Sella Octa bela	Selamobile724@gmail.com	Participants
352	Sepin Deyal	Sepindeal320@gmail.com	Participants
353	Septi Muthoharoh	septimuthoharoh@gmail.com	Participants
354	Septia Putri Anggraini	septiaputri230920@gmail.com	Participants
355	Septiana, S.P., M.Si.	septiana@polinela.ac.id	Participants
356	Septiani	septiyanii387@gmail.com	Participants
357	Septiyana	Septiyanappa@gmail.com	Participants
358	Seroja Eloka Pitaloka	serojaelokpl@gmail.com	Participants
359	Setiawan Rifaldo	rifaldosetiawan6@gmail.com	Participants
361	Sigit pratama	Sigitpratama699@gmail.com	Participants
362	Silvia Ayu Nuraini	Silviaayu0401@gmail.com	Participants
363	Sinta Fafrina	sintafafrina81@gmail.com	Participants
364	Siska Yunita Sari	siskayunitasari83@gmail.com	Participants
365	Sismita Sari	sismita@polinela.ac.id	Participants
366	Siti Hajar	Sitihajar090590@gmail.com	Participants
367	Siti Novridha Andini, S.P., M.P.	sitinovridaandini@polinela.ac.id	Participants
370	Sri Nurmayanti, S.P., M.Si.	sri.cece@gmail.com	Participants
371	Sri Rizki	sririzki603@gmail.com	Participants
372	Sugiman	sugimanae123@gmail.com	Participants
373	Supriyanto	Supriyanto@polinela.ac.id	Participants
374	Surfiana	surfianawrag@polinela.ac.id	Participants
375	Surfiana, S.P., M.Si.	surfianawrag@polinela.ac.id	Participants
376	Susanti, S.Pt., M.Si.	yasinsusanti@gmail.com	Participants
378	Syifa salsabila	syifasaal1@gmail.com	Participants
379	Syukron Abdillah	syukronabdillah18@gmail.com	Participants
381	Teguh Budi Trisnanto	dtetuko@gmail.com	Participants
383	Tentry Intan Putri	tentry3@gmail.com	Participants
384	Teuku Giovani Sentosa	teukugiovani010201@gmail.com	Participants
385	Tia sapitri	tiasapitri1200@gmail.com	Participants
386	Tiara Salsabila	tiarasalsa553@gmail.com	Participants
387	Tias Arlianti SP, MSi	misstias@yahoo.com	Participants

388	Tina Handayani	tinahndyni0202@gmail.com	Participants
389	Titin Liana Febriyanti, S.Pi., M.Si.	liana88.sutrisno@gmail.com	Participants
390	Toha rizky kurniawan	toharizkyk@gmail.com	Participants
392	Tri Yulita Dewi	yulita0247@gmail.com	Participants
393	Trima Relisa Andani	trimarelisa.andani@gmail.com	Participants
394	Tulas Aprilia,S.Pi., M.Si.	tulasaprilia@polinela.ac.id	Participants
395	Umarudin Kurniawan, S.E.,M.S.Ak	umarkurniawan@polinela.ac.id	Participants
396	Umi Listiana	umilistiana26@gmail.com	Participants
397	V. Ela Angela	veronikaelaangela@gmail.com	Participants
398	Vida Elsyana, S.Pd., M.Si.	vida@polinela.ac.id	Participants
399	Vika Artania	Vikakacu18@gmail.com	Participants
400	Vincent Ancelmus Depari	vancelmus@gmail.com	Participants
401	Violla Chinta Dewi	Violachinta99@gmail.com	Participants
402	Virda Yuni Saputri	virdayunisaputri@gmail.com	Participants
403	Vloren Wida ivana	vlorenwi@gmail.com	Participants
404	Vrisilia	vrisilia01@gmail.com	Participants
405	Wahyu nandia putri	wahyunandiaputri@gmail.com	Participants
406	Walita Nadina Astina	walitanadina99@gmail.com	Participants
407	Wanda Ayu Lestari	wandaayulestari22062001@gmail.com	Participants
408	Wandi Fadli Ilhami	wandyfadli88@gmail.com	Participants
411	Wenni Farnia	wenifarina@gmail.com	Participants
412	Widia Arum Sari	widiaarum75@gmail.com	Participants
414	Widian Andra Juliansyah	Widianandra2521@gmail.com	Participants
415	Wihelmina Panjaitan	mina.jait2206@gmail.com	Participants
417	Wildan brilian evadam	wildaneva22@gmail.com	Participants
419	Y. Tasya Azzahra	tasyaazzahra0129@gmail.com	Participants
420	Yadi Priabudiman	yadikumizh77@gmail.com	Participants
421	Yafi Angger Pangestu	yafianggerpangestu310701@gmail.com	Participants
423	Yatim	yatimwidodo@polinela.ac.id	Participants
424	Yatim R. Widodo	yatimwidodo@polinela.ac.id	Participants
426	Yesika Tarigan	sikayesikatarsil22@gmail.com	Participants
427	Yogi khoirul ansori	yogikhoirul99@gmail.com	Participants
428	Yohanes Anung Prasetyo	yohanesprasetyo1974@gmail.com	Participants
429	Yosua nainggolan	Yosuajr05@gmail.com	Participants
430	Yovie Wiweka Indrajati	yovifurios03@gmail.com	Participants
431	Yulmaini	yulmaini@darmajaya.ac.id	Participants
432	Yusuf Alvian	yusufalvian65@gmail.com	Participants
433	Yusuf Candra Laksana	yusuf.chandra25@gmail.com	Participants
435	Zakia Ramadhani Al Mukromin	daany047@gmail.com	Participants
436	Zakkiah sirozul hudah	Zakkiahsirozulhudah21@gmail.com	Participants
437	Zulfikar Aimar	toidiholiclucky@gmail.com	Participants

ICOAAS

International Conference on Agriculture and Applied Science

Supported By :

9 772776 043000

The Effectiveness of The Gamification Model on Learning English in The Pandemic of Covid-19

Y.W.A. Wibowo, R.Akmal, and H. Utami

Politeknik Negeri Lampung

Email: yusep.windu@polinela.ac.id

Abstract. The problem of decreasing student participation during the pandemic also occurs in learning English at SMK Negeri 1 Metro. Based on these problems, innovation in learning activities has been creating, namely Gamification-based E-Learning. The purpose of the research is to determine how effective of gamification model improve students' English skills. This study is quantitative research using an experimental approach where the researcher deliberately evokes the emergence of an event or situation. Researchers interviewed research subjects regarding their experiences about the effectiveness of the gamification method using Quizziz and Kahoot applications in online learning. They gave a questionnaire through the google form link to 69 students of class XII Hospitality at SMK Negeri 1 Metro. It consists of 14 closed-ended questions in the form of multiple choice. Most of the students stated that learning using gamification was effective because it was related to the previous topics, fun, easy to understand, accessible, increased enthusiasm and interest for learning. It also did not spend a lot of internet data plans and time.

1. Introduction

Since Covid 19, the lives of citizens around the world have experienced adaptations of activities in all fields. Terminology of Working from Home (WFH) and Learning from Home (LfH) is normal activities. Teachers, students, and all family members can adapt to online learning situations using IT and the Internet [1]

The lack of students' English skills indicates that online English learning in Senior Vocational Schools has not been effective. That happens because there is not enough money to top up their phone, the internet signal is not stable, and students' participation in English learning activities has decreased. Some students are actively present during learning activities. They collected assignments on time, but some did not do that. Some students do jobs copying and pasting their friends' projects. Online learning activities using the zoom application to see student attendance and monitor students in carrying out assignments cannot be carried out continuously because they consume a lot of credit. In addition, the stability of the internet signal in each student area is different, so it affects the ability of students to take part in online learning and send worksheets according to the specified time limit. This condition makes students' activeness decrease in online learning. It also occurs in learning English at Metro Senior Vocational

School 1. Teaching English in SMK has an urgent role provide the basics of English because it prepares students who will work or continue to university after they graduate. The beginning of the implementation of learning activities through online media received positive responses from students and could be an alternative to offline learning. There are complaints from students who already feel bored because the learning methods are always the same [2]. Besides that, there is also a lack of clear information about the worksheets that students must do, and It causes to decrease in the level of students' participation in learning and working on worksheets.

Based on that, an application in online learning has been found, namely gamification-based E-Learning learning, which aims to increase the willingness and enthusiasm of students to participate in learning activities with interactive and exciting games, especially during the Learning from Home. Gamification is a learning activity using a system model that can create a pleasant atmosphere and even make system users want to do it many times when they end a non-game task. [3] The researcher intends to learn English with a gamification model so that students learn English by playing a fun game so that they don't get bored. Knowing that uses the internet so that students who need it can access it wherever they live. Therefore, researchers will use gamification to learn English so that students do not have difficulties.

This study adopts a gamification model using the Quizziz and Kahoot applications, which are more accessible by paying attention to students' conditions and learning objectives. In general, the principle of gamification is based on creating and supporting long-term relationships. This condition can be achieved by visually combining and linking game layers. it's designed to get people involved, even people who have never played the game [4]

Based on the background described, the problem can be formulated as follows, How is the effectiveness of the application of the gamification model to improve the English skills of Metro Senior Vocational School 1 students. The purpose of this research is to find out how effective learning to apply the gamification model to improve the English skills of Metro Senior Vocational School 1 students

2. Method

This research was conducted at Metro Senior Vocational School 1 from July to August 2021. It is quantitative research by applying an experimental approach. The researcher raises an event or situation deliberately. The subjects in this research were students of class XII Hospitality 1, 2, and 3 who took English lessons.

This research consists of 4 stages: Planning, data collection, data analysis, and making research reports. [5] For this research has good credibility, the author will use various data collection techniques, among others, by filling out observation sheets that are used to see all learning activities in the classroom, especially when observing online learning, and interviews by giving questionnaires. Data analysis in this study consists of three stages: reducing data, disclosing data, and making conclusions.

3. Results and Discussion

Interviews were carried out by giving 69 students of class XII Hospitality at Metro Senior Vocational School 1 a questionnaire through a google form link. Students are given 1-2 hours to answer the questionnaire. The questionnaire consists of 13 closed-ended questions in the form of multiple choice. The following are questionnaire questions and respondents' answers (Table 1).

Table 1. Questionnaire questions and respondents' answers

Questions	Yes (%)	No (%)

Is the gamification learning method (QUIZIZZ, KAHOOT)) easy to be understood?	89,9	10,1
Are gamification learning methods (QUIZIZZ, KAHOOT) easy to ob obtain?	88,4	11,6
Do you spend a lot of Internet data plans when using gamification learning methods (QUIZIZZ, KAHOOT)?	78,3	21,7
Are you easy to contact your teachers or friends when using this gamification learning method (QUIZIZZ, KAHOOT, and the like)?	79,7	20,3
Does this gamification learning method (QUIZIZZ, KAHOOT) increase your enthusiasm for learning?	89,9	10,1
Does this gamification learning method (QUIZIZZ, KAHOOT, and the like) spend a lot of your free time?	94,2	5,8
Do you want to continuously use this gamification learning method (QUIZIZZ, KAHOOT)?	81,2	18,8
Is this gamification learning method (QUIZIZZ, KAHOOT) fun?	88,4	11,6
Does this gamification learning method (QUIZIZZ, KAHOOT) increase your willingness to learn?	85,5	14,5
Is this gamification learning method (QUIZIZZ, KAHOOT) fun?	88,4	11,6
Do you want this gamification learning method (QUIZIZZ, KAHOOT) to be used in other subjects?	78,3	21,7
Are our online learning methods effective enough?	55,1	44,9
Do English Teachers use an attractive online learning method?	52,2	47,8

4. Conclusions

Based on the results of data analysis and discussion, it can be concluded several things as follows: Learning English with the concept of gamification is effective, this can be seen from the responses of students in the learning process with the idea of gamification, most of them are interested because it is something new for them, but it is fun, easy to be understood and accessible, does not spend a lot of Internet data plans, increases enthusiasm for learning, does not spend a lot of time and it is related to previous topics. Even though there are several obstacles encountered in this study: quota constraints and signal stability in answering questions on quizziz and kahoot, the majority of students stated that online learning was more interesting.

References

[1] W. darmalaksana, Y. Ahmad, A. Masrur and Muhlas, "Analisis Pembelajaran Online Masa WFH Pandemic Covid-19," UIN Sunan Gunung Djati, Bandung, 2020.

[2] U. Raharja, A. Qurotul, A. Hayat and N. . P. L. Santoso, "Penerapan Gamifikasi Pada Penilaian

Absensi (PENA) Untuk Meningkatkan Motivasi Bimbingan," *Edutech*, vol. 18, no. teknologi pendidikan, p. 12, 2019.

[3] A. Adhiatma, T. Rahayu, and O. Fachrunnisa, "Gamified training: a new concept to improve individual soft skils," *Siasat Bisnis*, vol. 23, no. Management, p. 127, 2019.

[4] S. W. Handayani, M. Suyanto and A. F. Sofyan, "Penerapan Konsep Gamifikasi Pada E-Learning," *Telematika*, vol. 9, no. media informatika, p. 42, 2016.

[5] A. Sanusi, Metodologi penelitian bisnis, Jakarta: salemba, 2019.

Implementation of Naive Bayes Classifier (N.B.C.) on Chicken Egg Classification

T S Jaya[1*] and M Yusman[1]

[1] Informatics Management Study Program,
Politeknik Negeri Lampung, Indonesia

*Email: sandi@polinela.ac.id

Abstract. Egg quality has a significant impact on sales; However, many poultry farmers are still not paying attention to the effects of egg quality. This study aims to predict the quality of broiler eggs worth selling or not—classified by the Naive Bayes algorithm with the input variable (X). These factors affect the quality of chicken eggs in the form of 5 variables X and Y in chicken egg sales conditions. The data used are 215 data. The results show that the Naive Bayes model produces an accuracy of 86,7%.

1. Introduction

Eggs are known to be a rich source of nutrients. Eggs are one of the animal products consumed along with meat, fish, and dairy products. To meet consumer demand for eggs, egg production has become an important industry in many countries. The high demand for eggs must also be accompanied by the expectation and demand for good quality eggs so that egg companies compete not only for producing good quality eggs but also for being rich in nutrients like D.H.A., Omega3, etc. [1]. The fundamental nature of eggs is that they are perishable. Various types of egg damage reduce the quality of the eggs, including eggshell cracking, loss of CO2, spoilage, bacterial growth in eggs, and others. The nutritional value of a 50-gram egg is 6.3 grams of protein, 0.6 grams of carbohydrates, five grams of fat, vitamins, and minerals [2]. To determine a good hen's egg, you can look at the type, shell color, weight, and in this case, the Naive Bayesian Classifier (N.B.C.) method is used to analyze the quality and quality of the eggs being tested. They are worth selling or not.

The Naive Bayesian Classifier is a Bayesian classifier that combines the naivety of assuming that conditions between attributes are independent and predicts future opportunities based on experience [3]. One of the features of N.B.C. is that it can work with invalid attribute values, removing training data during modeling and forecasting[4]. Hence, strong N.B.C. is faced with unrelated attributes. Relational attributes can degrade the performance of the N.B.C. classifier because there are no longer any prerequisites for separating these attributes [5]. Bayes' theorem is combined with the naivety of predicting future possibilities based on experience, assuming These elements were previously used for manual calculations and analysis, making it faster, more efficient, and more accurate using the Naive Bayesian Classifier method to maximize the sale of eggs to customers.

Theoretical Basis. Naïve Bayes is a classification technique based on Bayes's theorem combined with naivety to predict future opportunities based on experience, assuming conditions between attributes are independent [7].

The characteristics of Naïve Bayes can be explained as follows [8]:

1. The Naïve Bayes method works robustly on isolated data. Naïve Bayes can handle incorrect attribute values by ignoring training data during the modeling and prediction process.
2. Strong in dealing with irrelevant attributes.
3. Attributes that have a relationship can degrade the performance of the Naïve Bayes classification because the assumption of the non-binding of the feature no longer exists.

Bayes' theorem is formulated as follows [9]:

$$P(H|X) = \frac{P(X|H)}{P(X)} . P(H) \quad (1)$$

Note :
X: Data with unknown class
H: Hypothesis data is a specific class
P(H|X): Probability of hypothesis H based on condition X (posterior probability)
P(H): Probability of hypothesis H (prior probability)
P(X|H): Probability of X based on condition on hypothesis H
P(X): Probability X

And this is the step by step how N.B.C. algorithm works [10].

Step 1 : Read the training dataset.
Step 2 : Calculate the mean and standard deviation of the predictor variables in each class.
Step 3 : Repeat
Calculate the probability of all predictor variables using the gauss density equation in each class.
Step 4 : Calculate the likelihood for each class.
Step 5 : Get the greatest likelihood.

Figure 1. Algorithm of N.B.C. Method

2. Methods

This part of the Method will explain the stages carried out in this research from beginning to end. The Method from this research is divided into some stages in Figure 2.

Figure 2. Research Method

2.1. Problem Identification

At this stage, identifying problems is carried out to determine the quality of chicken eggs worth selling. The results of interviews with farmers obtained variables used to determine egg quality. The variables used are color, size, sound, position, and thickness. The target achieved is Worth selling or not.

Table 1. Data Variable

Variable	Attribute	Information
X1	Color	Pale
		Bright
X2	Size	Small
		Normal
		Large
X3	Sound	Muted
		Voiced
X4	Position	Sinking
		Middle
		Floating
X5	Thickness	Thin
		Thick

2.2. Data Collecting

At this stage, the data that will be used is collected. The data used is data taken in one of the laying hens in Bandar Lampung. The data used are 215 samples. The data will be grouped into training data as many as 150 samples and test data as many as 65 samples.

2.3. Training

At this stage, the training data will be trained using the Naive Bayes method. Before being classified, it is preprocessing is carried out. Preprocessed data, a color attribute with pale value becomes 0; the bright value becomes 1. Size attribute with small value becomes 0; the average value becomes 1, the significant value becomes 2. Voice attribute with muted value becomes 0, and voiced value becomes 1. Attribute the position with the sinking value 0, the floating value 1, and the floating value 2. The thickness attribute with the thin value being 0 and the thick value being 1. After the preprocessing process, the training dataset sample will be trained using the Naive Bayes method.

2.4. Testing

Testing is done to determine whether the algorithm is running, assess the performance of the algorithm that has been implemented, and test calculations in training data by using data testing. During this testing phase, analysis of precision, recall, and accuracy is also carried out to test the accuracy of the application being built.

A Precision calculates the estimated proportion of actual positive cases [11].

$$Precision = \frac{TP}{TP + FP} \tag{2}$$

A Recall calculates the estimated proportion of positive cases that are correctly identified [11].

$$Recall = \frac{TP}{TP + FN} \tag{3}$$

An Accuracy is a calculation of the proportion of the total number of correct predictions [11].

$$Accuracy = \frac{TP + TN}{TP + FP + TN + FN} \quad (4)$$

Where
T.P.: True Positive
TN: True Negative
F.P.: False Positive
F.N.: False Negative

3. Result and Discussion

This section contains the results of the test and analysis and discussion of the difficulties that have been carried out. Testing the data for saleable eggs uses a dataset of 215 data. The dataset was taken from one of the laying hens in Bandar Lampung. Before being classified, preprocessing is carried out by changing the categorical data type into a numerical data type. Preprocessed data, a color attribute with pale value becomes 0; the bright value becomes 1. Size attribute with small value becomes 0; the average value becomes 1, the significant value becomes 2. Voice attribute with muted value becomes 0, and voiced value becomes 1—attribute position with sinking value to 0, floating value to 1, and floating value to 2. The thickness attribute with a thin value becomes 0, and the thick value becomes 1. The results of the test can be seen in table 2.

Table 2. Sample Dataset

Colour	Size	Voice	Position	Thickness	Worth
1	0	0	1	0	Yes
1	2	0	0	0	Yes
1	2	1	2	0	No
0	1	1	2	1	No
0	0	1	1	0	No
1	1	0	0	1	Yes
0	1	0	0	1	No
…	…	…	…	…	…
1	1	1	0	1	Yes
1	2	1	1	0	No
0	0	0	2	0	No
0	0	1	1	1	Yes
1	2	0	0	0	Yes
1	0	0	1	0	Yes
1	1	1	2	0	No
0	1	0	1	1	Yes

The sample data was processed using Orange Data Mining Software. The workflow can be seen in figure 2.

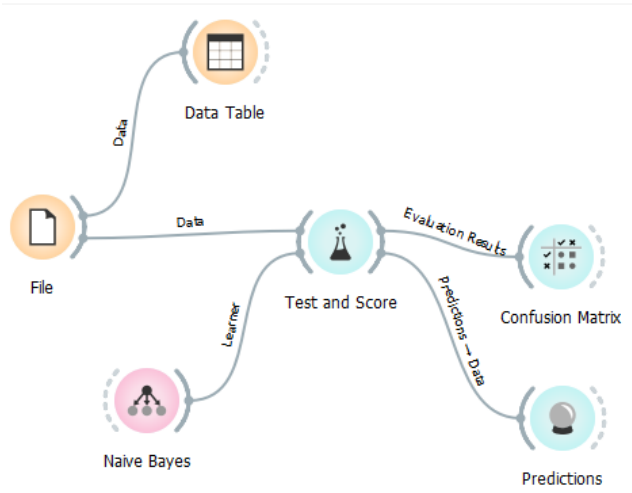


Figure 3 Processing Sample data Workflow

The Result of the Confusion Matrix can be Seen in Figure 4.

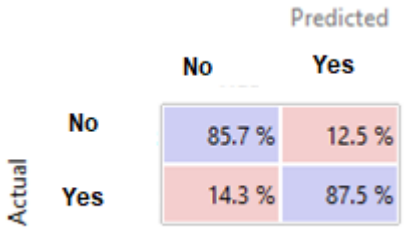


Figure 4 Confusion Matrix

The result of prediction using the Naïve Bayes Classifier model can be seen in table 3.

Table 3. Comparison of Actual Data with Predictions

Actual	Predictions
Yes	Yes
No	No
Yes	Yes
No	iNo
Yes	Yes
Yes	Yes
Yes	Yes
No	No
…	…
Yes	Yes
No	No
No	Yes
Yes	Yes
No	No
Yes	Yes
No	No

From Table 3, the dataset test with the Naive Bayes classifier model has an accuracy of 86.7%, precision of 86.7%, and recall 86.7%.

4. Conclusion

Based on the study results using the Naive Bayes classifier on the dataset that was tested with actual egg data from laying hens breeders, it resulted in 86.7% accuracy, 86.7% precision, and 86.7% recall. Of all the attributes tested were proven to affect the quality of the eggs produced. Therefore, using a naive Bayes classifier can help lay hens breeders determine the quality of the eggs produced so that egg sales increase.

References

[1] Dong J, Dong X, Li Y, Zhang B, Zhao L, Chao K and Tang X 2020 Prediction of infertile chicken eggs before hatching by the Naïve-Bayes Method combined with visible near infrared transmission spectroscopy *Spectrosc. Lett.* **53** 327–36

[2] Maimunah M and Whidhiasih R 2017 Identifikasi Mutu Telur Ayam Berdasarkan Kebersihan Kerabang Menggunakan Jaringan Syaraf Tiruan *Informatics Educ. Prof.* **2** 234362

[3] Osisanwo F ., J.E.T A, O A, J. O H, O O and J A 2017 Supervised Machine Learning Algorithms: Classification and Comparison *Int. J. Comput. Trends Technol.* **48** 128–38

[4] Vijay R, Vangara B, Thirupathur K, and Vangara S P 2020 Opinion Mining Classification using Naive Bayes Algorithm *Int. J. Innov. Technol. Explor. Eng.* **9** 495–8

[5] Ali Z M, Hassoon N H, Ahmed W S and Abed H N 2020 The Application of Data Mining for Predicting Academic Performance Using K-means Clustering and Naïve Bayes Classification *Int. J. Psychosoc. Rehabil.* **24** 2143–51

[6] Xu F, Pan Z and Xia R 2020 E-commerce product review sentiment classification based on a naïve Bayes continuous learning framework *Inf. Process. Manag.* **57** 102221

[7] Meiriza A, Lestari E, Putra P, Monaputri A and Lestari D A 2020 Prediction Graduate Student Use Naive Bayes Classifier *Sriwijaya International Conference on InformationTechnology* vol 172 (Atlantis Press) pp 370–5

[8] Zhang H, Jiang L, and Yu L 2021 Attribute and instance weighted naive Bayes *Pattern Recognit.* **111**

[9] Zhang H, Jiang L and Yu L 2020 Class-specific attribute value weighting for Naive Bayes *Inf. Sci. (Ny).* **508** 260–74

[10] Marcos De Moraes R, Soares E A D M G and MacHado L D S 2020 A double weighted fuzzy gamma naive bayes classifier *J. Intell. Fuzzy Syst.* **38** 577–88

[11] Santoso H A, Rachmawanto E H, Nugraha A, Nugroho A A, Setiadi D R I M and Basuki R S 2020 Hoax classification and sentiment analysis of Indonesian news using Naive Bayes optimization *Telkomnika (Telecommunication Comput. Electron. Control.* **18** 799–806

Identification of Soil Bearing Capacity for Polinela's New Campus Road Trace Planning using Dynamic Cone Penetrometer Test

Aniessa Rinny Asnaning[1], Mira Wisman[1], Tanya Audia Balqis[1]

[1]Teknologi Rekayasa Konstruksi Jalan dan Jembatan, Politeknik Negeri Lampung
*Email: aniessa.rinny@polinela.ac.id

Abstract. Along with the development of Polinela's campus followed by an increase in the number of students, a wider campus area is also needed to accommodate all lecture and practical activities at Polinela. Before starting the construction of buildings and other infrastructure, it is necessary to build a connecting road to access the points of development locations to be more connected. In road planning, it is required to investigate the bearing capacity of the subgrade first because it is the most crucial part of supporting road construction. This study aimed to measure variations in the value of the bearing capacity of the subgrade as the pavement's foundation. This study uses the Dynamic Cone Penetrometer Test (DCPT) to obtain predictive results from the bearing capacity of the subgrade in the form of the California Bearing Ratio (CBR) value. From six sampling points, the maximum CBR value was obtained at site 1 of 6.11% at a depth of 42 mm, site 2 of 1.21% at a depth of 365 mm, site 3 of 0.95% at a depth of 118 mm, site 4 of 2.08% at a depth of 535 mm, site 5 of 2.25% at a depth of 275 mm, and site 6 of 3.01% at a depth of 101 mm. The CBR value of the five points that did not reach the 6% standard was due to the location being cassava and corn plantations with subgrade soil that had undergone tillage so that the ground became loose and was no longer classified as the original soil.

1. Introduction

Lampung State Polytechnic (Polinela) is the first vocational college in Lampung Province, Indonesia. An increase follows the development of Polinela in the number of students, and a wider campus area is also needed to accommodate all lecture and practical activities at Polinela. Therefore, Polinela has a new campus area in Kota Baru, Lampung Province, Indonesia. The new campus is still vacant and only has a master plan of development plants. Before starting the construction of buildings and other infrastructure, it is necessary to build a connecting road to access the points of development locations to be more connected.

In road planning, it is necessary to investigate the bearing capacity of the subgrade first because it is the most crucial part of supporting road construction. This study aimed to measure the bearing capacity value of the subgrade excavation in the route plan for Polinela new campus. The way to get the value of soil's bearing capacity in the California Bearing Ratio (CBR) number is to do conventional laboratory CBR or field CBR testing. Still, this method requires a relatively long time, and CBR equipment is rather expensive.

The Dynamic Cone Penetrometer Test (DCP test) is one method to detect soil's bearing capacity. Until now, the DCP test is still the cheapest method of measuring CBR value in the field, and it is accurate enough to be carried out and is a non-destructive testing method [1]. The DCP test is also a

procedure that is easy and fasts to carry out in the field to get the value of the bearing capacity of the soil in the CBR number and is an alternative if the area CBR is difficult to do [2].

2. Related Research

Dynamic Cone Penetrometer Test (DCP tets) is a method to estimate the subgrade bearing capacity, which is relatively cheap and accurate. This method is one of the non-destructive testing methods used to investigate crushed stone foundation layers, gravel foundations, soil stabilization with cement or lime, and subgrade soils [1]. The DCP is an instrument designed for rapid in situ measurements of existing road pavement structural components with unbound granular materials. Continuous measurements can be made to an 800 mm or 1,200 mm depth when an extension rod is installed [3].TRL introduced DCP technology for testing in tropical and sub-tropical conditions as reported in Overseas Road Note 31, Crowthorne, the United Kingdom, in 1993. Several formulations of CBR values summarized by TRL, obtained from various equations :

Van Vuuren, 1969, (Conus 60^0) : Log CBR = 2,632 – 1,28(Log DCP) (1)
Kleyn & Harden, 1983, (Conus 30^0) : Log CBR = 2,555 – 1,145(Log DCP) (2)
Smith dan Pratt, 1983, (Conus 30^0) : Log CBR = 2,503 – 1,15(Log DCP) (3)
TRL, Road Note 8, 1990, (Conus 60^0) : Log CBR = 2,48 – 1,057(Log DCP) (4)

In addition to obtaining the CBR value, the DCP test is also used as a new method for assessing liquefaction potential. This study results found that the DCP test can be used as a new method to evaluate liquefaction potential, which is as good as the SPT test [4]. The DCP test is also used to generate the soil N-SPT value for the design of the foundation for power transmission towers located in tropical forests and challenging to access by motorized vehicle. The SPT and DCP tests carried out side-by-side resulted in four data groups: coarse-grained soil, fine-grained soil, coarse-grained soil above the groundwater level, and fine-grained soil below the groundwater level. These four data are then connected to form a correlation equation that is then successfully applied to predict the N-SPT value for the area not accessible by motorized vehicles [5].

The results showed that combining GPR, DCP, and drilling tests could accurately estimate the road layer thickness. DCP testing combined with non-destructive techniques such as visual condition surveys, FWD, Ground Penetration Radar (GPR), and pavement drilling can evaluate pavements traversed by heavy truck traffic, connecting ports, major roads and highways, airports, and industrial roads. DCP testing can also determine the subgrade strength and sub-base layers. FWD testing can be used to evaluate the pavement structure [6]. Other studies also use the DCP test to estimate the CBR value in the subgrade and sub-base layer with seasonal variations. The results showed no significant difference in the subgrade reaction modulus and CBR values under freezing, thawing, and summer conditions [7]. DCP tests are also used to evaluate the engineering properties of sandy soils under laboratory conditions. The research result is the relationship between Dynamic Penetration Index (DPI), relative density (Dr), modulus of elasticity (E), shear modulus (G), subgrade reaction modulus (K.S.), and soil friction angle obtained with a high determination coefficient value (N90%). The test results repeatability is also evaluated by calculating the coefficient of variation (Cv), less than 30% for all tests [8].

Research on DCP testing is also widely carried out in subtropical areas, namely the Instrumented Dynamic Cone Penetrometer (IDCP) to measure the thickness of the active layer that undergoes freezing and thawing due to global warming. This process can damage the infrastructure of highways, railroads, and underground pipelines embedded in cold areas. The result is that IDCP, which can transfer energy to the cone and stem head, can be applied to evaluate variations in strength and thickness of the active soil layer [9]. The DCP test is also used to determine the vulnerability of shallow landslides in the slopes of the Alps, causing loss of agricultural land. The results are the relationship between superficial subsurface structures (regolith) and the occurrence of shallow landslides. This research also makes it possible to predict the potential for landslide development through the secondary launch process [10]. DCP and FWD were used to evaluate various stabilization technologies on unhardened soils

damaged by the effects of freeze-thaw over two periods. This study shows that unpaved roads with Macadam Base Stone (MSB) produce the best freeze-thaw performance in terms of modulus of elasticity among all the stabilization methods examined [11].

3. Research Methods

This research was carried out by first conducting the DCP test to get the CBR value of the subgrade. DCP testing was carried out on Polinela's new campus in Kota Baru, Lampung Province, Indonesia. The research object is focused on the main road alignment plan in Polinela's new campus, which stretches for 1,178 meters. There are six DCP measurements points at the research site.

The data obtained from the DCP test will be used to calculate the CBR value of the subgrade. The calculation of the CBR value refers to the guidelines from the Circular Letter of the Minister of Public Works No. 04/SE/M/2010 concerning the Implementation of Guidelines for the California Bearing Ratio (CBR) Test with Dynamic Cone Penetrometer (DCP) as follows:

1. For conus 30^0

   Log CBR = 1.352 – 1.125(Log DCP) (cm/blow) (5)

2. For conus 60^0

   Log CBR = 2.8135 – 1.313(Log DCP) (mm/blow) (6)

This study used a DCP with conus 60^0, so the formula for calculating CBR value is as follows :

$CBR = 10^{2.8135-1.313(\log DCP)}$ (mm/blow) (7)

The CBR value is a correlation of the soil bearing capacity. In the new pavement design, it is required that the subgrade has an effective CBR of not less than 6% [12].

4. Results and Discussions

The maximum subgrade CBR value obtained from the results of the DCP test is presented in Table 1.

Table 1. Maximum CBR Value

Site	1	2	3	4	5	6
Depth (mm)	42	365	118	535	275	101
DCP value (mm/blow)	35	120	145	80	75	60
Maximum CBR value (%)	6.11	1.21	0.95	2.06	2.25	3.01

For site 1, the maximum CBR value obtained is 6.11% at a depth of 42 mm. The maximum CBR value for site 2 is 1.21% at 365 mm depth. In site 3, the maximum CBR value is 0.95% at 118 mm depth. The maximum CBR value in site 4 is 2.06% at 535 mm depth. In site 5, the maximum CBR value is 2.25% at 275 mm depth. And last, in site 6, the maximum CBR value is 3.01% at 101 mm depth.

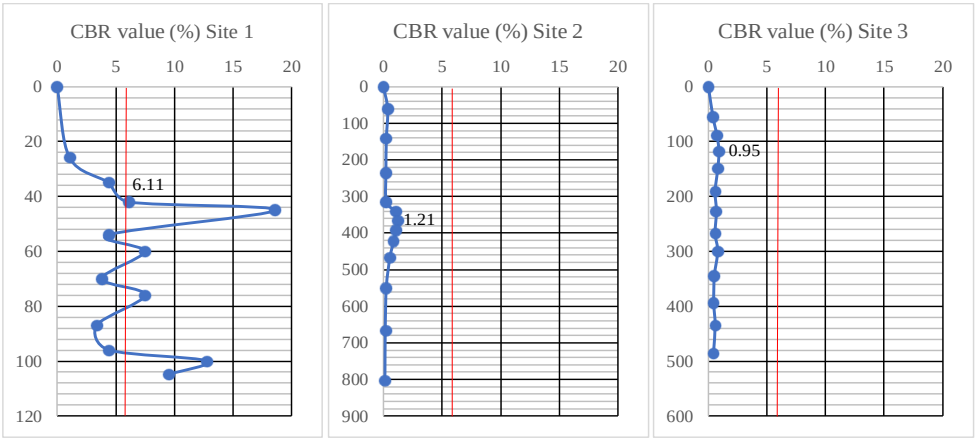


Figure 1. CBR Value at Site 1, Site 2, and Site 3

The red vertical line is the minimum required CBR value for the subgrade of 6%. As seen on the CBR value graph at Site 1, the minimum required CBR value is reached at a depth of 42 mm with a value of 6.11%. The maximum CBR value can reach 18.59% at a depth of 45 mm. A good CBR value is obtained because Site 1 is located on the perimeter of Polinela's new campus area, closer to the existing road. The soil condition at Site 1 is still the original undisturbed soil.

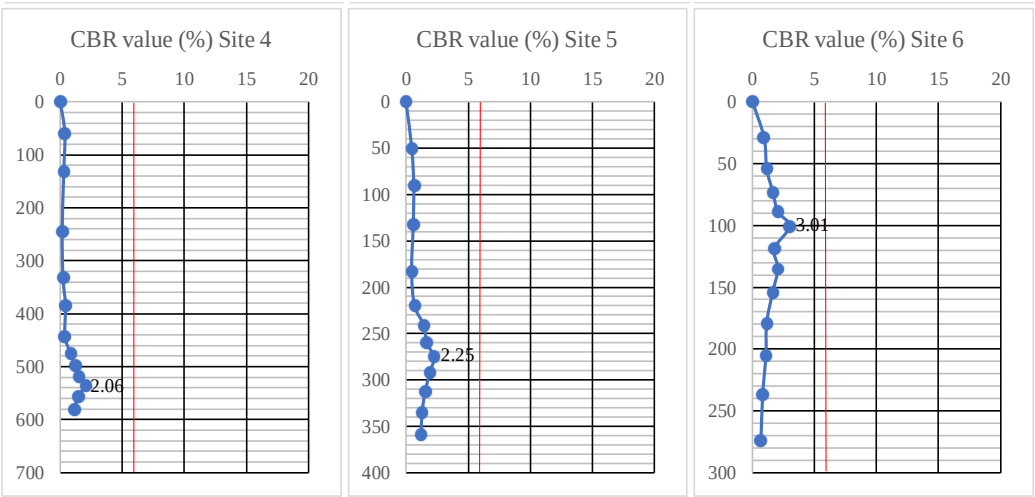


Figure 2. CBR Value at Site 4, Site 5, dan Site 6

At Site 2 to Site 6, the CBR value required for subgrade was not achieved. Even at Site 4, a maximum CBR value of 2.06 % was achieved at 535 mm depth. The other sites are located more profound into the area of Polinela's new campus. From the analysis results, it can be seen that the deeper land area, the CBR value does not meet the requirements, namely not less than 6%. The leak of CBR value is because the land area of Polinela's new campus is corn and cassava field that has undergone processing soil. Soil tillage is the process of loosening the soil to make it easier to plant and fertilize so that the soil grains become loose and not solid anymore. As a result of the tillage process, the soil's bearing capacity decreases to carry the load of the building on it.

5. Conclusions and Recommendations

From the results of the DCP test at six sites, the CBR value that meets the CBR requirements for subgrade is only found at Site 1, which is 6.01% at 42 mm depth. The CBR value at Site 2 to 6 did not reach the minimum required CBR value for subgrade. This is because Site 1 is close to the existing road and is still undisturbed soil. While Site 2 to Site 6 is located in an area temporarily used as corn and cassava fields planted by the community. The soil at Site 2 to Site 6 has undergone soil processing planted with corn and cassava. It is no longer undisturbed soil because the soil particles have become loose and reduced its bearing capacity.
Suggestions that can be given are to cut the soil to the depth of the roots of corn and cassava or obtain the subgrade, and then a DCP test is carried out so that the CBR value data obtained will be more accurate.

Acknowledgement
The author acknowledges the support from Politeknik Negeri Lampung (No. 209.27/PL15.8/PT/2021).

References
[1] Dachlan A T 2005 Pengujian Daya Dukung Perkerasan Jalan Dengan Dynamic Cone Penetrometer (Dcp) Sebagai Standar Untuk Evaluasi Perkerasan Jalan *J. Stand.* **7** 126

[2] Kementerian Pekerjaan Umum Tentang Cara Uji CBR Dengan DCP 2010 Surat Edaran Menteri Pekerjaan Umum No . 04 / SE / M / 2010 tentang Pemberlakukan Pedoman Cara Uji California Bearing Ratio (CBR) dengan Dynamic Cone Penetrometer (DCP) KEMENTERIAN PEKERJAAN UMUM

[3] Transport Research Laboratory 1993 a Guide To the Structural Design of Bitumen- Surfaced Roads in Tropical and Sub-Tropical *Overseas Road Note 31* 3

[4] Hashemi M and Nikudel M R 2016 Application of Dynamic Cone Penetrometer test for assessment of liquefaction potential *Eng. Geol.* **208** 51–62

[5] Ampadu S I K, Ayeh F F J and Boadu F 2018 Deriving SPT N-Values from DCP Test Results: The Case of Foundation Design in a Tropical Environment *Geotech. Geol. Eng.* **36** 2517–31

[6] Chao C C, Lin D F, Luo H L, Wang Y K and Lo W 2018 Non-destructive evaluation of a city roadway for pavement rehabilitation: A case study *Int. J. Pavement Res. Technol.*

[7] Zhang Y, Vennapusa P K R, White D J and Johnson A E 2018 Seasonal variations and in situ assessment of concrete pavement foundation mechanistic properties *Int. J. Pavement Res. Technol.* **11** 363–73

[8] Mohammadi S D, Nikoudel M R, Rahimi H and Khamehchiyan M 2008 Application of the Dynamic Cone Penetrometer (DCP) for determination of the engineering parameters of sandy soils *Eng. Geol.* **101** 195–203

[9] Byun Y H, Yoon H K, Kim Y S, Hong S S and Lee J S 2014 *Active layer characterization by instrumented dynamic cone penetrometer in Ny-Alesund, Svalbard* vol 104–105 (Elsevier B.V.)

[10] Wiegand C, Kringer K, Geitner C and Rutzinger M 2013 Regolith structure analysis - A contribution to understanding the local occurrence of shallow landslides (Austrian Tyrol) *Geomorphology* **183** 5–13

[11] Li C, Vennapusa P K R, Ashlock J and White D J 2017 Mechanistic-based comparisons for freeze-thaw performance of stabilized unpaved roads *Cold Reg. Sci. Technol.* **141** 97–108

[12] Marga D J B 2017 Surat Edaran Tentang Penyampaian Manual Desain Perkerasan Jalan Revisi 2017 68–70

Dioscorea hispida: economic potential and applications

R Ahmad[1]

[1]School of Industrial Technology, Universiti Sains Malaysia, 11800 USM, Pulau Pinang, Malaysia

*Email: rosmah@usm.my

Abstract. *Dioscorea hispida* is one of the 600 edible plant species belongs to Dioscoreaceae family. It is distributed in tropical and sub-tropical regions of Philippines, China, Taiwan, New Guinea, Malaysia, Fujian, Bhutan, Indonesia, Bangladesh, Sikkim, Thailand, Cambodia, Laos, Myanmar, Vietnam, and Africa. Each of the mature plant can produce up to 15 kg of tuber. However, it is economically insignificant due to the presence of toxic alkaloid dioscorine in the fresh tuber. The economic value and potential applications of *D. hispida* tuber starch will be discussed. Starch from *D. hispida* tuber has been researched for the applications in food and non-food industries. The starch was used as material in water filtration system, wastewater treatment, and thermoplastic film. The starch was also used as a food ingredient, and it can be further value added by converting it into glucose syrup and oligosaccharides prebiotic. Paste of *D. hispida* tuber has been shown to have ethno-pharmaceutical value in treating wound, vomiting and eye infection, and the fermented tuber (*tape* or *tapai*) has been shown to have health benefits in reducing hypertension and blood cholesterol level.

1. Introduction

Dioscorea hispida (or commonly known as yam) is a perennial monocotyledous tuber-producing climbing plant (**Figure 1**) which naturally thrives in tropical and sub-tropical regions of Philippines, China, Taiwan, New Guinea, Malaysia, Fujian, Bhutan, Indonesia, Bangladesh, Sikkim, Thailand, Cambodia, Laos, Myanmar, Vietnam, and Africa [1,2]. Although there are 1137 species of *Dioscorea*, only about 600 species are edible and *D. hispida* is one of them. Each mature plant of *D. hispida* can produce up to 15 kg of starchy tuber (**Figure 2**) which however contains water soluble toxic alkaloid dioscorine [3].

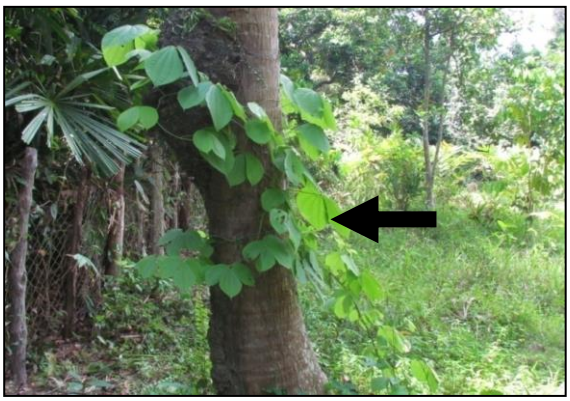


Figure 1. *D. hispida* climbing plant

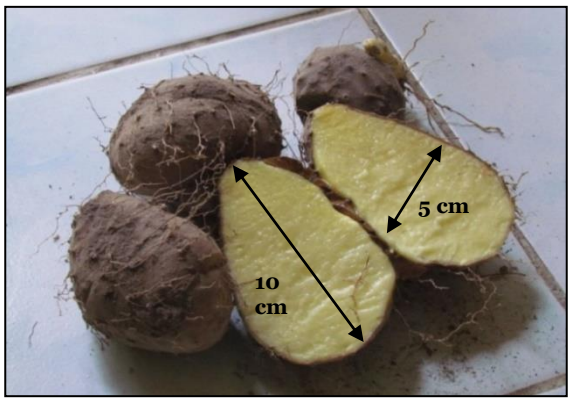


Figure 2. Tubers of *D. hispida*

The presence of dioscorine has negatively impacted the value of the starchy tubers. Nevertheless, traditional method of steeping the tubers in flowing water has successfully removed the toxin to a safe consumption level, and one kg of fresh tuber can produce up to 270 g of starch powder. Therefore, the economic value and potential applications of *D. hispida* tuber starch will be explained in this paper.

2. Composition and physical properties of starch from *D. hispida* tuber

The starch was processed from *D. hispida* tubers obtained from Marang, Terengganu, Malaysia following these steps: washing and peeling the tubers, slicing the tuber into thin slices, submerging the slices in 5% of NaCl solution for 3 days, grinding the slices, separating the slurry, collecting the filtrate, sedimentation of the starch and drying of the starch [4]. *D. hispida* starch powder contained (in dry basis) 0.42% total crude protein, 0.23% total crude fat, 0.47% ash, and 98.88% carbohydrate. The carbohydrate was mainly starch (88.8%) with amylose to amylopectin ratio of 28:72.

The proximate analysis in dry basis of *D. hispida* starch in comparison with other commercial starches (corn, sago, and potato) is shown in **Table 1** (Napisah, 2019).

Table 1. Proximate analysis of *D. hispida* and some commercial starches.

	Crude Protein	Crude Fat	Ash	Carbohydrate
D. hispida	0.42	0.23	0.47	98.88
Sago	0.22	0.14	0.19	99.45
Potato	0.13	0.11	0.43	99.33
Maize/corn	1.00	0.11	0.23	98.66

The crude protein content of the starches ranged between 0.13% and 1.00% (**Table 1**), and corn starch contained the highest protein. *D. hispida* starch contained the highest crude fat (0.23%) and its ash content (0.47%) was similar with potato but higher than sago and corn starches. Ash content is an indication of mineral content of a food. This therefore suggests that *D. hispida* starch could be an important source of mineral. All the starch sources had high carbohydrate content of over than 98%.

The physical property of *D. hispida* tuber starch is shown in **Table 2** (Napisah, 2019).

Table 2. Physical property of *D. hispida* tuber starch.

Parameter	Value
• Granular size and morphology	2-4 µm, polyhedral shape
• Bulk and tapped density	290 kg/m^3, 410 kg/m^3
• Swelling power and solubility capacity	14.22 g/g, 5.48%
• Water-holding and oil-holding capacities	2.78 g/g, 1.14 g/g
• Pasting property	Pasting temperature 78.15°C; peak time 5.87 min;

	peak viscosity 283.50 RVU
• Diffraction pattern	B-type starch

The granules of *D. hispida* starch were observed at 5000× and 10000× magnifications using a scanning electron microscope as shown in **Figure 3**. The granules were of polyhedral shape with coarse surfaced without fissure. The average diameter of *D. hispida* starch granule was 2-4 µm, the smallest granule if compared to other species of *Dioscorea* (23-40 µm) [5]. *D. hispida* starch granule was also the smallest as compared to that of sago (20-40 µm), potato (15-75 µm), and corn (8-12 µm). The compact and small granules make *D. hispida* starch has higher gelatinization temperature than corn starch. This is because corn starch granule has relatively weaker granular structural integrity due to the presence of natural pores and cavities on its surface [6].

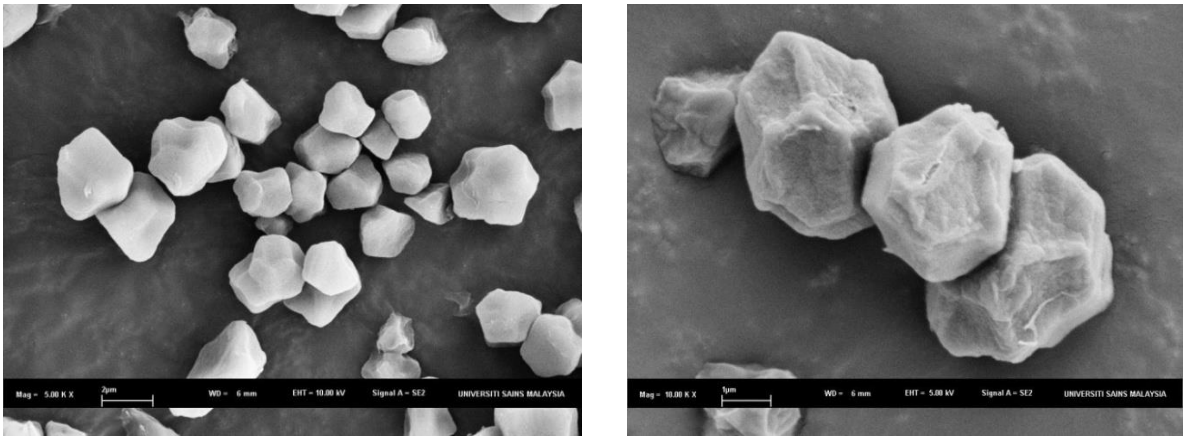


Figure 3. Scanning electron micrographs of *D. hispida* starch granules. Left, 5000×; Right, 10000×

3.1 Non-food industries

There are some potential applications of *D. hispida* tuber starch in non-food industries. Some but not limited examples are discussed here.

3.1.1 Coagulant in wastewater treatment. Starch from *D. hispida* tuber is used as natural coagulant, an alternative to environmental detrimental chemical coagulant in textile wastewater treatment [7]. Textile mill wastewater is a high turbidity effluent which contains large content of dyes, significant amount of suspended solids that contributes to high COD concentration. Incorporation of 2.5 g *D. hispida* starch per L of textile mill effluent at pH 7, managed to remove COD, turbidity, and colour of the effluent by 28%, 94% and 64% respectively.

3.1.2 Component in thermoplastic film. Chemical composition and physical property of starch and fibre waste from *D. hispida* tuber were analysed for the suitability as filler material for biodegradable thermoplastic film composite [8]. The experiment revealed that the starch and fibre have excellent thermal stability and high decomposition temperature of 309.7°C and 315.4°C, and crystallinity index of 27.5% and 39.0%, respectively. It was concluded that starch and fibre waste of *D. hispida* tuber could be promising alternative sustainable biomass materials as renewable filler materials in food packaging application.

3.1.3 Antifungal agent. Another application of *D. hispida* tuber starch is as an antifungal agent in wood decaying prevention [9]. An antifungal coating film containing *D. hispida* tuber starch to prevent wood decay was developed. Rubber wood coated with a modified film

coating formula with a ratio of 2:1:1:1 (polyvinyl alcohol: starch: sorbitol: hexamethylenetetramine) was able to retain approximately 50% of its original weight. Moreover, the coating film was effective to inhibit the growth of fungi *G. trabeum* and *C. versicolor*.

3.1.4 Component in water filtration membrane. D. hispida starch was used as the material in water filtration membrane. This is achieved by constructing a forward reverse membrane made of a glutaraldehyde-crosslinked chitosan and *D. hispida* starch (3% chitosan, 1.5% *D. hispida* starch, 5.6×10^{-5} mol glutaraldehyde, and 0.4% glycerol) into a fabricated water filtration bag [10]. It was concluded that the filtered brackish water using the filtration bag with chitosan/*D. hispida* starch membrane had met the quality standards for drinking water by WHO.

3.2 Food industry

3.2.1 Starch as food ingredient. D. hispida starch has been researched to be used as food ingredient in replacing a certain percentage of wheat flour in the making of muffin, cookies and bread, and these food products have gained good customers' acceptance. Therefore, *D. hispida* starch has the potential as a food ingredient in bread and confectionary. As a result, large quantity of *D. hispida* starch is needed to fulfill the industrial demand. Cell wall of *D. hispida* tuber contains up to 48.2% cellulose and pectin. Cell wall degrading enzymes such as cellulase and pectinase are commonly used to degrade the cell wall components to release the intracellular content.

Enzymatic approach was attempted to obtain a higher yield of starch extraction from *D. hispida* tuber. Cell wall degrading enzymes (cellulase, pectinase or combination of cellulase and pectinase) were added into *D. hispida* tuber pulp. After the enzyme reaction was terminated, starch slurry was left to sediment and the extracted starch was dried. **Table 3** shows the enzymatic reaction condition, yield of starch and percent increase in starch yield after incorporating cell wall degrading enzymes during the starch extraction method.

Table 3. Yield of extracted starch as affected by cell wall degrading enzymes.

Sample	Enzyme Reaction Condition	Yield of Starch (%, w/w)	% Increased
Without enzyme (Control)	-	27.00	-
Cellulase (C)	pH 5, 37°C, ratio 1:2, 2 h	39.15	45
Pectinase (P)	pH 4, 50°C, ratio 1:2, 3 h	35.78	29
Combination C and P	pH 4.5, 45°C, ratio 1:2, 2 h	51.98	97

Note: The enzyme reacted with tuber pulp at a ratio of 10 unit of enzyme to 10 g, 20 g or 30 g of pulp for a duration of 4 h with interval sampling.

The yield of the extracted starch was increased by 45%, 29% and 97% by using cellulase, pectinase, and combination of cellulase and pectinase (unpublished data), respectively as compared to the control sample which was extracted according to the conventional starch extraction method [4].

3.2.2 Glucose syrup. D. hispida tuber starch can be further processed to glucose syrup. Starch polysaccharides consist of amylose and amylopectin. Amylose is a linear polymer of glucose linked by α-1-4 glycosidic bonds and amylopectin is a branched polymer of glucose linked by α-1-4 and α-1-6 bonds. The glucose syrup was obtained by treating the gelatinized *D. hispida* starch with a consecutive action of α-amylase and glucoamylase [11]. **Table 4** shows the enzymatic reaction condition.

Table 4. Enzymatic reaction condition.

Sample	α-amylase	Glucoamylase
Gelatinized starch	pH 6.9, 70°C, 60 min	pH 4.5, 60°C, 40 min

Note: Enzyme was maintained at 1 U per 2 g of starch. Reaction was allowed to occur for 90 min for each enzyme and interval sampling was carried out for total reducing sugars concentration analysis.

α-amylase hydrolyzed amylose polymer into oligosaccharides and maltose. Reacting the starch polysaccharides with α-amylase for 60 min had increased the total reducing sugars concentration as maltose by 148%. The mixture was consecutively reacted with glucoamylase for 40 min and the final mixture had a total reducing sugars concentration of 4.42 mg/mL dextrose equivalent value of 42%. Glucoamylase hydrolyzed disaccharides maltose to glucose monomers. As a result of the enzymes reaction, the starch polysaccharides were fully hydrolyzed to glucose and fructose as determined by using a HPLC system. *D. hispida* glucose syrup had a dextrose equivalent value of 42% with 99.7% of the sugars were glucose and 0.3% was fructose.

3.2.3 Oligosaccharides prebiotic. Starch was extracted from *D. hispida* and further processed to oligosaccharides via enzymatic hydrolysis (Napisah, 2019). The oligosaccharides were evaluated for their prebiotic potential which are resistant to gastric acid and gastrointestinal enzymatic digestions, resistant to intestinal absorption. The prebiotic oligosaccharides should be metabolized by beneficial intestinal microflora and producing short chain fatty acids.

D. hispida oligosaccharides was obtained from the starch hydrolysis with sequential action of α-amylase and pullulanase on 10% (w/v) starch for 6 hours. The yield of oligosaccharides produced was 19.3 mg g^{-1} of starch and mixture with degree of polymerization (dp) of 2-7 was separated and used for prebiotic potential study (**Figure 4**).

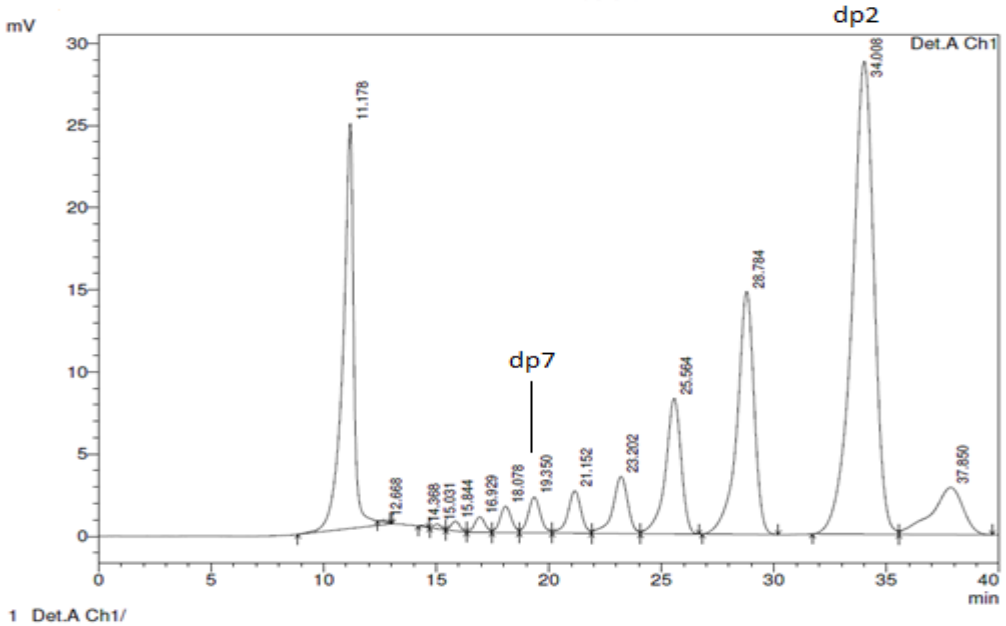


Figure 4. HPLC chromatogram of DHOS obtained after hydrolysis of 10% (w/v) *D. hispida* tuber starch by sequential activity of α-amylase and pullulanase for 6 h

The oligosaccharides were subjected to gastric juice digestion at pH 1-pH 4 for 180 h. The oligosaccharides were partially digested at high acidic pH 1 and pH 2 but resisted the digestion by the gastric juices at pH 3 and pH 4.

The oligosaccharides were also subjected to gastrointestinal tract digestive enzymes; salivary α-amylase, and pancreatic pepsin and pancreatin. At least 64% of the oligosaccharides were still intact and more than 50% of the *D. hispida* oligosaccharides retained in the dialysis tubing, indication of its resistance towards digestive enzyme hydrolysis and intestinal absorption.

Incorporation of *D. hispida* oligosaccharides in the culture medium of selected beneficial bacteria was able to enhance the bacterial growth, reduce the pH medium, produce substantial amount of lactic, acetic, and propionic acids, and exhibited positive prebiotic activity score [12]. In conclusion, oligosaccharides of *D. hispida* tuber starch have the potential to be used as a dietary prebiotic ingredient.

4. Pharmaceutical Benefits

4.1 Ethnobotanical use and ethnopharmacological use

Although the pharmaceutical benefits of *D. hispida* tuber have not been scientifically proven, native people around the world has been using the tuber for (a) eye treatment by applying the eye with water of soaked tuber, (b) foot skin treatment by pasting the tuber on the affected parts overnight to treat the peeling of skin, (c) treatment of vomiting, indigestion, and used as a purgative, (d) wound and injury treatment by applying roasted tuber paste on the affected area. Kumar and co-workers had studied on the ethnopharmacological potential and traditional use of *Dioscorea* species by the local people of Similipal Biosphere Reserve, Odisha, India [13].

Besides providing energy source from the dietary starch carbohydrate, tuber of *Dioscorea* species possess various secondary metabolites which are responsible for the medicinal properties of the tuber. Bioactive compounds identified in *Dioscorea* species were saponins, alkaloids, flavonoids, tannin, phenols, allantoin (a purine derivatives), furanoid norditerpenes cyanogens, and lutein. Allantoin was found to be in higher concentration in *Dioscorea* species than in any other plants (Fu et al., 2006). Therefore, it was recommended that allantoin be a standard compound for the quality control of *Dioscorea* tubers. Allantoin inhibits the activity of α-amylase and α-glucosidase which is responsible for its antihyperglycemic/antidiabetic action. Furthermore, it has antioxidant and antidyslipidemic activities.

Fermented *Dioscorea* sp. tuber (*tape* or *tapai ubi*) with red mold (usually is *Monascus* sp.) has been proven to have antihypertensive, antidiabetic, antilipidemic and anticancer activities.

4.1 Antihypertensive agent

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) of hypertensive rats, orally administered with 75 mg fermented *Dioscorea* per kg of body weight for 8 weeks, decreased significantly. Administering 150 mg/kg of fermented *Dioscorea* to the rats had significantly reduced the SBP and DBP after 8 h of administration. This is because the fermented *Dioscorea* contained γ-aminobutyric acid, anti-inflammatory yellow pigments (monascin and ankaflavin), and angiotensin-l-converting enzyme (ACE) inhibitory activity (Wu et al., 2009).

4.2 Antidiabetic and antistress agent

Fermentation of *Dioscorea* tuber with red mold produced a yellow pigment monascin. This pigment showed antidiabetic activity in streptozotocin-induced diabetic rats. Blood glucose and serum insulin of the rats which were fed with 30 mg monascin/kg/day for 8 weeks was attenuated and increased respectively (Shi et al., 2012). The same group of researchers also studied the effect of monascin from the fermented *Dioscorea* on the lifespan of *Caenorhabditis elegans* under a high-glucose condition, and it was found that monascin increased stress resistance and expression of the stress response genes, thus extended the lifespan of the *C. elegans*.

4.3 Antilipidemic activity

Monacolin K (lovastatin) is a secondary metabolite produced by *Monascus purpureus* during the fermentation of *D. hispida* tuber with red mold. Monacolin K is an inhibitor for HMG-CoA reductase in cholesterol biosynthesis. Fermented *Dioscorea* exhibited higher anti-cholesterol activity than fermented rice because monacolin K production was higher in the fermented *Dioscorea* (Lee et al., 2010). Besides monacolin K, yellow pigments monascin and ankaflavin produced during the fermentation had also shown significant effect on lowering cholesterol, triglyceride, and low-density lipoprotein cholesterol levels in the blood serum and aorta lipid plaque of the tested hyperlipidemic rats (Lee et al., 2010).

4.4 Anticancer activity

Ethanolic extract of fermented *Dioscorea* tuber with red mold was tested for its anti-cancer effect on cancer-induced hamster. The carcinogenesis of buccal pouch of the hamster was induced by 7,12-dimethyl-1,2-benz[a]anthracene (DMBA). The ethanolic extract had shown therapeutic potentials against oral cancer as it had decreased nitric oxide, reactive oxygen species, and prostaglandin E2 overexpression, and simultaneously increased p53, serum tumor necrosis factor-α (TNF-α), and interleukin-1β (IL-1β) to significantly stimulate caspase-8 and -3 activities, indicating that the extract had managed to reduce oxidative damage caused by DMBA and induced apoptosis in the oral cancer cells (Hsu et al., 2011).

5. Conclusion

D. hispida tuber has gained great attention due to its starch content. Starch of *D. hispida* tuber has potential use in food (as starch, oligosaccharides, and glucose syrup) and non-food industries (as thermoplastic film, antifungal agent, filtration membrane and coagulant). Secondary metabolites from fermented *D. hispida* tuber with red mold have been researched for their pharmaceutical benefits as antihypertensive, antidiabetic, antilipidemic and anticancer agent.

References

[1] Sharma L N and Bastakoti R 2010 Ethnobotany of *Dioscorea* L. with emphasis on food value in Chepang communities in Dhading district, central Nepal *Bot. Orient. J. Plant Sci.* **6** 12–7

[2] Nashriyah, M.; Salmah, T.; NurAtiqah, M.Y.; Siti Nor Indah, O.; MuhamadAzhar, A.W.; Munirah, S.; Nornasuha, Y. and Abdul Manaf A 2012 Ethnobotany and Distribution of Dioscoreahispida Dennst . (Dioscoreaceae) in Terengganu , Peninsular Malaysia *World Acad. Sci. Eng. Technol.* **72** 1782–5

[3] Tattiyakul J, Naksriarporn T, Pradipasena P and Miyawaki O 2006 Effect of moisture on hydrothermal modification of yam Dioscorea hispida Dennst starch *Starch/Staerke* **58** 170–6

[4] Kumoro A C, Retnowati D S, Budiyati C S, Manurung T and Siswanto 2012 Water solubility, swelling and gelatinization properties of raw and ginger oil modified gadung (Dioscorea hispida dennst) flour *Res. J. Appl. Sci. Eng. Technol.* **4** 2854–60

[5] Aboubakar N Y, Scher J and Mbofung C 2008 Physicochemical, thermal properties and microstructure of six varieties of taro (Colocasia esculenta L. Schott) flours and starches *J. Food Eng.* **86** 294–305

[6] Chan H-T, Bhat R and Karim A A 2010 Effects of sodium dodecyl sulphate and sonication treatment on physicochemical properties of starch *Food Chem.* **120** 703–9

[7] Yusoff M S, Juni F, Ahmed Z, Alazaiza M Y D and Aziz H A 2021 Dioscorea hispida starch as a novel natural coagulant in textile wastewater treatment *J. Eng. Technol. Sci.* **53**

[8] Hazrati K Z, Sapuan S M, Zuhri M Y M and Jumaidin R 2021 Extraction and characterization of potential biodegradable materials based on dioscorea hispida tubers *Polymers* **13** 1–19

[9] Lazim A M, Azfaralariff A, Azman I, Arip M N M, Zubairi S I, Mohd Kaus N H, Nazir N, Mohamad M, Kamil A, Azzahari A D, Abdullah A and Zul Ariff A L 2020 Improving wood durability against G. Trabeum and C. versicolor using starch based antifungal coating from Dioscorea hispida sp. *J. Taiwan Inst. Chem. Eng.* **115** 242–50

[10] Saiful S, Ajrina M, Wibisono Y and Marlina M 2020 Development of chitosan/starch-based forward osmosis water filtration bags for emergency water supply *Membranes* **10** 1–13

[11] Hazrati K, Sapuan S, Zuhri M and Jumaidin R 2021 Extraction and characterization of potential biodegradable materials based on Dioscorea hispida tubers *Polymers* **13** 584

[12] Napisah H and Rosma A 2020 Fermentation of Dioscorea hispida oligosaccharides as prebiotic potential by lactic acid bacteria and bifidobacterium *IOP Conf. Ser. Mater. Sci. Eng.* **716**

[13] Kumar S, Das G, Shin H-S and Patra J K 2017 Dioscorea spp. (A Wild Edible Tuber): A Study on Its Ethnopharmacological Potential and Traditional Use by the Local People of Similipal Biosphere Reserve, India *Front. Pharmacol. Wwwfrontiersinorg* **8** 52

Synthesis, Characterization and Antibacterial Activity Assay of Carboxymethyl Chitosan

I. N. Sari[1*], K.R. Ningtyas[1], dan T. N. Agassi[1]

[1]Jurusan Teknologi Pertanian, Politeknik Negeri Lampung
Jl. Soekarno-Hatta No. 10 Rajabasa, Bandar Lampung,35144
*Email: iranovitasari@polinela.ac.id

Abstract. Chitosan is a natural biopolymer with the second largest abundance after cellulose. This compound was obtained from the deacetylation of chitin from crab shell waste obtained in province of Lampung. It is known that chitosan has antibacterial properties because it has an amino group. However, a modification process needs to be carried out to produce compounds with more specific properties and benefits. The purpose of this study was to synthesize and to determine the characterization and antibacterial activity of carboxymethyl modified chitosan. Based on the research results obtained as much as 10.24% chitosan (per weight of crab shell powder) and carboxymethyl chitosan as much as 72.9% (per weight of chitosan). FTIR analysis of the derivative confirmed the incorporation of the carboxymethyl groups. Chitosan has a water content of 0.49% while carboxymethyl modified chitosan has a water content of 0.67%. The ash content of chitosan was 0.33% and the ash content of carboxymethyl modified chitosan was 0.69%. The synthesized chitosan has antibacterial activity against E.coli bacteria with the inhibition zone of 10 mm while against S. Aureus it had an inhibition zone of 11.89 mm. Meanwhile the inhibition zone of carboxymethyl chitosan against E.coli bacteria was 11.50 while that for S. Aureus was 12 mm.

1. Introduction

Chitosan is a natural product which is a derivative of the polysaccharide chitin. Chitosan is also an abundant cationic polymer after cellulose and is antibacterial, nontoxic, biodegradable and compatible. Chitin which is a source of chitosan can be obtained from marine biota, especially from crustaceans and arthropods such as shrimp and crabs. The process of isolation of chitin and chitosan from natural sources and the utilization of the antibacterial properties of chitosan have been carried out in previous studies.

[1] isolated chitosan from crab shell waste and has potential antimicrobial properties on various bacteria such as *Escherichia Coli, Straphylococccuc aureus etc*. [2] also stated that chitosan derived from shrimp has antibacterial activity against both gram-positive and gram-negative bacteria. Chitosan as an edible film has also been studied by [3], where chitosan effectively inhibits bacterial growth and effectively reduces water evaporation and product oxidation.

In this study, chitosan derivative compounds will be used, namely carboxymethyl chitosan from crab shell waste and tested for its antibacterial activity against gram-positive and gram-negative bacteria. Later this compound can be used as an antibacterial agent that is easily soluble in water media and can be applied in various fields such as; food, cosmetics, agriculture and pharmaceutical industries.

2. Methods

2.1. Material

The materials to be used are crab shell waste, NaOH, HCl, Acetic Acid, Methanol, Monochloroacetic Acid, Aquades, Filter Paper, gram positive bacteria (*Staphylococcus aureus*) and gram negative bacteria (*Escherichia coli*), aquades, Whatman 42 ashless circles filter paper 110 mm, universal indicator.

2.2. Chitosan synthesis

Crab shell powder was mixed with 4% NaOH solution and stirred for 60 minutes for the deproteination step. The precipitate obtained was washed and dried. The deproteinized precipitate was reacted with 1M HCl solution for demineralization. The chitin obtained was then converted into chitosan through a deacetylation process with 60% NaOH for 3 hours. The chitosan obtained was then washed with distilled water and dried at 60°C.

2.3. Synthesis of carboxymethyl chitosan

The synthesized chitosan was alkaline esterified using 20% NaOH solution for 15 minutes. Monochloroacetic acid was then added to the chitosan solution and stirred for 2 hours at 40°C. The solution mixture was then neutralized with acetic acid solution, then poured into an excess of 70% methanol solution. The solution mixture was then filtered and washed with methanol. The carboxymethyl chitosan product obtained was then dried at 55°C.

2.4. FTIR characterization of chitosan and carboximethyl chitosan

Chitosan and carboxymethyl chitosan were analyzed for water content and ash content using the AOAC method (1970) and characterized using an FTIR spectrophotometer to determine the functional groups characteristic of chitosan.

2.5. Antibacterial test of chitosan and carboximethyl chitosan using diffusion assay

S. aureus and *E. coli* were used as targeted Gram-positive and Gram-negative bacteria, respectively. Antimicrobial characteristics of the chitosan and carboxymethyl chitosan were determined using an agar diffusion assay (paper disk). In brief, 7 ml of soft-layer nutrient agar containing approximately 106 CFU/ml of the tested bacterial strains were poured over the plate count agar layer. The 1 cm in diameter shaped paper disk coated chitosan and carboxymethyl chitosan were placed on the plate and all plates were incubated at 37°C, and the zone of inhibition in contact and around the test samples were recorded after 24 h of incubation.

3. Results and Discussion

3.1. Chitosan synthesis

Chitosan preparation from crab shell waste is generally carried out through 4 stages of treatment, namely preparation, deproteination, demineralization, and deacetylation. The preparation stage includes washing, drying, and grinding the crab shells to obtain a powder that passes a 100 mesh sieve.

The deproteination stage aims to remove the protein contained in the crab shell. In the deproteination stage, the yield was 79.21%. This shows that the protein that is lost in the deproteination process is 20.79%.

The next stage is the demineralization stage, namely the removal of minerals in the crab shell. At this stage, the yield of 21.32% was obtained. This shows that most of the components that make up crab shells are metal minerals, especially calcium carbonate ($CaCO_3$) and calcium phosphate [$Ca_3(PO_4)_2$] [4]. The mineral removal process is estimated according to the following reaction:

$$2HCl(aq) + CaCO_3(s) \longrightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

$$Ca_3(PO_4)_2\ (s) + 6HCl(aq) \longrightarrow 3CaCl_2\ (aq) + 2H_3PO_4\ (aq)$$

The last step is deacetylation, which is the removal of the acetyl group. At this deacetylation stage, the yield of 60.67% was obtained. In the deacetylation process, the bond between the carbon in the acyl group and the nitrogen in the chitin is broken into an amino group. When the deacetylation process uses a high concentration of NaOH solution, in the solution NaOH will decompose into Na^+ and OH^- ions. The hydroxyl ion then attacks the electropositive carbonyl carbon. The final product of this reaction is chitosan and sodium acetate salt as a by-product.

Based on the yield data from the stages of deproteination, demineralization, and deacetylation, it can be concluded that in the preparation process of chitosan from crab shell powder, the total yield is 10.24%. So from the initial weight of 100 grams of crab powder, 10.24 grams of chitosan will be obtained.

Synthesis of carboxymethyl chitosan. Carboxymethyl chitosan, which is a chitosan derivative compound, was synthesized from chitosan raw material obtained through the preparation process from crab shell powder. Chitosan modified carboxymethyl was synthesized by reacting chitosan with monochloroacetic acid. The reaction for the conversion of chitosan to chitosan modified carboxymethyl is estimated as follows:

R-O**H** + Cl-**CH_2-COOH** → R-O-**CH_2-COOH**

Chitosan carboxymethyl chitosan

In this study, the yield of carboxymethyl chitosan was 72.9% by weight of chitosan powder. This shows that chitosan which is the raw material for the synthesis of carboxymethyl chitosan has decreased in mass because according to the theory, the mass of carboxymethyl chitosan should be greater than the mass of chitosan due to the substitution of hydroxyl groups with carboxyl groups. The phenomenon of decreasing the mass of chitosan may occur when mixing chitosan with 20% NaOH solution which causes the dissolution of protein residues and the possibility of breaking the acetyl group into an amine group [5] Thanakkasaranee, et al (2021).

Characterization of carboxymethyl chitosan. The formation of carboxymethyl chitosan is indicated by changes and shifts in the IR spectra of chitosan and carboxymethyl chitosan, as shown in Figure 1.

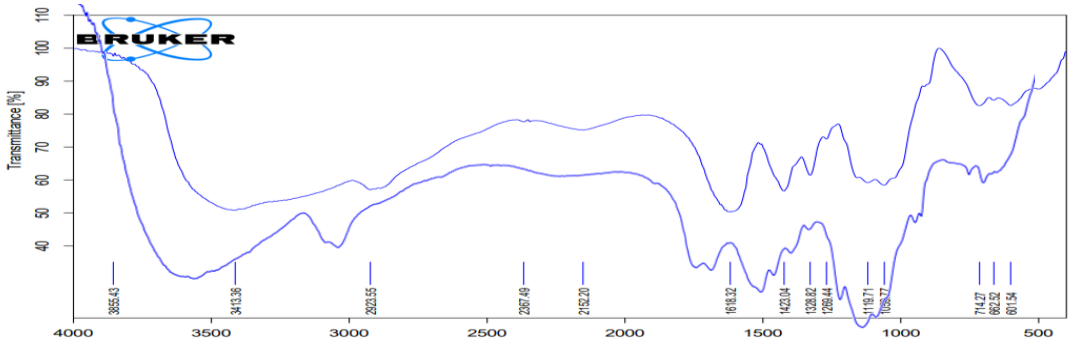


Figure 1. IR spectra of (A) Chitosan and (B) carboxymethyl chitosan

Based on Figure 1, it can be seen that in the IR spectra of carboxymethyl chitosan, an absorption peak appears at a wave number of 3448.72 cm-1 which is the absorption of the stretching vibration of the -OH group which overlaps the absorption of the stretching vibration of -NH. The absorption peak of the C-H stretching vibration shifted from 2854.65 cm-1 to 2885.51 cm-1 and the intensity decreased, possibly indicating the re-disconnection of the acetyl group from the chitosan polymer chain due to treatment with 20% NaOH solution. The increase in the absorption peak of the amide I band (C=O stretching) that appears at wave numbers 1658.78 cm-1 and 1627.92 cm-1 indicates an increase in the

C=O group due to the addition of a carboxylate group (-COOH) which means that CS-O has been formed carboxymethyl chitosan[6] Bukzem, et al (2021). In addition to the evidence of the appearance of two C=O absorption peaks, the formation of Carboxymethyl chitosan from chitosan can be strengthened by the widening of the CO stretching vibration absorption peak that appears at wave numbers 1072.42 cm-1 and 1026.13 cm-1, which indicates that there has been addition of a carboxylate group.

Based on the comparison analysis of functional groups between chitosan and carboxymethyl chitosan above, it is concluded that carboxymethyl chitosan has been formed due to the appearance of characteristic peaks of carboxymethyl chitosan, while characteristic peaks of chitosan are reduced.

Water content. The synthesized carboxymethyl chitosan in this study had a water content of 0.67%, which was higher than the initial water content of 0.49%. This shows that the carboxymethyl chitosan compound has the ability to bind water molecules stronger than the ability to bind water molecules by chitosan.

The greater ability to bind water molecules in carboxymethyl chitosan than chitosan is probably due to the presence of carboxymethyl groups in the structure of carboxymethyl chitosan. The presence of a carboxymethyl group that replaces the H atom in the hydroxyl group on the C-5 atom of the chitosan structure causes more hydrogen bonds to occur with water molecules, causing more hydrated water molecules surrounding the carboxymethyl chitosan chain than those surrounding the chitosan chain.

Ash content. The carboxymethyl chitosan synthesized in this study had an ash content of 0.69%. The ash content of carboxymethyl chitosan was higher than that of chitosan, which was 0.33%. These data indicate that chitosan derivative compounds have a higher carbon content than chitosan. The increase in ash content of carboxymethyl chitosan compounds was most likely caused by the substitution of H atoms in the hydroxyl group on the C-5 atom of the 23 chitosan structure with a carboxymethyl group so that the number of carbon atoms in the carboxymethyl chitosan chain was more than in the chitosan chain.

Antibacterial activity of chitosan and carboxymethyl chitosan. The inhibition zone of chitosan alone against E.coli and S.aureus is 10 mm and 11.89 mm respectively. While carboxymethyl chitosan with concentration of 1% has inhibition zone of 11.50 mm againts E.coli and has inhibition zone of 12 mm againts S. aureus. As is known, chitosan has an amino group (NH_2) which will become ammonium (NH^{3+}) in an acidic medium [7](Hoseinnejad, et al. 2018). The positive charge of this ion will interact with the negatively charged bacterial cell wall, so that it can inhibit the growth of bacteria, both gram-positive and gram-negative[8](Tanpichai, et al 2020). When viewed from the antibacterial activity of chitosan and carboxymethyl chitosan, there was no significant difference. However, the zone of inhibition against E. coli bacteria is smaller than that of S. aureus bacteria, this is because the cell wall structure of E. coli bacteria has a more complex cell wall structure (three layers). This inhibits the antibacterial agent from penetrating the bacterial cell wall.

4. Conclusions

Based on data analysis and discussion, it can be concluded that: (1) Carboxymethyl chitosan can be synthesized from chitosan derived from crab shell waste by reacting chitosan with monochloroacetic acid in 20% NaOH solution with 72.9% in yield from chitosan powder.; and (2) Carboxymethyl chitosan can act as antibacterial agents that have an inhibitory zone against E.Coli bacteria 11.50 mm and 12 mm againts S. Aureus.

5. Acknowledgment

The authors are grateful to the DIPA Politeknik Negeri Lampung for the funding support so that the research can be conducted and this article is published.

REFERENCES

[1] Gaikwad B, Koli J M and Desai S A 2015 Isolation and characterization of chitosan from crab (Scylla serrata) shell waste *Int. J. Sci. Appl. Res.* **2 (8)** 78–84

[2] Benhabiles M S, Salah R, Lounici H, Drouiche N, Goosen M F A and Mameri N 2012 Antibacterial activity of chitin, chitosan and its oligomers prepared from shrimp shell waste *Food Hydrocoll.* **29** 48–56

[3] Mohan C O, Ravishankar C N, Lalitha K V. and Srinivasa Gopal T K 2012 Effect of chitosan edible coating on the quality of double filleted Indian oil sardine (Sardinella longiceps) during chilled storage *Food Hydrocoll.* **26** 167–74

[4] Younes I and Rinaudo M 2015 Chitin and chitosan preparation from marine sources. Structure, properties and applications *Mar. Drugs* **13** 1133–74

[5] Thanakkasaranee S, Jantanasakulwong K, Phimolsiripol Y, Leksawasdi N, Seesuriyachan P, Chaiyaso T, Jantrawut P, Ruksiriwanich W, Sommano S R, Punyodom W, Reungsang A, Ngo T M P, Thipchai P, Tongdeesoontorn W and Rachtanapun P 2021 High substitution synthesis of carboxymethyl chitosan for properties improvement of carboxymethyl chitosan films depending on particle sizes *Molecules* **26**

[6] Bukzem A L, Signini R, dos Santos D M, Lião L M and Ascheri D P R 2016 Optimization of carboxymethyl chitosan synthesis using response surface methodology and desirability function *Int. J. Biol. Macromol.* **85** 615–24

[7] Hoseinnejad M, Jafari S M and Katouzian I 2018 Inorganic and metal nanoparticles and their antimicrobial activity in food packaging applications *Crit. Rev. Microbiol.* **44** 161–81

[8] Tanpichai S, Witayakran S, Wootthikanokkhan J, Srimarut Y, Woraprayote W and Malila Y 2020 Mechanical and antibacterial properties of the chitosan coated cellulose paper for packaging applications: Effects of molecular weight types and concentrations of chitosan *Int. J. Biol. Macromol.* **155** 1510–9

3D Modeling Ground Level Surface for Roadway Horizontal Alignment Design

K Istanto[1] and AR Asnaning[1]

[1]Politeknik Negeri Lampung

*Email: kelik@polinela.ac.id

Abstract. Road geometric design requires topographic data of road alignment plans. National Digital Elevation Model (DEMNAS), published by the Geospatial Information Agency, could be used as preliminary data to design horizontal and vertical alignments. This research aims to: the site plan of Polinela 2nd campus geometric correction, 3D modeling of ground-level surface based on DEMNAS, overlaying the road alignment plan on 3D modeling of ground-level surface, identifying the point of intersection, calculating parameters of road bend, describing the ground level profile of the roads alignment plan. Geometric correction, modeling, computing, and drafting were formulated with Autodesk Civil 3D software. The roads plan, which had a bend in its segment, was analyzed. The roads plan would be modeled on a 3D surface to be analyzed for its horizontal alignment parameters, including bend angle, bend radius, circular arc length, transition arc length, superelevation, and the appropriate type of bend. The horizontal alignment parameter analysis refers to the road geometric planning standards set by the Ministry of Public Works and Public Housing. The results show that the four road segments that had to be analyzed for the bend parameters and the appropriate type of bend were full circle (FC) and spiral spiral spiral (SCS).

1. Introduction

The road is a land transportation infrastructure that includes all parts, including complimentary constructions and equipment intended for traffic on the ground surface, above, or below ground level except for railroads, lorries, and cableways [1].

Politeknik Negeri Lampung (Polinela) has compiled a site plan of campus II that considers the direction of the Kota Baru area of Lampung Province, the movement network plan, the future development scenario Polinela, and other factors [2]. Apart from the layout of the building, the site plan visualized the road alignment plan (Figure 1).

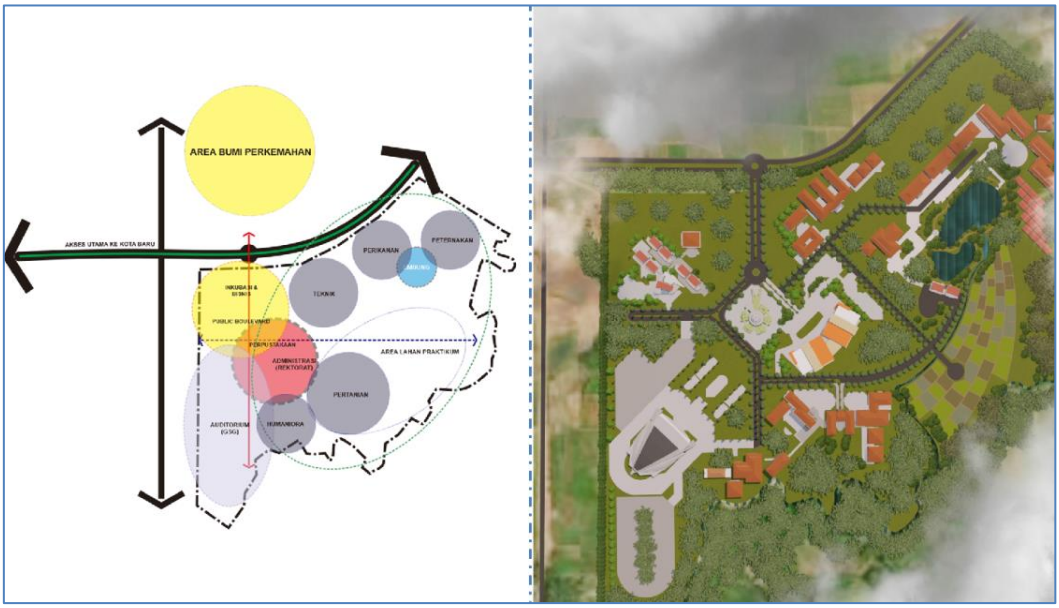


Figure 1. Road Network Plan of Polinela Campus II

The road network plan within the campus area needs to be planned appropriately following the standard set out in the geometric planning of the road, covering 3 (three) criteria: vehicles, traffic volume, and speed [3–7]. These three criteria would determine the road geometry, both horizontally and vertically. Horizontal alignment was the initial part of the geometric planning of the road, which includes planning the bend of the road along its trace.

There were 2 (two) essential things in planned road bends that must be determined based on field conditions, namely the shape of the curve and superelevation [5,8]. Based on the arc components that made the bend up, the shape of the bend was divided into 3 (three) conditions. They were full circle (FC) bend formed by whole circular arc, spiral–spiral (SS) bend formed by transitional arches, and spiral circle spiral (SCS) bend formed by transitional arcs and circular arc [9–11]. At the same time, superelevation was a transverse slope at the bend, which served to offset the centrifugal force received by the vehicle when the vehicle passed through the turn at the design speed [12,13].

Topography was an essential factor in the geometric planning of roads that would significantly affect the volume of earthworks (excavations and embankments), which would affect the investment costs of road construction [11,14,15]. Along with the development of technology, especially in geomatic, topographic data was not only in the form of coordinate point vector data but has developed towards digital data, namely digital elevation model (DEM). In the national scope of Indonesia, the Geospatial Information Agency has provided DEM, which was accessible to all parties, namely DEMNAS data which in raster type spatial data with good accuracy [16,17]. DEMNAS produced a minimum of 0.148 meters in residential areas [18].

Related to DEMNAS data used for geometric road planning, available modeling software for DEMNAS data processing and geometric road modeling was, such as Global Mapper, ArcGIS, AutoCAD, Autodesk Civil 3D, and others. The advantages of using it in geometric road planning were minimizing the cost of measuring the topography of the planned area, horizontal alignment planning became faster and more precise, and changed parameter values in the scheduled of road alignment would directly change all components of the planning, including situation map, alignment, longitudinal sections, cross-sections, and other desired design products.

2. Methods

This research was conducted from May to September 2021 on the campus II of Polinela, located in Kota Baru, Province of Lampung. The research method used is software modeling. The object of research is the road trace plan, which is visualized in Polinela Campus II's site plan.

Data were obtained from various sources, including Geospatial Information Agency and Polinela. Through the official website of BIG, DEMNAS was downloaded within an exciting area which provided from map of Polinela Campus II. The road trace was digitized based on the site plan map of Polinela Campus II. DEMNAS and the road path were projected in the same coordinate projection to be overlayed. The ground-level surface of the Campus II area was modeled from DEMNAS as a background in horizontal alignment design that referenced the site plan of road trace.

The road trace described the positioning of start, finish, and points of intersection (PI) between tangents. These data would be referenced in horizontal alignment modeling on the surface generated from DEMNAS.

The modeling designed parameters consisted of: plan speed, the radius of the circle, length of the process, length of spiral, and superelevation that modeled to three types of road bend were full circle (FC), spiral circle spiral (SCS), and spiral (SS). The type of bend that is most inlined to Bina Marga (BM) standard was chosen in each angle which is designed to refer to the point of intersection (PI) position (X, Y, Z) that would be used to draft bend and superelevation diagram.

The following design criteria based on the geometric design standards manual (Bina Marga Standard) were assigned to the horizontal geometry of the center line and also to the profile and cross-section of the roadway were: design speed 30 km h^{-1} average superelevation rate 2%, maximum superelevation rate 10%, crown road type, coefficient of friction 0.166, carriageway width 4 x 3.5 meter with 2-meter separator.

3. Results and Discussion

3.1. Point of Intersection

Digitized site plan resulted in road trace that described the positioning of start, finish, and points of intersection (PI) between tangents illustrated below (Figure 2).

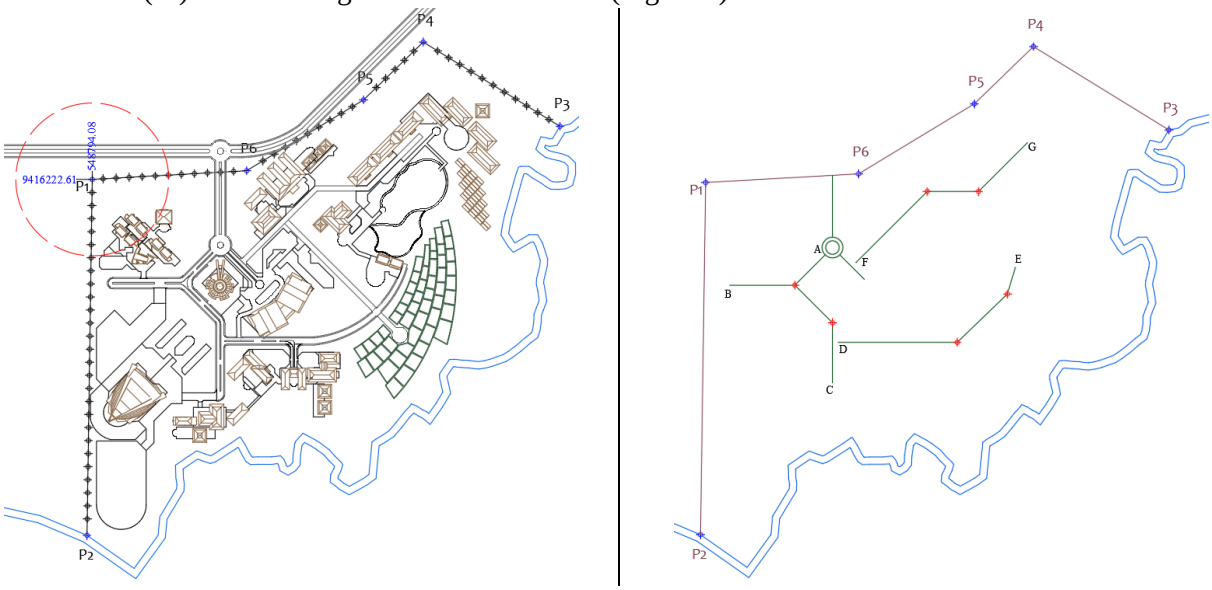


Figure 2. Position of start, finish, and PI

In this research, the object of traces are AB, AC, and BC that geographically could be defined as the position of start, finish, and points of intersection (PI) between tangents (Table 1).

Table 1. The object of traces are AB, AC, and BC that geographically could be defined as the position of start, finish, and points of intersection (PI) between tangents

Trace	PI	UTM Zone 48S		Tangent
		X	Y	
AB	PI_1	548.966,26	9.416.023,99	A-PI_1 and PI_1-B
AC	PI_1	548.966,26	9.416.023,99	A-PI_1 and PI_1-PI_2
	PI_2	549.038,99	9.415.951,24	PI_1-PI_2 and PI_2-C
BC	PI_1	548.966,26	9.416.023,99	B-PI_1 and PI_1-PI_2
	PI_2	549.038,99	9.415.951,24	PI_1-PI_2 and PI_2-C

3.2. Ground Level Surface

Overlaying traces on DEM resulted from an elevation of start, finish, and points of intersection (PI) between tangents (Figure 3). The slope value of the deviation could be calculated based on flat distance and difference in height between points.

The elevation of start, finish, and a 3D analysis calculated points of intersection (PI) between tangents to input DEMNAS cell values to facts overlayed. The difference of height (dz) and flat distance (dh) could calculate the ground surface at tangents slope (Table 2). The value of dz was determined by the difference of elevation between the two points. In comparison, the value of dh was determined by abscissa and ordinate between two points.

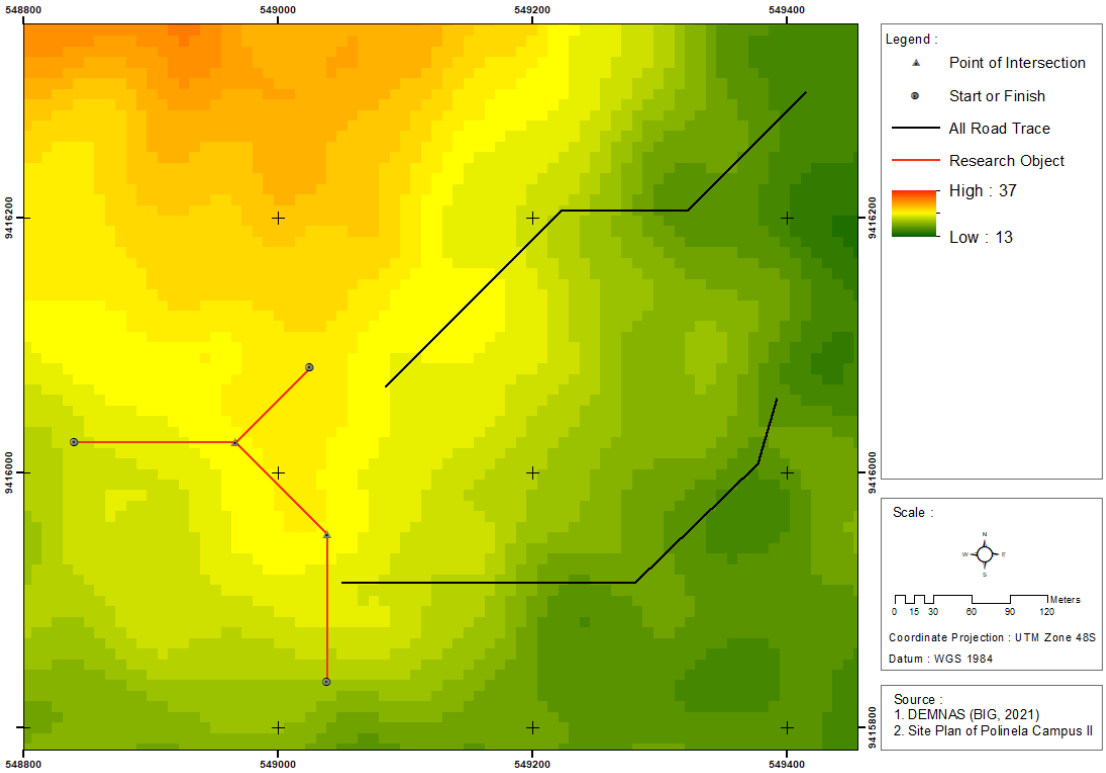


Figure 3. Overlaying Road Segment on DEMNAS

Table 2. The difference of height (dz) and flat distance (dh) could calculate the ground surface at tangents slope

Tangent	dh (m)	dz (m)	Slope
A-PI_1	82.99	-1.00	-0.0120
PI_1-B	126.47	-2.00	-0.0158
PI_1-PI_2	102.86	0.00	0.0000
PI_2-C	115.96	-3.69	-0.0318
B-PI_1	126.47	2.00	0.0158

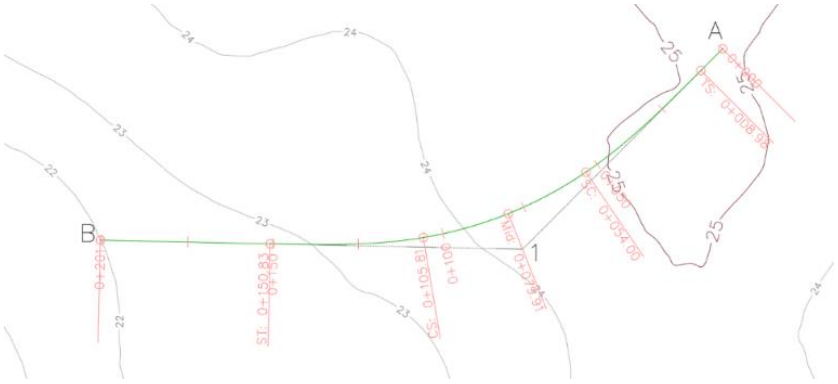
3.3. Bend Modeling

The assumptions used in the bend modeling were 30 kph in speed design, 2% for e_n, and maximum side slope (e_{max}) 10%. These values referred to BM standard with local road criteria on flat to hilly topographic terrain. Each trace (segment) of the road (AB, AC, and BC) were modeled to determine the type and parameters of bend on the point of intersection (PI).

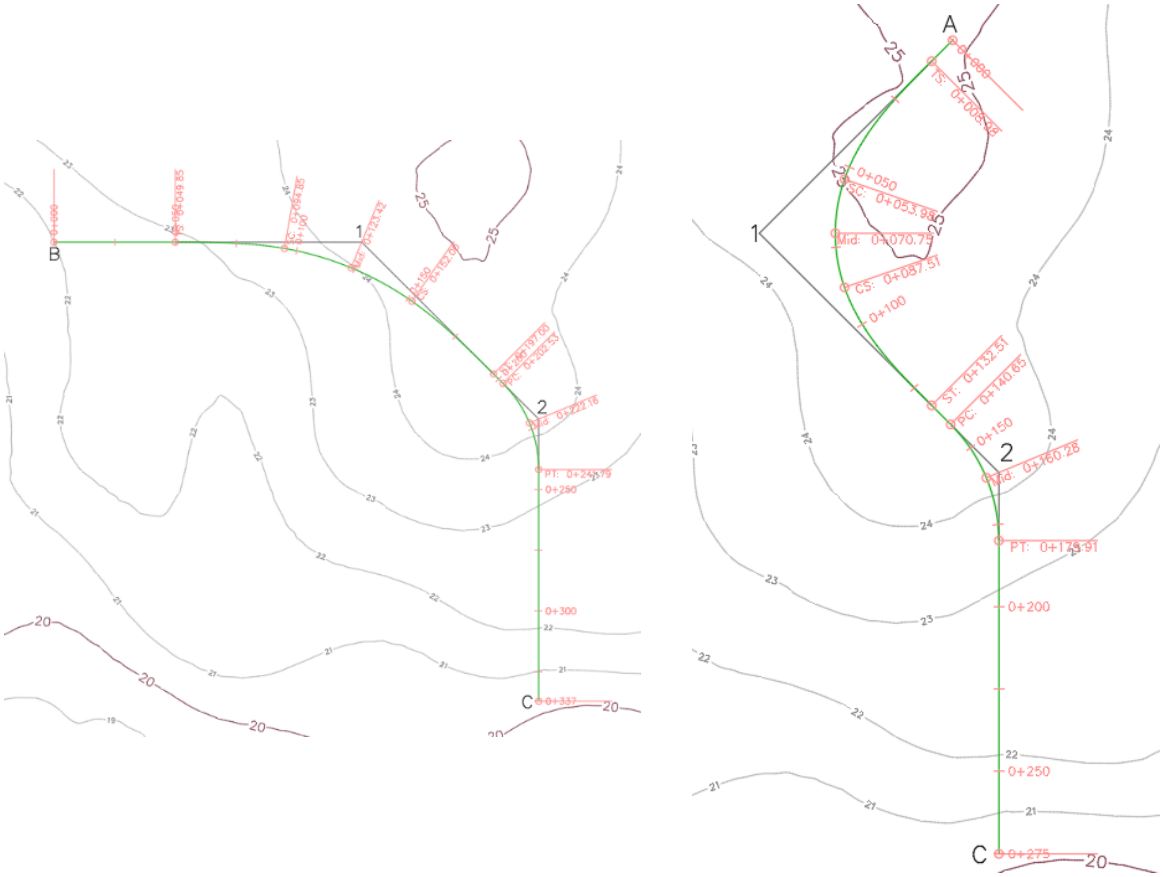
Bend modeling of segment AB determined that type of bend on PI_1 was SCS which parameters were 45 m for a length of spirals (LS), the radius of circle 120 m, and total length of bend reach 141.85 meters (sta. 0+008.98 to 0+150.83).

Bend modeling of segment AC determined that type of bend on PI_1 was SCS which parameters were 45 m for a length of spirals (LS), the radius of circle 50 m, and total length of bend reach 123.53 meters (sta. 0+008.98 to 0+132.51). While the type of bend on PI_2 was FC which parameters 50 m and 39.26 m for a radius of circle and length of bend (LC), 39.26 m length was measured from sta. 0+140.65 to 0+179.91.

Bend modeling of segment BC determined that type of bend on PI_1 was SCS which parameters were 45 m for a length of spirals (LS), the radius of circle 130.05 m, and total length of bend reach 147.15 meters (sta. 0+049.85 to 0+197.00). The type of bend on PI_2 was the same as the AC segment (Figure 4).



Horizontal Alignment of Segment AB

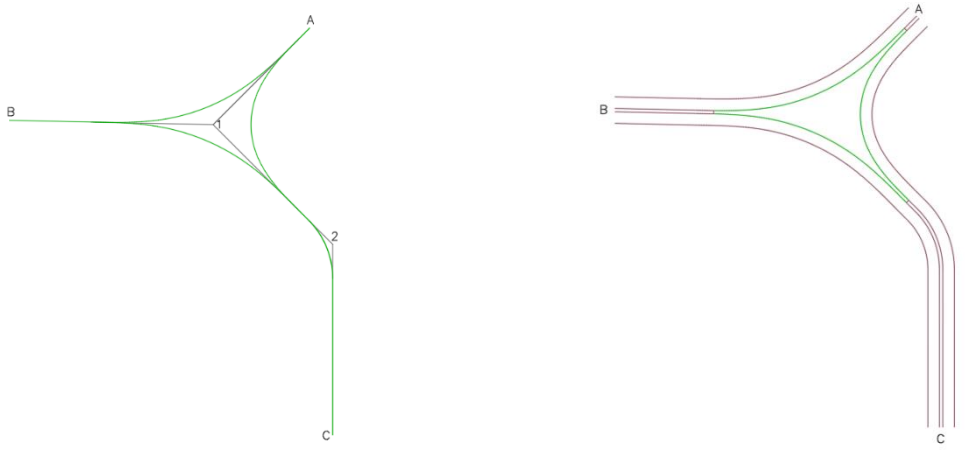


Horizontal Alignment of Segment BC

Horizontal Alignment of Segment AC

Figure 4. Bend Modeling in Autodesk Civil 3D

The results of the horizontal alignment modeling above were plotted on the ground surface to produce a flat alignment plan. The centerline of horizontal alignment was offset to reach the typical roadway cross-section, in this case, using a 4 x 3.5-meter carriageway width with a 2-meter separator (Figure 5). The offsetting of the centerline above resulted from a horizontal alignment plan of the roadway for AB, AC, and BC segments in the same surface field.



Center Line (CL) of Horizontal Alignment

Result of Offsetting CL

Figure 5. Horizontal Alignment Plan

3.4. Ground Level Along Trace of Road

Modeling surface from DEMNAS and horizontal alignment plan in Autodesk Civil 3D could describe ground level surface along the center line of flat alignment plan. The ground-level surface would be drafted in the long section from the start to the finish point of each segment (Figure 6).

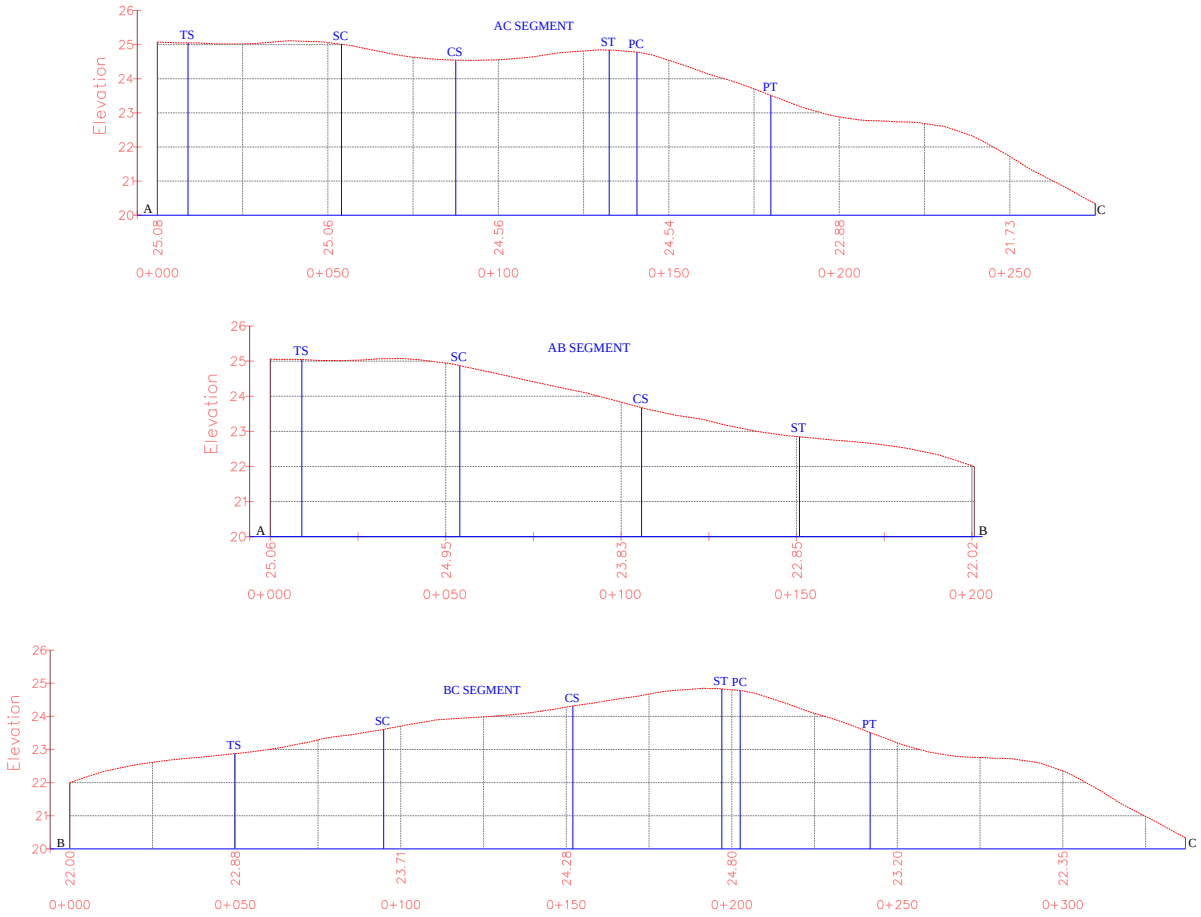


Figure 6. Ground Level Surface Along with CL of Horizontal Alignment

The long roadway segments section above gave important information of horizontal alignment were 1) original ground level along the center line of each segment and 2) original ground level of each bend parameters, TS – SC – CS – ST (SCS type) and PC – PT (FC type).

The long section of the AC segment described that ground-level surfaces were flat to hilly and through 2 (two) types of bend, SCS, and FC. The character in SCS type (TS to ST point) was relatively flat, so this section could design the vertical alignment that minimized excavation and embankment work. The AB segment's extended area was similar to the AC segment but along the segment just through 1 (one) type of bend, FC.

The long section of the BC segment described that the ground level surface was trough 2 (two) types of bend, SCS, and FC. The character in SCS type (TS to ST point) was hilly, uphill from TS to ST. Along the FC segment, the surface also was hilly, downhill from PC to PT, when the design of vertical alignment has to notice AC segment because FC section in BC segment is the same FC section in AC segment.

This information would be needed to design and model vertical alignment that would affect roadway safety and investment.

4. Conclusions

Based on the results of research and discussion, it can be concluded that the type of roadway bend was spiral – circle – spiral (SCS) and full circle (FC) for 3 (three) segments of the roadway as the research object. AC segment consisted of two types of bend, SCS, and FC, with a total length of angle, reaching 123.53 meters in SCS type and 39.26 m length in FC type. AB segment consisted of one kind of bend, was SCS with a total length of angle reach 141.85 meters. The BC segment consisted of two kinds of the curve, SCS, and FC, with a full bend, reaching 147.15 meters in SCS type and 39.26 m length in FC type. The ground-level surfaces of the centerline of the roadway were flat to hilly. The flat to hilly surfaces were revealed in AC and AB segments, and the fully hilly surface was in the BC segment.

REFERENCES

[1] Dewan Perwakilan Rakyat Republik Indonesia 2004 *Undang-Undang Republik Indonesia Nomor 38 Tahun 2004 Tentang Jalan* (Jakarta)

[2] Politeknik Negeri Lampung 2019 *Siteplan Kampus II Politeknik Negeri Lampung*

[3] Badan Standarisasi Nasional 2004 Geometri Jalan Perkotaan Standar Nasional Indonesia RSNI T-14-2004 1–60

[4] Chasanah K, Purwanto M Y J and Sudibyo T 2018 Evaluasi Alinyemen Vertikal dan Horizontal Studi Kasus di Depan Gedung Perpustakaan Kampus Dramaga IPB *J. Tek. Sipil dan Lingkung.* **3** 59–68

[5] Kaharu F, Lalamentik L G J and Manopo M R E 2020 Evaluasi Geometrik Jalan Pada Ruas Jalan Trans Sulawesi Manado-Gorontalo di desa Botumoputi Sepanjang 3 km *J. Sipil Statik* **8** 353–60

[6] Kementerian Pekerjaan Umum 2011 *Peraturan Menteri Pekerjaan Umum Nomor 19 Tahun 2011 Tentang Persyaratan Teknis Jalan dan Kriteria Perencanaan Teknis Jalan.* (Jakarta)

[7] Syifaurrahman D, Fauzan M and Sudibyo T 2019 Evaluasi Geometri dan Perlengkapan Jalan Lingkar Leuwiliang Bogor *J. Tek. Sipil dan Lingkung.* **4** 149–68

[8] Bethary R T, Pradana M F and Indinar M B 2016 Perencanaan Geometrik Jalan Alternatif Palima - Curug *J. fondasii* **5** 12–21

[9] Erga Rahmada Fauzan, Thoriq Y A, Arifi M Z and Wicaksono A 2013 Kajian geometrik jalan raya pada bundaran arteri baru Porong Sidoarjo *J. Mhs. Jur. Tek. Sipil* **1** 1175–90

[10] Kurniawan F and Sudarno S 2018 Analisis Geometrik Pada Tikungan Ruas Jalan Raya Magelang-Kopeng Dan Raya Soekarno-Hatta (Pertigaan Canguk) *Rev. Civ. Eng.* **2** 52–7

[11] Anjali Putri Lisu Langi, Joice E. Waani L E 2019 EVALUASI GEOMETRIK PADA RUAS JALAN MANADO – TOMOHON km 8 – km 10 *J. Sipil Statik* **7** 359

[12] Pusdiklat JP3I 2017 Dasar-Dasar Perencanaan Geometrik Ruas Jalan *Kementrian PU dan Perumah. Rakyat Badan Pengemb. Sumber Daya Mns.* 7

[13] Saodang H 2004 *Konstruksi Jalan Raya : Geometri Jalan Raya*

[14] Hasan A, Herius A and Prabudi D 2018 Analisis Spasial Aspek Topografi Dasar Perencanaan Jalan *Pilar J. Tek. Sipil Politek. Negeri Sriwij.* **13** 12–6

[15] Meila Mastura G S A 2018 Evaluasi Kinerja Alinyemen Horizontal Pada Jalan Bireuen – Panton Labu **01** 41

[16] Sulistiana T, Parapat A D and Aristomo D 2019 Analisis akurasi vertikal digital elevation model nasional (Demnas) studi kasus Kota Medan *FIT ISI 2019 dan ASEANFLAG 72nd Counc. Meet. Anal.* **1** 37–45

[17] Yumai Y, Tilaar S and Makarau V H 2019 Kajian Pemanfaatan Lahan Permukiman Di Kawasan Perbukitan Kota Manado *Spasial* **6** 862–71

[18] Sunu H A, Yuwono B D and Suprayogi A 2019 Analisis Ketelitian Dsm Kota Semarang Dengan Metode Insar Menggunakan Citra Sentinel-1 *J. Geod. Undip* **8** 17–26

Detection landslide vulnerable zones of West Lampung Regency using the geographic information system approach

I Zulkarnain[1], Suprapto[1] and K Istanto[1]

[1] Agricultural Technology Department, Politeknik Negeri Lampung

*Email: iskandar160575@polinela.ac.id

Abstract. West Lampung Regency is one of the regencies in Lampung Province that is vulnerable to landslides. Quoted from the official website of the National Disaster Management Agency (BNPB), it is stated that 50% of sub-districts in the West Lampung Regency are areas prone to landslides. This study detects landslide-prone zones in West Lampung Regency with a GIS spatial analysis approach. The results showed some sub-districts in West Lampung Regency that are at high to very high risk of landslide hazards with a percentage of 40.66% of the district's area.

1. Introduction

Indonesia is located on the equator, so it receives a lot of heat from the sun and high rainfall. As a result, Indonesia has become one of the areas prone to hydro-meteorological natural disasters such as floods, droughts, large ocean waves, and so on [1]. Data from the National Disaster Management Agency [2] recorded that throughout 2021 there had been various disasters in Indonesia, ranging from earthquakes, fires, droughts, floods, landslides, cyclones tidal waves.

Based on the data on the page, a landslide disaster is a disaster that ranks third in terms of the number of occurrences. It was recorded that throughout 2021 from January to mid-April, 222 landslides occurred across Indonesia. Landslide is a downslope movement by the mass of soil and rock that makes up the slope. This soil movement is one of the geological processes that occur due to the interaction of several conditions, including geomorphology, geological structure, hydrogeology, and land use [3].

The main factors that cause landslides include steep slopes, less dense and thick soil, high rainfall, types of land use, vibration, the presence of heap material on cliffs, old landslides, deforestation, and waste disposal areas [1]. In general, landslides occur in tropical, hilly areas, which often occur during the rainy season due to disturbance of soil stability. This disturbance of soil stability triggers the movement of soil and rock masses or a mixture of the two to descend the slope.

Like floods, landslides are natural disasters that can be predicted because they are associated with high rainfall. Because the water content factor is quite dominant, landslides often occur in the rainy season in areas with steep topography. The elements are closely related, such as soil type, rock type, rainfall, land slope, and land use. In addition, human factors, namely human activities on land that burden slopes, also contribute to the occurrence of landslides and in utilizing lands such as mining, explosions, land changes, and uncontrolled deforestation [4].

West Lampung Regency is one of the regencies in Lampung Province, with the capital city Liwa. The land area is dominated by hilly geographical conditions, mountainous regions, which are the ridges

of the Bukit Barisan with a land slope of more than 45%. Quarter volcanic overlooks the rock formations from several geological formations with rendzina and lithosol soil types. In general, West Lampung Regency is located at more than 500 meters above sea level, with high precipitation conditions. It is traversed by the Semangko Fault, with a zone width of 20 kilometers. This is what causes the West Lampung Regency area to have the highest vulnerability to the danger of landslides.

According to the geological agency, the threat of landslides in the West Lampung Regency is relatively high, even the highest in Lampung Province. More than 50% of the sub-districts in West Lampung Regency are areas with moderate to high landslide-prone areas.

One way that can be applied to predict landslide disasters is to use an application program approach that can take an inventory of affected locations using a Geographic Information System (GIS). Modeling by utilizing GIS through spatial analysis methods makes it possible to formulate pre-disaster management policies such as early warning, which can be an alternative for the West Lampung Regency Government, in providing thematic geospatial data information on which areas have high or very high vulnerability to environmental hazards. Landslide hazard in the form of a thematic map of landslide hazard zones. The objectives of this research activity are (1) determining the Landslide Prone Class Zone in the West Lampung Regency and (2) Making a Thematic Map of the Landslide Prone Zone in the West Lampung Regency.

2. Method

This research uses geospatial analysis research by utilizing graphic visual data in several thematic maps, which are the parameters that cause landslide hazards. The results of the geospatial analysis of the location are grouped into categories of vulnerability with the design of activities, as presented in Figure 1.

The materials used in this research activity consisted of the Administrative Map of West Lampung Regency, Map of Daily Rainfall for West Lampung Regency, Land Cover Map of West Lampung Regency, Slope Map of West Lampung Regency, Geological Map of West Lampung Regency, and Soil Type Map of West Lampung Regency. At the same time, the tools used in this research activity are computers, printers, and Arc Gis 10.3 software.

The research stages include (i) collecting information and data, (ii) scoring and parameter weighting, (iii) digital map overlaying, (iv) determining the total score, (v) determining class intervals, (vi) analyzing the level of vulnerability landslides, and (vii) presentation of a landslide hazard map in West Lampung Regency.

2.1 Stages of Research Implementation

2.1.1. Data information and collections. This research's information and data are secondary data, a parameter for determining landslide hazard analysis using a Geographic Information System (GIS) approach. The data was collected as mentioned in the section above.

2.1.2. Parameter scoring and weighting. Analysis of landslide hazard data was carried out after the thematic maps, namely soil type maps, rock type maps, land use maps, rainfall maps, and slope maps, were available and ready in the form of digital maps. Each type of map is classified based on the score. After that, the maps of the five parameters were overlapped to find the total score multiplied by the weight, then added up and classified the level of vulnerability based on the analysis of the total score.

Scoring is used to determine or assess the level of landslide susceptibility in the study area. The scoring refers to the parameters issued by the 2004 Puslittanak, where these parameters are used to classify and weight each map. The weight is based on the effect of the map on the occurrence of

landslides. The estimation model for analyzing landslide susceptibility refers to the research of the Research Center for Research and Development in 2004 with the formula:

Total Score = 0,3FCH+0,2FBD+0,2FKL+0,2FPL+0,1FJT

Where:

FCH = Rainfall Factor
FBD = Type of Geology
FKL = Slope Factor
FPL = Land Use Factor
FJT = Type f Land Factor

The weights and scores based on the results of the 2004 Puslittanak research in terms of analyzing landslide susceptibility are as presented in Table 1 to Table 5.

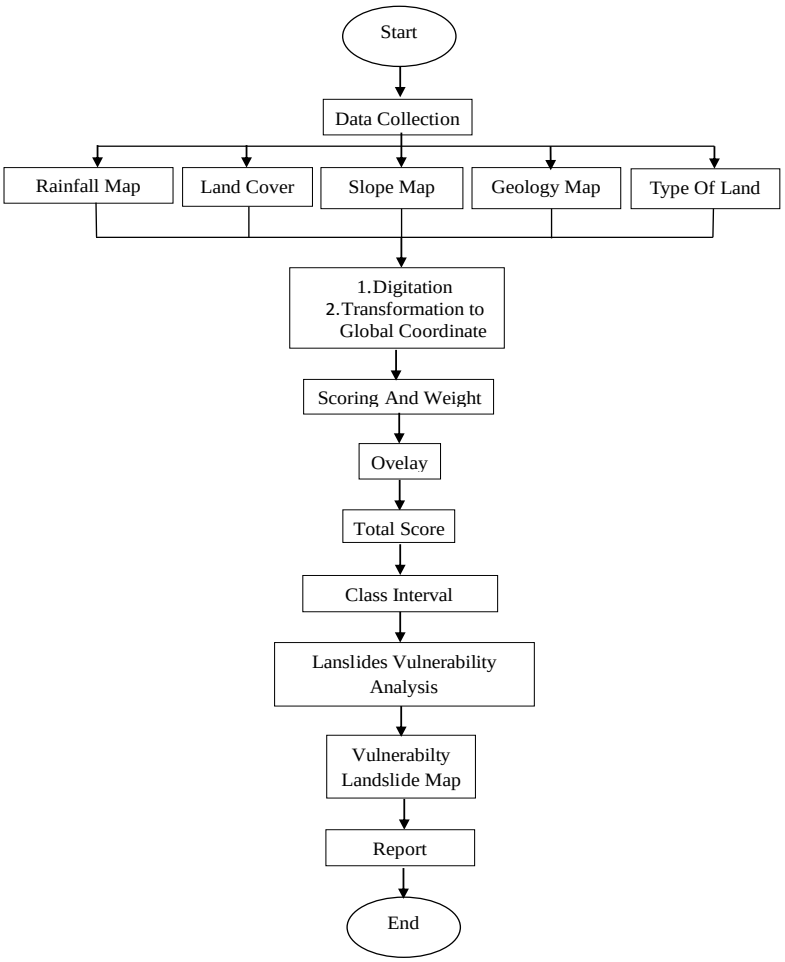


Figure 1. Flow Chart of Research Implementation.

Table 1. Classification of Rainfall Intensity (mm year^{-1}).

Parameter	Weight	Score

Very Wet (>3000)	30%	5
Wet (2501-3000)		4
Slighly Wet (2001-2500)		3
Dry (1501-2000)		2
Very Dry (<1500)		1

Source : [5]

Table 2. Classification of Sloope.

Parameter (%)	Weight	Score
>45 (Very Steep)	20%	5
30-45 (Steep)		4
15-30 (a bit Steep)		3
8-15 (Sloping)		2
<8 (Flat)		1

Source : [5]

Table 3. Classification of Geology.

Parameter	Weight	Score
Volkanik-2 (Qvsb, Qvst, Qvb, Qvt) dan Sediment-2 (Tmb, Tmbl, Tmtb)	20%	4
Sediment-1 (Tmn, Tmj)		3
Volkanik-1 (Qvsl, Qvu, Qvcp, Qvl, Qvpo, Qvk, Qvba)		2
Aluvial (Qav, Qa, a)		1

Source : [5]

Table 4. Classification of Land Used.

Parameter	Weight	Score
Moor, Ricefield	20%	5
Bush		4
Forest dan Plantation		3
City		2
Pond, Reservoir, waters		1

Source [5]

Table 5. Classification of Type Of Land.

Parameter	Weight	Score
Regosol	10%	5
Andosol, podsolik, Grumusol		4
Brown Latosol, Kambisol		3
Latosol, Yellow Brown Latosol Association		2
Aluvial		1

Source : [5]

2.2 Vulnerability Analysis

The value of an area's vulnerability to landslides is determined from the total score of each parameter. Very vulnerable regions will have a high total score, and vice versa, areas that are not prone to will have

a low total score.

Table 6. Vulnerability Class.

No.	Vulnerability Class	Total Score
1	Very Vulnerable (K1)	> 4,3
2.	Vulnerable (K2)	3,5 – 4,3
3.	Slightly Vulnerable (K3)	2,6 – 3,4
4.	Safe (K4)	1,7 – 2,5
5.	Very Safe (K5)	< 1,7

Source :[1]

3. Results and Discussion

3.1 Administration Map of West Lampung Regency

West Lampung Regency is one of the regencies in Lampung Province, formed based on Law no. 6 of 1991 dated July 16, 1991, and promulgated on August 16, 1991, with the capital city Liwa. West Lampung is a highland with an average height of + 645 meters above sea level, located at a position of 4º47'16" - 5º56'42" south latitude and between 103º35'08" - 104º33'51" east longitude. The administrative boundaries of West Lampung Regency are:

- In the north, it is bordered by South OKU Regency (South Sumatra Province);
- The east is bordered by North Lampung Regency, Way Kanan Regency.
- To the south, it is bordered by Pesisir Barat Regency and Tanggamus Regency,
- In the west, it is bordered by the Pesisir Barat Regency

The total area of West Lampung is in the form of a land area of 2,064.4 km2. The administrative area of West Lampung Regency consists of 15 sub-districts based on Law no. 6 of 1991 dated July 16, 1991, as presented in Table 7. The administrative map of West Lampung Regency with the existing fifteen sub-districts is shown in Figure 2.

Table 7. Total Area of Sub District West Lampung Regency.

No.	Sub District	Area (Km^2)	No.	Sub District	Area (Km^2)
1.	Balik Bukit	159.41	9.	Gedung Surian	76.96
2.	Sukau	146,07	10.	Kebun Tebu	61.55
3.	Belalau	93.91	11.	Air Item	108.12
4.	Sekincau	115.09	12.	Pagar Dewa	197.71
5.	Suoh	150.22	13.	Batu Ketulis	182.01
6.	Batu Brak	199.29	14.	Bandar Negeri Suoh	267.23
7.	Sumber Jaya	130.44	15.	Limbok Seminung	98.88
8.	Way Tenong	129.70			
Total Area Of West Lampung Regency 2.116,59					

Source : [6]

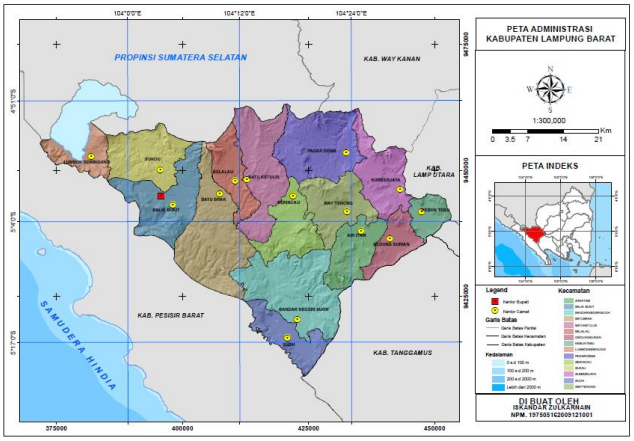


Figure 2. Administration Map of West Lampung Regency.

3.2 Rainfall Map of West Lampung Regency

Rainfall in West Lampung Regency, based on climate data found at the Balik Bukit and Belalau Climatology Stations, is known to range from 2,000-3,500 mm per year. The humidity regime is classified as wet (UDIC), with 50 – 80% humidity. The temperature regime ranges from hot (is hypothermic) in the coastal plains (in the west) to cold (isosesic) in hilly areas, with the percentage of sunlight ranging from 37.9 – 50.0%. Rainfall Map of West Lampung Regency as presented in Figure 3.

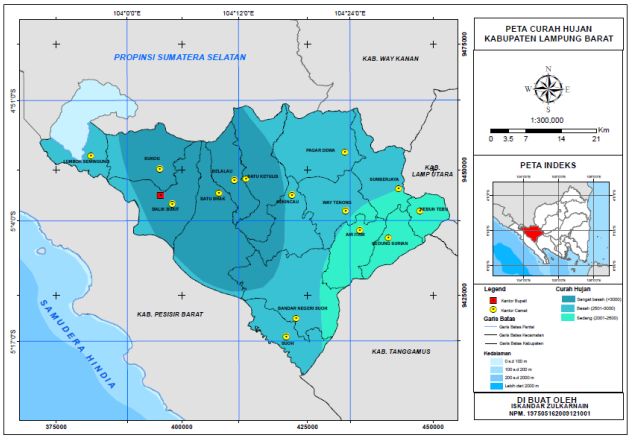


Figure 3. Rainfall Map of West Lampung Regency.

Rainfall in the range of 2000 mm – 2500 mm (moderate humidity) occurs around Kebun Tebu District, Gedung Surian, Air Itam, a small part of Sumber Jaya District, and Bandar Negeri Suoh. Average rainfall of 2500 mm – 3000 mm (wet humidity) occurred in Suoh, Bandar Negeri Suoh, Sekincau, Way Tenong, Sumber Jaya, Pagar Dewa, Lumbok Semingung, and a small part of the sub-districts of Batu Ketulis, Balik Bukit, and Sukou. Meanwhile, high rainfall > 3500 mm (very wet humidity) occurred in the Districts of Belalau, Batu Brak, Batu Ketulis, Balik Bukit, Sukou, and a small part of the districts Sekincau Subdistrict and Bandar Negeri Suoh.

3.3 Slope Map of West Lampung Regency

The shape of the land slope in the administrative area of West Lampung Regency is divided into 5 (five) land slope classes as presented in Table 8.

Table 8. Slope Of Land In West Lampung Regency**.**

No.	Land Type	Sloope (%)	Area (Km^2)	Percentage
1	Flat	0 – 8	604,84	29.30%
2.	Sloping	8 – 15	487,68	23.62%
3.	A Bit Steep	15 – 30	643,19	31.16%
4.	Steep	30 – 45	240,87	11.67%
5.	Very Steep	> 15	87,83	4.25%
	Total		2064,4	100%

Source : Data Analysis, 2021

Based on Table 8, it can be said that the shape of the slopes of the Lampung Regency area varies significantly with flat to sloping land by 52.92% while the slope conditions with the steep, steep to very steep at 47.08%. For each sub-district, the percentage of land slope type is presented in Table 9

Table 9. Percentage Sloope in Each Sub-District West Lampung Regency.

No.	Subdistrict	% of Type of Land				
		Flat	Sloping	A Bit Steep	Steep	Very Steep
1	Balik Bukit	34.74%	19.26%	30.17%	12.13%	3.71%
2.	Sukau	25.74%	23.46%	34.95%	11.64%	4.22%
3.	Belalau	26.50%	30.23%	30.24%	9.46%	3.57%
4.	Sekincau	30.13%	25.47%	28.76%	12.13%	3.50%
5.	Suoh	34.85%	13.73%	30.82%	15.27%	5.34%
6.	Batu Brak	17.96%	23.79%	41.98%	13.30%	2.97%
7.	Sumber Jaya	25.48%	23.04%	29.66%	15.67%	6.14%
8.	Way Tenong	41.30%	23.16%	21.12%	9.39%	5.04%
9.	Gedung Surian	50.73%	15.83%	19.11%	10.55%	3.78%
10.	Kebun Tebu	50.17%	11.45%	23.48%	11.06%	3.84%
11.	Air Itam	39.20%	23.90%	23.05%	10.14%	3.71%
12.	Pagar Dewa	28.83%	29.98%	26.28%	11.04%	3.86%
13.	Batu Ketulis	27.46%	33.02%	33.30%	5.73%	0.49%
14.	Bandar Negeri Suoh	24.33%	23.67%	39.88%	10.52%	1.59%
15	Lumbok Seminung	10.25%	12.02%	24.15%	24.84%	28.74%

Source: Data Analysis, 2021

The dominance of the slope class ranging from a bit steep, steep dan very vertical with a percentage of more than 50% is in the Sukau, Suoh, Sumber Jaya, Lumbok Seminung, Suoh, and Batu Brak Sub-districts. 50% of the sub-district area is dominated by a bit steep to very steep.

The dominance of slope classes ranging from flat to sloping with 50% - 60% is in the Districts of Balik Bukit, Belalau, Sekincau, and Pagar Dewa. The dominance of slope classes ranging from flat to sloping with more than 60% is in Way Tenong, Gunung Surian, Kebun Tebu, Air Itam, and Batu Ketulis Districts.

Overall, the graphic data in the Thematic Slope Map of West Lampung Regency is presented in Figure 4.

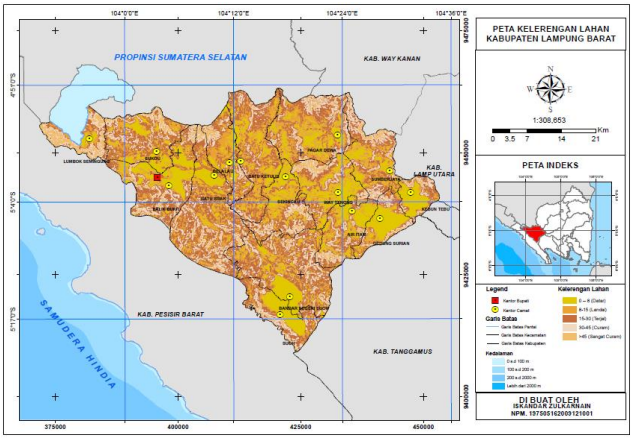


Figure 4. Slope Map Of West Lampung Regency

3.4 Geology Map of West Lampung Regency

Based on the search for soil type data in the West Lampung Regency, the results are presented in Table 10.

Table 10. Soil Type of West Lampung Regency.

No.	Soil Type	Area (ha)	Percentage
1	Latosol	43.53	2.11%
2.	Yellow Brown Latosol Association	907.24	43.95%
3.	Aluvial Hidromorf	773.05	37.45%
4.	Podsolic	340.58	16.50%
	Total		100%

Source : Data Analysis, 2021

Based on Table 10, it can be seen that the type of soil in West Lampung Regency is dominated by Latosol soil by 46.6%, which is spread over several sub-districts. At the same time, the minor type of soil is Podsolic which reaches an area of 16.50%. The details of the soil types in the West Lampung Regency are as follows:

- Soil types in West Lampung Regency are dominated by four soil types, namely Alluvial Hydromorph, Latosol, Yellow Brown Latosol Association.
- Alluvial Hydromoprh soil type is found in some areas of Kebun Tebu Sub-district, part of Sumber Jaya District, part of Pagar Dewa District, part of Batu Ketulis District, part of Way Tenong Sub-district of Way Tenong, part of Gunung Surian District, part of Air Itam District, part of Sekincau sub-district area, part of Bandar Negeri Suoh sub-district, and Belalau.
- Latosol soil type is found in a small part of Sumber Jaya District and Bandar Negeri Suoh
- Soil type Asosiasi Yellow Brown Latosol Association is found in the District of Suoh, Bandar Negeri Suoh, Batu Brak, Batu Ketulis, Sukou and Lumbok Seminung
- Podsolic soil type is found in part of Kebun Tebu Sub-district, part of Gunung Surian District, part of Air Itam District, part of Way Tenong District and part of Sekincau Sub-district, part of Belalau District, part of Belalau District, part of Batu Ketulis, and part of the Pagar Dewa District Area

Overall graphic data in the form of the Thematic Map of Soil Types for West Lampung Regency is presented in Figure 5

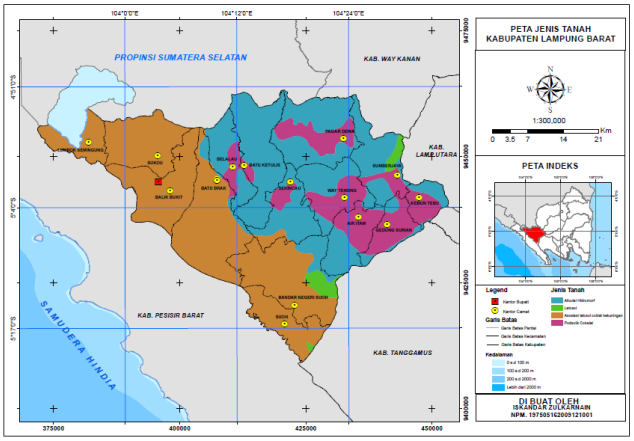


Figure 5. Soil Type of West Lampung Regency.

3.5 Land Use Map of West Lampung Regency

Based on the search for land use data in the West Lampung Regency, the results are presented in Table 11.

Table 11. Land Use Map of West Regency.

No.	Land Use	Area (ha)	Percentage
1	Plantation/Gardens	1187.749	57.53%
2	Lake	2.322211	0.11%
3	Pond	0.017408	0.00%
4	Swamp	0.073436	0.00%
5	River	3.838707	0.19%
6	Shrub	242.144	11.73%
7	Bare Land	0.997445	0.05%
8	Ricefield	113.4756	5.50%
9	Building	28.44557	1.38%
10	Forest	427.0068	20.68%
11	Moor/Field	58.32932	2.83%
	Total		100%

Source: Data Analysis, 2021

Overall, the graphic data in the Thematic Map of Soil Types for the West Lampung Regency is presented in Figure 6.

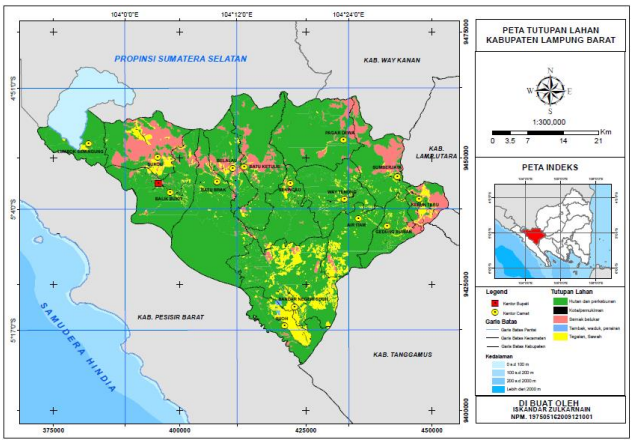


Figure 6. Land Use Map Of West Lampung Regency.

3.6 Data Analysis

Based on the parameters identified and collected, with the overlay method using the Arc Gis 10.3 application, a spatial analysis of the overlay with the intersect toolbox will be carried out, which will overlap all the thematic map parameters.

Based on the calculation of the total score of each parameter that determines the potential for landslide hazard and using an interval range of 0.68, it is obtained a classification of the area with five classes of flood vulnerability, namely Very Safe, Safe, Slightly Vulnerable, Vulnerable and Very Vulnerable.

The results of the classification of landslide-prone classes using the Sturgess formula can be seen in Table 12.

Table 12. Vulnerability Class Base on Sturgess Formula.

No.	Class of Vulnerability	Total Score
1	Very Vulnerable (K1)	4,02 – 4,70
2.	Vulnerable (K2)	3,34 – 4,02
3.	Slightly Vulnerable (K3)	2,66 – 3,34
4.	Safe (K4)	1,98 – 2,66
5.	Very Safe (K5)	1,30 – 1,98

Source : Data Analysis, 2021

An Overlay Analysis with Intersect is performed in the ArcGis 10.3 arc toolbox. The overlay involves spatial elements in the form of a map of each parameter and the accompanying attributes. The results of overlaying landslide-prone parameter maps can be seen in Figure 7.

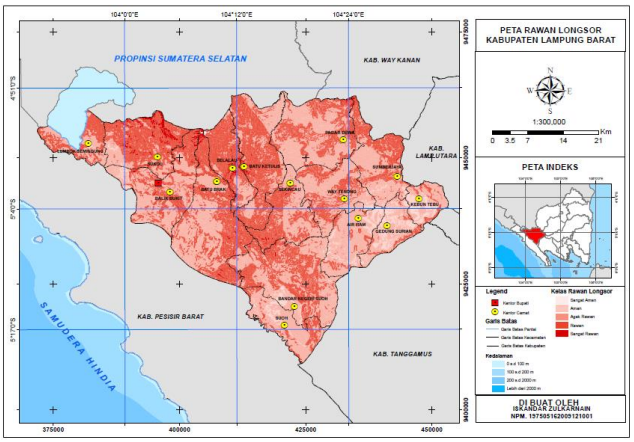


Figure 7. Landslide-Prone Class Map of West Lampung Regency.

Based on the results of the overlay of the landslide-prone parameter map, the calculation of the area of each class was carried out with the help of ArcGIS 10.3 software. The results of the analysis of the location of each class classification map prone to landslides in the West Lampung Regency are presented in Table 13.

Table 13. Prone Class Map of West Lampung Regency.

No.	Prene Class	Score	Area	Percentage
1	Very Vulnerable (K1)	4,02 – 4,70	27.55	1.30%
2.	Vulnerable (K2)	3,34 – 4,02	833.16	39.36%
3.	Slightly Vulnerable (K3)	2,66 – 3,34	1136.67	53.70%
4.	Safe (K4)	1,98 – 2,66	119.02	5.62%
5.	Very Safe (K5)	1,30 – 1,98	0.19	0.01%
	Total			100%

Source: Data Analysis, 2021

4. Conclusion

Based on the results of the analysis and discussion, it can be concluded several things, namely: (1) The level of vulnerability to landslides in the West Lampung Regency is divided into five classes: Very Safe, Safe, Slighly Vulnerable, Vulnerable dan Very Vulnerable.; (2) The landslide-prone level that dominates West Lampung Regency is the landslide-prone level in the category Slightly Vulnerable with an area of 1.136,67 km^2 (53.70%); (3) Areas prone to landslides with a category Very Vulnerable are located in the Districts of Balik Bukit, Sukau, Belalau, Sekincau, Batu Brak, Sumber Jaya, Pagar Dewa, Batu Ketulis, and Bandar Negeri Suoh. With a relatively Curam land slope and very high rainfall and soil types that are susceptible to landslide hazards.; and (4) Most of the areas are categorized as Safe to Very Safe are in Kebun Tebu District, Gedung Surian District, Suoh District, and Air Itam District.

References

[1] Yuniarta H, Saido A P and Purwana Y M 2015 Kerawanan Bencana Tanah Longsor Kabupaten Ponorogo 94–201

[2] Badan Nasional Penanggulangan Bencana 2021 Geoportal Data Bencana Indonesia [Online] Available: https://gis.bnpb.go.id/. [Accessed: 20-Apr-2021].

[3] Fauzan M 2015 Pemetaan Daerah Rawan Longsor Dengan Menggunakan Sistem Informasi Geografis Studi Kasus Kabupaten Bondowoso **1452**

[4] Hardiyatmo H C 2012 *Tanah Longsor & Erosi: Kejadian dan Penanganan*, 1st ed. Yogyakarta: Gadjah Mada University Press

[5] Puslittanak 2004 Laporan Akhir Pengkajian Potensi Bencana Kekeringan, Banjir dan Longsor di Kawasan Satuan Wilayah Sungai Citarum-Ciliwung, Jawa Barat Bagian Barat Berbasis Sistem Informasi Geografi Jakarta

[6] Badan Pusat Statistik and Kabupaten Lampung Barat 2021 Lampung barat dalam angka

Vertical Evacuation for Pedestrians of Near-Field Tsunami Using Agent Based Modeling (ABM)

M. J. Shofa[1], Sahrupi[2], M. Rizki[3], and N. Restiana[4]

[1,2]Industrial Engineering, Faculty of Engineering, Universitas Serang Raya, Indonesia
[3] Industrial Engineering, Faculty of Science and Engineering,Universitas Islam Negeri Sultan Syarif Kasim, Indonesia
[4] PT. Krakatau Steel (Persero), Tbk.

*E-mail: m.j.shofa@gmail.com

Abstract. One of the critical actions in catastrophe conditions is how to evacuate effectively. However, instead of horizontal evacuation, vertical evacuation is the better protective action. This research aims to evaluate the vertical evacuation for pedestrians near field tsunami using agent-based modelling (ABM). The data was obtained from the Tsunami disaster in Banten in 2018, such as milling time, walking speed, shelter location and tsunami wave. We evaluated the effectiveness of evacuation regarding the number of people evacuated safely and the mortality rate. Some scenarios was evaluated with various parameters. This research reveals that milling time and walking speed are critical points to create good vertical evacuation.

1. Introduction

Indonesia is one of archipelago country with many active volcanoes. Also, it is located in the ring of fire which is surrounded by three world tectonic plates, namely the Indo-Australian Plate, the Eurasian Plate and the Pacific Plate. The volcanic activity causes catastrophic eruptions, while the activity of tectonic plate may cause earthquakes and tsunamis[1]. The impact of the disaster is in the high risk category. The data show that the total number of people exposed to the risk of tsunami disaster in Indonesia is 4,102,406 people in all provinces in Indonesia with a potential loss of IDR 879 Trillion[2]. One of the areas that has a risk of earthquake and tsunami threat is Banten Province with the potential for earthquake and tsunami losses calculated to reach 148,390 people[1].

These risks can't be avoided, but their impact should be minimized. The way to minimize the catastrophe's risk is evacuation. Afew of studies attempt to analyze how to carry out an effective evacuation[3–5]. However, these researchesare still limited to hurricane disasters.

Furthermore, as an effort in terms of planning an effective evacuation strategyis necessary to know the behaviour disaster evacuation. The agent based model (ABM) approach is the appropriate model to determine evacuation behaviour during disasters such as explosions[6], excavations[7], fires[8,9], volcanoes [10], earthquakes[11,12], as well as earthquakes and tsunamis[13].

Unlike other disasters, tsunamis take approximately 20-40 minutes after the initial earthquake and generally have limited time to provide early warnings before the disaster strikes [14]. Thus the evacuation will be different. Research that discusses tsunami evacuation is carried out by [15] where evacuation is carried out using vertical evacuation with the help of a tsunami evacuation building

(TEB). this study only simulates the effectiveness of buildings in saving people. On the other hand, the effectiveness of evacuation is strongly influenced by human behaviour[16–18] during early warning, during a disaster and after a disaster with factors that influence, including age, gender [19,20], early evacuation and location safe [20] .

Thus, research is needed to examine the effectiveness of evacuation that focuses on human behaviour in responding to disaster information. While one of the approaches used is the agent based model (ABM). Research using ABM has been carried out, where this study focuses on the behaviour of individual agents[21,22]compared to the community, because it is closer to reality. While other studies add the agent's behaviour on foot [23] or the interaction between car and walking transportation modes[14,22,24,25]. However, the car mode of transportation creates a new problem, namely overcrowding which can cause a slowdown in evacuation, so[26]suggests evacuating by foot.

In this study, observations were made for the evacuation of walking with the consideration of avoiding overcrowding during evacuation. As a consideration in the evacuation, evaluate evacuation routes, shelter locations. Thus, this study will develop a model that can help to identify the vertical behaviour of earthquake and tsunami evacuation for walkers using an agent-based model (ABM) approach.

2. Methods

The object of this research is the behaviour of earthquake and tsunami evacuation based on age, gender, occupation, shelter location, shelter capacity. To develop this simulation model, it involved the participation of communities disaster-affected by the earthquake and tsunami in Carita Beach, Banten. The model evaluates the interactions that occur between evacuating groups and walker evacuation behaviour. For research stages are: (1) identify the behaviour of the earthquake and tsunami mode, (2) conduct *focus group discussion* (FGD) on disaster evacuation behabiour for pedestrians in Carita Beach, Banten, (3) determine of agents, (4) using computational agent-based model simulation (ABMS), and (5) determine the best alternative solution.

In this study, the agents involved were evacuees and tsunamis with the explanations as shown in Table 1. While the description of the model showed in Table 2.

Table 1. Agents of Model

Agents	Functionalities
Evacuees	Represents the people in the vulnerable area. In the simulation, the number of evacuee agents is taken between 300 and 500. The speed of evacuees is taken by various parameters.
Tsunami	Represents the tsunami. For initial tsunami is random at speed defined based on the various parameters.

Table 2. Description of Model

Agents	State	Action	behaviour
Evacuees	Alive, in motion, dead	Walk towards the shelters, die	When the agents see the tsunami indication, they walk toward the shelters
Tsunami	Propagate, stop propagate, affect evacuees	Disperse, affect the evacuees	The tsunami starts at the beginning of simulation and disperse with the time.

Based on the literature review stage, this study uses several parameters and simulation scenarios. The scenarios are divided into three which differ on the parameters used. For details as in Table 3.

Table 3. Paremeter dan Scenarios

Parameter	Scenario A	Scenario B	Scenario C
Walking speed	1 ms^{-1}	1.5 ms^{-1}	2,5 ms^{-1}
Tsunami speed	5 ms^{-1}	5 ms^{-1}	5 ms^{-1}
Milling time	10 minutes	10 minutes	10 minutes
Location Shelter	5 in random	5 in random	5 in random
Capacity/Shelter	Undefined	Undefined	Undefined

3. Results and Discussion

For three scenarios, the results are shown in figure 1. Number of survived evacuees is depend on walking speed that she/he took. In scenario C with walking speed that is fastest than the others, It gets the best result with 441 alive evacuees (59 missing persons). In other hand, the worst result is scenario A with 399 alived evacuees. From these scenarios reveals that with lower walking speed-represents the physical ability- impacts on high mortality rate.

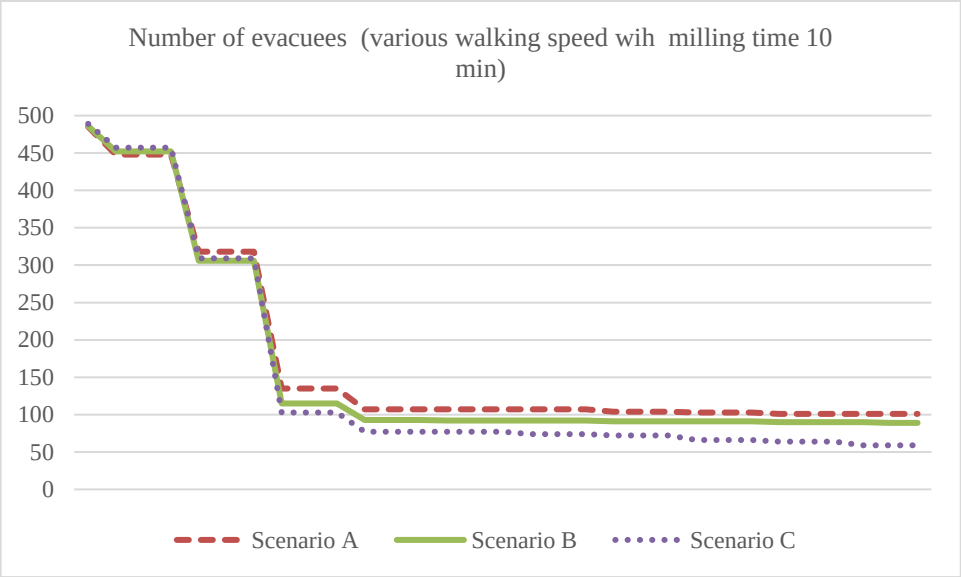


Figure 1. Number of evacuees based on three scenarios

Furthermore, Figure 2 shows the number of evacuees with scenario C in longer milling time (20 minutes). For this scenario, the number of alived evacuees is higher than scenario C in shorter milling time (10 minutes) with 452 and 441 refugees respectively. These means the impact maximum of milling time on mortality rate is lower.

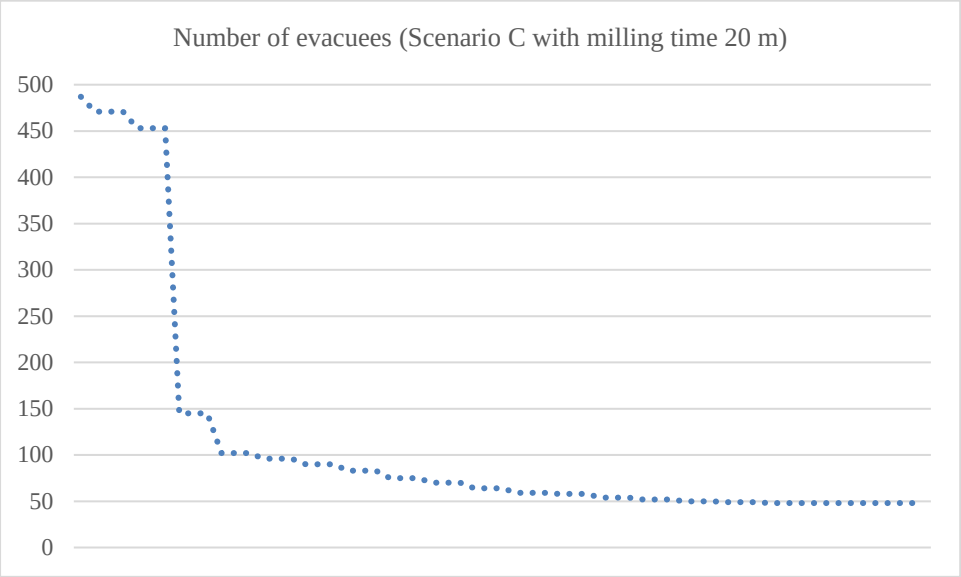


Figure 2. Number of evacuees based on scenario C with mlling time 20 minutes

4. Conclusions

In this paper, we conducted a framework the vertical evacuation behavioural for near-field tsunami using agent based model. Focusing on both milling time and walking speed, this research reveals that both of them are critical points that impact on mortality rate. It means that maximum milling time and walking speed impact on good vertical evacuation.

Aknowledgement

This research was funded by Minister of Education, Culture, Research and Technology (Kementrian Pendidikan, Kebudayaan, Riset, dan Teknologi) Indonesiaunder contract No. 065/SP2H/LT/DRPM/2021 for which the authors are grateful. However, the authors are solely responsible for the findings of the research.

References

[1] Amri M ., Yulianti G, Yunus R, Wiguna S, Adi A ., Ichwana A ., Randongkir R . and Septian R . 2016 *Risiko Bencana Indonesia* (Jakarta)

[2] BNPB 2014 *Rencana Nasional Penanggulangan Bencana 2015-2019* (Jakarta)

[3] Yin W, Murray-tuite P, Ukkusuri S V and Gladwin H 2014 An Agent-Based Modeling System for Travel Demand Simulation for Hurricane Evacuation *Transporatation Res. Part C* **42** 44–59

[4] Lindell M K, Kang J E and Prater C S 2011 The Logistics of Household Hurricane Evacuation *Nat. Hazards* **58** 1093–109

[5] Huang S-K, Lindell M K, Prater C S, Wu H-C and Siebeneck L K 2012 Household Evacuation Decision Making in Response to Hurricane Ike *Nat. Hazards Rev.* **13** 283–96

[6] Cimellaro G P, Mahin S and Domaneschi M 2019 Integrating a human behavior model within an agent-based approach for blasting evacuation **34** 3–20

[7] Yang W, Hu Y, Hu C and Yang M 2018 An agent-based simulation of deep foundation pit emergency evacuation modeling in the presence of collapse disaster *Symmetry (Basel).* **10** 1–22

[8] Mehmood S, Ahmed S and Kristensen A S 2019 Application of integrated model of evacuation psychology in an agent-based simulation *ACM International Conference Proceeding Series* pp 70–4

[9] Adam C and Gaudou B 2017 Modelling human behaviours in disasters from interviews: Application to Melbourne bushfires *J. Artifiicial Soc. Soc. Simul.* **20** 1–17

[10] Jumadi, Carver S and Quincey D 2016 A conceptual framework of volcanic evacuation simulation of Merapi using agent-based model and GIS *Procedia - Social and Behavioral Sciences* vol 227 (The Author(s)) pp 402–9

[11] Lu X, Yang Z, Cimellaro G P and Xu Z 2019 Pedestrian evacuation simulation under the scenario with earthquake- induced falling debris *Saf. Sci.* **114** 61–71

[12] Cimellaro G ., Ozello F, Vallero A, Mahin S and Shao B 2017 Simulating earthquake evacuation using human behavioral models *Earthq. Eng. Struct. Dyn.*

[13] Takabatake T, Fujisawa K, Esteban M and Shibayama T 2020 Simulated effectiveness of a car evacuation from a Tsunami *Int. J. Disaster Risk Reduct.*

[14] Wang H, Mostafizi A, Cramer L A, Cox D and Park H 2016 An Agent-Based Model of A Multimodal Near-Field Tsunami Evacuation: Decision-Making and Life Safety *Transp. Res. Part C Emerg. Technol.* **64** 86–100

[15] Karon J and Yeh H 2011 *Comprehensive Tsunami Simulator For Cannon Beach, Oregon* (City of Cannon Beach)

[16] Prati G, Saccinto E, Pietrantoni L and Pérez-Testor C 2013 The 2012 Northern Italy Earthquakes: Modelling human behaviour *Nat. Hazards* **69** 99–113

[17] Durage S W, Kattan L, Wirasinghe S C and Ruwanpura J Y 2014 Evacuation Behaviour of Households and Drivers During A Tornado: Analysis Based on A Stated Preference Survey in Calgary, Canada *Nat. Hazards* **71** 1495–517

[18] Yang H, Morgul E F, Ozbay K and Xie K 2016 Modeling Evacuation Behavior Under Hurricane Conditions *Transp. Res. Rec. J. Transp. Res. Board* **2599** 63–9

[19] Yeh H and Asce M 2010 Gender and Age Factors in Tsunami Casualties *Nat. Hazards Rev.* 29–34

[20] Yun N Y and Hamada M 2015 Evacuation Behavior and Fatality Rate During the 2011 Tohoku-Oki Earthquake and Tsunami *Earthq. Spectra* **31** 1237–65

[21] Helton W S, Kemp S and Walton D 2013 Individual Differences in Movements in Response to Natural Disasters *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* vol 57 pp 858–62

[22] Di-Mauro M, Megawati K, Cedillos V and Tucker B 2013 Tsunami Risk Reduction for Densely Populated Southeast Asian cities: Analysis of Vehicular and Pedestrian Evacuation for The City of Padang, Indonesia, and Assessment of Interventions *Nat. Hazards* **68** 373–404

[23] Wood N J and Schmidtlein M C 2012 Anisotropic Path Modeling to Assess Pedestrian-Evacuation Potential from Cascadia-Related Tsunamis in The US Pacific Northwest *Nat. Hazards* **62** 275–300

[24] Mas E, Suppsri A, Imamura F and Koshimura S 2012 Agent-based Simulation of the 2011 Great East Japan Earthquake / Tsunami Evacuation : An Integrated Model of Tsunami Inundation and Evacuation *J. Nat. Disaster Sci.* **34** 41–57

[25] Aguilar L, Wijerathne L, Ichimura T, Hori M and Tanaka S 2016 Mixed Mode Large Urban

Area Ttsunami Eevacuation Considering Car-Pedestrian Interactions *J. Japan Soc. Civ. Eng. Ser. A2 (Applied Mech.* **71** I_633-I_641

[26] Usman F, Murakami K, Dwi Wicaksono A and Setiawan E 2017 Application of Agent-Based Model Simulation for Tsunami Evacuation in Pacitan, Indonesia *MATEC Web of Conferences* vol 97 pp 2–16

Potential of durian seed (*Durio zibenthinus* Murr.) flour as the source of eco-friendly plastics materials: a mini-review

N D Permatasari[1,2*], J E Witoyo[3], E Ni'maturohmah[4], M Masruri[5], S S Yuwono[6], and S B Widjanarko[6]

[1]Doctoral Student of Food Science, Department of Agricultural Product Technology, Faculty of Agricultural Technology, Universitas Brawijaya, Jalan Veteran, Malang, 65141, Indonesia
[2]Department of Food Technology, Politeknik Tonggak Equator, Jl. Fatimah No 1-2, Pontianak, 78243, Indonesia
[3]Doctoral Student of Agroindustrial Engineering, Department of Agroindustrial Technology, Faculty Faculty of Agricultural Technology, Universitas Brawijaya, Jalan Veteran, Malang, 65141, Indonesia
[4]Pilot Plant Laboratory, Faculty of Agricultural Technology, Universitas Brawijaya, Jalan Veteran, Malang, 65141, Indonesia
[5]Department of Chemistry, Faculty of Science, Universitas Brawijaya, Jalan Veteran, Malang, 65141, Indonesia
[6]Department of Agricultural Product Technology, Faculty of Agricultural Technology, Universitas Brawijaya, Jalan Veteran, Malang, 65141, Indonesia

*Email: nelsypolteq@gmail.com

Abstract. Currently, plastics from non-renewable sources are being used less due to environmental concerns and switching to eco-friendly plastics. Eco-friendly plastics are usually produced from renewable materials, such as durian seed flour (DSF). DSF is a product made from durian seeds, and currently, it is only limited to a substitute for other ingredients in food products systems. However, DSF contains specific constituents that can be used to create eco-friendly plastics, rarely discussed. Thus, this mini-review briefly discusses the chemical composition and potential of DSF as a source of eco-friendly plastic materials.

1. Introduction

Plastics derived from non-renewable sources have posed significant problems and challenges to the world today. It produces more than 400 Mt per year worldwide and takes a long time to decompose. As a result, nonrenewable-source plastics have unfriendly environmental properties that pollute humans indirectly [1]. So, the exploration of more eco-friendly plastic raw materials is needed to support creating a clean environment.

Indonesia is a tropical country with high plant biodiversity [2], including tropical fruit plants [3], [4], with 592 species spread across its islands. Durian is one of the fruit cultivated in Indonesia and has higher production. According to [5], the durian production in Indonesia reached 1169802 tons in 2019. Generally, the durian fruit consumed directly is only fruit flesh and only has a percentage of 30 -35% of whole durian fruit. Furthermore, with 20-25%, the other part is fruit seeds, and 40-50% is fruit skin [6], [7]. From this fact, it is known that more than 233960.4 tons of durian seeds as a by-product of

durian refers to durian production data published by the 2020 Central Statistics Agency. However, the community consumed only a tiny portion of durian seeds as a snack by boiling the durian seeds, and the rest was not appropriately utilized [8]–[10]. Furthermore, durian seeds have complete nutritional content. Nevertheless, the disadvantage of durian seeds is that they have a relatively high moisture content [7], [9], so they are easily damaged and have a short shelf life. Further processing into durian seed flour (DSF) maintains durian seed nutrition and shelf life.

DSF is a product from the durian seed through a simple processing method [6], [11]. Many researchers reported that the DSF has high starch gum content and also contains trace elements and minerals [6], [11]–[17]. According to Thakur *et al.* [18], starch, gum, protein, and lipid are the constituent components in manufacturing bioplastics or biofilm. Eco-friendly plastics, known as bioplastics, are plastics made from biological materials from animals, plants, or microorganisms to overcome environmental problems due to plastic waste disposal [19]–[21]. The criteria for determining the quality of the plastics, both bioplastics, and synthetic plastics, are mechanical properties and thermal stability. Commonly, the best bioplastics must have high mechanical properties and thermal stability [19]. However, no in-depth review has been found to discuss the potential of DSF as a bioplastic material that has not been widely studied. Therefore, this short paper review will be discussed that.

2. Durian Seeds and Its chemical Properties

Durian seeds are a by-product of the durian fruit. Durian seeds range 20-25% from whole durian fruit [6], [7]. In Indonesia, the production of durian seeds is approximately more than 233960.4 tons when referring to data from the Indonesian Central Statistics Agency in 2020 [5]. The main composition of fresh durian seed flour is moisture content, ranging from 48 -51.5%. Moreover, the fresh durian seed also contains 2-3% protein content, the fat content of <1%, carbohydrate content of 43.6 -47%, and ash content of 1-2% [7], [9]. The trace minerals compiler of the fresh durian seed of Ca (17 mg 100 g^{-1}), P (68 mg 100 g^{-1}), Fe (1 mg 100 g^{-1}), Na (3 mg 100 g^{-1}), K (62 mg 100 g^{-1}), betacarotene (250 µg100 g^{-1}), riboflavin (0.05 mg 100 g^{-1}), and niacin (0.9 mg 100 g^{-1}) [9]. In another study, Kumoro and his colleagues [4] also reported that the seed kernel of durian had a carbohydrate content of 18.92%, the protein content of 3.4%, a fat content of 1.32%, the fiber content of 19.88%, ash content of 1.58%, and moisture content of 54.9%. Based on the Kusriani *et al.*.study [8], the dried durian seed had higher moisture, ash, protein, crude fiber content, and lower fat content than the other fruit, such as dried jack fruit seed. In contrast, the dried durian seed had lower ash, fat, protein, crude fiber, and high moisture content compared with dried avocado seed. The comparison data is listed in Table 1.

Table 1. The chemical properties of durian seed compared with jack fruit, and avocado seeds

Parameters	Unit	Durian seed	Jackfruit seed	Avocado seed
Moisture content	%	9.0	8.0	6.5
Ash content	%	4.0	3.0	6.0
Crude fat content	%	3.6	3.7	5.0
Crude protein	%	14.6	13.9	17.1
Crude fiber	%	8.9	8.6	9.1

Sources: Kusriani *et al.*. [8]

3. Durian Seed Flour, and it's potential as eco-friendly plastics raw materials

Durian seed flour (DSF) is a product made from durian seeds [7], [22]. In general, the durian seed flour processing follows: Firstly, the durian seed was washed using water to remove the dirt, peeling, slicing, and drying using the sunlight or artificial dryer. Moreover, the dry durian seed was ground using mechanical milling and sieve with 80 mesh to obtain the DSF [7], [17]. The composition of DSF is listed in Table 2.

Table 2. The Composition of DSF

Parameters	Unit	Content	Reference
Carbohydrate	%	70.99 – 87.24	[11]–[17]
Protein	%	0.10 – 8.12	[11]–[17]
Fat	%	0.02 – 3.07	[11]–[17]
Moisture	%	4.78 – 17. 86	[11]–[17]
Ash	% d.b	0.23	[16]
Amylose	% d.b	22.76	[16]
Resistant starch	% d.b	29.83	[16]
Yield of starch	% d.b	18.2	[16]
Starch	%	40.29	[6]
Gum yield	% d.b	55.44	[6]
Starch yield	% d.b	26.58	[6]

Eco-friendly plastics, known as bioplastics, are defined as plastics that can be biodegradable by the environment, usually made of biological materials derived from animals, plants, or microorganisms [19]–[21]. Commonly, derived plants used as raw materials are starch [18] or whole flour [23]. According to Thakur *et al.*. [18], starch, gum, protein, and lipid are the main constituents for the bioplastic former. The main component of the bioplastic former was further explained as follows:

1) Starch

Starch is composed of amylose and amylopectin, which are the main constituent components of durian flour. The hydroxyl group in starch plays a role in forming hydrogen bonds [3]. Amylose plays a role in creating the film's mechanical properties [4]. Starch is generally widely used in producing bioplastics. It makes an odorless, tasteless, transparent film with the same properties as synthetic plastics [5] but has weaknesses in mechanical strength and sensitivity to high humidity [6]. Based on Table 2, the starch content in DSF was 40.29% [6], with an amylose content of 22.76% d.b [16].

2) Gum

Gum is a polymer that can form a gel soluble in water to expand by absorbing moisture and creating a rigid gel [24]. The gum content in DSF was 55.44% d.b, based on Table 2. Gum in DSF has a vital role in forming pastes and gels [6].

3) Protein

Proteins are macromolecules composed of several amino acids with functional properties such as solubility, gel formation, and water binding [25]. Proteins can be used as an ingredient in the manufacture of films or combined with other materials such as polysaccharides and lipids [26]. Based on Table 2, protein content in DSF was 0.10 – 8.12% [11]–[17]. The addition of protein in film making will improve the mechanical properties and barrier properties against water vapor [27].

4) Lipid

Lipids are compounds that contain hydrophobic fatty acids. Lipids can be used as ingredients in the manufacture of edible films or together with other materials such as polysaccharides and proteins [26]. In DSF, containing of fat/ lipid content was 0.02 – 3.07% [11]–[17]. The function of lipid incorporation into the film will affect the barrier properties of water vapor. It causes lipids to withstand water vapor transmission rate [28].

Based on these criteria, DSF meets all. DSF contained relatively high starch content, amylopectin content, starch yield, and gum yield, as previously explained. DSF is an excellent potential source to be developed as a raw material for making eco-friendly plastics. This potential needs to be studied further through scalable experimental studies. The previous survey was conducted by Retnowati *et al.*. [23], which transformed DSF into a biodegradable film. Their results showed that biodegradable film had bad characteristics like the lowest modulus young, tensile strength, and elongation break. Thus, the enhancement properties of bioplastics from DSF might be incorporated by other components.

Other components to improve the bioplastic properties of DSF can be done by adding other polysaccharide components, plasticizers, natural extracts, and so on to achieve the desired bioplastic characteristics. The functions and effects of incorporated other materials to bioplastics are described as follows:

1) Polysaccharide

Polysaccharides are polymeric molecules with constituent monomers in sugars or disaccharides. Polysaccharides are soluble in water and their ability to form gels. Non-starch polysaccharides hydrocolloids or gums because they can form colloids when they are dissolved in water. Examples include agar, alginate, carrageenan, gellan gum, pectin, grain gum, xanthan gum. There is also a class of proteins that include hydrocolloids, namely gelatin. The function of polysaccharides is as a thickener, gelling, stabilizer, and film-forming [25]. The addition of hydrocolloids will reduce the gelatinization temperature of starch. Films with the addition of hydrocolloids have been carried out, which affect the gelatinization temperature with the addition of pectin, gum Arabic [17], guar galactomannan, carrageenan, guar gum, and xanthan gum [29], [30], [31], [32],

Chitosan is a linear polysaccharide of N-acetyl-D-glucosamine and D-glucosamine obtained by deacetylation of chitin that is insoluble in water but readily soluble in acid solutions, making it ideal for the production of less hydrophilic bioplastics [33]. Several studies reported that the addition of chitosan increased the thickness, decreased the water vapor transmission rate, and had no effect on water's transparency, water solubility, and bioplastic's compressive strength [33], [34]. In addition, the application of chitosan as a filler increased the tensile strength, density, and modulus of elasticity and decreased elongation break of bioplastics [34]–[37] and LDPE plastics [38]. However, in Harsojuwono *et al.'s* study [7], chitosan improved the tensile strength elongation break and decreased the modulus young in bioplastic.

Glucomannan is a neutral hetero-polysaccharide composed of D-glucose and D-mannose linked by -1,4 glycosidic bonds [39]. The primary source of glucomannan abroad is the konjac tuber and similar tubers that are widely grown in the plains of East Asia, such as China and Japan [40]–[42]. In addition, glucomannan can be obtained from schlep tubers [43] and porang tubers [44]–[46]. Incorporating glucomannan as a form of konjac extract in the edible film-based whey protein improved the thickness, tensile strength, elongation breaks, and water vapor transmission rate [47]. The incorporation of glucomannan in chitosan-lysozyme film decreased edible film's moisture content, L*, and whiteness index. Moreover, the addition of glucomannan increased in elongation break, a*, b*, ΔE, opacity and did not affect the thickness, water vapor permeability, and tensile strength [48].

2) Plasticiser

The addition of plasticizers in bioplastics aims to increase flexibility and reduce their brittleness by expanding the space between polymer chains to reduce intermolecular attractions, and usually, plasticizers are hydrophobic [49]. Commonly, plasticizers used for bioplastics are glycerol and sorbitol [35]–[37], [49]–[51]. Applying glycerol as a plasticizer (in 5-30%) in bioplastic or edible film decreased the density, tensile strength, and modulus elasticity and improved bioplastic's elongation break [36]. Moreover, applying 0.3% glycerol as a plasticizer in the konjac-based bioplastics decreased the tensile strength and enhanced the elongation break, water vapor transmission rate, and water solubility [49].

Another plasticizer used is sorbitol. The 10-50% application decreases tensile strength and enhances bioplastics' elongation breaks [35]. Sofiah *et al..*[50] comparing the glycerol and sorbitol as a plasticizer in *Musa paradisica Formatypica* concentrate based bioplastic showed the bioplastics with sorbitol of 1-5 ml as plasticizer had the higher tensile strength and also had the higher elongation break at used sorbitol of 4-5 ml than glycerol. However, the trend of tensile strength of bioplastic decreased with the increase of both plasticizers. Furthermore, the direction of elongation break bioplastic with sorbitol as plasticizer increased as a function of increased sorbitol addition. The same trend was also found in bioplastics with glycerol as plasticizer until 3 ml and decreased. Fahrullah *et al..* [51] also compared the glycerol, sorbitol, and polyethylene glycol as a plasticizer at 30% concentration in whey composite edible film. The results showed that whey composite edible film

with glycerol as a plasticizer had a lower tensile strength and higher elongation break than the edible film with sorbitol and polyethylene glycol as a plasticizer. However, all the edible film samples had a similar thickness and water vapor transmission rate.

Asia *et al.*. [52] added sorbitol and glycerol with a 1-4% concentration on the edible film. The film added with sorbitol is more rigid and harder the texture than film without plasticizers. While the film is added with glycerol, the resulting film is more elastic and has a flexible surface. The addition of 2% sorbitol and 2% glycerol resulted in the tensile strength of 41.60 MPa and 35.72 MPa, respectively. The results showed that the film from Belitung taro starch with the addition of glycerol as a plasticizer had a lower tensile strength when compared to the movie with the addition of sorbitol as a plasticizer.

3) Natural Extract

The addition of an additive, like natural extract, aims to improve their functionality as active bioplastics with specific purposes, like anti-microbial, anti-bacterial, anti-fungi, and so on. Generally, the natural extract incorporated in bioplastics is an essential oil (like clove oil and so on), crude, or fractionation extract. Ulyarti *et al*.. [33], in their study, incorporated clove oil in bioplastics with concentration 0.3 -1.5%, and its effect in the increase of thickness decreased transparency water vapor transmission rate. It did not affect water solubility and bioplastic's compressive strength. Hashemi and Jafarpour [53] incorporated the ethanolic extract of *saffron petals* in konjac glucomannan-based edible film. The results showed that the increases of saffron petal extract decreased water vapor permeability, improved transparency, and moisture content, and did not affect the thickness of the edible film. Moreover, the increases of *saffron petal* extract from 1 to 5% significantly increased the inhibition zone in all bacteria observed, like *S. Typhi, E. coli, S. sonnei, B. cereus*, and *S. aureus* in the edible film. Umiyati *et al*.. [54] reported that adding *Calophyllum inophyllum* extract 5-20% w/w into bioplastics increases tensile strength but has no effect on elongation at break and modulus of elasticity, reduces water solubility and water vapour permeability, inhibits the growth of *E. coli* and *S. Aureus* bacteria. Velasco *et al*.. [55] added the carvacrol with a concentration of 0-10% into the film mixture and inhibited the growth of *S. aureus*. With the addition of 8% carvacrol, it had the best zone inhibition with 15.89 mm.

However, the formulation with other components like another polysaccharide, plasticiser, natural extract, etc., should be done to obtain the optimum or best condition for producing eco-friendly bioplastic from durian flour according to the application later.

4. Conclusion

The DSF had the potential as a new renewable source for eco-friendly plastics production. According to the chemical composition, the DSF was rich in starch, gum content, and other trace components like protein and lipids, which are constituents of eco-friendly plastics formers. However, the formulations with other constituents of eco-friendly plastic compiler need to be observed and researched to find the optimum or best condition for the different applications.

References

[1] Fahim I, Mohsen O and Elkayaly D 2021 Production of fuel from plastic waste: A feasible business, *Polymers (Basel).* **13** 1–9.

[2] Kusmana C and Hikmat A 2015 The Biodiversity of Flora in Indonesia *J. Nat. Resour. Environ. Manag.* **5** 187–198.

[3] Ningrum A and Schreiner M 2017 Review: Extensive Potentiality of Selected Tropical Fruits from Indonesia," *Indones. Food Nutr. Prog.* **14** 85.

[4] Kumoro A C, Alhanif M and Wardhani, D H 2020 A Critical Review on Tropical Fruits Seeds as Prospective Sources of Nutritional and Bioactive Compounds for Functional Foods Development: A Case of Indonesian Exotic Fruits *Int. J. Food Sci* **2020**

[5] Badan Pusat Statistik 2020 Statistik Indonesia 2020 Jakarta

[6] Leemud P, Karrila S, Kaewmanee T and Karrila T 2020 Functional and physicochemical properties of Durian seed flour blended with cassava starch *J. Food Meas. Charact.***14** 388–400.

[7] Djaeni M and Prasetyaningrum A 2010 Kelayakan buah durian sebagai bahan pangan alternatif : aspek nutrisi dan tekno ekonomi *Riptek* **4** 37–45.

[8] Kusriani R H, Rahmawati I and Musfiroh I 2014 Karakterisasi Pati Biji Buah Durian, Biji Buah Nangka, Dan Biji Buah Alpukat *J. Farm. Galen.* **1** 8–11.

[9] Nurfiana F, Mukaromah U, Jeannisa V C and Putra S 2009 Pembuatan Bioethanol Dari Biji Durian Sebagai Sumber Energi Alternatif in *Seminar Nasional V SDM Teknologi Nuklir*. 669–676.

[10] Cornelia M, Siratantri T and Prawita R 2015 The Utilisation of Extract Durian (*Durio zibethinus* L.) Seed Gum as an Emulsifier in Vegan Mayonnaise *Procedia Food Sci.* **3** 1–18

[11] Cahyani D A and Hakim L 2017 Pengaruh Perebusan dan Perendaman pada Proses Pengolahan Tepung Biji Durian *Media Agrosains* **19** 19–22.

[12] Suparno S, Efendi R and Rahmayuni R 2016 Pengaruh Perendaman Kapur Sirih dan Garam terhadap Mutu Tepung Biji Durian **44**160–197.

[13] Kumoro A C and Hidayat J P 2018 Effect of soaking time in sodium metabisulfite solution on the physicochemical and functional properties of durian seed flour *MATEC Web Conf.* **156** 01028.

[14] Azima F, Anggraini T, Syukri D and Septia R A 2017 Effects of sodium bisulfite soaking on the quality of durian seed flour and its application to dakak-dakak production (west sumatra's traditional snack) *Pakistan J. Nutr.* **16** 175–178.

[15] Sigiro O N, Sukmayani S, Habibah N and Kristiandi K 2020 Potensi Bahan Pangan Tepung Biji Durian Setelah Melalui Masa Penyimpanan *Agro Bali Agric. J.* **3** 229–233.

[16] Tongdang T 2008 Some properties of starch extracted from three thai aromatic fruit seeds *Starch/Staerke.* **60** 199–207.

[17] Kumoro A C and Hidayat J P 2018 Functional and thermal properties of flour obtained from submerged fermentation of durian (*Durio Zibethinus Murr.*) seed chips using Lactobacillus plantarum *Potravin. Slovak J. Food Sci* **12** 607–614.

[18] Thakur R, Pristijono P, Scarlett, C J, Bowyer M, Singh S P and Vuong Q V 2019 Starch-based films: Major factors affecting their properties *Int. J. Biol. Macromol.* **132** 1079–1089.

[19] Selvamurugan Muthusamy M and Pramasivam S 2019 Bioplastics – An Eco-friendly Alternative to Petrochemical Plastics *Curr. World Environ.* **14** 49–59.

[20] Thielen M 2019 Bioplastics - Plants and crops, raw materials, products *Publ. Berlin Fachagentur Nachwachsende Rohstoffe e.V.*,.

[21] Emadian S M, Onay T T and Demirel B 2017 Biodegradation of bioplastics in natural environments *Waste Manag.* **59** 526–536.

[22] Prasetyaningrum A 2010 Mekanisasi proses olahan biji durian menjadi produk pangan yang kompetitif *Riptek.* **4** 47–52.

[23] Retnowati D S, Ratnawati R and Purbasari A 2015 A biodegradable film from jackfruit (Artocarpus heterophyllus) and durian (durio zibethinus) seed flours *Sci. Study Res. Chem. Chem. Eng. Biotechnol. Food Ind.* **16** 395–404,.

[24] Phillips G O and Williams P A (Eds.) 2009 *Handbook of hydrocolloids*. Elsevier.

[25] Estiasih T, Harijono, Waziiroh E and Fibrianto K 2016 *Kimia dan Fisik Pangan*, 1st ed. Jakarta: Bumi Aksara.

[26] Robertson, G L 1993 *Food Packaging Principles and Pratice*. New York: Marcel Dekker, Inc,.

[27] Zink J, Wyrobnik T, Prinz T and Schmid M 2016 Physical, chemical and biochemical modifications of protein-based films and coatings: An extensive review *International Journal of Molecular Sciences* 17 1376.

[28] Shabrina A 2017 Sifat Fisik Edible Film Yang Terbuat Dari Tepung Pati Umbi Garut Dan Minyak Sawit *J. Apl. Teknol. Pangan*. **6** 138–142.

[29] Ferrero C, Martino M N and Zaritzky N E 1996 Effect of hydrocolloids on starch thermal transitions, as measured by DSC *J. Therm. Anal.* **47** 1247–1266.

[30] Sabanis D and Tzia C 2011 Effect of hydrocolloids on selected properties of gluten-free dough and bread *Food Sci. Technol. Int.* **17** 279–291.

[31] Leite T D, Nicoleti J F, Penna A L B and Franco C M L 2012 Effect of addition of different hydrocolloids on pasting, thermal and rheological properties of cassava starch *Food Sci. Technol.* **32** 579–587.

[32] Torres M D, Moreira R, Chenlo F, Morel M H 2013 Effect of water and guar gum content on thermal properties of chestnut flour and its starch *Food Hydrocoll.* **33** 192–198.

[33] Ulyarti U 2021 Development of yam-starch-based bioplastics with the addition of chitosan and clove oil *Makara J. Sci.* **25** 91–97.

[34] Fathanah U, Lubis M R and Moulana R 2015 Biopolymer From Starch and Chitosan As Bioplastic Material for Food Packaging *Proc. 5th Annu. Int. Conf. Syiah Kuala Univ. (AIC Unsyah).* **5** 44–49.

[35] Ginting M H S, Lubis M, Sidabutar T and Sirait T P 2018 The effect of increasing chitosan on the characteristics of bioplastic from starch talas (*Colocasia esculenta*) using plasticiser sorbitol *IOP Conf. Ser. Earth Environ. Sci.* **126** 012147

[36] Ginting M H S, Hasibuan R, Lubis M, Alanjani F, Winoto F A and Siregar R C 2018 Utilisation of avocado seeds as bioplastic films filler chitosan and ethylene glycol Plasticiser *Asian J. Chem.* **30** 1569–1573.

[37] Paradika Y P M 2017 Effect of Plasticizer and Chitosan Composition on the Plastic Biodegradable Quality from Starch Cassava Rubber (Manihot Glaziovii) as Alternative Plastic *Aasic.Org*. 83–88.

[38] Kusumastuti Y, Putri N R E,Timotius D, Syabani M W and Rochmadi 2020 Effect of chitosan addition on the properties of low-density polyethylene blend as potential bioplastic *Heliyon* **6** e05280

[39] Alonso-Sande M, Teijeiro-Osorio D, Remuñán-López C and Alonso M J 2009 Glucomannan, a promising polysaccharide for biopharmaceutical purposes *Eur. J. Pharm. Biopharm.* **72** 453–462.

[40] Behera S S and Ray R C 2016 Konjac glucomannan, a promising polysaccharide of *Amorphophallus konjac* K. Koch in health care *Int. J. Biol. Macromol.* **92** 942–956.

[41] Behera S S and Ray R C 2017 Nutritional and potential health benefits of konjac glucomannan, a promising polysaccharide of elephant foot yam, *Amorphophallus konjac* K. Koch: A review *Food Rev. Int.* **33** (1) 22–43.

[42] Ray R C and Behera S S 2016 Amorphophallus: Technological Interventions in *Tropical Roots and Tubers: Production Processing and Technology* First Edit., H. K. Sharma, N. Y. Njintang, R. S. Singhal, and P. Kaushal, Eds. John Wiley & Sons, Ltd. 591–612.

[43] Kurt A and Kahyaoglu T 2017 The Physicochemical and Structural Characteristics of Cultivated Sahlep *Int. J. Second. Metab.* **4** 488–498.

[44] Widjanarko S B, Faridah A and Sutrisno A 2014 Optimisation of ultrasound-assisted extraction of konjac flour from *Amorphophallus muelleri* Blume in *17th Gum and Stabilisers for the Food Industry: The Changing Face of Food Manufacture: The Role of Hydrocolloids*. 109–121.

[45] Yanuriati A, Marseno D W, Rochmadi and Harmayani E 2017 Characteristics of glucomannan isolated from fresh tuber of Porang (*Amorphophallus muelleri* Blume) *Carbohydr. Polym.* **156** 56–63.

[46] Harmayani E, Aprilia V and Marsono Y 2014 Characterisation of glucomannan from Amorphophallus oncophyllus and its prebiotic activity in vivo *Carbohydr. Polym.* **112** 475–479.

[47] Fahrullah F, Radiati L E, Purwadi and Rosyidi D 2020 The physical characteristics of whey based edible film added with konjac *Curr. Res. Nutr. Food Sci.* **8** (1) 333–339.

[48] Ma S, Zheng Y, Zhou R and Ma M 2021Characterization of Chitosan Films Incorporated with Different Substances of Konjac Glucomannan, Cassava Starch, Maltodextrin and Gelatin, and Application in Mongolian Cheese Packaging *Coatings* **11** 1–16.

[49] Wiset L, Poomsa-ad N, Jomlapeeratikul P and Borompichaichartkul C 2014 Effects of Drying Temperatures and Glycerol Concentrations on Properties of Edible Film from Konjac Flour *J. Med. Bioeng.* **3**171–174.

[50] Sofiah, Yuniar, Aznury M and Melianti 2019 Mechanical Properties of Bioplastics Product from Musa Paradisica Formatypica Concentrate with Plasticizer Variables *J. Phys. Conf. Ser*. **1167** 012048

[51] Fahrullah F, Radiati L E, Purwadi P and Rosyidi D 2020 The Effect of Different Plasticisers on the Characteristics of Whey Composite Edible Film *J. Ilmu dan Teknol. Has. Ternak*. **15** 31–37

[52] Asria M, Elizarni, and Samah D S D 2015 The effect of the addition of sorbitol and glycerol towards the edible film characteristics of the belitung taro starch and the lime leaves as anti-microbial *AIP Conf. Proc.* **1699** 040011

[53] Hashemi S M B and Jafarpour D 2020 The efficacy of edible film from Konjac glucomannan and saffron petal extract to improve shelf life of fresh-cut cucumber *Food Sci. Nutr.* **8** 3128–3137.

[54] Umiyati R, Millati R, Ariyanto T and Hidayat C 2020 *Calophyllum inophyllum* extract as a natural enhancer for improving physical properties of bioplastics and natural anti-microbial *Biodiversitas*. **21** 1794–1802.

[55] Velasco E M Z and Fundador N G V 2020 Development and use of anti-microbial durian starch-carrageenan/carvacrol films *Mindanao J. Sci. Technol.* **18** 118–128

Implementations Of The Discretionary Accruals (Da) Method For Detecting Earning Management In Agricultural Sector Companies During The Covid-19 Pandemic

Rusmianto[1] and A Makhsun[1*]

[1] Tax Accounting Study Program, Department of Economy and Business, Politeknik Negeri Lampung, Bandar Lampung, Indonesia

*Email: rusmianto@polinela.ac.id

Abstract. This research was conducted to obtain empirical evidence of the practice of earning management and the effect of company size and gender management on the earning management of agricultural sector companies in Indonesia during the Covid-19 pandemic. This research was conducted on agricultural sector companies on the Indonesia Stock Exchange (IDX). This study uses Discretionary Accrual as a proxy to detect the earning management of agricultural sector companies. The test was carried out using the Discretionary Accrual average difference test before and after the Covid-19 pandemic and multiple regression analysis. The results of the tests conducted show a significant difference between Discretionary Accrual (DA) before and after the Covid-19 pandemic. Further, there is no significant effect of company size and gender management on earnings management. This indicates the change in earnings quality reported by agricultural sector companies registered on the IDX before and after the Covid-19 pandemic.

1. Introduction

The Covid-19 pandemic has had a huge impact on the Indonesian state, not only in the health sector but also in the economic sector. The impact of the Covid-19 pandemic on the Indonesian economic sector is reflected in negative economic growth throughout 2020. The Central Statistics Agency BPS noted that economic growth throughout 2020 is as shown in Table 1.

Table 1. Indonesia's Economic Growth in 2020

No	Quarter	Economic growth
1	I	2.97
2	II	-5.32
3	III	-3.49
4	IV	-3.45
	Average	-2.32

Throughout 2020, Indonesia's economic growth experienced negative growth with an average growth throughout 2020 of -2.32. This means that Indonesia's Gross Domestic Product has decreased which indicates an increase in the unemployment rate, a decrease in retail sales, and a contraction in manufacturing and company income.

Likewise, the impact of the Covid-19 pandemic has been quite severe on the agricultural sector. The gross domestic product (GDP) of the agricultural sector throughout 2020 experienced a fairly severe contraction, namely experiencing negative growth of 20.15 percent in the fourth quarter compared to the previous quarter [1]. This indicates a decrease in income earned by companies in the agricultural sector listed on the Indonesia Stock Exchange (IDX).

The occurrence of revenue contraction in the company as a result of unfavorable economic conditions (Covid 19) will encourage company management to regulate reported earnings. This is driven by the motivation that management will try to meet the expectations of *stakeholders* (shareholders, investors, creditors) to continue to perform well even in times of crisis[2]. In addition, the motivation of management to regulate earnings is to avoid shareholders replacing management when the company's performance declines or is not good because management's failure to overcome the impact of the Covid-19 pandemic on company performance is a reflection of the company's management incompetence [3]. Previous studies have also confirmed earnings management by management during the financial crisis [4]–[6].

Various characteristics of the company are also suspected to have an effect on earnings management, such as: company size, and gender of management. Company size plays an important role for companies that practice profit management. Larger companies generally receive more attention from external parties such as investors, analysts, and the government, so large companies should be more careful in managing their financial statements. The presentation of earnings in large companies is suspected to be more accurate and more careful because the operating activities of large companies are more complex. With a more accurate and careful presentation of earnings, there is a small possibility for large companies to regulate earnings [7].

Women and men have different abilities due to differences in the socialization process. Women emphasize helping others, whereas men focus on making money and moving up in the organizational hierarchy. In addition, women are more likely to report fraudulent financial incidents. Therefore, it is suspected that the greater the composition of female management, the less likely the company is to regulate earnings [8].

The Covid-19 pandemic has an impact on the company's low performance which will encourage company management to make adjustments to reported profits. The management of this profit arrangement is detected by the value of *Discretionary Accrual* which increases (decreases) from the previous period. In addition, the Covid-19 pandemic has had various negative impacts in terms of company size, and the company's gender composition. This research will be carried out with the aim of Obtaining empirical evidence of profit-regulating practices of agricultural sector firms in Indonesia during the Covid-19 pandemic by using Discretionary Accruals and Obtain empirical evidence of the effect of firm size and gender management of profit management of agricultural sector companies in Indonesia during the Covid-19 pandemic.

2. Methods

This research was conducted on 22 companies in the agricultural sector on the Indonesia Stock Exchange (IDX). The data used in this study are secondary data of agricultural sector companies on the Indonesia

Stock Exchange in the form of annual financial report data, company stock prices, stock trading volume, for 2017, 2018, and 2019. The accounting period studied in this study is January 1, 2017 to December 31, 2020. The data was obtained from the data center of the Indonesia Stock Exchange, Indonesian Capital Market Directory.

Following Almarhameh et al., [9], earnings arrangements are estimated using the modified Jones (1995) *Discretionary Accrual* model before and after the Covid-19 pandemic period with January 1, 2020 as the separator date according to the Covid-19 pandemic that occurred in 2020. Company size is a classification of whether the company is included in the large or small category which is calculated based on the number of assets owned by the company. With this separation, it can be seen that the profit management activities carried out by large-scale companies as well as small-scale companies. Firm size is defined as the logarithm of total assets. The female board of directors reflects the care and full consideration of the information that will be distributed to other parties. With this composition, it can be seen that the profit management activities by companies with different compositions of female directors can be seen. The composition of female directors is measured by the percentage of the number of directors in each company.

3. Results and Discussion

This research was conducted on agricultural sector companies on the Indonesia Stock Exchange (IDX). The number of research samples used in this study are as follows:

Table 3. Research Sample

No	Criteria	Amount
1	Number of Agricultural Sector Companies	22
2	Companies registered after 2017	5
3	Companies that are delisted/suspended in 2017-2020	2
	Research Sample	15

The number of agricultural sector companies listed on the IDX is 22 companies. 5 companies listed after 2017 and 2 companies delisting/suspending/not submitting reports in the 2017-2020 period so that these two groups cannot be used as research samples. In the end, the number of samples used in this study amounted to 15 companies.

Abnormal accruals. Abnormal accruals are proxies used to estimate profit arrangements before and after the Covid-19 pandemic for agricultural sector companies. Abnormal accruals explain management behavior in influencing the amount of company profits through the selection and making of accrual policies that are required to be standard or not. The greater the value of abnormal accruals, the greater the behavior of management in influencing the amount of profit and vice versa. Abnormal accruals negative values indicate management tends to reduce profits and positive values Abnormal accruals indicate management behavior to increase accounting earnings.

Table 4. Descriptive Statistics *Abnormal accruals*

	Before Covid-19 Pandemic Period	After Covid-19 Pandemic Period
N	15	15
mean	-0.081	0.023
median	-0.052	0.003
Standard Deviation	0.090	0.201
Minimum	-0.346	-0.303
Maximum	-0.001	0.658

Based on Table 4, it can be seen that the minimum value of *Abnormal accruals* (ACC) in the year before the Covid-19 Pandemic was -0.346 while the maximum value of *Abnormal accruals* (ACC) was -0.001. The average value of *Abnormal accruals* (ACC) is -0.081 with a standard deviation of 0.090. What can be learned from the negative average value of *Abnormal accruals* (ACC) is that prior to the Covid-19 Pandemic, in general, agricultural sector companies tended to decrease profits through their accrual policies.

Based on Table 4, it can also be seen that the minimum value of *Abnormal accruals* (ACC) in the Covid-19 Pandemic Period was -0.303 while the maximum value of *Abnormal accruals* (ACC) was 0.658. The average value of *Abnormal accruals* (ACC) is 0.023 with a standard deviation of 0.201. What can be learned from the positive average value of *Abnormal accruals* (ACC) is that after the Covid-19 Pandemic, agricultural sector companies tend to increase their profits through their accrual policies.

Abnormal accruals (ACC) before the Covid-19 Pandemic Period were negative while *Abnormal accruals* (ACC) after the Covid-19 Pandemic Period were positive. What can be indicated from the descriptive statistics above is that there are differences in management responses before and after the Covid-19 Pandemic Period. Before the Covid-19 Pandemic, management tended to decrease profits, while after the Covid-19 Pandemic, management tended to increase profits.

The first alternative hypothesis in this study is that the management of agricultural sector companies regulates reported profits during the Covid-19 pandemic. Earnings arrangement is estimated using *abnormal accruals (*) . Then the test was carried out using a different test for the average *abnormal accruals* before and after the Covid-19 pandemic.

Table 5. Statistical Test *Abnormal Accruals*

	Before	After
Observations	15	15
mean	-0.081	0.023
Standard Deviation	0.090	0.201
Z	-2,499	
Asymp.Sig.(2-tailed)	0.012	

Table 5 shows that the absolute average value of *abnormal accruals* before the Covid-19 pandemic was 0.081 with a standard deviation of 0.090. While the absolute average value of *abnormal accruals* after the Covid-19 pandemic is 0.023 with a standard deviation of 0.201. What can be learned is that the

absolute average value of *abnormal accruals* before and after the Covid-19 pandemic is not much different, but the absolute value of *abnormal accruals* after the Covid-19 pandemic is more varied. This shows that management is responding in various ways to the Covid-19 pandemic.

Based on Table 5, it can be seen that the Z value is -2.499 with a significance value of 0.012 in *the Wilconxon signed rank test,* so it can be concluded that the alternative hypothesis can be accepted. In other words, the results obtained from the average difference test for *abnormal accruals* indicate that statistically there is a significant difference in *abnormal accruals* between the period before the Covid-19 pandemic and after the Covid-19 pandemic. Thus, it can be concluded that the management of agricultural sector companies regulates reported profits during the Covid-19 pandemic.

This finding is in line with the findings of previous studies which state that management manages earnings in times of crisis. Kumar and Vij (2017) examined the earnings management behavior by management of companies in India during the 2008 economic crisis and compared the earnings management behavior by management before and after the 2008 economic crisis. This study uses data from 500 companies and the research period is from 2007 to 2007. with 2012. The final result of the study states that there is a significant increase in earnings management in the period before the crisis and after the crisis for negative *Discretionary Accruals* . Filip and Raffournier (2014) examined earnings management behavior for companies in Europe during the 2008 crisis. They used data from 16 European countries. They found that earnings regulation decreased drastically during times of crisis and found a relationship between the level of earnings regulation and the rate of economic growth. Bepari et al (2013) conducted a study on earnings management behavior by management in Australian companies during the 2008 economic crisis. They found evidence that companies practiced earnings management in their financial statements during the 2008 crisis period. This study used 149 Australian companies. with the research period 2006-2009. Berndt and Offenhammer [10] conducted a study on earnings management behavior by management in banking companies in Germany during the 2008 economic crisis. The results show that earnings management practices have a significant impact on the statement of financial position and income statement. In addition, they also find that the increase in earnings management practices is influenced by the size of the company and the function of the capital market.

Several things can be learned based on the results of the research which states that the management of managing earnings in times of crisis is important for investors to consider the quality of earnings as a basis for making investment decisions. In addition, it is important for regulators to improve the quality of their regulations so that the information produced by companies is truly reliable and relevant.

Testing the Effect of Firm Size and Gender on Arrangements Profit. The second alternative hypothesis in this study is that the size of the company, the composition of management gender affects the company's profit management during the Covid-19 pandemic. The analytical tool to test this hypothesis is multiple regression analysis (*multiple regression*).

Table 6. Regression Results

Note:	n	r^2	F	Sig	B	t	Sig
Anova Test	30	0.051	0.735	0.488			
Constant					-0.339	-1,313	0.200
Company Size					0.020	1,212	0.236
Gender					-0.019	-0.064	0.949

Table 5 illustrates the results of the regression analysis of the effect of firm size and gender on earnings management. The value of adjusted r square = 0.051, so that 5% of the profit management model can be explained by company size and gender variables, while the remaining 95% is explained by other factors outside the model. The thing that can be learned from the small coefficient of determination is that company size and gender are not the main factors that encourage management to regulate earnings.
The ANOVA test or the f statistic test resulted in a significant level of 0.488. Since the significance level is greater than 0.10, the regression model cannot be used to predict earnings management, or it can be said that company size and gender together have no significant effect on earnings management.

The partial test of the regression model also yields the same conclusion, namely that the variables of firm size and gender have no significant effect on corporate earnings management. The firm size coefficient is positive (0.020) meaning that firm size has a positive effect on earnings management, but with a significance value of 0.236 which is greater than 0.01, it can be concluded that there is no real evidence that firm size has an effect on corporate earnings regulation. The Gender coefficient is negative (-0.019) meaning that Gender has a negative effect on earnings management but with a significance value of 0.949 which is greater than 0.01, it can be concluded that there is no real evidence that Gender has an effect on corporate profit regulation.

4. Conclusion

The main objective of this study is to provide empirical evidence whether or not earnings regulation is proxied by *abnormal accruals* (ACC) before and after the Covid-19 pandemic. The results of the tests carried out show that there is a statistically significant difference between *abnormal accruals* (ACC) before and after the Covid-19 pandemic. This indicates that there is a change in the quality of earnings reported by agricultural sector companies listed on the IDX before and after the Covid-19 pandemic

References

[1] Statistics Central Bureau, “Infografis-Pertumbuhan-Ekonomi-Indonesia-Triwulan-IV-2020,” Jakarta, 2020.

[2] N. Türegün, “Does financial crisis impact earnings management? Evidence from Turkey,” *Journal of Corporate Accounting and Finance*, vol. 31, no. 1. John Wiley and Sons Inc, pp. 64–71, Jan. 01, 2020. doi: 10.1002/jcaf.22418.

[3] W. E. Lo, “Pengaruh Tingkat Kesulitan Keuangan Terhadap Manajemen Laba: Teori Keagenan Versus Teori Signaling,” *Journal of Accounting and Financial Research*, vol. 8, no. I, pp. 1–18, 2012.

[4] M. Kumar and M. Vij, “Earnings Management and Financial Crisis: Evidence from India,” *Journal of International Business and Economy*, vol. 18, no. 2, pp. 84–101, Jul. 2017, doi: 10.51240/jibe.2017.2.4.

[5] A. Filip and B. Raffournier, “Financial crisis and earnings management: The european evidence,” *International Journal of Accounting*, vol. 49, no. 4, pp. 455–478, Dec. 2014, doi: 10.1016/j.intacc.2014.10.004.

[6] M. K. Bepari, S. F. Rahman, and A. T. Mollik, “Value relevance of earnings and cash flows during the global financial crisis,” *Review of Accounting and Finance*, vol. 12, no. 3, pp. 226–251, 2013, doi: 10.1108/RAF-May-2012-0050.

[7] D. Kusuma, W. Pipit, and D. Isbela, “Pengaruh Strategi Bisnis dan Karakteristik Perusahaan Terhadap Manajemen Laba,” *Scientific Journal of Accounting and Business*, vol. 13, no. I, pp. 91–105, 2017.

[8] A. A. Gull, M. Nekhili, H. Nagati, and T. Chtioui, “Beyond gender diversity: How specific attributes of female directors affect earnings management,” *British Accounting Review*, vol. 50, no. 3, pp. 255–274, Apr. 2018, doi: 10.1016/j.bar.2017.09.001.

[9] M. I. Almaharmeh and R. Masa’deh, “Mandatory IFRS Adoption and Earnings Quality: Evidence from the UK,” *Modern Applied Science*, vol. 12, no. 11, p. 197, Oct. 2018, doi: 10.5539/mas.v12n11p197.

[10] T. Berndt and M. A. C. Offenhammer, “Earnings Management in the Financial Crisis 2007/2008,” 2011.

The role of women farmers in coffe farming West Lampung

M Apriyani[1*] and T B Trisnanto[2]

[1] Food Agribussiness Study Program, Politeknik Negeri Lampung, Indonesia

*E-mail: marlindazein@polinela.ac.id

Abstract. This study aims to (1) analyze the role of female farmers in coffee farming, and (2) analyze the constraints faced by female farmers in an effort to increase coffee farming productivity. The method used in this research is survey. The analysis method used is descriptive analysis and quantitative analysis. Women farmers play an important role in their involvement in farming activities to increase coffee production. Farming activities carried out by female farmers are influenced by outpouring of work time. The outpouring of the working time of the female farmer in productive activities depends a lot on socio-economic factors and the condition of her family. The wider the area of farming that is cultivated, the more female laborers are poured out, which indicates the variation and variety of activities and quantity of time spent / labored by female farmers. The lower the economic level of a farmer's household, the greater the amount of time / energy for women to generate family income. In coffee farming, women farmers play a role in the activities of planting, fertilizing, pruning, weeding, harvesting and post-harvesting. The constraints faced by women farmers for increasing coffee productivity are lack of knowledge and skills, physical constraints, lack of access to farmer groups, and no access to cooperatives or financial institutions.

1. Introduction

Lampung Province is one of the largest coffee producers in Indonesia. Coffee plants are spread in several districts in Lampung Province. One of the biggest coffee producing districts is West Lampung Regency. Coffee production in this district is supported by the geographical conditions of the area which is mostly mountainous. The area of coffee plantations in West Lampung in 2015 amounted to 53,606.0 ha with a total coffee production of 52,644.9 tons. The level of productivity of coffee plants in West Lampung Regency is 0.98 tons ha^{-1} [1].

Agricultural development aims to increase farmers' income and living standards, grow employment and business opportunities, improve nutrition and household food security, and alleviate rural poverty. All of this is closely related to the roles, tasks and functions of women in the countryside. household, as an effort to reduce rural poverty.

Women have a dual role in the household, which is implicated in (1) the role of work as a feminine role, which although indirectly generates income but productively works to support men (family heads) to look for income (money); and (2) the role of breadwinner (additional or main). At present, women not only carry out activities within the family sphere, but many in the areas of people's lives that require the presence of women 4 in their handling. The participation of women in economic activities is not something new. Women try to earn income due to several things, including the willingness of women to be independent in the economic field, namely trying to finance their living needs and the necessities of life of the people they are responsible for. In addition, the need to increase family income and the

widespread employment opportunities that absorb female labor is also one of the driving factors for women to work [2].

Sumber Jaya District is one of the sub-districts in West Lampung Regency. Most of the population in this area works in the agricultural sector of plantation crops, especially coffee plants. In carrying out its farming, residents in this area used women as their workforce. The population in Sumber Jaya Subdistrict, West Lampung Regency was 23,618 people, consisting of 12,198 male souls and 11,420 female souls. The ratio of men and women is 55: 45. This ratio shows that women are a large resource in this area [1].

The resources of female farmers are one of the great potentials in contributing labor to production activities [3]. Women farmers play an important role in their involvement in farming activities to increase coffee production. Farming activities carried out by female farmers are influenced by outpouring of work time. The outpouring of the working time of the female farmer in productive activities depends a lot on socio-economic factors and the condition of her family. Socio-economic factors that influence the outpouring of working time for female farmers are age level, number of family dependents, wage level, land area, marital status, education level, and level of experience [4].

In rural farm households, women farmers as wives play an important role because they are fully responsible for regulating and controlling the stability and sustainability of family life. Farmers play an active role in helping farming activities and earning a living in the sub-sector off and non-farm. The wider the area of farming that is cultivated, the more female laborers are poured out, which indicates the variation and variety of activities and quantity of time spent/labored by female farmers. The lower the economic level of a farmer's household, the greater the time/energy spent by women in generating family income [5].

Based on this background, the research on the role of women farmers in increasing the productivity of coffee farming is very important to do. The implementation of this research is expected to be able to produce useful information for scientific enrichment in the socio-economic field of agriculture and gender-related policy making. This study aims to analyzing the role of peasant women on coffee farming and analyzing the obstacles faced by female farmers in an effort to increase coffee farming productivity.

2. Method

The method used in this research is survey. Respondents of this research are wife of coffee farmers. Respondents spread in West Lampung Regency. The analysis method used is descriptive analysis and quantitative analysis. Descriptive analysis is used to clearly describe the role of peasant women on coffee farming and the obstacles faced by female farmers in an effort to increase coffee farming productivity in West Lampung.

3. Result and Discussion

The data used are primary data with respondents are 40 womens farmers. Respondents spread in several districts in district Sumber Jaya West Lampung. Role is an individual behavior that is important for social structures, which ultimately will provide certain facilities in accordance with that role. Role is a dynamic aspect of status, when someone has done an obligation in accordance with his status, then he has a role. In a society there will be a balance if the role and position run in a balanced manner. However, if all people are able to play a role according to their role, then it is not necessarily the community to provide equal opportunities. In fact, it is often found that people are forced to limit these opportunities, as is the case with rural peasant women, all of which are related to their ability (potential) inherent [6].

According to Sajogyo [7], to maintain the continuity of households, dual women are productive jobs because they involve earning income (income earningwork) and managing the household (domestic/household work).

In rural farm households, women farmers as wives play an important role because they are fully responsible for regulating and controlling the stability and sustainability of family life. Arrangement of household living expenses related to family health and nutrition, children's education, and survival in needy communities economic skills and knowledge. The amount and outpouring of women's time / energy in managing household continuity is higher than that of men as family heads. On the other hand, as members of farmer households, farmer women play an active role in helping farming activities and earning a living in the sub-sector off and non-farm. The wider the area of farming that is cultivated, the more women will be poured out, which indicates the variation and variety of activities and quantity of time spent / labored by female farmers. The lower the economic level of a farmer's household, the greater the amount of time / women spent on generating family income [5].

On coffee farming, the activities / work carried out are: (1) preparation of the land, (2) tillage, (3) planting, (4) plant maintenance (pruning, weeding, fertilization, and pest and plant disease control), (5) harvest, and (6) post-harvest (drying and milling).

The role of women farmers in coffee farming is in planting activities / work, maintenance (pruning, weeding and fertilizing), harvesting, and post-harvest (drying). The percentage of the outpouring of female labor on coffee farming can be seen in Figure 1.

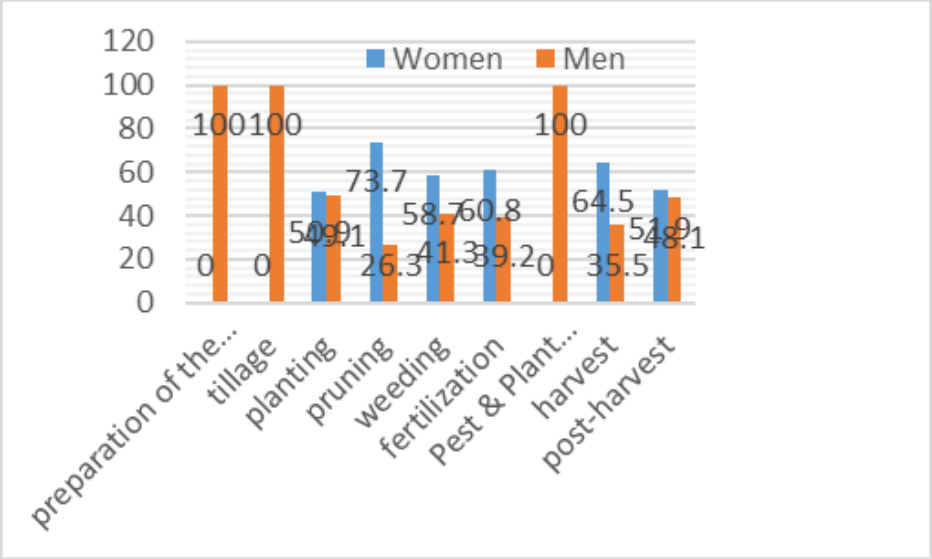


Figure 1. Percentage outpouring of women workers on coffee farms

Figure 1 shows that female farmers provide a significant role in coffee farming. For activities / jobs that use female labor the percentage exceeds male labor. The biggest outpouring of female labor is the job of pruning which is equal to 73,7 precent. However, work such as land preparation, land processing, and fertilization is entirely done by men. Obstacles faced by women farmers in order to increase the productivity of coffee farm.

Women are potential families who have enthusiasm but are helpless so they need to empowered. The position of women in the family is very important, but various problems and constraints still overshadow women farmers. Internally the obstacles faced by women farmers include low levels of education, skills, motivation, and self-confidence. Externally, various social support communities, cultural values, appropriate technology, and the policy is still less favorable to women [6].

The obstacles faced by women farmers to increase coffee productivity is lack of knowledge and skills, physical constraints, lack of access to farmers' groups, and there is no access to a cooperative or financial institution.

a. Lack of knowledge and skills about farming
Coffee farm women have limitations in the knowledge and skills of coffee farming. So far, they only carry out routine work without initiative. The level of education is one factor. The average education level of coffee farmer women is basic education.

Table 1. The level of education of women farmers

Level of Education	Amount	Percentage
No school	4	10
Primary school	19	47.5
Elementary school	9	22.5
High school	8	20
Total	40	100

b. Physical constraints
Women have a dual role in their daily lives. Daily domestic work requires a lot of energy coupled with farming work. This condition causes a physical woman to look weaker than a man. The average number of working hours for women on coffee farming is 5-7 hours. However, before carrying out farming activities, women farmers must complete housework in the morning and evening. If averaged a woman's working time is 18-20 hours.Do not use the word “essentially” to mean “approximately” or “effectively”.

c. Lack of access to farmer groups
The division of labor is divided into three types of work, namely reproductive, productive and social society. Most reproductive work is done by women. Included in this reproductive work are cooking, cleaning the house, washing clothes, caring for children and so on. Productive work is a job to make money in the household. This work is done by husband and wife. Social work is dominated by husbands. One of the social activities is participation in farmer groups.

d. No access to cooperatives or financial institutions
Women farmers do not have access at all to get credit from cooperatives or banks. Loans that can be obtained by women come from neighbors and relatives. Even though he did not have access to credit, his wife continued to play a role in managing the credit received by her husband. Limited access to credit in cooperatives is caused by formal requirements determined by the cooperative. Requirements for applying for credit is a member of a cooperative. The whole member of the cooperative is the husband who is the head of the farmer's household.
Women farmers do not become members of farmer groups. At the study site there were no agricultural extension activities aimed at wives or women. Extension activities and external activities related to farming were only followed by the husband. Women have limitations in getting information related to their farming. Also with agricultural information, there were 30% of respondents who received agricultural information from their husbands after participating in agricultural extension activities. Problems related to coffee farming will be solved by the husband.

Women's empowerment is very important because they are the ones who generally haven't gotten it chance. This is so that they can function as subjects and objects in various aspects of development, both as planners, decision makers, implementers, as well as evaluating and enjoying various development outcomes evenly.

4. Conclusions

In coffee farming, women farmers play a role in the activities of planting, fertilizing, pruning, weeding, harvesting and post-harvesting. The constraints faced by women farmers for increasing coffee

productivity are lack of knowledge and skills, physical constraints, lack of access to farmer groups, and no access to cooperatives or financial institutions.

References

[1] Lampung Province Central Bureau of Statistics 2017 West Lampung in Figures 2016 Lampung

[2] Sumarsono S 2009 Theory and Resource Economy Public Policy Human Yogyakarta: Graha Ilmu

[3] Sukesi K M 2002 Work Relationships and Dynamics of Gender Relations in Community Sugar Cane Exploitation System UB Faculty of Agriculture Publishing Institute Malang

[4] Novita R 2001. Factors Affecting the Outflow of Work Time for Farmers in Rice Field Farming (Case Study in Ngarjo Village, Mojoanyar District, Mojokerto Regency) Thesis of the Department of Social Economics of Agriculture, Faculty of Agriculture, Universitas Brawijaya

[5] Elizabeth R 2007 Women's empowerment supports gender mainstreaming strategies in rural agricultural development policies *Agro Economic Research Forum* **25** 126-135

[6] Elizabeth R 2008 Farmer women in achieving rural household food security *Food Crop Science and Technology Journal* **3** 59-68

[7] Sajogyo P 1994 The role of women in economic development Torch

In vitro regeneration of porang (*Amorphophallus muelleri* Blume) at several concentrations of BAP (benzyl amino purine)

Ferziana[1*], L Erfa[1], D Maulida[1], R M Sari[1] and F Yuniardi[1]

[1] Politeknik Negeri Lampung, Soekarno-Hatta Number 10 Street, Rajabasa District, Bandar Lampung, Indonesia

*E-mail: ferziana@polinela.ac.id

Abstract. There is problem about propagating porang by seed that caused it is not always available. Planting by bulbs, bulbil, or leaf cuttings need longer times caused by dormancy problems. Micropropagation by tissue culture is an alternative method that can be choose to fix the problem. This research is aim to obtain the best concentration of BAP to regenerate 'Madiun 1' variety of porang plants by shoots (organogenesis) formation. The research was carried out using complete randomized design with 7 treatments concentrations of BAP, that was: P1 (0 mg l^{-1} BAP), P2 (1 mg l^{-1} BAP), P3 (2 mg l^{-1} BAP), P4 (3 mg l^{-1} BAP), P5 (4 mg l^{-1} BAP), P6 (5 mg l^{-1} BAP), and P7 (6 mg l^{-1} BAP). Each treatment was consisted of 5 replications. Observation were made on number of budding, number of shoots, and shoot height. The data were analyzed using ANOVA, and the differences between treatments were tested using the LSD test at the 5% level. The results revealed that 2 mg l^{-1} (P3) was the best concentration of BAP to be added to the media to regenerate katak porang tubers of Porang Madiun 1 by in vitro.

1. Introduction

Porang (*Amorphophallus muelleri* Blume) or Iles-iles is one of bulbous plant from the *Araceaea* family which received a lot of attention and become famous among farmers recently. Porang is a food crop commodity that has high economic value. The high demand for porang increasing its exports to some countries such as Japan, China, Vietnam, Taiwan, Myanmar, and Thailand. According to [1] on July 2020, the shipments of porang commodities through agricultural quarantine increased to 160% from 2019. On July 2020 the shipments of porang reached Rp. 2.7 billion especially from Flores. Even the total value of porang exports from various regions in 2020 reached more than Rp. 1.3 trillion. The Minister of Agriculture enacting Porang as one of commodity that is included in the three-fold expo (Gratieks) movement because its export increasingly [2]. Porang is not only having high economic value, but also can be used as functional food ingredients because its contain of high fiber [3]. Porang tubers also contain glucomannan compounds [4] which according to [5] has benefit as cholesterol-lowering, anti-inflammatory [6], and anti-diabetic [7]. Porang tubers can be used as materials in food, cosmetic and pharmaceutical industries [2].

Porang plants grow well in tropics area, especially in Indonesia. This plant includes plants that are very easy to be cultivated and can grow well in the shade or direct sunlight. Porang planting can be done either using seeds or using stem tubers and katak/leaf bulbs [8]. However, porang tubers are mostly harvested before flowering. Harvesting after flowering can cause shrinking tubers and decrease its glucomannan

content. Thus seeds are not always available [9]. Planting with bulbs, bulbil, or leaf cuttings is constrained by dormancy problems so it takes long time. Another alternative is needed in porang propagation.

Micropropagation by tissue culture is an alternative method that can be used to reproduce porang plants. Micropropagation can produce plants faster, free season, in large quantities with relatively fast time. In addition, the seeds produced by tissue culture are better quality because they are uniform and free of disease [10]. One of the factors that mostly affect the success of propagation by tissue culture (in vitro) is the composition of the culture medium [11]. Growth regulators in the media can affect growth and morphogenesis in culture [12].

Growth regulators are one of the factors that determine the success of in vitro plant regeneration. Growth regulators that used to regenerate plants from the formation of shoots are cytokinins. Several types of cytokinins that can be used are Kinetin, Zeatin, 2l-P, Benzeladenine (BA), PBA and Thidiazuron (TDZ). According to [13], cytokinins added to culture media are generally to stimulate cell division, induce shoot formation and axillary shoot proliferation, but can inhibit root formation. The response of plant tissue/plant parts that were cultured was different to PGR auxins [14] and cytokinins [15], depends on the genotype (type and cultivar) of the plant [12]. Similarly, the response of plant cultivars to the concentration of growth regulators is determined by the genotype of the plant. The results of the research by [16] on 4 different tin cultivars (Poona Fig, Brown Turkey, Conadria and Deanna) and treated with different BAP concentrations (2.5 and 3.5 mg.l-1) showed the response of the four Tin cultivars depends on the genotype/cultivar of the plant. For this reason, this research is aim to observe the response of tuber explants to the application of several concentrations of BAP to regenerating Madiun 1 variety of porang from shoot formation/organogenesis. The research is aim to obtain the best concentration of BAP to regenerate Madiun 1 variety of porang from shoot formation (organogenesis).

2. Material and Methods

The research was carried out from June to October 2021, at Tissue Culture Laboratory of Politeknik Negeri Lampung. The materials used in this research were: Katak bulbs (bulbil) from Madiun 1 variety of Porang plant, chemicals (basic media Murashige and Skoog, 1962) supplemented with vitamins (thiamine-HCl, pyridoxine-HCl, nicotinic acid) and myo inositol, BAP growth regulators, as well as HCl and NaOH. Media-making materials include jelly, sugar, rubber, plastic, and aluminum foil. The tools used include autoclave, laminar air flow cabinet, hand sprayer, tweezers, scalpel, and petridish.

The experiment was carried out using complete randomized design with 7 treatment concentrations of BAP, that was : P1 (BAP 0 mg l^{-1}), P2 (BAP 1 mg l^{-1}), P3 (BAP 2 mg l^{-1}), P4 (BAP 3 mg l^{-1}), P5 (BAP 4 mg l^{-1}), P6 (BAP 5 mg l^{-1}), P7 (BAP 6 mg l^{-1}). Each treatment was consisted of 5 replications. The data were analyzed using Variety Analysis, and the differences between treatments were tested using the LSD test at the 5% level.

The research started with preparing media and explants. MS media was prepared by adding BAP with concentrations based on the treatments (0, 1, 2, 3, 4, 5, 6 mg.l-1)) ([17] on explants porang shoots (from seeds); [3] using explants iles-iles/porang leaf stalk; and [18] with tuber explants of Amorphophallus sp.). The pH of the medium was adjusted to 5.7 with the addition of HCl or NAOH. then the media was sterilized at 121 ◦C for 20 minutes. Sterile media are incubated for 3-5 days.

Porang tuber explants that have passed its dormancy period are grown in vitro. The tubers were washed and carefully soaped under tap water, then soaked in 2 g l^{-1} fungicide and bactericide each for 1 hour. Surfacing sterilization of explants was carried out by immersing the tubers in 50% bayclin solution for 30 minutes, and then the explants were removed and placed into the petridians. The tubers were peeled thinly and then soaked again in 10% bayclin for 10 minutes, and rinsed with sterile water 3 times. Furthermore,

the tubers were cut into quarters and planted in the treatment media 2 pieces per bottle. Subculture was carried out by removing tubers on 45 days after planting on the same treatment medium. Explants that have been planted and subcultured were maintained by placing culture bottles in ± 26 ◦C room temperature, with 16 hours of light and 8 hours of darkness. Observations for contamination were carried out every day. Contaminated culture bottles are immediately removed from the culture maintenance room.

Observation for budding was carried out by counting the number of spheres formed on explants with 2 mm of minimum diameter. The number of shoots was observed by counting all the shoots produced, with 5 mm of height. The shoot height (cm) was observed by measuring the shoots from the base to the tip of the highest shoot.

3. Results and Discussion

The initiation of culture was carried out using bulbs, in the form of katak bulbs or bulbils with 2.5-3 cm of diameter. The tubers were carefully washed under tap water and soaped, soaked with systemic fungicides and bactericides. Then sterilized in laminar.

Contamination is a major problem in growing porang tubers in vitro. To get sterile tubers, the tubers were sterilized using various methods of preparing tubers (peeled & unpeeled), concentration and duration of sterilization/soaking of tubers with sterilants. However, the results of sterilization obtained only 5-10% sterile tubers, while 90 to 95% contaminated. The main contaminants that cause tuber contamination are fungi (Figure 1), while bacterial contaminants reach 10-15% (Figure 2).

Figure 1. Contamination of tuber explants caused by fungus.

Figure 2. Contamination of tuber explants caused by bacteria.

Sterile bulbs began to respond on 15 days after planting by enlarging. Callus began to form on explants on 30 days after planting, from inside the cut tuber (Figure 3a). The texture of callus formed is little compact. Callus development can be seen on Figure 3.

In general, the addition of BAP to culture media can stimulate callus formation on explants of katak porang's tube pieces. The response of callus regeneration to be budding and shoot are different between benzyl amino purine concentrations treatments added to the media. The highest number of was obtained from explants cultured on media that was added 2 mg l^{-1} (P3) and 5 mg l^{-1} (P6) of BAP (Figure 4), followed by explants applied by 1/3/ 4/ 7 mg $l^{-1}$of BAP. The least number of shoots was produced on explants cultured on media without BAP (P1) (table 1). Explants cultured on media that were given 6 mg l^{-1} of BAP (P7) significantly produced better number of shoots than explants cultured on media without BAP or 1, 2, and 3 mg l^{-1} of BAP, shoots were produced on media treated with 4 mg l^{-1} (P5) and 5 mg l^{-1} (P6) of BAP did not significantly different. The highest growth of explants were cultured on media without the addition of BAP

(P1) (figure 5a). The addition 2 mg l^{-1} of BAP resulted the higher growth than the addition 3 mg l^{-1} of BAP. There was no differences in shoot height on explants cultured on media added 1, 4, 5, and 6 mg l^{-1} of BAP.

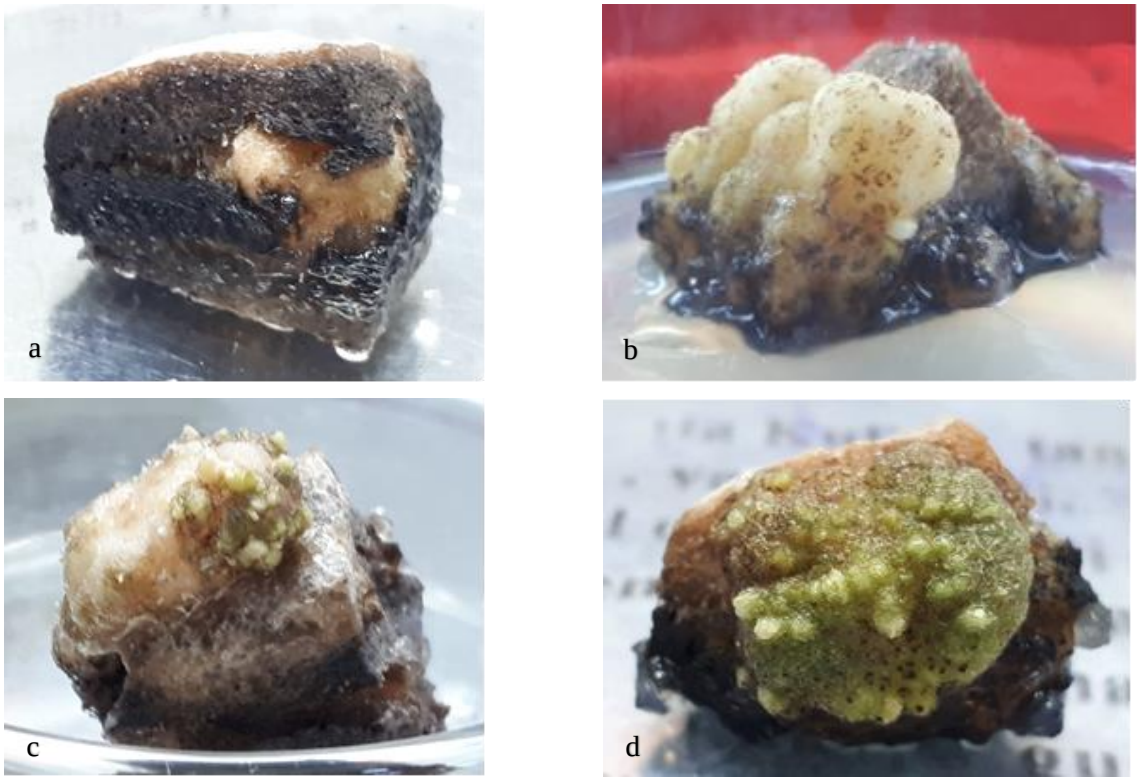


Figure 3. Callus development and growth of budding on explants of katak porang's tube pieces: initiation of callus on explant pieces on 30 days after planting (a), enlargement of callus groups out of tubers on 45 days after planting (b), initiation of budding on the callus surface on 60 days after planting (c), and the number and size of budding on the callus surface getting increase by the time (d).

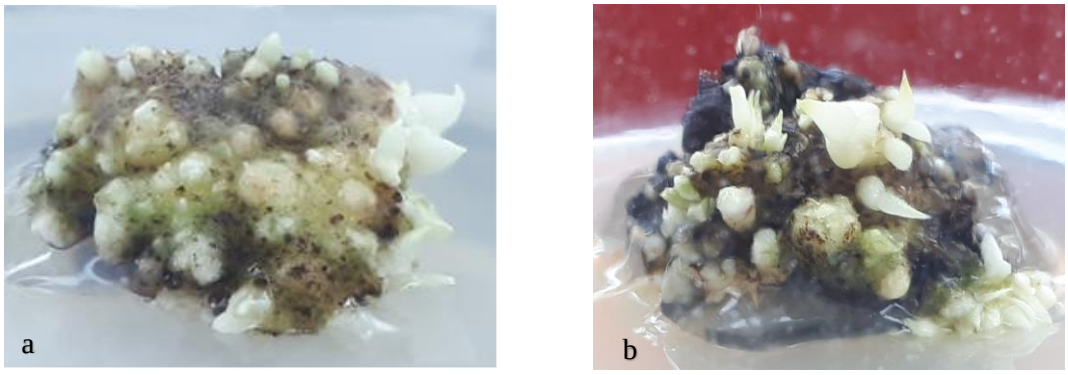


Figure 4. Growth of budding and shoots on explants treated with BAP: budding and shoots on explant with P3 media/BAP 2 mg.l^{-1} (a) and budding and shoots on explants with p6 media/BAP 5 mg.l^{-1} (b)

Table 1. Average number of shoots, shoot height, and number of porang buds in BAP concentration treatments.

Treatment	Average Number of Budding ± SD	Average Number of Shoots ± SD	Average Shoot Height (Cm) ± SD
P1 : (BAP 0 mg l^{-1})	3.4000 C	1.2000 D	1.0220 A
P2 : (BAP 1 mg l^{-1})	26.2000 B	2.6000 C	0.7380 B C
P3 : (BAP 2 mg l^{-1})	34.8000 A	4.0000 B	0.7537 B
P4 : (BAP 3 mg l^{-1})	26.0000 B	4.0000 B	0.6507 C
P5 : (BAP 4 mg l^{-1})	25.8000 B	4.8000 A B	0.7326 B C
P6 : (BAP 5 mg l^{-1})	32.2000 A	4.6000 A B	0.6963 B C
P7 : (BAP 6 mg l^{-1})	25.8000 B	5.8000 A	0.6826 B C

Note: The average number of budding, number of shoots, and shoot height followed by the letter the same results showed that it was not significantly different from the LSD test at the 5% level.

The fastest and highest shoot growth (Figure 5a) occurred in P1treatment (without the addition of BAP), although the number of budding and shoots produced were little. This is presumably that without giving BAP to the growth media, budding growth upwards (high growth), while with BAP the growth was to the side (multiplication of prospective shoots occurs in explants). This is in accordance in banana propagation, to duplicate the buds on banana propagules at the multiplication stage, the media was added by cytokinins (BAP), while for the banana shoot growth stage, the media was no longer added by BAP [10]. The growth of shoots (bud proliferation) and shoot height produced in explants without BAP or in explants that produced many buds on BAP-treated media (Figure 5).

From the results of the Tukey's HSD test on Table 1, can be seen that the addition of BAP to the media explant of porang katak tuber could induce callus formation on the explants of porang katak tuber. Application of BAP can also increase callus regeneration to form budding and increase the proliferation of budding into shoots. Benzyl Amino Purine is a cytokinin growth regulator which is widely used to stimulate shoot doubling. According to [19] cytokinins play a role in morphogenesis, such as inducing the formation of shoot organs. The strong activity of BAP [20] has led it to widely use to stimulate shoot multiplication in vitro. On the three variables observed (Table 1), the application 2 mg l^{-1} (P3) and 5 mg l^{-1} (P6) of BAP was the best concentration to regenerate katak tubers of porang by indirect organogenesis. This can be seen from the number of potential shoots produced on explants, although the number of shoots produced by the explants and the shoot height obtained the second best results. By subculture to the shoot elongation stage, it is possible to produce more shoots than other treatments. This needs to be studied more at a further stage, both proliferation and multiplication of these buds for propagation, because in research is not yet known the growth rate (number and height) of budding. Based on the results about the response of explants that applied by 2 mg l^{-1} (P3) and 5 mg l^{-1} (P6) of BAP at the same number of budding, number of shoots, and shoot height, it can be concluded that the best concentration for regenerating Porang Madiun 1 was the treatment with the addition 2 mg l^{-1} of BAP (P3).

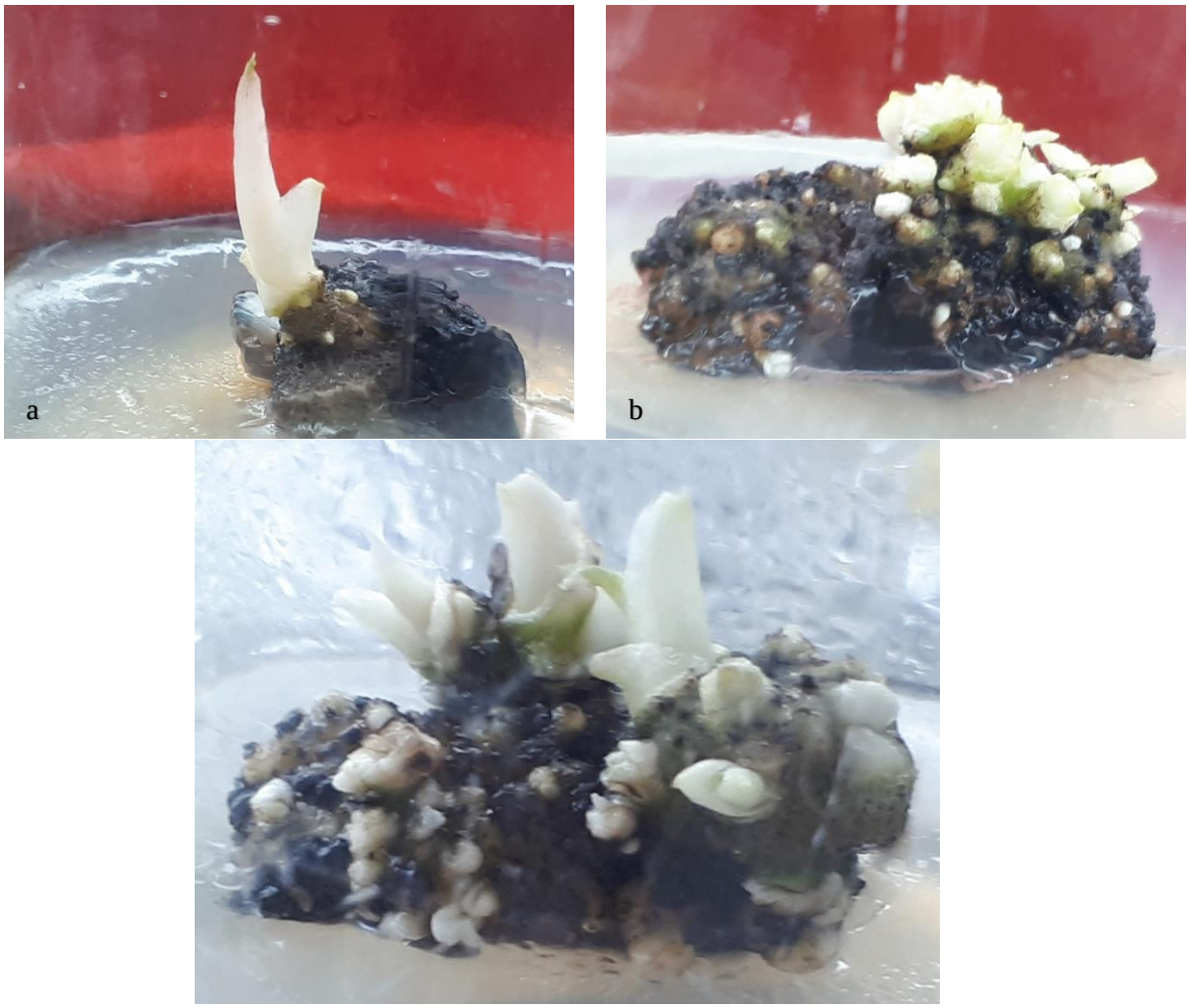


Figure 5. Growth of shoots on explants cultured on media without BAP and on media provided by BAP: growth of shoot height on explants cultured on P1 medium/0 mg l^{-1} (a), growth of shoot height on explants cultured on P7 media/BAP 6 mg l^{-1} (b), and growth of shoot height on explants cultured on P7 BAP 6 mg l^{-1} media (c).

4. Conclusion

The best concentration of BAP to be added to the media to regenerate the katak tubers of the Porang Madiun 1 was 2 mg l^{-1} (P3).

References

[1] Agrofarm 2020 Indonesia's Porang Exports Increase up to 160 Percent https://www.agrofarm.co.id/2020/08/26495/.

[2] Bandono S 2021 Ministry of Agriculture Prepares Porang Development Strategy as a 'Mahkota' Commodity http://technology-indonesia.com/pertanian-dan-pangan/inovasi-pertanian/kementan-siapkan-strategi-pengembangan-porang-sebagai-komoditas-mahkota/.

[3] Maria I, Wulansari A and Yuyu P S 2008 Regenerasi tunas dari kultur tangkai daun iles-iles (*Amorphophallus muelleri* Blume) *Biodiversitas* **9** 173–176 https://biodiversitas.mipa.uns.ac.id/D/D0903/D090304.pdf.

[4] Yohanes M, Tanto H and Novita D 2017 Pengaruh pemberian tepung porang (*Amorphophallus muelleri* Blume) terhadap kadar ureum pada tikus (*Rattus novergicus*) strain Wistar DM tipe 2 *J. Nurs. News*, **2** 665–667

[5] Zhang M, Sun L, Zhao W, Peng X, Liu F, Wang Y, ... and Zhou Y 2014 Cholesteryl-modification of a glucomannan from bletilla striata and its hydrogel properties *Molecules* **19** 9089–9100 doi: 10.3390/molecules19079089

[6] Zheng Q, Li W, Liang S, Zhang H, Yang H, Li M and Zhang Y 2019 Effects of ultrasonic treatment on the molecular weight and anti-inflammatory activity of oxidized konjac glucomannan *CYTA - J. Food* **17**, 1–10 doi: 10.1080/19476337.2018.1541195

[7] Kumar D S C P, Lokesh T, Gobinath M and Kumar B 2013 Anti-diabetic and anti-hyperlipidemic activities of glucomannan isolated from *Araucaria cunninghamii* seeds *J. Chem. Pharm. Sci*.**6**, 204–209

[8] Sumarwoto 2005 Iles-iles (*Amorphophallus muelleri* Blume); description and other characteristics *Biodiversitas J. Biol. Divers.* **6** 185–190 doi: 10.13057/biodiv/d060310

[9] Aziz M M, Ratnasari E and Rahayu, Y S 2014 Bulb callus induction of iles-iles (*Amorphophallus muelleri*) with combination concentration of 2,4-D and BAP by in vitro *LenteraBio*. **3** 109–114

[10] Sulistiani S A and Yani 2012 *Production of Plant Seeds Using Tissue Culture Techniques* Bogor: SEAMEO BIOTROP

[11] Widiyanto S 2011 *Micropropagation in Plant Science and Biotechnology.* Bandung: Scientific Speech Papers of Professors of the Bandung Institute of Technology

[12] Gunawan L W 1992 *Plant Tissue Culture Techniques. Ministry of Education and Culture*. Bogor: Directorate General of Higher Education, Inter-University Center for Biotechnology IPB

[13] Purnomo R, Santoso M and Heddy S 2013 Effect of various organic and inorganic fertilizers on growth and yield of cucumber (*Cucumis sativus* L.) *J. Produksi Tanam.* **1**, 93–100

[14] Firoozabady Y, Moy E 2004 Regeneration of pineapple plants via somatic embryogenesis and organogenesis *Vitr. Cell Dev. Biol. Plant* **40** 67 – 74

[15] Sripaoraya M R, Marchant S, Power R and Davey J D 2003 Plant regeneration via somatic embryogenesis and organogenesis of commercial pineapple (*Ananas comosus* L.) *Vitr. CellDev. Biol. Plant* **39** 450–454.

[16] Dhage S S, Chimote V P, Pawar B D, Kale A A, Pawar S V and Jadhav A S 2015 Development of an efficient in vitro regeneration protocol for fig (*Ficus carica* L.) *Journal of Applied Horticulture* **17** 160–164

[17] Suheriyanto D, Romaidi and Resmisari R S 2012 Pengembangan bibit unggul porang (*Amarphopallus oncophilus) melalui teknik kultur in vitro untuk mendukung ketahanan pangan* nasional *El-Hayah* 3, 16–2

[18] Thach B D, Linh N K, Duy T T B, Giang T T L, Uyen N P A, Suong N K and Van Du N 2016 Preliminary selection and in vitro propagation of glucomannan distributed in Vietnam *Eur. J. Adv. Res. Biol. Life Sci*.**4** 1–7

[19] Wiraatmaja I W 2017 *Gibberellins and Cytokinins Growth Regulators* Bali

[20] Zaer and Mapes 1982 *Action of growth regeneration In. Bonga and Durzan (eds.)* London

The influence of job stress and job satisfaction on turnover intention at food company workers

A N Fauziah[1], A Suyantohadi[1], and D Purwadi[1*]

[1] Department of Agro-industrial Technology, Faculty of Agricultural Technology, Universitas Gadjah Mada, Indonesia

*E-mail: didik@ugm.ac.id

Abstract. The high number of employee turnover is a problem that must be faced by the company. The intention of workers to leave is influenced by factors of job stress and job satisfaction. This study aims to analyze how far the effect of job stress and job satisfaction on turnover intention. The research object is workers at SPN food company, with a sample of 41 respondents taken by simple random sampling technique. To examine the effect of job stress and job satisfaction on turnover intention, multiple linear regression analysis was used. Based on the research conducted, the results obtained that partially job stress has a significant effect on turnover intention, while job satisfaction has no significant effect on turnover intention. Taken together, job stress and job satisfaction affect turnover intention with a large contribution effect of 76%, while the other 24% are influenced by other factors.

1. Introduction

The success or absence of a company in achieving its goals is not only seen from the means of production used, but also in the human resources that exist in the use of sara production. Labor can at any time improve a company's ability to produce effectively and efficiently, but at the same time labor can also decrease the productivity of the company. Labor is one of the important factors in determining the success of a company, but in these efforts often experience failures, one of which is labor dissatisfaction with the policies that have been set by the company. When continued will cause a decrease in morale.

The company needs to pay attention to its workforce as one of the company's assets, so that workers' rights can be fulfilled and will pay due to labor turnover. Employee turnover is a key area in the study of human resource management [1]. Labor turnover is the voluntary or involuntary permanent resignation of a company. High labor turnover rates result in large costs of recruitment, selection, and training. In addition, high labor turnover rates can also interfere with the efficient production process of the company [2]. A high turnover rate will have a negative impact on the company, which can result in the ineffectiveness of the company due to the loss of experienced workers [3]. The impact of turnover has received great attention by senior management, and human resources professionals. To explore turnover in more detail, this text can examine most sources of turnover rates, their effects and advocate some of the ways but the company will retain staff and reduce turnover rates [4]. Employee turnover poses recurring challenges for most business organizations globally. Be it small sizes or large size organizations, they are all exposed to employee turnover [5].

Turnover rate of SPN food company is increased. Turnover rate in 2020 divided into 2 periods can be seen in Table 1.

Table 1. Percentage turnover in workers in 2020.

Period	Month	Number of workers		Turnover (%)
		In	Out	
1	January - June	29	0	0
2	July - December	43	14	24

Source: SPN food Company, 2020

The period from July to December was also a turnover of 24% of workers. According to Gillis (1994) in Hartono and Setiawan (2013), employee turnover is said to be normal ranging from 5-10% per year, said to be high when more than 10% [6].

Moreover Manurung and Ratnawati (2012), in his research proved that work stress positively affects turnover intention. That is, the higher the work stress experienced, the higher the turnover intention. This indicates that excessive workload, unclear coverage and responsibilities, conflicting demands from various colleagues, lack of cooperation between departments within the organization, the provision of difficult-to-meet work standards from above and unclear promotional opportunities can be the cause of work stress [7]. Job satisfaction has a negative and significant effect on turnover intentions. This means that the better the job satisfaction, the lower the turnover intention. Employees or workers who have good job satisfaction have a desire to get out of a low company [8]. The objectives of this research is to analyze the effect of work stress on turnover intentions, analyze the effect of job satisfaction on turnover intentions, and analyze the effect of work stress and job satisfaction intentions.

2. Research Method

2.1. Research object

The object of the study is a worker at SPN food company, the data was collected in January – April 2021

2.2. Research variables

There are two variables: dependent variable and independent variable. The dependent variable was *turnover intention* (Y). The independent variables were work stress (SK) and job satisfaction (KK).

2.3. Technical analysis

Technical analysis uses linear regression model, which its equations based on straight lines that reflect the linear relationship between independent variables (X) and a dependent variable (Y). Regression uses linear trends (straight lines), whose linear regression equations express linear relationships between dependent variables to one or more independent variables [9]. Moreover, Tariq et al (2013) described that the steps for analysis are employee turnover, workload, work stress, employee pay, job satisfaction, and work to family conflicts. Correlation and regression tests are used for research studies to analyze the relationship between independent and dependent variables. The results of the regression analysis confirmed that organizational performance was negatively and insignificantly associated with employee turnover, workload, work stress, salary, and family conflicts to work [10]. Staff turnover give impact on the effectiveness and performance of organizations. High staff turnover rates can threaten efforts to achieve organizational goals. The research design used in the study was a descriptive approach, allowing researchers to use semi-structured questionnaires when collecting data [11].

Multiple linear regressions are equations that express linear relationships between variables bound to more than one free variable. The simple linear regression equation is shown in the following formula.

$Y = b_0 + b_1x_1 + b_2x_2 + \cdots + e$

Y = dependent variable

b_0 = Constanta

b_1 and b_2 = Coefficient of regression

e = *error*

3. Result

3.1. Work stress description

Table 2. Results of categorization of work stress variables.

Category	Score Interval	Number	Percentage (%)
High	$X > 10{,}51$	6	14,63
Medium	$6{,}81 \leq X \leq 10{,}51$	29	70,73
Low	$X < 6{,}81$	6	14,63

The work stress response by 41 respondents had varying scores (tiered) with 70.73% of respondents fall into the category of moderate work stress indicating that the majority of respondents feel reasonable stress. While respondents who had high and low categories of 14.63%, respectively, showed that respondents felt heavy work stress and respondents felt mild work stress.

3.2. Work satisfaction description

Table 3. Results of categorization of job satisfaction variables.

Category	Interval Skor	Number	Percentage (%)
High	$X > 27{,}94$	8	19,5
Medium	$22{,}11 \leq X \leq 27{,}94$	26	63,42
Low	$X < 22{,}11$	7	17,07

Based on table 3 it can be known that the job satisfaction variables responded by 41 respondents have varying values (tiered) with 63.42% of respondents included in the category of moderate job satisfaction which indicates that the majority of respondents feel satisfied job satisfaction. While respondents who have high and low categories of 19.5% and 17.07% respectively, indicate that respondents feel very satisfied job satisfaction and respondents feel less satisfied job satisfaction.

3.3. Turnover intention

Table 4. Variable categorization results turnover intention.

Category	Score Interval	Number	Percentage (%)
High	$X > 18{,}02$	5	12,20
Medium	$12{,}13 \leq X \leq 18{,}02$	32	78,05
Low	$X < 12{,}13$	4	9,76

Based on Table 4, it can be known that the intention turnover variable responded by 41 respondents has a varied value (tiered) with 78.05% of respondents fall into the category of moderate intention turnover which indicates that the majority of respondents have a not too strong intention to leave their work. While respondents who have high and low categories of 12.20% and 9.76%, respectively, indicate that respondents will leave their jobs and respondents who do not want to leave their jobs.

3.4. Regression Analysis

Table 5. Multiple linear regression results.

Coefficients							
		Unstandardized Coefficients		Standardized Coefficients			
Model		B	Std. Error	Beta	t	Sig.	Corellation
1	(Constant)	1.969	2.912		.676	.503	
	SK	1.408	.138	.886	10.182	.000	.871
	KK	.036	.088	.036	.414	.681	-.324

a. Dependent Variable: Y

Multiple linear regression analysis can be formulated into the form of multiple linear regression equations as follows:

$$Y = 1{,}969 + 1{,}408SK + 0{,}036KK \quad \text{..... (4. 1)}$$

Y = Turnover Intention
b_0 = Constant is the value of Y when independent variables are zero
b_1 and b_2 = Regression coefficient
SK = Work stress
KK = Job satisfaction

Work stress has a positive relationship and has a significant effect on turnover intentions. Variable job satisfaction does not significantly affect turnover intention.

Table 6. F-test results (ANOVA).

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	263.526	2	131.763	60.141	.000[b]

a. Dependent Variable: Y
b. Predictors: (Constant), KK, SK

Model regression research can be declared fit for use. In addition, these results mean that work stress and job satisfaction together affect turnover intention.

Table 7. Coefficient of determination (R^2).

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.872[a]	.760	.747	1.48017

a. Predictors: (Constant), KK, SK

The result of the coefficient of determination of the regression model used is the value of R square which in the table obtained a value of 0.760 or 76%. This suggests that the contribution of work stress and job satisfaction to turnover intentions is 76%, while the other 24% is influenced by other factors not contained in this regression model.

4. Findings

4.1. The influence of work stress to turnover intention

Work stress is associated with the demands and resources of a worker. Demands are the responsibility, pressure, and obligations of the worker. Resources are things that can be controlled by an individual that can be used to settle demands as a worker [12].

Work stress has a positive influence on turnover intentions. This is because if an individual or worker experiences work stress, there will be a desire to move from the job. In this case it can be concluded that the higher the stress experienced by a worker, the higher his desire to move from the company.

The contribution of work stress to worker turnover intention is relatively high with a regression coefficient value of 1,408. In this case, work stress has 2 factors that underlie the occurrence of a surge in stress in a job by workers or individuals. These factors include organizational factors and individual factors themselves. Organizational factors influence work stress as well as workers which include job or task demands and relationship demands between workers or personal. While individual factors that affect work stress as workers can be economic problems, family problems, and personality problems of the individual itself. With the high number of contributions from work stress, companies need to pay attention to the management of the work received by workers and the relationship between workers.

4.2. The influence of work satisfaction to turnover intention

Job satisfaction has a negative influence on turnover intentions. This is because if a worker is satisfied with his job, then it is less likely for him to think about moving jobs from that job. Thus, it can be concluded that the higher the satisfaction felt by a worker, the lower his desire to move from the company.

The consequence of job satisfaction to worker turnover intention is relatively low, which is only 0.036. Indicators that affect the satisfaction of workers with their work include: the job itself, supervision or supervision, co-workers, and salary. The job indicator itself refers to the attractiveness of the work to be completed. If the job is attractive to a worker, then the worker will feel satisfied when completing the job. On the supervisory or supervisory indicator, workers assess the ability and concern of supervisors in the workers under them. Workers will tend to be satisfied when they have supervisors who have good working skills and have high concerns. On the coworker indicator, satisfaction will be obtained by workers when they have co-workers who are cooperative, able to work in teams, and can compensate for those workers. The salary indicator is a sensitive indicator that workers will be satisfied when obtaining a salary that can meet the needs of the worker.

5. Conclusion

Work stress has a significant positive influence on turnover intentions, while job satisfaction has an insignificant negative influence on turnover intentions. Together work stress and job satisfaction affect turnover intentions. The effect of work stress and job satisfaction on turnover intentions is 76%.

References

[1] Yanjuan Z 2016 A Review of Employee Turnover Influence Factor and Countermeasure. *Journal of Human Resource and Sustainability Studies* **4** 85-91 Published Online June 2016 in SciRes. http://www.scirp.org/journal/jhrss http://dx.doi.org/10.4236/jhrss.2016.42010

[2] Robbins S and Judge T 2008 *Organization Behavior* (Perilaku Organisasi) Edisi 12 Jakarta: Salemba Empat

[3] Andini R 2006 *Analisis Pengaruh Kepuasan Gaji, Kepuasan Kerja, Komitmen Organisasional Terhadap Turnover Intention* Tesis Universitas Diponegoro Semarang

[4] Habib, Ahsan, Sheikh Md. H and Nabi N 2018 Employee Turnover & It's Impact on Apparel Industry in Bangladesh: A Case Study of Mondol Group *Human Resource Management Research* **8** 63-68 DOI: 10.5923/j.hrmr.20180803.03

[5] Akiyomi O J 2016 Labour Turnover: Causes, Consequences and Prevention *Fountain University Journal of Management and Social Sciences* **5** Special Edition 105 – 112

[6] Hartono B and Setiawan R 2013 Pengaruh Komitmen Organisasional Terhadap Kepuasan Kerja Karyawan Paparon's Pizza City Tomorrow *Agora* **1**

[7] Manurung M T and Ratnawati I 2012 Analisis Pengaruh Stres Kerja Dan Kepuasan Kerja Terhadap Turnover Intentionkaryawan (Studi Pada Stikes Widya Husada Semarang) *Diponegoro Journal of Management* **1** 145-157

[8] Susilo J and Satrya I H 2019 Pengaruh Kepuasan Kerja Terhadap Turnover Intention Yang Dimediasi Oleh Komitmen Organisasional Karyawan Kontrak *E-Jurnal Manajemen* **8** 3700-3729

[9] Herispon 2020 *Panduan Pengolahan Data Penelitian Menggunakan Spss 23* Pekanbaru: Sekolah Tinggi Ilmu Ekonomi Riau

[10] Tariq M N, Ramzan M and Riaz A 2013 The Impact of Employee Turnover on the efficiency of The Organization *Interdisciplinary Journal of Contemporary Research in Business* **4**

[11] Taye, D and Getnet B 2020 The Impact of Employee Turnover on Organizational Performance: A Case Study of Mada Walabu University, Bale Robe, Ethiopia. *American Journal of Pure and Applied Biosciences* **2** 51-63 https://doi.org/10.34104/ajpab.020.051063

[12] Robbins S and Judge T 2013 *Organizational Behavior* New Jersey: Pearson

Storynomic tourism as destination DNA in an effort to increase demand for agricultural visit of Way Lalaan water fall destination

R Akmal[1*] and M Astriyantika[1]

[1] Politeknik Negeri Lampung

*E-mail: refdi@polinela.ac.id

Abstract. Way Lalaan is one of the leading agrotourism destinations in Tanggamus Regency, Lampung. The construction of infrastructure at this location has been well managed, but the number of visits is still below the local government's target. Based on these conditions, promotion techniques are important to study as a form of branding and driving the interest of potential tourists to visit Way Lalaan. This study examines the marketing policies carried out and the possibility of the storynomics presentation model as a promotional strategy which is expected to be able to create the uniqueness and excellence of destinations. The results of this study indicate that the promotion pattern that has been carried out has not maximized the storynomic tourism strategy which will encourage tourists not only enjoy the beauty of nature, but are also expected to be able to know the story behind the destinations visited so that it has an impact on tourist behavior, including longer visits, regional exploration, maximum travel, gain new knowledge and experience, and provide testimonials or recommendations to others. This research also finds a number of aspects that have the potential to be used as material in the preparation of marketing strategy for storynomic tourism.

1. Introduction

Agrotourism is an activity that seeks to develop the natural resources of an area that has potential in agriculture to be used as a tourist area [5]. The contained potential must be seen in terms of the natural environment, geographical location, types of agricultural products or commodities produced, as well as facilities and infrastructure [11]. The development of agro-tourism is essentially an effort to exploit the potential of agricultural tourism attractions. These potentials are capital that can make a major contribution to local, regional economic development and the creation of jobs through the development of the tourism industry [10]. Agrotourism is developed in developing countries as a potential development model to preserve natural resources and support the process of improving the economy of local communities. Agrotourism is a narrowing of ecotourism as a concept that can provide an alternative economic improvement to resource management activities, and to generate income for local communities.

Empowerment of the region with all its potential is a step to increase the role and contribution of the region towards the independence of the nation [7]. Tanggamus Regency is one of the tourist destinations that is trying to align itself with other tourist areas that developed earlier [9]. There are relatively many potential locations to be developed into tourist areas in Tanggamus Regency, one of which is the government's priority is Way Lalaan Waterfall, which is the direction of its development to the concept of Agrotourism.

Searches through questionnaires examining tourist destinations in Tanggamus Regency that have been visited by tourists indicate that the highest interest in tourist visits is the Way Lalaan Waterfall destination. This is directly proportional to its status as a leading regional tourist destination which is the main focus of the development and management of the local government.

The excellence of the tourism sector of Way Lalaan Waterfall, which has been known since 1937, was during the Dutch colonial administration which had made cement stairs leading to the waterfall valley. Since the establishment of the Way Lalaan Waterfall Tourism Object, it is hoped that it can provide employment opportunities for the local community and the income from this tourism object can contribute to increasing the income of the surrounding community in particular.

However, the facts show that the growth of tourists is currently at 8.3% while the standard set by the Tanggamus Regency Tourism Office is 15% per year, this means that it is still far below the standard set by the Tanggamus Regency Tourism Office. This is influenced by the average number of tourists who change or fluctuations due to natural conditions such as high rainfall and lack of promotion in Way Lalaan Waterfall agrotourism, Tanggamus Regency, Lampung Province [2].

Table 1. Number of tourist visits to Way Lalaan in 2016-2019.

No	Year	Visitors	Changes (%)
1	2016	7803	-
2	2017	7883	1.03
3	2018	10382	31.70
4	2019	10468	0.83
	Average	**9134**	**-**

Source: Tourism Office of Tanggamus, 2019

Other factors that affect the number of requests for visits are the economic instability of the community, the delivery of promotions that are not well targeted and the ineffective use of promotional media. Promotions and information are usually used by the manager to introduce tourism objects in order to attract tourists to visit [13], among others is storynomics.

In simple terms, storynomic Tourism is a tourism approach that puts forward narrative, creative content, and living culture and uses the power of culture as the DNA of a destination. In another language, the Minister of Tourism said, later the promotion of tourist areas will be carried out with story telling narratives and packaged in interesting content related to local culture. There is a reciprocal relationship between humans and the environment. Landscapes become part of the humans who live in them and vice versa [4].

Folklore which is a cultural heritage from the past turns out to be very relevant to contemporary life in the global era [8]. Folklore if packaged in an interesting way it will be economically useful. The folklore has been processed into storynomic so that it can be used as tourism branding. Examples of folklore that have succeeded in becoming tourism branding in their respective regions include: Sangkuriang folklore as a branding for the tourism area of Mount Tangkuban Parahu, West Java. The folklore of Putri Mandalika as a tourism brand in the Lombok area, as well as the story of Bale Gajah Tumpang Salu, a story about the traditional house of the Sidetapa community, one of the Bali Aga villages, in North Bali.

Thus, it can be emphasized that folklore which is identified with the past is actually very useful for social, cultural, and economic life today and in the future. Integrated Marketing Communication Mix such as (advertising, personal selling, direct marketing, sales promotion, public relations and e-WOM) is expected to introduce and develop a tourism especially in increasing the intention to visit tourists [1]. The concept of storynomic tourism which is considered good enough to be applied in Indonesia, if it is not supported by adequate infrastructure such as cleanliness, environmental quality, security, safety and so on, it will not work well either.

2. Method

The research was conducted for 5 months in June-October 2021 at Way Lalaan Agrotourism located in Kota Agung Timur District, Tanggamus Regency, Lampung Province. Selected as a research location based on considerations of cultural and ecological quality as a potential tourist attraction to be studied and developed as a basis for community empowerment as well as a source of local income and media for promoting regional excellence.

The sample or informants in the study are divided into 5 (five) points of view, namely the government, academics, traditional leader figures, communities, and tourists [11]. Based on its structure, the closed interview approach will provide more detailed results because it is guided by directed questions [3]. In-depth interviews were conducted with traditional leaders using a snowball interview approach and using a question guide related to the data/information to be sought. To verify the exploration results from the traditional texts and interviews with traditional leaders, a field visit was conducted. In addition, the collection of data from the perception of the public and tourists.

Table 2. Selection of research informants and respondents.

Informant	Total
Tanggamus tourism office	1
Academician f	3
Tradition igure	3
Native people	30
Tourists	30

The data needed in this study include primary data and secondary data. Primary data obtained through observation and interviews. The primary data needed in this study are related to the existing condition of the Way Lalaan Agrotourism component. Furthermore, the primary data needed are the views of the Government, academics, traditional leaders, local communities and tourists. Meanwhile, secondary data were obtained from documentation techniques. The secondary data needed in the form of statistical data related to tourism, literature studies and policy documents related to the development of Way Lalaan Agrotourism.

The data collection method in this study consisted of three parts: observations were carried out to collect data by systematically observing and recording the symptoms or phenomena that existed in the research object [12]. In-depth interviews were also conducted with informants for more open issues, where the parties invited to the interview were asked for their opinions and ideas [10]. As reinforcement, literature studies were also carried out by taking sources from books, scientific journals, government policy documents, as well as sources from online media (internet) such as official government websites, statistical data institutions, educational and research institutions, news, as well as access to journals. domestic & abroad.

The data analysis used in this research is descriptive qualitative analysis. Descriptive analysis is used to identify the opinions of experts or institutions from various sources related to the components supporting the development of Way Lalaan Agrotourism. Data from primary and secondary sources are described, then conclusions are drawn as findings from the research conducted.

3. Results and Discussion

The management of Way Lalaan Waterfall has been developed into the concept of agro-tourism because it is supported by the surrounding area which is the agricultural land of the local community, both fisheries, livestock, plantations, and even rice fields which are actively managed well. Some examples of plants that can be found easily include durian, mangosteen, duku, and avocado which are currently being developed. Based on information from the Tourism Office of Tanggamus Regency, this type of

plant for agro-tourism activities will continue to be developed together with other sectors in the wider agricultural scope .

Way Lalaan Agrotourism has been designated by the Tanggamus Regency government as one of the leading destinations, this is strongly supported by the development of governance, infrastructure development and promotional strategies carried out.

3.1 Infrastructure facilities that have been established in Way Lalaan Agrotourism

The Department of Tourism and Culture is actively engaged in developing Way Lalaan Agrotourism governance as a leading destination for Tanggamus Regency. A major effort in recent years is the construction of tourist facilities and infrastructure to create a comfortable visit so as to increase tourist satisfaction, this of course has a positive impact on impressions and requests to come to the location. Previously, the infrastructure at this location was still limited, or even the lack of maintenance on buildings or other facilities, but in 2021 it has seen quite a number of new buildings being built to beautify the location, create tourist comfort, and even add shooting points that are considered attractive for tourists. The infrastructure facilities are as follows: Entrance and parking, photo spots, hall, souvenir center, stairs to the waterfall, Ratu food stall, hobbit house, garden, underwater photo spots, signage of Way Lalaan and open stage

3.2 Way Lalaan agro-tourism promotion strategy

Promotion strategy carried out by the Tourism and Culture Office of Tanggamus Regency to attract tourists to visit Way Lalaan Waterfall.

3.2.1 Promotional photos and videos. This strategy utilizes social media as a platform to introduce Way Lalaan Waterfall to the general public with a wide reach and unlimited time to access it. The social media used are the Instagram (@majectic.tangmus) and youtube (Majestic Tanggamus) platforms which are managed by the Tanggamus Tourism and Culture Office to promote all destinations in Tanggamus Regency, one of which is Way Lalaan. In an effort to produce attractive photos and videos, Tanggamus Regency uses the services of a professional team that has experience in photography and videography. The photos are also printed to become banners or flyers with additional descriptions and persuasive sentences which are also one of the promotional tools in the form of print media.

3.2.2 Discounts and bonuses (sales promotion). This strategy is used by the Department of Tourism and Culture of Tanggamus Regency by providing special coupons in the form of tickets that have been purchased by tourists and then exchanged for beverage products according to the number of tickets/coupons.

3.2.3 Participating in tourism exhibitions. One of the efforts of the Tanggamus Tourism and Culture Office is to participate in tourism exhibitions such as the "Semaka Bay Festival" which is an annual party for the Tanggamus community to explore local tourism and culture. Way Lalaan Waterfall always hosts these events with the aim that apart from promoting the Tanggamus culture, the manager can also introduce Way Lalaan as a leading destination. The hope is that the event held at Way Lalaan can provide a strong branding among tourists. In addition, the Tanggamus Tourism Office promotes and introduces the object of Way Lalaan Waterfall on the national stage by participating in the "Archipelago Tourism and Culture Festival" at the Jakarta Convention Center. This annual event of the Ministry of Tourism and Creative Economy is always included in the agenda of the Tanggamus Tourism and Culture Office because it is an opportunity to openly market the potential of its tourism objects to a wide range, considering that the event is also visited by a lot of domestic and foreign tourists.

3.2.4 Branding icon. The Tanggamus Tourism Office together with Way Lalaan tourism activists apply the Catalog Marketing concept in the form of printed brochures containing Way Lalaan attractions ranging from area descriptions, location images, infrastructure, area access maps, ticket prices, and now

has been supported by the Tourism Information Center service. Tourism ambassadors or commonly called "Muli Mekhanai" play an important role in communicating for the promotion of tourist destinations in the Tanggamus Regency when in public activities or tourism events. It aims to socialize and introduce to the general public what tourism products are in Tanggamus Regency, especially superior tourism, either orally or by providing printed brochures.

3.2.5 Public relations. In implementing integrated marketing communications, tourism managers must also carry out public relations whose benefits can provide a good image to the community. In this realm, the Tourism Awareness Group (Pokdarwis) plays an important role in contributing to tourism development in order to create Sapta Pesona, a local tourist destination that has elements of security, order, cleanliness, friendliness, beauty, coolness and memories. Tanggamus Regency is recorded to have 9 Pokdarwis, one of which is Pokdarwis in the Way Lalaan area. Way Lalaan Waterfall also has a cooperative relationship with the local community in developing the Way Lalaan tourism sector, besides that the purpose of this Pokdarwis is so that the Tanggamus Tourism Office can reach tourists massively from community assistance both in terms of promotion, buying and selling of the MSME sector such as special foods, processed products. earth, various handmade and artistic products typical of Tanggamus Regency as well as community activities with elements of local culture.

3.3 Potential of storynomics tourism

The concept of a storynomic tourism approach that puts forward narratives, creative content, and a living culture is believed to be able to accelerate the development of the tourism industry in the current digital era. Storynomic tourism is used to increase the interest of tourists who are interested in traditional stories, traditions, culinary, and the culture of these tourist destinations. Efforts to support this concept include the assistance of tour guides, influencers, as well as the provision of facilities containing signs/barcodes that display destination information. Not only enjoying the natural beauty, this concept is also expected to be able to make tourists know the stories behind the destinations visited so that it has an impact on tourist behavior: visiting longer hours, exploring tourist areas optimally, gaining new knowledge and experiences, and providing testimonials or recommendations to others. The storynomic potential that needs to be developed to increase the selling value of the Way Lalaan tourist destination can be explained as follows.

3.3.1 History of Way Lalaan waterfall. According to traditional leaders in the Tanggamus Regency, Way Lalaan Waterfall has been found since ancient times. Starting from a prince who is always restless and feels sad, this has an impact on his declining physical condition. Seeing the crown prince who will continue the leadership of the kingdom in a bad condition, the Queen was very worried and not calm. For days the Prince still never felt happy, until finally he asked to find a place that could create peace for him. The Queen who really loves her son (Prince) then orders the Hulu Balang with the royal guards to explore every area of the kingdom to find a shady and blessed place so as to create happiness and tranquility for the Prince according to the desired criteria.

After days of exploring the Tanggamus area, passing through the coast, jungle, settlements, plantations, and hills, they finally found a very clear water flow. Then the flow of the water was traced, and it turned out that there was a very beautiful waterfall in accordance with the criteria for the place that the Prince expected. Hulu Balang and the guards returned to the palace to convey this good news to the Queen and Prince who welcomed them with great expectations. After the news was delivered, then they all went to the location in question. Arriving there, the Prince was very impressed and satisfied to see the natural beauty that existed and the aura of happiness emanating from his face. This, of course, made the Queen feel emotional and happy because her son was back in the spirit as usual. At that time, the Prince asked all his people to keep the area sustainable and enjoyed for generations to posterity, then he named the water flow "Way Lalaan Waterfall".

Literally the name Way Lalaan taken from the Lampung language; way means water or river, Lalaan comes from the word Lala which means spicy, so Way Lalaan means "spicy water or river". There is an

interesting story with the naming of this waterfall. The word ‘way’ in Lampung language means water/river. It is said that the naming of Way Lalaan itself is to balance the name of the waterfall which is located to the south of Way Lalaan Waterfall, namely Way Kandis waterfall. If “way’ means water or river, then ‘kandis’ in Lampung language means sour.

3.3.1 Myths in Way Lalaan waterfall area. The existence of the Way Lalaan area, which has been known since the days of the kingdom, left a belief for the local community which is quite thick with customs and culture. The stories from generation to generation are still believed by the Tanggamus community regarding the myths that exist in several locations in the Way Lalaan area. This is also widely conveyed to tourists to foster attractiveness and curiosity about the uniqueness of a tourist attraction.

The myths found in the Way Lalaan Agrotourism area include:

a. The Myth of Way Lalaan angel's tears

The water that comes out of the cracks in the rock walls at Way Lalaan Waterfall is believed to be the tears of an angel. The water that comes out is still clear like springs in general. It is said that if a person takes a bath or washes his face with the tears of an angel, that person will increase his aura of beauty or handsomeness, besides that, the tears of an angel are believed to make him stay young. Again, this is just a myth, regardless of whether it is true or not.

b. The myth of the Way Lalaan waterfall love tree

The Way Lalaan tourist destination has one tree that grows in the tourist area. Local people know him as the Kerincing Tree, but people know him better as the Love Tree. The position of this tree is at the top of the stairs when we go down the stairs to Way Lalaan I Waterfall, so we can be sure that all tourists will be easy to reach because it is on the main route. It is said that if there are lovers who make a promise to live and die under the tree of love, then their love relationship will last until death do them part. This is just a myth that develops in the community, but many visitors sit on this tree on weekends.

c. The myth of the stone hermit Way Lalaan waterfall

Way Lalaan has a unique and myth-colored boulder. At first glance the shape of this stone resembles a seat for meditation, and it is said that according to local stories, this stone was used for meditation by the ancestors and the royal family. This stone is located not far from Way Lalaan Waterfall. Usually this stone is used for seating by tourists who come to visit. Around the Way Lalaan waterfall, you can find several large stones that are easy for tourists to access as a place to sit or put their luggage.

4. Conclusion

The promotional concept carried out by the Tanggamus Tourism Office to introduce Way Lalaan has been very good, but to achieve maximum market penetration, it is better for each concept to be carried out consistently to create branding in the general public. This promotional activity is also very influential when collaborating with tourism stakeholders who are often called Pentahelix consisting of academics, business or private sector, media, government, and the community. This, of course, will get feedback in the form of positive testimonies, suggestions, and input for the development of promotional strategies and governance of the flagship destination of this Tanggamus district.

It is necessary to make a printout of the storynomic tourism guide and place it at the Tourism Information Center to facilitate access, as well as regular training of tour guides specifically for the Way Lalaan area to understand the narrative flow of storynomic tourism that is conveyed to tourists so that the information conveyed is in the same direction. This is expected to be able to provide impressions, information and knowledge for post-visit tourists.

References

[1] Abubakar A and Ilkan M 2016 Impact of online WOM on destination trust and intention to travel: A medical tourism perspective *Journal of Destination Marketing & Management* **5,** 192-201

[2] Dinas Pariwisata Tanggamus. https://web.disparbudtanggamus.id/

[3] Djaelani and Rofiq 2013 Teknik Pengumpulan Data Dalam Penelitian Kualitatif *Majalah Ilmiah*

Pawiyatan **1**

[4] Ingold T 1993 Temporality of the Landscape *World Archaeology* **25** 152–174

[5] Kusudianto and Hadinoto 1996 Perencanaan Pengembangan Destinasi Pariwisata Jakarta: UI-Press

[6] Nafi 2017. Pengembangan daerah Ekowisata Buku Bunga Rapim 6672

[7] Nandi 2005 Memaksimalkan potensi wisata alam di Jawa Barat *Jurnal Manajemen Resort and Leisure* **1** 1-11

[8] Sari I A L 2019 Kajian Komparatif Wacana Kearifan Lokal Cerita Rakyat Bali Aga dan Ainu Jepang Fakultas Ilmu Budaya, Universitas Udayana.

[9] Setiawan A 2012 *Wisata Tanggamus* http://agusskn.blogspot.com/2012/03/wisatatanggamus.html

[10] Sugiharto B 2011 Analisis pengaruh komunikasi, kepemimpinan dan Pendidikan terhadap tingkat partisipasi masyarakat dalam pengembangan desa wisata *Jurnal Ilmiah Pariwisata Bina Wisata Nusantara* **16** 44-61

[11] Sumarwoto J 1990 Pengembangan Agrowisata: Potensi dan Prospek.

[12] Tika H, and Panbudu M 2005 Metode Penelitian Geografi. Jakarta: Bumi Aksara

[13] Yoeti O 2006 Pengantar Ilmu Pariwisata Bandung: Penerbit Angkasa

 Doi: https://doi.org/10.25181/icoaas.v2i2.2490

Spray distillation model development for bioethanol downstream processing

I S Kartawiria[1*], A R Putri[1], Jessica[1], N Nadya[1] and D I Widiputri[1]

[1]Chemical Engineering Department, Faculty of Life Sciences and Technology, Swiss German University, Tangerang, Indonesia 15143

*Email: Irvan.kartawiria@sgu.ac.id

Abstract. Spray distillation process as a novel process was developed to overcome the energy requirement of separation and purification of bioethanol. Unlike conventional distillation method that utilizes difference in boiling point to provoke phase change, spray distillation column utilizes the gradient concentration of ethanol contained in the droplets and the surrounding air to provoke transfer of compound out of the droplets. Previous study has developed a basic model of spray distillation and proven that the separation process could be achieved at relatively low temperature of 40°C. However, the basic model, which was based on classical mass, energy, and momentum balances could not describe the process in higher scale. This study aims to develop the better modelling of spray distillation process by taking into consideration vapor flux and diffusion model of throughout the column. The information is required to develop larger scale equipment which is more suitable to be further increased to actual industrial capacity. Modelling show that ethanol vapor travels in the opposite direction of the spray with the affecting variables: Velocity of counter current air (u_{CC}), density of surrounding gas (ρ_g), volume of vapor (V_V), droplet velocity (u_d) and the amount of feed (m_0). Vapor flux model defined as the function of droplet radius (r_c), column radius (r_d), and number of droplets inside the column (N_D), which affecting the sizing of prototype of distillation column in combination with diffusion model. Testing and simulation at 15-80% v/v ethanol water mixture shows that spray distillation performance is comparable with microbubble distillation and pervaporation with better energy consumption.

1. Introduction

The production of bioethanol as greener replacement of fossil fuel is facing several problems. While the fermentation itself has been considered as mature technology, the development of separation and purification process of bioethanol experienced slower pace. The oldest and most common apparatus used in bioethanol purification is a distillation column. However, it holds some disadvantages, such as large installation cost, high operational cost caused by the high energy consumption [1].

Spray distillation process as a novel process was developed to overcome the energy requirement of separation and purification of bioethanol. Unlike conventional distillation method that utilizes difference in boiling point to provoke phase change, spray distillation column utilizes the gradient concentration of ethanol contained in the droplets and the surrounding air to provoke transfer of compound out of the droplets. Mixture of bioethanol and water from filtered and clarified fermentation broth were sprayed into a slightly heated column. The separation of bioethanol from water mixture occurred at the interface between the liquid micro droplets with surrounding air. Spray distillation apparatus utilizes diffusivity,

phase transformation, concentration gradient, and extremely large surface area to separate ethanol from the water mixture. It works at lower temperature compared to conventional distillation process [2].

Previous study has developed a basic model of spray distillation and proven that the separation process could be achieved at relatively low temperature of 40°C. However, the basic model, which was based on classical mass, energy, and momentum balances could not describe the process in higher scale. The flow pattern of the ethanol vapor and the effect of diffusion through the droplets during its journey from the top to bottom of column has not yet studied. The information is required to develop larger scale equipment which is more suitable to be further increased to actual industrial capacity.

This study aims to develop the better modelling of spray distillation process by taking into consideration vapor flux and diffusion model of throughout the column.

2. Materials and method

The model developed for the spray distillation enhancement was divided into vapor flow modelling, vapor flux model development, and diffusion model. Model testing was done in a developed prototype with various ethanol-water mixture concentrations. The material used in this experiment was ethanol 70% v/v technical grade. The experiment was tested against different feed concentration and feed flow rate.

2.1. Vapor flow direction

In order to model the direction of ethanol vapor released from the droplets, momentum balance was generated. Since the prediction was based on the movement of a falling droplet through a specific height, the forces that affect the movement of vapor released from the surface of the droplet were also the same. Said forces could be elaborated as drag force, buoyancy force, and gravitational force. The starting equation for the model is described in Eq 1.

$$\frac{d(mu_{v)}}{dt} = F_g - F_b - F_d \quad (eq.1)$$

where m is the mass of feed, u_v is vapor velocity, while F_g, F_b, and F_d are gravitational force, buoyancy, and drag force respectively.

2.2. Vapor flux model

Vapor flux is used to represent the velocity of vapor movement through the top outlet of the column. The equation was generated in order to support the flow of vapor through the outlet for vapor collection. It was necessary to determine the factors that influenced vapor flux inside the column. With greater vapor flux, it was predicted that more vapor would go out from the outlet and more chance on collecting the vapor. The vapor flux modelling was based on the evaporative mass transfer equation created by Lupo and Duwig (2017)[3], as presented in Eq 7.

$$\dot{m}_{of\ a\ droplet} = 4\pi\bar{\rho}_g\bar{D}_{v,g}r_d \ln(1 + B_M) \quad (eq.7)$$

Where m is mass evaporative rate of a droplet, $\bar{\rho}_g$ is the gas density, $\bar{D}_{v,g}$ represents diffusivity between the vapor and gas, r_d represents droplet radius, while B_M is Spalding mass transfer number.

2.3. Diffusion model

When droplets of ethanol-water mixture fall in the column, the concentration gradient between the droplet surface with the surrounding air promotes the diffusion or evaporation. Due to the continuous evaporation, droplet radius will decrease from time to time [4]. The previous momentum balance developed assumes that the droplet is free-falling inside the column [2]. However, it is suspected that there is a force that contributes to the velocity of a droplet falling. The force comes from the pressure where the feed is sprayed at the beginning and it will affect the rate of evaporation itself.

3. Results and discussion

3.1. Vapor flow direction

Vapor flow direction is an important aspect because it determines in which section of the column should the outlet be installed. The momentum balance of vapor direction was done by referring to the momentum balance of droplet. According Cai (2018)[5], the momentum balance of a droplet is influenced by several forces. However, due to the extremely small size of droplets, it was assumed that there were only three forces influences the droplet movements as presented in Eq 1.

$$\frac{d(mu_{v)}}{dt} = F_g - F_b - F_d \quad (eq.1)$$

Neglecting the small gravitational force surrounding the droplet, the mathematical modelling for predicting vapor direction generated the following equations:

$$\frac{d(mu_{v)}}{dt} = F_g - f\left(u_{cc}, \rho_{g,} V_v\right) - \frac{A\rho_v C_D {u_d}^2}{2} \quad (eq.2)$$

$$\frac{d(m\theta)}{dt} = -f\left(u_{cc}, \rho_{g,} V_v\right) - \frac{A\rho_v C_D {u_d}^2}{2} \quad (eq.3)$$

$$m_0 \frac{d(\theta)}{dt} + \theta_0 \frac{d(m)}{dt} = -f\left(u_{cc}, \rho_{g,} V_v\right) - \frac{A\rho_v C_D {u_d}^2}{2} \quad (eq.4)$$

$$m_0 \frac{d(\theta)}{dt} = -f\left(u_{cc}, \rho_{g,} V_v\right) - \frac{A\rho_v C_D {u_d}^2}{2} \quad (eq.5)$$

$$\frac{d\theta}{dt} = -f\left(u_{cc}, \rho_{g,} V_v\right) - \frac{A\rho_v C_D {u_d}^2}{2m_0} \quad (eq.6)$$

The Eq 2 – 6 above stated that the vapor travels in the opposite direction of the spray with the affecting variables as mentioned: Velocity of counter current air (u_{CC}), density of surrounding gas (ρ_{g}), volume of vapor (V_{V}), droplet velocity (u_{d}) and the amount of feed (m_0). Therefore, the large-scale prototype column must be designed in such a way that the vapor outlet is located on the top section of the column.

3.2. Vapor flux model

Vapor flux (θ) plays a huge role in determining the characteristic of vapor flow inside the column. It was done by considering the evaporation rate of droplet surrounded by gas phase. According to Lupo and Duwig (2017)[3], mass evaporation rate of a droplet is as stated in Eq.7.

$$\dot{m}_{of\ a\ droplet} = 4\pi\bar{\rho}_g \overline{D}_{v,g} r_d \ln(1 + B_M) \quad (eq.7)$$

The mass evaporative rate of a droplet was altered in order to suit the case of spray distillation column and to predict the velocity of vapor flowing inside the column. Since vapor flux equation aims to predict the rate of vapor that travels inside the column and there would be more than one droplet produced by the nozzle, further transformation of the equation could be observed below:

$$\dot{m}_{of\ a\ droplet} = 4\pi\bar{\rho}_g \overline{D}_{v,g} r_d \ln(1 + B_M)\, N_D \left[\frac{kg}{s}\right] \quad (eq.8)$$

$$V = 4\pi \frac{\bar{\rho}_g}{\bar{\rho}_v} \overline{D}_{v,g} r_d \ln(1 + B_M)\, N_D \left[\frac{m^3}{s}\right] \quad (eq.9)$$

$$\theta = 4 \frac{\bar{\rho}_g}{\bar{\rho}_v} \overline{D}_{v,g} \ln(1 + B_M)\, N_D \, \frac{1}{\pi {r_c}^2} \left[\frac{m}{s}\right] \quad (eq.10)$$

$$\theta = 4 \frac{\bar{\rho}_g}{\bar{\rho}_v} \overline{D}_{v,g} \frac{r_d}{{r_c}^2} \ln(1 + B_M)\, N_D \left[\frac{m}{s}\right] \quad (eq.11)$$

Where θ represents vapor flux, $\overline{D}_{v,g}$ represents diffusivity between the vapor and gas, r_d represents droplet radius, r_c shows the column radius, $\bar{\rho}_v$ shows the density of vapor species, $\bar{\rho}_g$ is the density of the gas surrounding the droplet, and N_D shows the amount of droplets. Vapor flux itself, could be defined as the function of droplet radius (r_c), column radius (r_d), and number of droplets inside the column (N_D) as shown in Eq.12.

$$\theta = f(r_d, r_c, N_D) \quad \text{(eq. 12)}$$

High vapor flux is desired because with higher flux means that a faster and higher rate of vapor flow took place in the system. It is beneficial for condensation because with more flux means the possibility of condensation would also increase. The modelling also resulted knowing in three factors contributing to vapor flux, name: droplet radius, column radius, and the number of droplets.

3.3. Diffusion model

Diffusion model took into account the effect of water evaporation in the modelling of droplet diffusion, thus changing the momentum balance by studying the initial velocity of the feed. It was then established that the height of the spray distillation column was influenced by the droplet concentration; meaning changes in droplet radius over time was taken into consideration. The diffusion model also consents a relationship between initial velocity, feed rate, and number of sprays. In addition, because there were observable changes in the effect of water evaporation towards the process, the diffusion model has established that the critical process and design parameters were column height and number of sprays.

With the additional effect of water evaporation, the modelling for ethanol and water fraction can be calculated as follow:

$$Vles_{t+\Delta t} = \frac{\frac{bVles_t {r_t}^3 - ar_t\left(\frac{Yves_t}{\sum iYvis_t}\right)}{\rho e}}{\frac{bVles_t {r_t}^3 - ar_t\left(\frac{Yves_t}{\sum iYvis_t}\right)}{\rho e} + \frac{c(1 - Vles_t){r_t}^3 - ar_t\left(\frac{Yvws_t}{\sum iYvis_t}\right)}{\rho w}} \quad \text{(ethanol fraction)}$$

$$Vlws_{t+\Delta t} = 1 - Vles_{t+\Delta t} \text{ (water fraction)}$$

Thus, contributing to the change in ethanol and water evaporation rate over time as:

$$\frac{dF}{dt} = \frac{d(u_d)}{dt} = \frac{\frac{4}{3}\pi r^3 \rho g - \frac{4}{3}\pi r^3 p_g g - 4\pi r^2 p_g C_D \frac{{u_d}^2}{2} - \frac{\dot{V}_F}{\pi {r_d}^2 N_s}\frac{m_{end} - m_{start}}{\Delta t}}{\frac{4}{3}\pi p_0 {r_0}^3}$$

both variables affected the modelling in terms of its momentum balance as both affects the height of the column. The diffusion model assumes that there is an optimum time for evaporation where ethanol fraction is greater than water fraction, which is the ideal condition for achieving high purity and high yield outcome. Therefore, predicting that with different feed ethanol concentration required a different height of column.

3.4. Model simulation

Several feed concentrations were tested, which were 15%, 30%, 45%, 60%, and 70% (all in v/v %). Observation of the prototype shows that condensate was formed on the collection area despite its low volume thus making direct measurement of ethanol purity from the top product still a problem to decipher. It was observed that higher feed concentration led to less condensate; on the other hand, a higher feed rate is the opposite, it contributes to the likelihood of more condensate formation.

Measuring the decrease of ethanol concentration of bottom product in comparison to the feed concentration, shows that separation has been achieved. Comparison of separation factor between spray drying as modelled in this study with other separation method is presented in Table 1.

Table 1. Performance comparison of spray distillation to other distillation method [1,6]

Feed concentration (% v/v)	Spray distillation (36 ml/ min, 40^{o}C)	Microbubble distillation (150^{o}C)	Pervaporation (50.88 mmHg, 60^{o}C)
15	9.71	11.2	9.70
30	5.47	8.40	4.50
45	3.55	6.00	N/A
60	2.38	3.60	N/A
70	1.81	N/A	N/A

From Table 1 it is observable that the performance of the prototype developed based on the modeling done in this study provide comparable performance to other downstream processing method used for bioethanol separation. The fact that spray drying is operating at much lower temperature compared to microbubble distillation shown the potential of further development of the process into low energy method for separation. Spray drying process is also in comparable performance with more advance pervaporation process, but without the need to create the vacuum condition.

4. Conclusions

The diffusion model which takes into account the effect of evaporation of water results in prototype design of column size and number of sprays installed. The diffusion model established as well that the critical processing parameters of spray distillation are feed rate and concentration. The model developed for the spray distillation process was successfully resulting in working prototype with comparable performance with other ethanol-water separation process.

Acknowledgement

The authors would like to express gratitude to Ministry of Education, Culture, Research and Technology, Republic of Indonesia, for funding the research through Daftar Isian Pelaksanaan Anggaran (DIPA)

Direktorat Jenderal Pendidikan Tinggi, Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi Tahun Anggaran 2021, Nomor SP DIPA-023.17.1.690439/2021 rev 04, 4 June 2021.

References

[1] Al-Yaqoobi A, Hogg D and Zimmerman W B 2016 Microbubble distillation for ethanol-water separation *Int. J. Chem. Eng.* **2016** 1–10

[2] Sari M and Kartawiria I S 2019 Design of spray distillation apparatus for ethanol purification *AIP Conf. Proc.* **2085**

[3] Lupo G and Duwig C 2018 A Numerical Study of Ethanol-Water Droplet Evaporation *J. Eng. Gas Turbines Power* **140** 1–9

[4] Sefiane K, Tadrist L and Douglas M 2003 Experimental study of evaporating water-ethanol mixture sessile drop: Influence of concentration *Int. J. Heat Mass Transf.* **46** 4527–34

[5] Cai B, Tuo X, Song Z, Zheng Y, Gu H and Wang H 2018 Modeling of spray flash evaporation based on droplet analysis *Appl. Therm. Eng.* **130** 1044–51

[6] Kaewkannetra P, Chutinate N, Moonamart S, Kamsan T and Chiu T Y 2011 Separation of ethanol from ethanol-water mixture and fermented sweet sorghum juice using pervaporation membrane reactor *Desalination* **271** 88–91

Netting House Application as a Facility for Rice (*Oryza sativa L*) Breeding Activities in Rice Fields

Hartono and Jamaludin Adimiharja

Department of Food Crops Cultivation, Lampung State Polytechnic Jl. Soekarno-Hatta Rajabasa, Bandar Lampung, Postal Code 35144

*E-mail:hartono@polinela.ac.id

Abstract. Paddy is an annual plant that can adapt to waterlogged land. Rice is a self-pollinating plant (autogamy) which is a grammar group with a stem composed of several segments, fibrous roots, the presence of a tongue and leaf ear, and a collection of rice flowers (spikelets) called panicles. Cross-pollination can be done in several ways, namely artificial and natural pollination. Natural pollination is done with the help of wind, birds, and insects. The success of producing superior non-hybrid (Inbrid) rice by cross-pollination is complicated because rice is a self-pollinating plant. Artificial cross-pollination with the help of human hands will make it easier to produce new types of superior inbred rice. At the beginning of the establishment of the Seed Technology Study Program from 2009-2020, Seed Technology students carried out rice plant breeding practices in greenhouses. The available greenhouses are composed of glass walls and glass roofs. This can increase the temperature in the room. The optimum temperature for rice plant growth is 23°C-25°C. Meanwhile, the temperature in the greenhouse >30°C has an unfavorable impact on rice plants. The lack of success during the practice, namely the temperature in the greenhouse, is very high, reaching >30°C, thus increasing the transpiration rate in rice plants. As a result, rice plants experience stress due to a lack of water. This research aims to make a net house with a plastic roof (netting house) in the rice fields so that rice plants can grow optimally supported by temperature and rainfall. The netting house function can also protect rice plants from pests like rats, leafhoppers, bugs, and other pests. The benefits of this research are as a means for practicum and research activities for students, Education Laboratory Institutions (PLP), and lecturers to produce new varieties of rice.

1. Introduction

Rice is one of the crucial commodities in Indonesia. Rice is a favorite food that has been attached to people's hearts. The culture and habits of the Indonesian people who have the stigma of "not being full if you haven't eaten rice" indicate how Indonesian people have a strong culture of eating rice (Haryadi, 2006). Good quality rice can be done by breeding rice, namely by cross-breeding between two elders who have special characters. Increasing the yield potential of a plant can be done by modifying the type of plant (Donald, 1968). Before crossing, first characterized by observing quantitative characters of rice plants such as plant height, number of productive tillers, panicle length, amylose content, amylopectin content, flowering age, grain weight of 1000 grains, In Indonesia, the increase in new types of rice has been started since 1995. Abdullah et al. (2008), One way to assemble superior varieties is by collecting singular characters from various parents in a combination, so it takes a long time to produce traits that align with expectations. In 2016 research conducted by Adimiharja et al. (2016) which was carried out at the Lampung State Polytechnic has produced promising lines, namely RP1, RP2, RP3, RP4, RP5 (the

result of crossing the Rojolele variety with Pandan Wangi), RG1, RG2, RG3, RG4, RG5 (the result of crossing the Rojolele variety with this variety). Gilirang), MR1 and MR2 (a cross between Mentik Wangi and Rojolele).

The self-pollinating plant line assembly course (PGTMS) is a course that directs students to become experts in the field of plant breeding. The course focuses on self-pollinating plants such as rice, tomatoes, chilies, soybeans, etc. The practicum activities are carried out in a greenhouse with a closed room condition consisting of a glass roof and glass walls. This condition becomes an obstacle to the practicum results that are not following the student's competence. Many plants wilt quickly due to lack of water due to high room temperatures that reach >30°C. Matthews et al. (1997) showed that an average temperature increase of 1°C would reduce rice production by 5-7%. Many nuisance pests in the greenhouse interfere with practical activities such as rats, birds, stink bugs, and other nuisance pests. Rice can grow well in an environment with sufficient water soil with a specific ratio of sand, silt, and clay fractions. This research aims to create a place for practicum activities and rice research in the fields.

Lampung State Polytechnic is a vocational college that has a learning curriculum of 70% practical components and 30% theory. With a practicum component of 70%, it is hoped that Polyneta alumni, especially the Seed Technology Study Program, have the expertise to produce superior seeds. The Seed Technology Study Program has the vision to make an excellent applied expertise program in producing applied graduates with high integrity, innovation, entrepreneurial spirit, and competence in tropical plant seed technology activities.

In this study, the researcher was determined to create a net house to support students, PLP, and lecturers of rice plant researchers, especially in the Seed Technology Study Program, to produce new types of rice according to the community's interests..

Other paragraphs are indented (BodytextIndented style).

2. Another section of your paper

Determine the size according to the previously measured land area. Determining the building's size, design, and direction is essential in building a net house for the functionality and effectiveness of all operations in the plant shade house.

2.1. Shade House Making.

After determining the design and size, build the framework structure by making arrangements starting from the walls doors to the roof and installing ultraviolet plastic with a measure that has been adjusted to the top of the net House. The plastic used is polycarbonate, so it is not easily torn. The walls are covered with paranet. Bolts are used to attach the paranet to the frame wall to be strong and not easily blown away by the wind.

2.2. Test Room.

After the shelter assembly activity was completed, the room was ready to be tested in the fields at the Lampung State Polytechnic. The trials carried out are:

a. The first trial was to plant rice in a shade house for one season. Observations were made from planting to harvesting. The stability of indoor growth is the main factor in the success of the shade house-made.
b. In the next growing season, the second trial was carried out by conducting artificial pollination. The room's success was seen from the success of fertilization after artificial pollination was carried out.

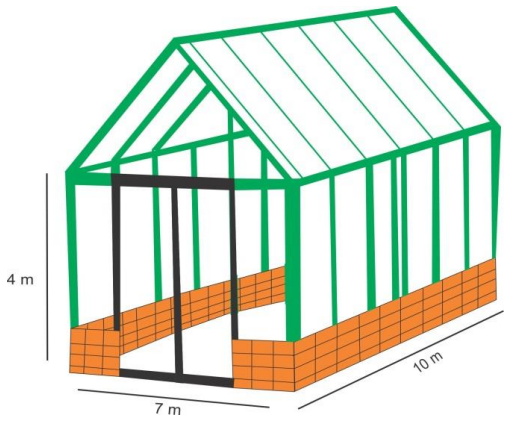


Figure 1. Netting House building design

3. Result And Discussion

A netting house is interpreted as a net house because the building is net and see-through. Along with the development, other materials such as plastic, paranet, and fiberglass were found, so the name became a plant house. A netting house can be defined as a building with a roof and walls made of nets with a light steel frame. In the research carried out, netting houses are used as a means for breeding rice plants by providing an environment suitable for the agro-climate. The roof of the netting house deliberately does not use a plastic top so that rice plants can meet their water needs when it rains. When the experiment was conducted, the air temperature and the duration of irradiation in the netting house did not interfere with rice plants' growth. Rice planting is done on bucket media. Height Air temperature and irradiation time can cause a shortage of water in the media due to evaporation at the soil surface. There are several obstacles when it rains; pollinating is complicated during high rainfall. During the flowering phase, especially during pollination, high rainfall will cause wet pollen due to rainwater, so that the pollination process will be disrupted (Purnomo, 2016).

The advantage of using a netting house application is the length of irradiation and the intensity of light according to the needs of the rice plant. Extended irradiation can affect the flowering process. In the research of Warner and John (2003), the application of 8 hours irradiation on Rhododendron plants will increase the number of flower initiations.

Figure 2. The appearance of the netting house

Figure 3. Rice plants in the netting house

Rice plants in the netting house are tall and short because of the influence of the climate. Suprihatno's research (2010) stated that climatic and weather factors could cause the characteristics of plant height that have a short size.

4. Conclusion

They are netting House provides good growth space during practicum and research. Pest attacks are still there but not as intensive as rice in paddy fields in general. Pest and disease control is easier to do in the netting house. The netting house will be better if you add Smart farming technology to determine each plant's temperature, humidity, and fertilizer needs.

5. Acknowledgment

We want to thank the Lampung State Polytechnic, which has funded the implementation of PKM through the 2021 DIPA funds, and the Polinela Research and Community Service Unit (UPPM), which has helped carry out Community Service so that it can run smoothly.

References

[1] Adimiharja, J., J. Kartahadimaja, and EE Syuriani. 2016. Agronomic character and yield potential of rice segregant (Oryza sativa L.) formed in the third generation (F3). Journal of Applied Agriculture. 17(1):33-39.

[2] Purnomo, E. 2016. Effect of Concentration of Administration of Growth Regulatory Substances Gebberellins on Production of Rice Seed (Oryza sativa L.) Established Hybrid P05 PT Primasid Andalan Utama in the rice fields of Kaliglagah Hamlet, Kalibeji Village, Tuntang District, Semarang Regency. Salatiga: Satya Wacana Christian University.

[3] Warner, RM, and EE John. 2003. Effect of photoperiod and daily light integral on flowering of five Hibicus sp. Scientia Horticulturee. 97(3): 341-351.This reference has two entries but the second one is not numbered (it uses the ‘Reference (no number)’ style.

Energy Efficiency of Clean Water and Performance of Laboratory Equipment With the Utilization of Air Conditioning Flue Water Circulation System

Subandi and Sukiyadi

Lampung State Polytechnic Jl. Soekarno-Hatta Rajabasa, Bandar Lampung, Postal Code 35144

*E-mail: subandi@polinela.ac.id

Abstract. In this case, with clean water in Indonesia, energy reserves are increasing day by day shrink. This is also exacerbated by wastage in its use; On the other hand, clean water is still often used excessively tends to be wasted. Let's look carefully at some government agencies that still encounter wasteful practices. The use of clean water is usually found in several leaky faucets in the room, office showers, ablution places, and toilets and sinks in water laboratories flow is wasted. Laboratory equipment that requires groundwater that flows continuously as long as the equipment is operating is one of the practices of wasting energy, clean water. Besides that, it has the potential moss growth and movement of the heating plate occurs.

1. Introduction

Energy Efficiency is an effort to conserve energy. According to Government Regulation No. 70 of 2009 concerning Energy Conservation, what is meant by energy conservation is a systematic, planned, and integrated effort to conserve domestic energy resources and increase the efficiency of their utilization. Energy efficiency is a general term that refers to using less energy to produce the same amount of valuable services or output using energy as effectively and efficiently as possible.

There is a need for public awareness of energy conservation so that efficient and efficient habits are formed in using energy entrenched in the future. There are many ways to save energy, including saving water. Energy efficiency, including water efficiency, is one solution to overcome the energy crisis and reduce the environmental damage that can occur. There are many ways to save water, including limiting its use. Even though this water is a renewable resource, it turns out that this resource cannot be renewed for clean water. (Madonna S. 2014).

The quality of water used for daily needs for humans is water that meets clean water criteria. Clean water is water that can be used for everyday needs whose quality meets health requirements and can be drunk when cooked. What is called drinking water is water that has gone through a processing or processing stage that meets health requirements and is consumed immediately. Health requirements for drinking and clean water include bacteriological, chemical, and physical conditions. (Waluyo, 2009).

The criteria for the quality of water used for human life are different from the criteria for water required for the industrial world. Industrial raw water treatment is the main activity of various industrial processes, including heating. A water heater is a device used to heat water that uses energy as a heating source, namely electricity, gas, or the sun. Of the three types of energy sources used, electrical energy is more widely used because it is more practical in its use and installation. Inadequate water treatment

procedures can have a significant adverse impact on the process and the quality of the final product; the surfaces of pipes and vessels may suffer corrosion and scale or rust. The scale is an oxide layer of inorganic compounds that settles and forms crystal deposits on the surface of a substrate. The process of crust formation is the result of hydrodynamic and thermal conditions in a system or the result of chemical kinetics, thermodynamic conditions, and chemical properties of substances such as alkaline, calcium, chloride, sulfate, nitrate, iron, zinc, copper, phosphate, or aluminum which are affected by various factors such as water content, supersaturated solution conditions, water rate, temperature, type and type of impurity, number of inhibitors to absorb ions, calcium index level, pH, and other factors. (Merdah & Yassin, 2007). thermodynamic state and chemical properties such as alkaline, calcium, chloride, sulfate, nitrate, iron, zinc, copper, phosphate, or aluminum which are influenced by various factors such as water content, supersaturated solution conditions, water rate, temperature, type, and the type of impurity, the amount of inhibitor to absorb ions, the level of calcium index, pH, and other factors. (Merdah & Yassin, 2007). thermodynamic state and chemical properties such as alkaline, calcium, chloride, sulfate, nitrate, iron, zinc, copper, phosphate, or aluminum which are influenced by various factors such as water content, supersaturated solution conditions, water rate, temperature, type, and the type of impurity, the amount of inhibitor to absorb ions, the level of calcium index, pH, and other factors. (Merdah & Yassin, 2007).

In the water purification process, the goal is to soften the water or remove the mineral content. The water will be softened by using a kind of resin that contains a charge of Na+ cations which will bind Ca2+ and Mg2+ ions more strongly than the Na+ bonds in the wax. When water passes through the resin, Ca2+ and Mg2+ ions will be bound by the resin, and Na+ ions will be released, making the water more 'soft.' If all the mineral content in the water is to be removed, the water will be passed through a resin containing an H+ charge and through a second resin containing an OH- charge. The H+ and OH- ions will react and will produce more water. The result of this process is mineral-free water.

Incoming raw water contains hardness, silica, alkalinity, and oxygen, all of which can harm evaporation. These components must be handled effectively to protect the heat exchanger lining from scale and corrosion. (Rahayu 2019). AC exhaust water results from the condensation process from the air in a room; thus, it has Physico-chemical properties and characteristics almost the same as distilled water. The results of the study obtained that the pH measurement data for Aquadest was 6.85; AC Water 6.64, negative Aquadest Mineral Qualitative Test, damaging AC Water, buoyant Faucet Water, Aquadest Absorbance Test 0.001, AC Water 0.006, Faucet Water 0. 374 Thus, AC wastewater which is managed in such a way can be used as a substitute for distilled water and maintain laboratory equipment to save on lab costs and maintenance of laboratory equipment. (Subandi, 2018).

In this study, the authors will use air conditioning wastewater from previous research as feeder water for the heating chamber and at the same time as a cooler for extraction and distillation equipment in the laboratory with the circulation method, by utilizing a water aspirator equipped with a controlled water pump so that the water flow rate can be adjusted later. Water circulates from the water aspirator to the cooling pipe and then back to the water aspirator. To control the temperature of the cooling water, a thermometer is installed. To cool the water, a water cooler is prepared with increased water temperature. Thus it can reduce the use of clean water and can avoid damage to laboratory equipment.

2. Methods

2.1. Cleaning of cooling ducts/pipes and heating plates.

Cleaning the cooling channel/pipe (Condenser). The first step of the research process is to clean the cooling tube (Condenser) on the dirty Sohlet on the inside through which the cooling water flows. The cleaning step for this cooling pipe is to remove one by one from the Soxhlet apparatus, then the spiral tube is filled with a dilute NaOH solution and then allowed to stand for 3 to 5 hours; this is intended to clean the moss and deposits that stick to it. The inside of the pipe is then washed using clean water flowing into the tube at high flow speed so that the moss and dirt in the line fall out and are carried away by the flow of water. Next, the clean cooling pipe (Condenser) is reassembled on the Soxhlet device.

It was cleaning the water heater room (Water heater). The water heater in the Soxhlet is cylindrical made of glass in which there is a pair of electrodes made of stainless steel. The cleaning step is to fill the heating chamber with a dilute NaOH solution and then let it stand for 3 to 5 hours; this is intended to clean rust and scale attached to the electrodes, then wash using clean water flowing into the heating chamber with a high flow speed so that rust and scale that sticks to the electrodes fall out and are carried away by the flow of water so that the heating chamber becomes clean.

2.2. Installation of the circuit for cooling water circulation

A tub made of fiber with a capacity of 20 liters is equipped with a pump to drain water and a thermometer to control the temperature of the water used; an elastic-plastic hose is installed to drain the cooling water. Some of the flowing water is used as a steam feeder to be heated as a producer of heat energy. . Furthermore, the exhaust pipe from the cooler is connected to an elastic-plastic hose so that the water is used for the cooling process flows back from the cooling tube to the reservoir.

2.3. Operation of the appliance with exhaust water AC circulation system

After ensuring that the cooling duct pipe and heating room are clean, the tool is appropriately and properly connected. Then the tub is filled with AC wastewater from the reservoir by measuring to determine the initial volume, and then the water pump is turned on so that the water is pushed into the hose leading to the drain. Heating chamber (Steam) and cooling chamber (Condensor) until it flows back into the reservoir and then ensures no leaks.

The experiment in this study was designed to obtain data on the amount of AC waste water used during the extraction process, the impact of using AC waste water on the cooling pipe, and the impact of using AC wastewater on the heater plate and heating room (Steam). The experiment was carried out by:

a. To obtain data on the amount of AC wastewater used during the extraction process. The tool (Soxhlet) is turned on for the extraction experiment for 3 or 4 hours, periodically checking the thermometer as a water temperature indicator. Suppose there is an increase in water temperature. In that case, the effort to stabilize the water temperature is by inserting the Cool pack into the water bath to stabilize the temperature by room temperature. After the extraction experiment was completed, the Soxhlet was turned off and then measured the AC waste water, which was used to obtain data on the reduction (shrinkage) of water used in heating in the heating room (Steam). This experiment was repeated several times for the extraction process.
b. The impact of air conditioning wastewater on the cooling pipe. The tool (Soxhlet) is turned on for the extraction experiment for 3 or 4 hours; after the extraction process is complete, the Soxhlet and the water pump are turned off but make sure the water in the cooling pipe does not come out (still soaking) the cooling tube. This experiment was repeated several times for the extraction process.

The impact of air conditioning wastewater on the heating plate (heater) and the heating room (steam). The tool (Soxhlet) is turned on for the extraction experiment for 3 or 4 hours. After the extraction process is complete, the Soxhlet and the water pump are turned off, but it is ensured that the water in the heating chamber (Steam) does not come out (still soaking) the heating plate (Heater). This experiment was carried out several times. Repetitions for the extraction process.

3. Result And Discussion

After testing, it is continued with observations which include:

a. Amount of AC wastewater used during the extraction process.
b. Condition of the cooling pipe, is there any sediment and signs? Moss growth?
c. Conditions in the heating room (steam) and the heating plate (heater), whether the water is cloudy and there are deposits in the heating chamber (steam), and there are signs of crusting on the heating plate (heater)?

From the observations obtained the following data:
a. Amount of AC wastewater used during the extraction trial is as much as 20.15 liters.
b. The cooling pipe on the Soxhlet device looks clean and doesn't grow moss and dirt deposits.
c. The heating chamber and heating plate are clean. There are no deposits attached and no signs of rust.

The extraction trial process took 3 hours (according to the shortest time in the extraction process), that is, according to the capacity of the tub chamber volume was 20 liters, in the first 1 hour trial, the water volume was still constant, and the temperature was relatively stable. Still, starting from more than The first 1 hour, the water began to look a little less, this was because some of the water went into the steam heater to heat the hot steam as a fat flask heater to boil the extraction solvent, so that the volume of water decreased during the trial process (3 hours) which was 150 ml. Furthermore, the water temperature in the reservoir has increased several degrees from room temperature. This is because the water flowing in the cooling pipe above the extraction flask is in contact with hot air from the solvent vapor, so the longer it is in connection with the hot steam, the water temperature increases. Because the function of the AC wastewater here is not only as a steam feeder but also as a coolant, so that cooling runs well and efficiently, the water temperature must be kept cold stable. In implementing this test, we applied it by giving ice cubes to the water reservoir and cooling and increasing the volume of water that is decreasing. With the general method, when the tool is operated, the water flow rate used is generally 2.4 liters/minute, so if the device is tested and worked for 3 hours, it consumes 432 liters of water.

The cooling pipe on the Soxhlet apparatus is made of glass that forms a spiral circle inside a glass tube, with a spiral diameter of about 5 mm and a cooling glass tube diameter of about 5 cm and a pipe hole of about 2.5 mm in diameter, with helical pipe conditions in such a complicated way that it can be it is said that this cooling pipe is a tool that is very vulnerable to breakage, easy to get dirty and difficult to clean, so it needs special attention in its operation and maintenance, for that, it is necessary to use clean water with low ions and low hardness. With the use of AC wastewater during the trial process up to several months after the trial, the cooling pipe still looks clean. There is no growth of moss and deposits attached to the pipe surface.

The heating chamber in the Soxhlet device is a place to produce steam which is then flowed to heat the fat cup so that the solvent evaporates. Inside the heating room, there are a pair of heating plates (heater), a couple of containers that carry electricity when filled with water then a healing process occurs. If the water used for heating contains minerals, there will be movement on the surface of the plate, and the longer the buildup occurs, it will interfere with the tool's performance. In trials using AC wastewater that is low in ions and free from minerals, the heating chamber and heating plate appear clean. There are no signs of rust, and no deposits occur.

4. Conclusion

From the research results above, it can be concluded that with the circulation method, the efficiency of saving the use of clean water is 410.5 during the operation of the tool with a time of 3 hours. There is no growth of moss and deposits adhering to the surface of the pipe, and the cooling line still looks clean. There are no signs of rust and no assurances on the heating plate so that the tool's performance can be maintained.

5. Acknowledgment

We want to thank the Lampung State Polytechnic, which has funded the implementation of PKM through the 2021 DIPA funds, and the Polinela Research and Community Service Unit (UPPM), which has helped carry out Community Service so that it can run smoothly.

References

[1] Anonymous. (2008). Government Regulation Number 42 of 2008 concerning Management of Water Resources.

[2] Anonymous. (2009). Government Regulation of the Republic of Indonesia Number 70 of 2009 concerning Energy Conservation.

[3] Anonymous. (2010) Permenkes RI number 492/Menkes/Per/IV/2010 concerning the chemical requirements for clean water.

[4] Anonymous. (2011). Presidential Instruction of the Republic of Indonesia Number 13 of 2011 concerning Energy and Water Saving.

[5] Anonymous. (2012). Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia Number 15 of 2012 concerning Conserving Groundwater Use.

[6] Anonymous. (2017). Big Indonesian Dictionary (KBBI). Available from : (https://kbbi.web.id/komitmen) http://repository.poltekkes-denpasar.ac.id/333/4/BAB%20II.pdf

[7] Madonna S. (2014). Energy Efficiency Through Saving Water Use . Journal of Civil Engineering, VoL. 12, No. 4,

[8] Oktavianto A. (2014). EVALUATION OF DRINKING WATER SOURCES SAFETY IN MOJO VILLAGE, PADANG DISTRICT, REGENCY

[9] LUMAJANG Journal of Agrotechnology Vol. 08 No. 02 Rahayu (2019). Analysis of pH and Total Hardness in Boiler Feed Water at PMKS PT. SISIRAU Aceh Tamiang. Journal of Science and Applied Chemistry Volume 1, Number 1

[10] Rokhandi Z. (2017). Journal of Electrical Technology, Mercu Buana University ISSN: 2086-9479. Vol. 8 No. 3

[11] Subandi (2018). AC Wastewater Production as a Substitute for AquadesTo Save Practicum Costs And Laboratory Equipment Maintenance. Research Report.

[12] Sutandi. M C. (2012) CLEAN WATER RESEARCH AT PT. SUMMIT PLAST CIKARANG Journal of Civil Engineering Volume 8 Number 2.

[13] Yudo S. (2018). Efforts to Save Clean Water in Office Buildings Case Study : Water Saving in BPPT Office Building. Journal of Environmental Technology Vol. 19, No. 1.

[14] Zuwina Miraza (2019) Analysis of Economic Value Added (EVA) in Assessing the Company's Financial Performance at PT. Indosat Tbk. Thesis USU Medan.

Manufacturing of Aluminum Metal Smelting Furnaces with LPG Gas Fuel to Support Student Practicums

Subarjo, Triwidodo, and Feni Setiawan

Education Laboratory Institution of Agricultural Mechanization Study Program, Department of Technology

*E-mail: subarjo@polinela.ac.id

Abstract. Work in aluminum metal casting includes several stages: preparation of raw materials, mold making, smelting process, the casting of castings, dismantling, cleaning, and inspection of castings. Students are ready to compete in the industrial world or entrepreneurship with these hands-on skills. To achieve this goal, the Polytechnic provides adequate learning and practice experiences to form professional abilities in science and technology. Competence in one field, for example, in material knowledge (metal casting). Because the tools for the metal smelting process are not available yet, this research aims to design and manufacture an aluminum smelting furnace fueled by LPG gas, which can also be helpful and contribute to the process of making aluminum metal smelting furnaces. The test results show that the aluminum metal smelting furnace with LPG gas fuel and aluminum metal raw materials for motorcycle brake canvas can operate and work well. The need for LPG gas fuel to melt aluminum canvas motorcycle waste material is 0.6 to 1 kg. The temperature required to melt aluminum metal is 658 °C to 784 °bC with a melting time of 10 to 18 minutes. The maximum capacity that can be smelted raw materials is 1000 grams.

1. Introduction

Aluminum metal is found in many homes as a material for pots, soft drink bottle caps, and milk can lids, and so on. Aluminum is also used to coat electronic equipment such as compact discs and car lights. Quality and competitive aluminum casting work will produce good aluminum to compete in the increasingly stringent metal industry. Work in aluminum metal casting includes several stages: raw material preparation, mold making, smelting process, casting castings, demolition, cleaning, and inspection of castings.

Aluminum can be forged into sheets, drawn into wire, and extruded into bars of various cross-sections. In addition, aluminum is also resistant to corrosion. Aluminum is used in many ways, generally used in high-voltage cables. In addition, it is also used in window frames and airframes.

The development of industry in Indonesia makes the need for the metal industry to increase. One of them is the aluminum metal industry as a substitute for non-ferrous metals. Aluminum is soft, light, and a good conductor of electricity and heat. Various efforts have been made to assist entrepreneurs in the non-ferrous metal foundry industry, especially aluminum, by developing furnaces or furnaces for smelting. The development of the furnace/kitchen is generally carried out to improve the furnace's performance so that its combustion efficiency can be increased.

The smelting process is melting the material (cast iron) by heating it in a smelting furnace; after the material has melted, it is poured into a mold (Arifin, 1976). In the aluminum smelting process, a crucible-type furnace is used. The Crucible kitchen is the oldest used kitchen. This kitchen is the most

straightforward construction and uses a fixed position where the molten metal is taken using a ladle or dipper. This kitchen is very versatile and versatile for minor and medium-scale melting. Krusibel's kitchen is in the form of a pot made of clay mixed with sand. According to fuel, there are three kinds of crucibles: gas, oil, and coke. The burning rate of used fuel oil is the same as that of a used oil-fueled smelting furnace (Palace & Lukman, 2016).

Some of the aluminum smelting furnaces that have been developed include gas-fired furnaces reported by (Sundari 2011). The stove or kitchen designed is a crucible kitchen with LPG gas fuel in the form of a cylinder with a diameter of 220 mm and a height of 300 mm with a capacity of 30 kg. The test results show that it takes 1 hour 37 minutes to smelt aluminum scrap weighing 30 kg, and the fuel used is 3.60 kg. The results of previous studies also designed a crucible furnace with LPG gas fuel to work well(Irvan & Suryadi, 2017).

The metal industry, especially metal casting, has a significant role in supporting current development. Furnace/kitchen is needed for the smelting process of non-ferrous metals, especially aluminum. Casting is one of the most critical areas of expertise and must be mastered by students, especially students of Agricultural Mechanization. In the subject of knowledge of engineering materials, technical material lectures are only limited to theory, so competence is lacking in mastering skills in casting, especially metal casting. With skills and direct practice in the field, students will be able to explore or add insight to be ready to work in industry or entrepreneurship. In terms of completeness of the Laboratory, Metal and Automotive do not yet have this equipment, with skills and direct practice in the field, students will explore or add insight to be ready to work in the industrial world or entrepreneurship.

The smelting process is melting the material (cast iron) by heating it in a smelting furnace; after the material has melted, it is poured into a mold. (Arifin, 1976). In the aluminum smelting process, a crucible-type furnace is used. This kitchen has a straightforward construction and uses a fixed position where the molten metal is taken using a ladle or dipper. This kitchen is very versatile and versatile for minor and medium-scale melting. According to fuel, there are three kinds of crucibles: gas, oil, and coke. Krusibel Kitchen with coke fuel is rarely used because it is less efficient.

From the test results of the aluminum smelting furnace, it is known that the furnace designed can melt aluminum scrap on average 2.5 kg per hour with a fuel-burning rate of 3.25 per hour. This means that the fuel requirement for smelting aluminum is 1.3 kg of fuel per kg of aluminum scrap. The burning rate of this fuel is smaller than that of diesel-fueled smelting furnaces, which reach 1.4 liters per kg of aluminum scrap, smelting furnaces fueled by used oil, which comes 1.5 liters per kg of aluminum scrap and kerosene-fueled smelters. which reaches 1.6 liters per kg of aluminum scrap (Sudjana, 2008)

Polytechnic is a professional education directed at the readiness to apply specific skills. To achieve this goal, the Polytechnic provides adequate learning and practice experiences to form professional abilities in science and technology. Competence in one field, for example, in material knowledge, especially metal casting. So students are required to do metal casting, one of which is aluminum metal. In contrast, the tools for the metal smelting process are not yet available, both simple tools and more modern tools. So based on these problems, we will make a simple aluminum metal casting (smelting) device so that the learning activities of engineering material knowledge can be achieved. With this metal smelting furnace, students are expected to have competence in metal smelting in general and aluminum. In addition to practicum mechanical technology for CNC Milling machines.

This research aims to design and manufacture an aluminum metal smelting furnace with LPG gas and to analyze the melting capacity, melting temperature, and melting time of aluminum. This research is expected to provide benefits and contribute to knowledge about making crucible furnaces and metal smelting processes, especially aluminum..

2. Methodes

2.1. Tool Design.

The design planning was blinded based on the tool specification data carried out in the literature study. At this stage, the output was a tool planning drawing.

2.2. Tool Making.

The manufacture of the tool is carried out based on the design drawings obtained, using the materials and equipment provided. The manufacture is carried out first by making the outer wall of the furnace with a diameter of 30 cm and an inner diameter of 15 cm and a height of 30 cm, materials from a plate, cauldron/power with size 10 cm, height 25 cm,(Meilana, 2018)In planning this smelting furnace will be made as follows:Result And Discussion

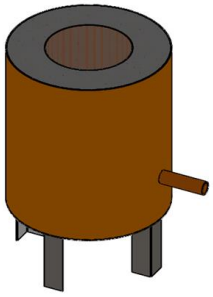


Figure 1. Aluminum smelting furnace/furnace

2.3. Crucible furnace/furnace.

Crucible kitchen is the oldest used kitchen. This kitchen is the most straightforward construction. Krusibel has a function as a kitchen where aluminum melts. Krusibel is made using low carbon steel material with 300 mm in diameter, 300 mm in height, and 3 mm in thickness. The crucible design that will be made can be seen in Figure 1.

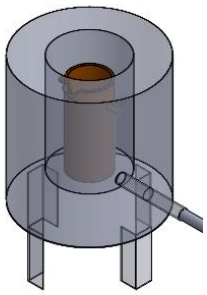


Figure 2. Furnace wall/blanket

2.4. Furnace Wall.

The material used to make the furnace walls is a steel plate with a thickness of 1.2 mm, which is rolled with an outer diameter of 300 mm, and an inner diameter of 153 mm with an overall height of 300 mm, and between the outer and inner walls is filled with refractory cement. The furnace wall design that has been made can be seen in Figure 3. (Rachmat & Sulaeman, 2020).

Figure 3. Kowie/material smelting cauldron

2.5. Kowei/cauldron.

This Kowei is a place for cooking/melting material with a diameter of 100mm and a height of 250mm. The aluminum material for motorcycle brake canvas waste is inserted into the Kowei and then heated until it melts, as shown in Figure 3.

2.6. Furnace Testing.

The smelting furnace was tested three times using scrap aluminum as the material to be smelted and LPG gas as fuel. The test steps are as follows:

1. Prepare the smelting furnace with its equipment, energy, and smelting material;
2. Taking temperature measurements with an infrared laser thermometer to be used as a benchmark for the initial temperature;
3. To measure the initial weight of LPG gas fuel before it is turned on;
4. To calculate the importance of the waste aluminum material, motorcycle brake canvas shoes (waste) to be melted down, then put into a cauldron/crucible;
5. Igniting the fire is then followed by the ignition of the blower to raise the temperature faster;
6. Perform temperature measurements at each stage for 2 minutes;
7. Measure the temperature at which the material begins to melt;
8. Stir while removing the existing dirt;
9. After the material is melted, wait until the pouring temperature (700 0C)
10. Prepare the mold;
11. Lift the crucible and pour the melted material into the mold carefully, but it must not stop. It must continue until the material runs out (Palace & Lukman, 2016).

Observation Parameter; Material volume; Fuel requirements (LPG); and temperature every 2 minutes until the material melts

3. Results amd Discussion

Design Process. The design is carried out based on the plan drawings, the dimensions of the material are adjusted to what is planned. The results of the invention are shown in Figure 5. Furthermore, the performance test of the furnace is carried out, starting from the weight of the material 250 gr, 500 gr, 750 gr, and 1000 gr. Temperature changes were recorded every 2 minutes, and the results were obtained as shown in table 3. The table shows that in less than 15 minutes, the temperature has reached above 600 °C. In the performance test of the initial weight of 250 gr, the material begins to melt at a temperature of 675 °C with a time of 8 minutes and is aged into a mold at a temperature of 707 °C with a time of 10 minutes. For material weights of 500 gr, 750 gr, and 1000 gr, it begins to melt at 705, 688, 705 °C, respectively.

Table 1. Measurement of time and temperature for different quantities of materials

Time (min)	250 (g)	500 (gr)	750 (gr)	1000 (g)
0	32	46	58	100

2	360	450	320	320
4	385	532	360	380
6	490	600	430	430
8	675	625	460	460
10	707	653	570	470
12		705	610	600
14		752	688	658
16			710	705
18				784

There is a difference in the melting point of each of these performance tests due to differences in the material being melted down because it comes from various brands and types of motorcycle canvas waste. It can also be seen that dirt and other metal mixtures affect the melting temperature and time, as shown in Table 1.

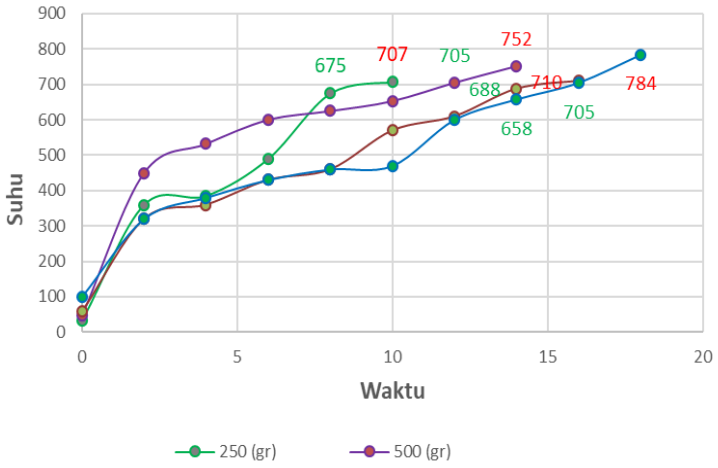


Figure 4. Graph of Melting temperature and time at volume 250, 500, 750 and 1000 grams of waste aluminum metal

Figure 4. shows a very rapid increase in temperature that occurs in the early minutes before the ingredients are put into the cauldron/kowie. The heat propagation possibly influences this from the furnace to the kowie, and there is no obstacle. Still, after the material is put into the kowie, there is a slight slowdown in the increase in temperature. Because the energy is absorbed into the material to be smelted, from the graph, it can also be seen that it takes the least time to melt 250gr of fabric (8 minutes) and the longest time to melt 1000gr of material (16 minutes).

The smelting furnace performance test results show that to smelt 250gr aluminum (waste) material, 0.6kg of LPG gas is needed, 0.8 kilograms of 500gr of LGP is needed, 750gr and 1000gr of LPG are 1.0 kilograms needed. From these data, it can be seen that to smelt 750gr and 1000gr materials, we need the same LPG, which is 1.0 kg. This shows that the more material we melt, the less LPG is required. This is possible because the smelting furnace room is already conditioned to heat. With the addition of the melted material, only a slight effect on the decrease in temperature is shown in Figure 5.

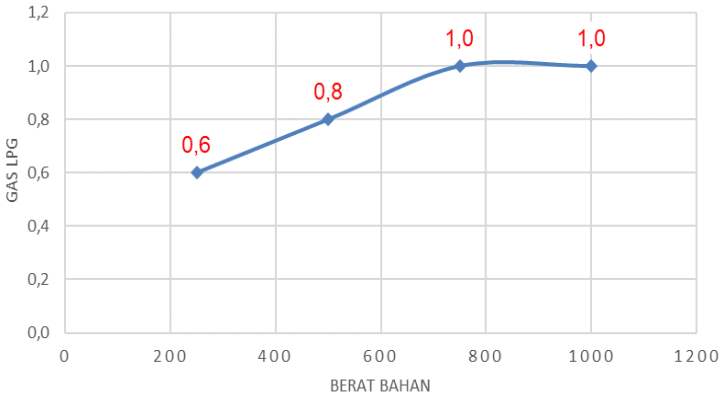


Figure 5. Graph of LPG gas consumption on the melted/melted material

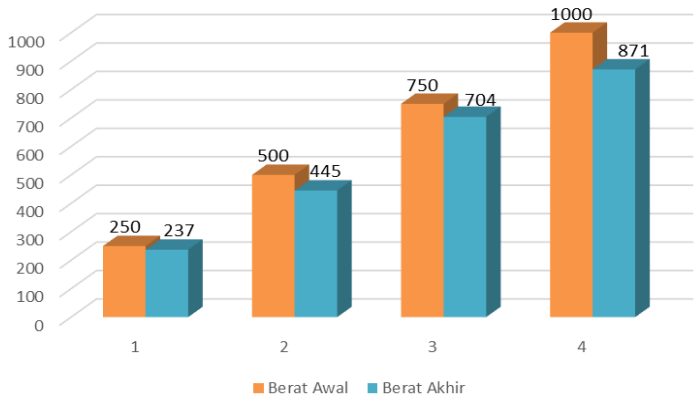


Figure 6. Graph of depreciation of raw materials into materials after being smelted/melted

The performance test results can also be seen in the yield of each tested material (figure 6.). The percentage yield of the tested materials was 94.80%, respectively; 89.00%; 93.87%, and 87.10%. The performance test results of the highest product were on a fabric with a weight of 250gr, and the average product was 91.19%.

The results of the furnace design and performance test, the specifications of this smelting furnace are 30 cm high furnace, 30 cm outer diameter, 7.38 cm furnace wall thickness, 4560 cm3 combustion chamber volume, the capacity of the cauldron/kowie 1963, 5 cm3 and a temperature of 848 °C. The test results with the waste material of the motorcycle brake canvas can accommodate 1000 grams of material by reducing the size of one canvas and cutting it into two parts.

4. Conclusion

The results of the aluminum smelting furnace's design and performance test can be concluded as follows: (1) Aluminum metal smelting furnace with LPG gas fuel and aluminum metal raw materials for motorcycle brake canvas can operate and work well.; (2) The need for LPG gas fuel to melt aluminum canvas motorcycle waste material is 0.6 to 1 kg. ; (3) The temperature required to melt aluminum metal is 658 °C to 784 °C with a melting time of 10 to 18 minutes.; and (4) The maximum capacity that can be smelted raw materials is 1000 grams.

References

[1] Arifin, S. (1976). Metal Science (Volume 1). Indonesian Ghalia.

[2] Irvan, A., & Suryadi. (2017). Gas-Fired Metal Smelting System For Small And Medium Industries. Elektra Journal, 2(1), 50–57. https://pei.e-journal.id/jea/article/view/20

[3] Istana, B., & Lukman, J. (2016). Design and Test of Aluminum Smelting Furnaces Fueled by Used Oil. Surya Teknika Journal, 2(04), 10–14. https://doi.org/10.37859/jst.v2i04.42

[4] Meilana, E. (2018). The design and manufacture of crucible furnaces for smelting aluminum with gas fuel and the process of observing the stove and the casting test process using black sand molds with variations in pouring distance. Muhammadiyah Surakarta.

[5] Rachmat, A., & Sulaeman, M. (2020). Making aluminum smelting furnace by utilizing coconut shell waste as fuel. Incitec Journal, 07(01), 491–499.

[6] Sudjana, H. (2008). Casting Technique Volume 1 for SMK (1 (ed.)). Directorate of Vocational High School Development.

[7] Sundari, E. (2011). Design and build a gas-fuel aluminum smelting kitchen—Journal of Austenite, 3(April).

[8] Yahya, A. (2017). The Design Of Used Metal Melting Furnaces (Non-Ferro) With A Capacity Of 5 Kg Using Lpg Gas Fuel. Mechanical Engineering Study Program, Faculty of Engineering, Universitas Nusantara Pgri Kediri 2017, 01(08).

Increasing Vase Life and Quality of Dendrobium Cut Flowers using Aluminum Sulfate $Al_2(So4)_3$ and Sugar Solution

Yusanto*, R.B. Nugroho. and Septiana

[1]Politeknik Negeri Lampung

*e-mail: yusanto@polinela.ac.id

Abstract. Orchids, especially Dendrobium is a famous ornamental plant that has various flower diversity i.e. size, shape, and color. For decorative use like the display of vases and bouquets, Dendrobium cut flowers are one that consumers are interested in. This study aimed to identify the best preservative solution that can prolong vase life and the quality of Dendrobium orchid cut flowers. This study was conducted in a Floriculture rearranged in Randomized Complete Block Design (RCBD) with two factors, repeated three times. The factor I is the concentration of aluminum sulfate which consists of 4 levels: AL 0 ppm, AL 200 ppm, AL 400 ppm, and AL 600 ppm; followed with factor II is the concentration of sugar which consists of 4 levels: G 0%, G 2%, G 4%, and G 6%. Dendrobium cut flower had longest vase life (48 days) with less withered bud in 2% sugar with 200 ppm aluminum sulfate medium. 2% sugar with 200 ppm aluminum sulfate also showed the most absorbed solution which indicated that formulation was the most suitable medium for Dendrobium cut flowers. Replacing the fresh solution of 2% sugar with 200 ppm aluminum sulfate every month we guess can prolong the vase life and need to be tested in further study.

1. Introduction

Orchids are the largest family of flowering plants with 25,000 to 35,000 species belonging to 600 to 800 genera [1]. They are valued for their extraordinary diversity in size, shape, and color as well as their distinctive flower appeal and their high maintenance quality for up to 10 weeks. The world's orchids cut flowers trade mostly consists of 85% of the genus Dendrobium and 15% of the genera Phalaenopsis and Cymbidium, predominantly supplied from Asia [2]. Orchids cut flowers are flowers or buds that have been cut from the plant for decorative use like the display of vases and bouquets.

Dendrobium orchids are widely used in flower arrangements because of their relatively long vase life, varied flower colors and shapes, flexible flower stalk that is easy to assemble, and high productivity. The longevity of vase life of orchids cut flowers is greatly influenced by post-harvest treatment or handling. Extending vase life is an important fact-based on consumer preferences which have been optimized by several previous studies [3]. Adding chemical preservatives is a common practice for cut flowers storage [4].

Vase life of cut flowers depends on internal factors like genetic, food reserve (carbohydrates, proteins, and fats), water content, plant health, etc; and also external factors like humidity, light, and temperature. According to [5], the quality decrease of cut flowers is caused by respiration and transpiration as well as loss of food reserve during the shelf life, therefore it needs some efforts to preserve cut flowers quality.

Provision of a refreshing solution to cut flowers, better known as the preservative solution can be applied by soaking flower stalk in preservative solution with an interval of 2 – 24 hours immediately after harvest to maintain the freshness of cut flowers [3]. Generally, the preservative solution contains carbohydrates as an energy source combined with a germicide.

Carbohydrate is a major food reserve that functionally as photosynthetic precursors needed for growth, inhaled substrates, osmoregulatory, and osmoprotectants. In addition, carbohydrates can act as cellular signals by controlling gene expression. Sugar added to the preservative solution can prolong vase life in some cut flowers like *Liatris spicata* (L.) because it can maintain the respiration rate of floral tissues [6, 7].

In addition to sugar as a source of carbohydrates, the preservative solution needs to contain germicide as an anti-microbial agent. Some micro-organisms can produce ethylene or toxins that potentially reduce the quality and vase life of cut flowers. The presence of bacteria at the base of the stem will decrease the absorption of plant stems and interfere plant metabolism [8, 9]. There are several common germicide options, such as silver nitrate, hydroquinone, silver thiosulfate, and aluminum sulfate [10, 11, 12].

Previous studies reported that aluminum sulfate (Al2(SO4)3) could extend the freshness and vase life of some cut flowers like Lisianthus and also for foliage [13, 14, 3]. Besides anti-microbial agent in preservative solutions, aluminum sulfate also maintained the moisture content and reduced transpirational losses through stomata regulation [14]. This study aimed to identify the best preservative solution that can prolong vase life and quality of Dendrobium orchid cut flowers.

2. Method

This experiment was arranged in Randomized Complete Block Design (RCBD) with two factors. Factor I is the concentration of aluminum sulfate which consists of 4 levels: AL 0 ppm, AL 200 ppm, AL 400 ppm, and AL 600 ppm. Factor II is the concentration of sugar which consists of 4 levels: G 0%, G 2%, G 4%, and G 6%. Each treatment was repeated three times so that 48 experimental units were obtained. The data were analyzed for variance and we used LSD test at a level of 0.05 for advanced analysis [15].

2.1. Maintenance of orchids as broodstock

Research material had a uniform flower size and flowering time also free from disease. We used 2 g per liter of Growmore leaf fertilizer (high P and K content) plus 2 ml/l vitamins MS given twice a week and flower inducers containing BA/TDZ were given once a week. Spraying 2 g/l insecticide applied every 2 weeks.

2.2. Harvesting flowering plants

Flowers picked at 75% bloom, have 8 – 10 flowers, and healthy plants. Harvesting was done by cutting the ends of the flower stalks carefully using a sharp, clean and sterile cutter. To remove air bubbles, the stem ends were cut back under tap water to produce a peduncle about 12 cm from the lowest open floret.

2.3. Treatment and storage

The treatment solution was put into a 100 ml bottle and then the flowers were added according to the treatment, stored in the isolation space (unexposed to sunlight and water splashes). After treatment, the inflorescences were kept in a controlled environment room at 25 ± 2°C under a cool white fluorescent lamp with a relative humidity of 60 – 70%.

3. Results and Discussion

The combination of sugar with aluminum sulfate into the preservative solution showed a significant interaction for vase life, the total solution absorbed, and the percentage of withered flowers (Table 1). The longest flower freshness was 48 days after treatment, viz. 2% sugar with 200 ppm aluminum sulfate. It was 11 days longer than the control followed by less withered bud. This result relates to [16] reported

that a solution containing Al2(SO4)3, 8-HQS, and sugar was able to prolong the vase life of three different hybrid Dendrobium orchids.

Table 1. The results of vase life, absorbed volume, blossoms, and withered buds

Concentration Alumunium Sulfat (ppm)	Concentration Sugar (%)	Vase life (day)	absorbed volume (ml)	Blossoms (%)	Withered buds
0	0	37 d	23,33 c	0,71	38, 41 e
	2	39 cd	26,67 d	1,89	24,81 bc
	4	39 cd	20 b	1,05	24,93 bc
	6	37 d	21,67 bc	1	25,65 c
200	0	43 bc	23,33 c	2,65	24,93 bc
	2	48 a	26,67 d	0,67	19,00 a
	4	44 b	21,67 bc	1,67	19,53 ab
	6	43 bc	21,67 bc	1,65	22,89 bc
400	0	38 d	21,67 bc	1,38	23,01 bc
	2	46 ab	25,00 cd	1,83	19,81 ab
	4	44 b	18,33 ab	1,26	22,73 b
	6	42 bc	16,67 a	1,77	24,53 bc
600	0	40 cd	18,33 ab	1,62	32,23 d
	2	41 cd	15 a	1,38	25,73 bc
	4	42 bc	26,67 d	0,81	25,80 c
	6	40 cd	25,00 cd	1,01	31,70 d

The reason why 2% sugar with 200 ppm aluminum sulfate affected the longest vase life with less withered bud was that solution was the most absorbed compared to other treatments. The higher absorption, the more energy obtained. It indicated cut flowers fit that solution and can maximize the solution content. Instant energy from sugar prolong vase life and flowers need. It was relevant with [17] who reported that sugar is a carbon source that plays an important role in petal growth and inhibits aging. Also, flower blooms can be used as an indicator that plant tissues are still carrying out metabolic activities and they gradually wilt due to the limited supply of food reserves in plant tissues, water, and external nutrition. In addition, anti-microbial agents sourced from aluminum sulfate contribute to the free disease of cut flowers.

Adding more sugar wasn't deal longer vase life, on the contrary, it slightly reduce vase life compared to 2% sugar added. Adding a lot of sugar increase viscosity of the solution, thereby interfering with the diffusion and osmosis processes in cut flowers. [18] reported that the inhibition of the absorption of the solution causes flower wilt quickly. Also, high concentration of aluminum sulfate is unnecessary to cut flowers. It can reduce pH solution and toxic for some plants [19]. 4.8 – 5.8 is the best suitable pH medium for Dendrobium orchids [20], so that, adding a lot of aluminum sulfate potentially causes an unsuitable medium for Dendrobium orchids. That condition can reduce vase life and the number of wilt flowers.

4. Conclusions

Sugar and aluminum sulfate in preservative solution proven to prolong vase life and quality of Dendrobium cut flowers. For the specific concentration, we recommend 2% sugar with 200 ppm aluminum sulfate because it has a good result for Dendrobium cut flowers vase life, moreover the most economical treatment.

Acknowledgements

Authors thankfully acknowledge support provided by UPPM Politeknik Negeri Lampung, to conduct this research.

References

[1] Chowdhery H J 2001 Orchid diversity in north-east India *J. Orchid Soc. India* **15** 1–17

[2] De, L.C., Deb, P., Chhetri G 2015 Pre-and post-harvest physiology of Cymbidium orchids *Int. J. Hortic.* **5** 1–5

[3] Reid, M.S., Jiang C . 2012 Postharvest biology and technology of cut flowers and potted plants *Hortic. Rev. (Am. Soc. Hortic. Sci).* **40** 1–54

[4] Hajizadech E, Seifi A, Zarandi MHF T I 2012 A hybrid modeling approach for forecasting the volatility of S&P 500 index return *Expert Syst. Appl.* **39** 431–6

[5] Suyanti 2002 Teknologi Pascapanen Bunga Sedap Malam Balai Penelitian Tanaman Hias *J. Litbang Pertan.* **21**

[6] Da Silva J A T 2003 The cut flower: postharvest considerations *J. Biol. Sci.* **3** 406–442

[7] Ikram, S., Habib, U., Khalid N 2012 Effect of different potting media combinations on growth and vase life of Tuberose (Polianthes Tuberosa Linn.) *Pakistan J. Agriultural Sci.* **49** 121–125

[8] Stigter HCMD. 1981 Effects of glucose with 8- hydroxyquinoline sulfate or aluminum sulfate on the water balance of cut Sonia roses *Zeitschrift. Pflanzenphysiol* **101** 95–105

[9] Doom VWG R R 1990 Hydroxyquinoline citrate and low pH prevent vascular blockage in stems of cut rose flowers by reducting the number of bacteria *J. Am. Soc. Hortic. Sci.* **115** 979–81

[10] Yulianingsih, D. Amiarsi dan S 2000 Penggunaan Larutan Perendam dalam Menjaga Kesegaran Bunga Potong Anggrek Dendrobium Sonia Deep Pink *J. Hort.* **1** 219–24

[11] Amiarsi, D., Sjaifullah dan Y 1999 Komposisi Terbaik untuk Larutan Perendaman Bunga Anggrek Potong Dendrobium Sonia Deep Pink *J. Hort* **9** 45–51

[12] Jowkar MM, Khalighi A, Kafi M H N 2012 Evaluation of aluminium sulphate as vase solution biocide on postharvest microbial and physiological properties of 'Cherry Brandy' Rose *Ann. Biol. Res.* **3** 11–32

[13] Van doorn, W.G., Stead A D 1997 Abscission of flowers and floral parts *J. Exp. Bot.* **48** 821-–837

[14] Shigefumi Ueyama and Kazuo Ichimura 1998 Effects of 2-hydroxy-3-ionene chloride polymer on the vase life of cut rose flowers *Postharvest Biol. Technol.* **14** 65–70

[15] Fisher A R 1935 *The Design Of Experiment* (Edinburgh: Oliver And Boyd)

[16] Obsuwan, K., Changpun, W., Thongpukdee, A., Chanjirakul, K. and Thepsithar C 2013 Evaluation of tested vase solution compared to commercial vase solution on cut Dendrobium hybrids *Acta Hort.* **970** 255–60

[17] Younis A, Khan MA P M 2006 Effect of different chemicals on the vase life of cut rose flowers *Cad. Pesqui. J.* **18** 17–27

[18] DURKIN D 1979 What classroom observations reveal about reading comprehension instruction *Read. Res. Q.* **14** 481–533

[19] Seyf, M., Khalighi, A., Mostofi, Y., Naderi R 2012 Study on the effect of aluminum sulfate treatment on postharvest life of the cut rose 'Boeing' (Rosa hybrida cv. Boeing) *J. Hortic. For. Biotechnol.* **16** 128-–132

[20] Widiastoety, DS, Kartikaningrum P 2005 Pengaruh pH media terhadap pertumbuhan plantlet anggrek Dendrobium *J. Hort* **15** 18–21

READINESS OF THE LAMPUNG LOCAL FOOD AGROINDUSTRY FOR HALAL POLICY

Sudiyo*[1], Muhammad Zaini[1] and Kusmaria[1]

[1] Politeknik Negeri Lampung, Lampung, Indonesia

*e-mail: sudiyo@polinela.ac.id

Abstract. The obligations or conditions of food products traded by producers in terms of guaranteeing halalness have been regulated in Law No.33 of 2014 concerning Guaranteed Halal Products. In the regulation, precisely in article 4 it is explained that products that enter, circulate, and are traded in the territory of Indonesia must be certified halal. The purpose of this study was to analyze the readiness of local food agroindustry UMKM in Lampung towards halal certification policies and the factors that influence it. The results of the study revealed that the readiness of small and medium-scale food industry players in the research locations was not ready to implement halal policies. Based on the results of research at the research location, it is known that the factors of knowledge about halal, awareness to find out, technology used, scale of business, knowledge of bureaucratic rules and certification costs (0.40) This is due to a lack of understanding of the urgency of halal certification and the relatively small scale of business.

1. Introduction

The rules regarding the obligation of halal certification on products circulating in the territory of Indonesia have been regulated in Law no. 13 of 2014 concerning Halal Product Guarantee. This obligation has been in effect since 2019 as explained in the Law that the obligation for halal certification is valid for the next 5 years since the Law was enacted in 2014.[1] However, it must be acknowledged that the halal handling process still encounters several obstacles and challenges in the future, such as clarity on the direction of halal policies that determined, the availability of access to policies applied to the business world, the duties and authorities of each stakeholder involved as well as the standard system for handling halal food products. The resolution of these obstacles and challenges is expected to be able to make a positive contribution and benefit to maintain the peace of the community in their daily lives. Therefore, it is deemed necessary to conduct a critical study of agroindustry readiness for halal policy in local food agroindustry in Lampung.

According to the Decree of the Minister of Religion, R.I. number 518 states that halal certification is a written fatwa declaring the halalness of a food product issued by the Institute for the Study of Food, Drugs and Cosmetics of the Indonesian Ulema Council (LPPOM MUI). Halal certification in Indonesia is officially issued by the MUI which indicates that the product has passed the halal test test.[2] Products that have halal certification are products that have been tested for halal and can be consumed by Muslims. so that there are no cases of halal inclusion in the product, but it does not have a halal certificate.[3] Products that already have halal certification are proven by the inclusion of a halal logo on the product packaging.

Providing halal and safe food is a very prospective business, because with a halal label (certification) it can invite loyal customers who are not only in demand by Muslims but also non-Muslim communities. On the other hand, for producers who do not provide halal information who market their products in countries such as Indonesia, which has a Muslim majority population, their products are less desirable, thus harming the business actors themselves. Halal food for Muslims is proven to be of high quality and very good for the health of the human body[4]

2. Materials and Method

This research was conducted from April 2021 to September 2021. carried out in the city of Bandar Lampung. The location of this research was determined purposively, with the consideration that Karang Anyar Village is a village that has a local food agroindustry. Sources of data used in this study are primary data and

secondary data. Primary data comes from agro-industry players in Karang Anyar. Industry players who became the source of this research consisted of 20 entrepreneurs as respondents who did not have a certificate. Meanwhile, secondary data was obtained from the literature and related agencies that provided data relevant to the research.

The method used in collecting primary data is a survey method by conducting direct observations in the field and filling out questionnaires through direct interviews with agro-industry actors who are respondents. Data collection by interview. Data analysis was carried out descriptively . The data obtained is that the scale of business and knowledge of the procedures for obtaining halal certificates by business actors is very low. from 100% only found at 30% The data is described descriptively to provide an overview of the object under study.

3. Result and Discussion

Agroindustry is an industry that involves raw material components mainly sourced from the agricultural sector. Gedong Tataan District is one of the sub-districts that has an agro-industrial sector, especially the leading home industry in Pesawaran Regency. Karang Anyar is a village that has the largest home industry business sector and is a leading village in Gedong Tataan. Home industry businesses in Karang Anyar village are very diverse in producing processed snacks, one of which is lanting which has a very large population.

The age range of business actors as well as business owners (home industries) in this clanting business ranges from 20 years to 70 years. From the table data, home industry business actors who are of concern are the productive age whose average age is 30 years to 40 years occupying the position of 30%. Likewise, those aged 50 years and over, in other words, those who already have life and business experience also occupy a position at 30%. While the age range of 20-30 years and 40-50 years each is 20%.

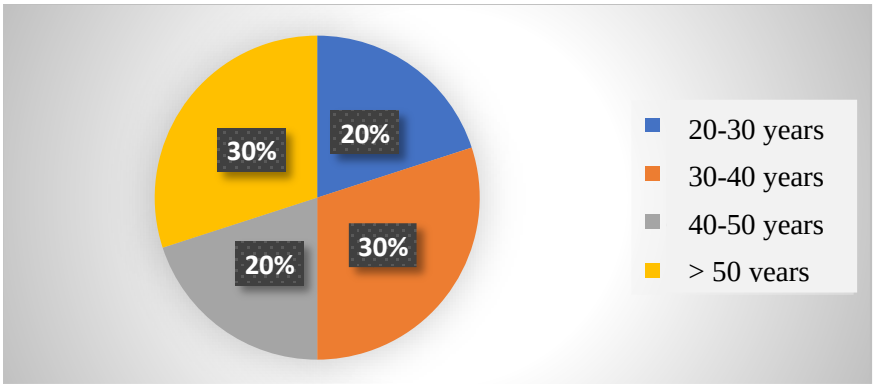


Figure 1. The age range of business actors as well as business owners (home industries) in this clanting business

Lanting is a traditional food that comes from the main raw material, namely cassava and typical food from Java. Lanting has various types including lanting getuk and lanting grated. Lanting produced by the home industry of Karang Anyar Village is lanting getuk which uses raw cassava butter with an original taste.

The amount of lanting produced by the home industry is determined by the type of cassava, the current season and the amount of raw materials used. The number of raw materials used is large in the lanting production process, the more production results are obtained. The lanting production process was compiled based on observations made in the home industry in Karang Anyar Village, Gedong Tataan District, Pesawaran Regency. The process of making lanting consists of stripping, washing, steaming, seasoning, making getuk, grinding, printing, drying, turning, frying and packaging. Paying attention to the importance of halal certification as a supporting factor for the sale of a product, knowledge of the process becomes important.[5]The stages or steps of the procedure and the mechanism for determining the halal fatwa can be explained as follows:

MUI provides knowledge briefing to LP.POM (MUI) auditors about haram objects according to Islamic Shari'ah, in this case li-zatihi and haram li-ghairih objects which because of the way they are handled are not in line with Islamic Shari'a.[6] With the meaning of the word auditor must have adequate knowledge about these illicit objects.

Auditors conduct research and audit to factories (companies) that request halal product certification. Examination which includes: a. Careful inspection of product ingredients, both raw materials and additional (auxiliary) materials. b. Examination of proof of purchase of product materials.

The materials are then examined in the laboratory, especially materials suspected of being illegal objects or containing unclean objects (najis), to obtain certainty.

Examination of a company is not uncommon to be carried out more than once; and not infrequently auditors (LP.POM MUI) suggest and even require that a substance that is suspected or suspected to contain unlawful (najis) ingredients be replaced with materials that are believed to be halal or have been certified as halal

products from MUI or from other institutions deemed competent, companies still want to get a halal product certificate from MUI.

The results of the examination and audit of the LP.POM MUI are then included in a Minutes; and then the Minutes are submitted to the MUI Fatwa Commission for trial. In the Fatwa Commission Session, LP.POM MUI submits and explains the contents of the Minutes; and then discussed carefully and in depth by the MUI Fatwa Commission Session.

A product that still contains ingredients of doubtful halalness, or there is evidence of the purchase of product materials which are deemed not transparent by the Fatwa Commission Session, shall be returned to LP.POM MUI for research or re-auditing to the company concerned. [7]As for products that have been confirmed to be halal by the Fatwa Commission Session, the halal fatwa is carried out by the Fatwa Commission Session.

Halal criteria for food and drink that are not listed in the Qur'an and Sunnah are thoyyib. [8]Thoyyib according to the opinion of the scholars is something that is considered delicious, lawful, holy, not unclean, and does not harm the body or mind. Haram criteria for food and beverage products that are not mentioned in detail in the Qur'an and Sunnah, there are at least five criteria, namely khobits, unclean, harmful, intoxicating, and made from human organs. [9]This means, if any of these criteria are found in the item or food, it is haraam.

Responses to the statement of respondents' knowledge about halal, certification and halal management policy bureaucracy are on average good. This means that there is value in understanding the importance of halal certification. So it can be seen from the level of awareness of the production process and their attention to quality leading to thoyyib has been carried out, it is also reflected in a very good level of value weighting. It's just that on a business scale that is classified as very small and the technology owned, it also has an impact on turnover which is not yet large, which is the cause of the obstacles for lanting business actors to take care of halal certification.

Table.1. Descriptive Analysis of Respondents Response Variable X^1

No	Indicator	1	2	3	4	5	average	Conclusion
1	X1	0	0	2	8	0	3.8	Well
2	X2	0	0	5	5	2	4.5	Very good
3	X3	0	3	7	1	0	3.1	Not good
4	X4	0	0	9	1	0	3.1	Not good
5	X5	0	5	4	2	1	3.5	Well
6	X6	0	5	5	0	2	3.5	Well

Statistical analysis used in this study is the mean, mode, median, deviation, and others. The variables used are knowledge of halal and halal certification, awareness of halal production processes, and readiness to implement halal certification policies.The measurement of the variables available by the researcher uses a Likert scale, which is usually used to measure individual or group personal perceptions about social phenomena, attitudes, and opinions.[10] Then it is known that the Likert scale has a gradation of levels from very good (positive) to very bad (negative). The weighting of the levels of strongly agree is 5, agree 4, disagree 3, disagree 2, and strongly disagree 1. From the results of data collection, then calculations and statistical weighting are carried out, so that the weight value of each statement will be known.[11]

Conclusion

Based on the results of research that has been carried out on the lantimg industry in Karang Anyar Village, Gedong Tataan District, Pesawaran Regency, it can be concluded that the readiness of business actors regarding halal certification policies is still low. The most dominant factor is the small scale of the business so that it has an impact on the difficulty of fulfilling the obligations of halal certification. Business actors also do not fully understand the established halal certification policy. although in terms of food processing already apply good standards. This is because the regulations on halal policies have not been fully socialized.

Recommendation

Small industry players should be a priority to get government assistance to register their products. In addition, the certification process is still not well understood, if the conditions are still as it is now, halal certification should still be an option for agro-industry business actors as part of marketing, as a step towards moral obligations and official regulations..

References

[1] SOFYAN HASAN H K 2014 *Sertifikasi halal dalam hukum positif regulasi dan implementasi di Indonesia* (Yogyakarta: Yogyakarta Aswaja Pressindo)
[2] Agus P A 2017 Kedudukan Sertifikasi Halal Dalam Sistem Hukum Nasional Sebagai Upaya Perlindungan Konsumen Dalam Hukum Islam *Amwaluna J. Ekon. dan Keuang. Syariah* **1** 150–65
[3] Khanifa N K, Ariono I and Handoyo H 2020 Perlindungan Konsumen: Pencantuman Label Halal Tanpa Sertifikat Mui Perspektif Maṣlaḥah Mursalah *Manarul Qur'an J. Ilm. Stud. Islam* **20** 147–66
[4] Hidayat A S, Siradj M and Selatan J 2015 Sertifikat Halal dan Non Halal pada Produk Pangan Industri *J. Ahkam* **XV** 199–210
[5] Fatmasari Sukesti and Mamdukh Budiman 2014 the Influence Halal Label and Personal Religiousity on Purchase *Int. J. Business, Econ. Law* **4** 2012–5
[6] Anon https://www.halalmui.org/images/stories/kebijakan-halal-di-indonesia/PP_Nomor_39
[7] Ambali A R and Bakar A N 2014 People's Awareness on Halal Foods and Products: Potential Issues for Policy-makers *Procedia - Soc. Behav. Sci.* **121** 3–25
[8] Mashudi 2015 *Konstruksi hukum & respons masyarakat terhadap sertifikasi produk halal studi socio-legal terhadap lembaga pengkajian pangan, obat-obatan, dan kosmetika Majelis Ulama Indonesia* (Yogyakarta: Pustaka Pelajar)
[9] Atiah I N and Fatoni A 2019 Sistem Jaminan Halal: Studi Komparatif Indonesia dan Malaysia *Syi`ar Iqtishadi J. Islam. Econ. Financ. Bank.* **3** 37
[10] Kusumawardhani T 2021 Analisis Kesiapan UMKM Bidang Kuliner di Kota Samarinda terhadap Kewajiban Sertifikasi Halal *Undergrad. Thesis* **http://rep** 6
[11] Koeswinarno 2020 *Sertifikasi Halal Yes Or No*

Model to Incubate Rural Agribusiness in Central Java: Lessons from an Action Research

Istiqomah[1*] and Wiwiek Rabiatul Adawiyah[1]

[1]Fakultas Ekonomi dan Bisnis Univeristas Jenderal Soedirman, Jl. HR. Boenyamin 708 Purwokerto Utara Kodepos 53122

*e-mail: istiqomah@unsoed.ac.id

Abstract. This paper aims to develop a model to incubate a rural agroindustry. It elaborates the steps in the participatory development of group entrepreneurship utilizing local resource, identifies the enabling and inhibiting factors and the challenges ahead. This is a collaborative action research between Jenderal Soedirman University (Unsoed), Politeknik Banjarnegara, and the local government of Banjarnegara district. The research team consists of multidisciplinary personnels (economics, management, and food technology). The project began with intensive coordination between Unsoed and The Planning, Research and Development Board of Banjarnegara district. The board identified taro as a local natural resource that has not been processed for commercial purposes despite its huge potential to be developed as a promising food processing industry. Unsoed and the board agreed to develop entrepreneurship by utilizing this local resource. The board has led the collaboration among the local government agencies involved in this project. Group was chosen as a strategy to develop entrepreneurship. Members were recruited from farmer groups, women farmer groups and rural youth. They have been provided with motivational support, trainings on taro processing, production tools and machines, packaging and labeling, promotion and business networking and other business assistance necessary to develop the new venture. Data were collected through documents, participatory observations, informal interviews and group discussions with members of the new venture group and the relevant government agencies. Online discussions were also conducted to intensify communication between stakeholders. Through reflective evaluation based on the collected data, the authors and stakeholders discussed the corrective steps to succeed the new venture. Data collection and decision making about the progress of business (product, pricing, promotion, sales, human resource, and profit) went on a regular basis. Based on this process, lessons learned were concluded. The results show that the strong support from the district government, good coordination among government agencies and other stakeholders, provision of entrepreneurial motivation, training, and mentoring have lifted up the branding of taro from low-value to higher-value commodity, and provide employment and income to rural people. The identified enabling factors are trust, support and coordination among stakeholders, and innovation. Building trust between organizations instead of individuals could be challenging in the future. Another challenge is the capacity building of the group-based venture to facilitate continuous improvement.

1. Introduction

Most of the world's poor live in rural areas and are primarily engaged in agriculture. However, with more open trade, low prices of staple cereals in world markets, and slower population growth, the importance of agriculture for economic growth and poverty reduction is no longer so clear. Therefore, the main pathways out of poverty should be connected to increased productivity in farming, rural non-farm enterprises or by rural-urban migration. In most developing countries rural non-farm output now accounts for roughly half of rural income. The rural non-farm livelihood often enjoys greater potential

for growth in income than agriculture, especially for rural areas with high levels of physical infrastructure and human capital. The non-farm income increase welfare in rural areas[1], increase school participation rate among among children of low-educated and poor mothers and thereby bridging the gap of inequality in rural education [2]. Non-farm livelihood improved nutrient supply and farming households participating in non farm enterprises are better off than non-participants [3].

Although there have been many studies on rural non-farm entrepreneurship, few have focused on discussing how to initiate entrepreneurship in rural areas that face multiple constraints such as lack of motivation, skills, capital, and network. Therefore, this paper fills this gap by discussing the steps to kick off entrepreneurial activities in the village by utilizing local potential, which is based on an action research, and the lessons learned from this initiative.

The relationship between economic growth and entrepreneurship begins with Schumpeter's contribution [4]. Schumpeter developed the theory of creative destruction, in which discoveries by entrepreneurs with temporary monopoly power generated new knowledge, which were spilled over the whole economy through imitation and shifted the economy to a higher income level. Although the model of economic growth according to neoclassical school of thought [5] does not emphasize the role of entrepreneurship in economic growth, but endogenous growth theory [6,7] addresses the role of entrepreneurship more explicitly. According to the endogenous model, the knowledge available in a region provides opportunities that are exploited through new ventures [8]. There have been no prescriptions to boost economic growth. Nevertheless, Tridico stressed the importance of human development and institutions [9]. Tridico specifically mentions that there are two types of education: learning by schooling and learning by doing. These two aspects ─ education with learning by doing approach and institutional strengthening ─ are adopted in this study because both aspects also encourage the growth of entrepreneurial activity.

Universities were once described as 'ivory tower' institutions focusing only on teaching and research which then evolved into the engagement of universities in 'third mission' and 'triple helix mission' [10]. The 'third mission' can be interpreted as putting knowledge produced into use by reaching out to social and economic players outside the sphere of knowledge production. The 'triple helix mission' relates to knowledge production and knowledge use as systemic functions in a dynamically interactive knowledge network and innovation model [11]. It follows from triple helix concept that institutions mediate interaction of subsystems of the innovation system and ensure communication with the agents that are outside the community [12].

The evolving mission of universities has led to studies on university spin off, incubators, and business mentoring [10,12–16]. This paper deals more with efforts to develop a new venture. Launching a new business is hard; US Census data shows that approximately 25 percent of new businesses are abandoned within the first year of founding, 55 percent fail by their fifth year, and only 30 percent last beyond their tenth year. In facing such situation, business incubators, including those based in university, can play a determining role. Firms joining a business incubator expect to benefit from additional resources, connections, and legitimacy that can help a firm connect with key stakeholders such as suppliers, investors, distributors, and markets, which can promote firm survival and performance. University incubated firms have greater employment and sales and grew faster in number of jobs and sales than non-incubated firms because university incubators typically provide greater connectivity and legitimacy to key industry and community stakeholders [16]. Based on the experience of Indonesian public universities and expert evaluation, the framework of successful business incubators consist of nine independent variables and three moderating variables. The independent variables include ability of the business incubators, incubator governance, entry criteria, exit criteria, mentoring and networking, funding and support, governance support and protection, university regulation, and system infrastructure. The three moderating variables include the age of facilities, credibility of facilities, and credits and rewards [15].

Some authors emphasize the significance of trust among network players [10,14]. This is particularly challenging when key personnel in the communities change positions [14]. Nakwa and Zawdie also points out the weak role of intermediaries in promoting network development and the absence of consistent policy support to network development [10]. Halaby further notes the particular importance to identify and utilize basic technological platforms to address the key challenges of distance and

program scalability [14]. Choudhary et al reported that an action research to develop farmers' resilience through community-based enterprise have contributed to increased productivity and farmer incomes [17]. The results show that policy change, improved provision of technical and financial services, establishment of common facility centers, and strengthening of farmers' institutions are imperative to enable smallholder farmers to engage in value chains and thus increase their resilience.

This paper presents an action research to alleviate poverty in rural areas by promoting non-farm enterprise in Balun, a mountainous village in the district of Banjarnegara, Central Java province. The village was purposively chosen because during 1996-2017 rural poverty in Indonesia was persistently higher than urban poverty (BPS, 2019). Poverty rate in the district has decreased from 29.40 percent in 2006 to 15.46 percent in 2018. However, the figures are higher than the national figures. The national poverty rate decreased from 17.8 percent to 9.66 percent during the period (bps.go.id). In 2018, the poverty rate of Banjarnegara Regency was 15.46 percent, the 6th highest among 35 districts / cities in Central Java. Banjarnegara is one of the districts in the western part of Central Java province covering an area of 106,971.01 hectares. Banjarnegara clearly defined its first mission to improve community welfare through agriculture-based development and competitive local potentials. Based on data from the Statistics Agency (BPS), the contribution of agriculture to Gross Regional Domestic Product of the district at current prices in 2017 was 30.21 percent, the highest among other sectors.

2. Methods

This paper presents a two-year participatory action research of a collaborative initiative to develop a group entrepreneurship by the Faculty of Economics and Business, Jenderal Soedirman University, Politeknik Banjarnegara and the Government of Banjarnegara district. The research team from Jenderal Soedirman University and Politeknik Banjarnegara consists of multidisciplinary backgorunds: development economics, management, and food technology. Participatory action research actively involves the stakeholders (see Table 1) to review the existing conditions and to make decisions about actions to be implemented in order to make change toward a better future.

Rural poverty in Indonesia has been persistently higher than urban poverty. Therefore, efforts to alleviate poverty should be prioritized for rural areas. The village of Balun in Wanayasa subdistrict was selected as it is among the poorest villages in Banjarnegara district. Based on the identification of local potential by The Planning, Research and Development Board of Banjarnegara district, taro was selected as the local raw product to be developed as it is very typical in the areas. Despite its potentials, it was hardly processed into food products for commercial purposes. Group entrepreneurship was chosen as a strategy to develop entrepreneurship in the village because the principle of kinship has been widely known in rural areas. This action research was funded by The Directorate General of Research and Community Development of The Ministry of Research, Technology and Higher Education and the government of Banjarnegara district provided supplementary funding for trainings and promotion. The interventions for incubating the new business consisted of training, capital provision, business consulting, promotion and marketing assistance. The effect of entrepreneurship training or business development services are stronger than that of financial intervention [18].

The steps to execute the action research began with coordination with The Board of Planning, Research and Development of Banjarnegara district. The board is the local body responsible for coordinating the district agencies. Therefore, the research team chose the board as the initial partner. The board then identified the local government agencies of Banjarnegara district which should coordinate to support the actions to develop entrepreneurship in the research area. Because the project is to develop agroindustry in rural areas, based on the job descriptions of the agencies, The Agency of Industry, Trade, Cooperative, Small and Medium Enterprises is in charge for leading the project. The person in charge of the project is the Head of Agroindustry Section of the agency. Therefore, the most intense communication was conducted with the Agroindustry Section. Apart from collaborating with district agencies, the team also collaborated with other stakeholders such as local food industry and distributors. There have been two food industry enterprises that supported the project and two distributors to extend the marketing coverage. The identified stakeholders and their roles are presented at Table 1.

Table 1. Project stakeholders and their roles.

No.	Stakeholder	Role
1.	Head & Vice Head of Banjarnegara district	Policy maker of development in Banjarnegara district
2.	Board of Planning, Research and Development	Coordinating collaboration among government agencies
3.	Agency of Industry, Trade, Cooperative, Small and Medium Enterprises	Partner in supervising the development of manufacturing, marketing, and institutional aspects
4.	Agency of Health	Partner in supervising and issuing permit of household industry
5.	Agency of Agriculture and Livestock Production	Policy maker in the development of local agriculture and livestock commodities
6.	Subdistrict Head of Wanayasa	Policy maker in the community supervision in Wanayasa subdistrict
7.	Agency of Agricultural Extension of Wanayasa Subdistrict	Partner in community supervision to cultivate taro and its processing
8.	Village Head of Balun	Partner in community supervision in Balun village
9.	Local flour producer	Partner in producing taro flour
10.	Bakery	Provide production training and marketing
11.	Community groups in Balun (farmer group, women farmer group, youth)	Direct beneficiary of the project

Data were collected through documents, participatory observations, informal interviews and group discussions with members of the new venture group and the relevant stakeholders. Online discussions were also conducted to intensify communication between stakeholders. Through reflective evaluation based on the collected data, the authors and stakeholders discussed the corrective steps to succeed the new venture. Data collection and decision making about the next steps (product, pricing, promotion, sales, human resource, and profit) went on a regular basis. Based on this process, lessons learned were concluded. These methods have been used in other studies on entrepreneurship training (see for example [19].

3. Results and Discussion

3.1. The Model

Several The plan to develop rural entrepreneurship was communicated to the relevant parties to ask for commitment of support and to identify their respective roles in the project. In addition to the support from district agencies, support from the top management of the district is the most important as it facilitates coordination among lower-level district agencies. Therefore, the plan was also reported to the head and the vice head of Banjarnegara district. The commitment was realized by The Planning, Research and Development Board of Banjarnegara district by visiting Bogor municipality which has been well known as a center of taro agroindustry to learn about the policies needed to create an agroindustry center. Relevant agencies took part in the visit, which strengthened the commitment of the district government to develop a local resource-based agroindustry.

The initiative begins with an agreement between the Planning Agency, Research and Development of Banjarnegara Regency with the research team to determine the local potential to be developed. The agency coordinated the collaboration with the Agency of Agriculture (to guarantee the supply of raw materials), The Agency of Health (to guarantee the quality of food products), and the Agency of Industry, Trade, Cooperative and SMES (to ensure the consistency of production and distribution).

The Agency of Agriculture through the Agricultural Extension Service provides counseling about taro cultivation in Balun and surrounding villages to ensure the availability of taro. The Agency of Health organizes counseling about food security, while The Agency of Industry, Trade, Cooperative and SMEs provides various packaging and product promotion trainings. In addition, the Agency also channeled the new business group to a large company that provides Corporate Social Responsibility (CSR) funds for SME assistance and retailers who help product marketing.

The university transfer knowledge, technology, and initial capital to the new business group. The research team also collaborated with the local flour industry and the bakery industry. The local flour producer usually only produces modified cassava flour. With the same technique, the manufacturer was asked to make flour from taro. The flour was then given to bakery for product experiments. The two companies were then asked to train the new business group to make taro flour and its derivative products.

Based on the above explanation, here is our model that we developed for incubating an agroindustry in rural areas by utilizing local resources.

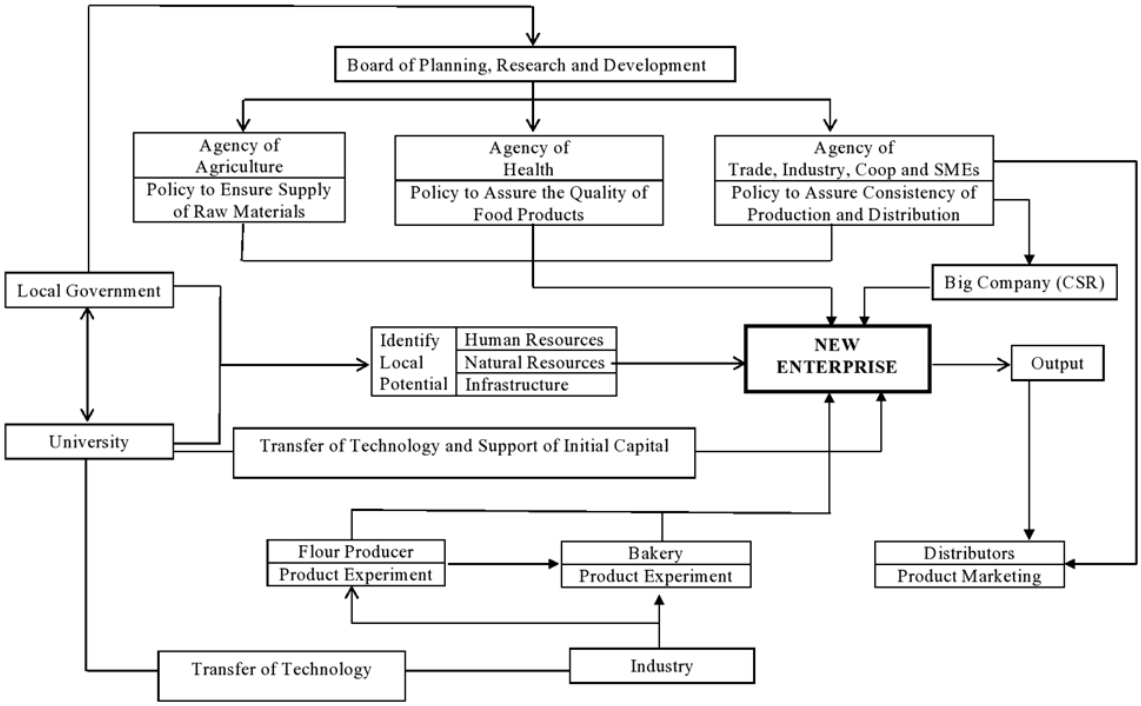


Figure 1. Model of incubating an agroindustry in the village of Balun, Wanayasa, Banjarnegara
Source: based on authors' action research

Having received commitment and support from the top management and agencies at the district level, the team proceeded with communicating the plan to the subdistrict head and the village head who enthusiastically responded to the initiative. Together with the village head, the team identified the beneficiaries of the project. They involve the following groups: farmer group to supply raw material, women farmer group to process the raw material and the village youth to distribute the products. Farmer groups were chosen because farmers are the poorest group in the village. The project is intended to improve the community welfare. It is therefore, farmer groups should be the appropriate beneficiary.

The first meeting with the beneficiaries was attended by the research team, the head of the Agency of Industry, Trade, Cooperative, Small and Medium Enterprise, the subdistrict head of Wanayasa, the village head of Balun, and the beneficiaries. The first meeting aimed to generate awareness of the

beneficiaries to improve their welfare by utilizing local resources. Local resource has high potential to increase income by creating value added. At the end of the meeting, the beneficiaries consisting of 24 members committed themselves to the project. They also agreed to name their group "Kelompok Usaha Bersama Begug Sejahtera".

So far, in the village, taro was only steamed for home consumption. In fact, based on the observation in Bogor municipality and discussion with food industries in Banjarnegara, it should be possible to process taro into various higher value-added products. Therefore, the team facilitated a women farmer group called Sinar Tani to produce taro flour, which has been produced on a laboratory scale at campus. Sinar Tani was selected as it has been successful to produce modified cassava flour. The modified taro flour produced by Sinar Tani was then used as a sample during the training in the village of Balun. The flour was also delivered to two bakery industries for product experiment. The results of their experiments were then transferred through trainings to the beneficiaries in the research area.

One week later, the beneficiaries participated in a 3-day training on production techniques. They were trained to produce flour from taro, which were then used as raw material to produce brownies, rainbow cakes, and eggrolls. They were granted with the necessary production tools such as mixer and oven. Stoves were not provided because they have had stoves at their kitchen. In addition, three production machines were granted to the group by the research team: slicer, cabinet dryer, and disk mill for flour production. The trainer of the flour production is a member of the research team, while the rest of the products were trained by the owners of bakery industries. Having learned the production techniques, the group was provided with an opportunity to practice at home. The research team supplied working capital to facilitate the practices. The team also facilitated the group with proximate testing and shelf-life testing of the products.

In the following week, there was a supervision from the Agency of Health about the requirements to get permit of household industry. Three days later, the team from the Agency of Health visited three production sites of the group to make sure that the kitchens met the required standards. One week later, the Agency issued the permit of household industry for the four products of the group: taro flour, "BROWNISTA" (taro brownies), "PELANGI" (taro rainbow cake), and "ROLLAS" (taro eggroll).

Five days after getting the permit, the center of taro agroindustry was officially launched by the Vice Head of Banjarnegara district. The new products were introduced to the public. Many participants of the launching ceremony appreciated the new products. The Vice Head of the district published the ceremony in his Instagram as well as Facebook account. Because it was launched by the Vice Head of Banjarnegara district, mass media were interested to disseminate the news. These publications have served as a very positive campaign to elevate the branding of taro from neglected into higher value-added products. The taro products since then have been being promoted continuously through various promotional events such as trade expo and participation in district celebrations. In addition, The Agency of Industry, Trade, Cooperative, Small and Medium Enterprises linked the group with food product distributors.

3.2 Sales and Problems Associated with Group Entrepreneurship

Only within 2.5 months, total sales has been IDR 9.6 million. It is a promising figure as compared to total assets granted to the group of about IDR 20 million. Paramanandam and Packirisamy emphasized the important role of marketing techniques that require immediate attention from those promoting microenterprises [20].

As a new group-based venture, some problems appeared during the course of the business including variation in product quality due to skill differences, fluctuation of member participation, and conflicts between members. The research team and relevant stakeholders discussed about the problems to find solutions. [21] argued that combination of skills, capital, and counseling based on main constraints of target group is important to achieve better results.

Because there were many products, job specialization was then arranged depending on the skills of individual members to ensure consistent product quality. Having discussed about fluctuation of member participation, it was conlcuded that some members were busy with houseworks and/or farm work making it difficult for them to leave home. The agreed solution is that there are some jobs that

must be done at the production site and there are jobs that can be accomplished at members' respective homes. Therefore, members who have difficulty leaving home can do parts of the job at home. Consequently, there is a need for additional production equipment.

Conflicts between members are caused by unfair distribution of income. There are members who spend less time at work and some who spend more time, but they receive the same share of income. The team recommended that members' working time be recorded daily and then used as a basis for profit sharing. Group members were trained in simple bookkeeping to calculate profit. The group discussed how much profit is retained and how much is shared with members.

A more serious problem is the unpreparedness of members to become entrepreneurs. They used to work in farms and receive daily wages. They are not accustomed to taking risks. In fact, products that are distributed in outlets are not necessarily sold. To overcome this conflict, at the beginning the group only produced by order so that income can be immediately shared. To encourage member entrepreneurship, the research team provided a guarantee that the group losses due to product withdrawal would be reimbursed. For this guarantee, the group began distributing products to outlets with a consignment contract. However, not all outlets showed good performance. From this experience, members learned to select best-selling outlets to reduce risk.

Because the research team only incubated the group for two years, the issue of sustainability became a critical point. For this reason, the Agency of Industry, Trade, Cooperatives and SMEs took the initiative to link the group with a large company in Banjarnegara so that the group would be assisted through its corporate social responsibility (CSR) programs.

3.3 Lessons Learned

At the very beginning, trust between the initiating parties has been crucial. The success of this incubation effort requires the cooperation of many parties in ensuring the availability of raw materials, adequate training, smooth licensing, consistency in product quality, production and marketing. For this reason, mutual trust between stakeholders is essential for each of them to realize their commitments. Before launching this project, the team from the Faculty of Economics and Business Jenderal Soedirman University has been in intense collaboration with two government agencies for research and community empowerment for about three years, which facilitates gradual trust building between both parties. Based on a shared value, both parties have committed to sustain the efforts to empower the community. The challenge lies in the fact that trust has been built between the individuals, not between organizations. So, it could be quite difficult to sustain the commitment when employee rotation or promotion takes place at the district agencies. The result confirms [14] and [10] who emphasized the significance of trust among network players.

In addition to trust, support and coordination among stakeholders are two fundamental aspects in such a project. Therefore, the role of the distric top leader has been very determining to help promote the new product and to coordinate the district agencies. The Vice Head of Banjarnegara district has aggressively promoted taro products in his social media accounts and through mass media publications. Moreover, as a local government agency, The Planning, Research, and Development Agency has been organizing the coordination among other district agencies very well, especially regarding budgeting to develop the new agroindustry center. For example, The Agency of Agriculture and Livestock Production allocated budget to improve the techniques of taro cultivation and to empower the community to cultivate taro at their home garden, and The Agency of Industry, Trade, Cooperative, Small and Medium Enterprises allocated budget to develop taro processing industry. Only when the whole stages in supply chain are taken care, the development of the agroindustry would be successful. [10]accentuated the weak role of intermediaries in promoting network development and the absence of consistent policy support to network development among the constraints to realize triple helix mission.

Continuous innovation is the key to business success. Previously taro was simply steamed for home consumption. Therefore, further processing into flour, cakes and cookies has been very attractive to the market. Many of the public do appreciate the fact that local flour can be a perfect substitute of wheat flour, which cannot be produced locally. So far innovation has been induced by project initiator

in collaboration with food processing industry. In order to sustain the business survival and progress, the group should innovate unceasingly to win competition against other food processing enterprises. This could be a challenge because the group members are not used to be exposed to business competition. Awareness and capacity building should be the homework in the later stage of the project.

4. Conclusions

University has evolved from traditional practices of teaching and research to active engagement in community empowerment. In response to the increased rural-urban inequality, this action research developed a collaboration between university and local government to create an agroindustry processing low-value into higher-value local resource. By selecting the poorest village as the study site, it is expected that this effort will contribute to generate an equitable economic growth. The results show that the strong support from the district government, good coordination among government agencies and other stakeholders, provision of entrepreneurial motivation, training, and mentoring have lifted up the branding of taro from low-value to higher-value commodity, and provide employment and income to rural people. In such an effort to empower community, the critical factors should be taken care. These include trust, support and coordination among stakeholders, and capacity building to facilitate continuous innovation.

5. Acknowledgment

The authors would like to express their deepest gratitude to the Directorate General of Research and Community Development of The Ministry of Research, Technology, and Higher Education for providing the research grant and to two anonymous reviewers who have helped improve the quality of this paper.

REFERENCES

[1] Al-Amin A K M A and Hossain M J 2019 Impact of non-farm income on welfare in rural Bangladesh: Multilevel mixed-effects regression approach World Development Perspectives 13 95–102

[2] Janssens C, van den Broeck G, Maertens M and Lambrecht I 2019 What if mothers are entrepreneurs? Non-farm businesses and child schooling in rural Ghana Journal of Rural Studies 66 95–103

[3] Tsiboe F, Zereyesus Y A and Osei E 2016 Non-farm work, food poverty, and nutrient availability in northern Ghana Journal of Rural Studies 47 97–107

[4] Schumpeter J A 1934 The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle (New Brunswick, NJ: Transaction Book)

[5] Solow R M 1956 A Contribution to the Theory of Economic Growth The Quarterly Journal of Economics 70 65

[6] Romer P M 1986 Increasing Returns and Long-Run Growth Journal of Political Economy 94 1002–37

[7] Lucas R E 1988 On the mechanics of economic development Journal of Monetary Economics 22 3–42

[8] Romer P M 1994 The Origins of Endogenous Growth Journal of Economic Perspectives 8 3–22

[9] Tridico P 2012 The determinants of economic growth in emerging economies: A comparative

analysis Journal of Current Issues in Finance, Business and Economics 5 145–73

[10] Nakwa K and Zawdie G 2016 The 'third mission' and 'triple helix mission' of universities as evolutionary processes in the development of the network of knowledge production: Reflections on SME experiences in Thailand Science and Public Policy 43 622–9