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18

H Index

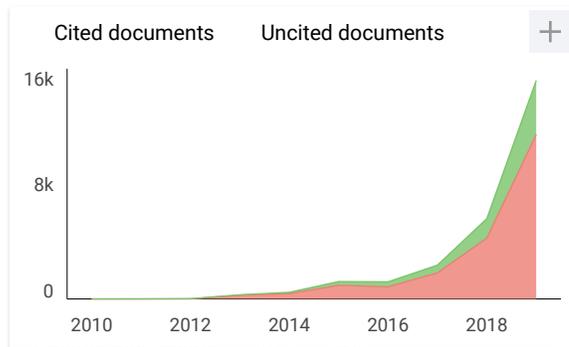
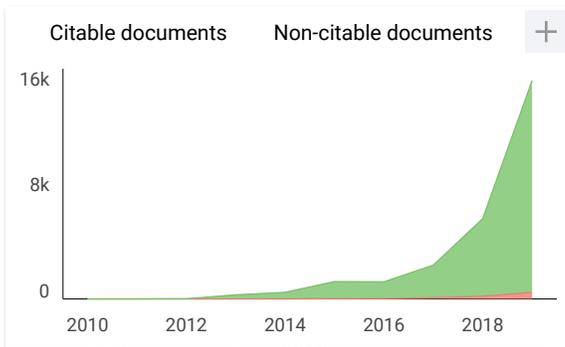
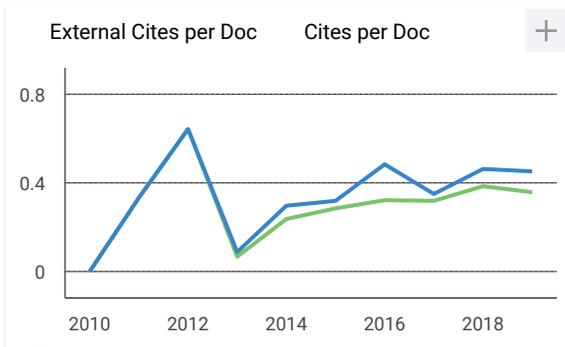
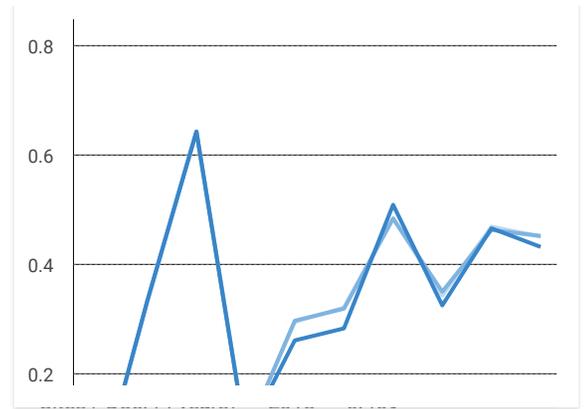
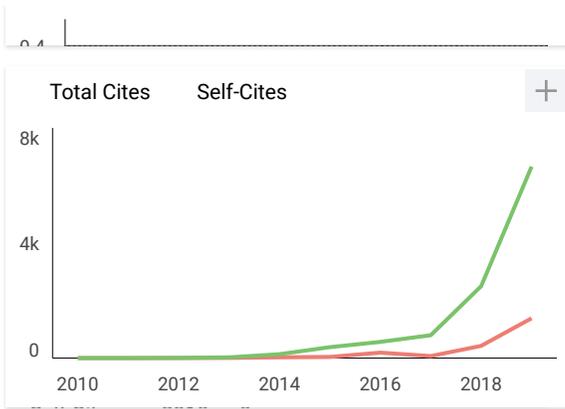
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[Earth and Planetary Sciences \(miscellaneous\)](#)
[Environmental Science](#)
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Preface

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PREFACE

The 2nd International Conference on Food Security and Sustainable Agriculture in the Tropic (IC-FSSAT 2019) was held in Makassar, Indonesia on September 2 2019. As in previous conference, IC-FSSAT 2019 is dedicated to address issues related to food security and sustainable agriculture in the Tropics. This event was hosted by Faculty of Agriculture and Publication Management Centre (PMC), Universitas Hasanuddin.

The major goal and feature of the conference was to promote knowledge, science, and technology as well as to address issues in food security and sustainable agriculture in the tropics, by bringing together researchers, scientists, practitioners and scholars in the respected fields. While food security and sustainable agriculture issues had been discussed broadly in several conferences, our conference emphasizes on the tropical agriculture. A total of 7 Keynote/Invited Speakers from Australia, Germany, Taiwan, Czechoslovakia, Japan and Indonesia delivered an insight into the state of art of the challenges in food security and sustainable agriculture in the tropics and any possibilities that could arise in developing integrated problem solving and collaboration to create better world.

This proceedings present selected papers submitted to the conference by academics and researches from universities and research institutes. All papers were subjected to rigorous peer-reviews by conference committee members and international reviewers to ensure their compliance to meet the required standard for qualified scientific publication. This volume presents recent researches in the field of Food Security and Sustainable Agriculture in the Tropic covering various related areas of Crop Production and Environment, Plant Breeding and Biotechnology, Biodiversity and Climate Change, Integrated Pest and Disease Management, Genetically Modified Foods, Food Safety, and Product Development, Geospatial Agriculture, Agricultural Engineering and Sustainable Agriculture and Rural Development.

We would like to appreciate all authors who have contributed to this proceedings, the conference committee, speakers, attendees, organizing committee and sponsors who have made the 2nd IC-FSSAT a succes. We wish the conference will have significant contribution in field of food scurity and sustainable agriculture. We are also expecting that this conference proceedings contributes in looking at a new paradigm for food security and sustainable agriculture, especially in the tropic.

Rinaldi Sjahril

Chair of Organizing Commitee 2nd IC-FSSAT 2019



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Table of contents

Volume 486

2020

[◀ Previous issue](#) [Next issue ▶](#)

2nd International Conference on Food Security and Sustainable Agriculture in the Tropics 2 September 2019, Makassar, Indonesia

Accepted papers received: 24 March 2020

Published online: 26 May 2020

[Open all abstracts](#)

Preface

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Preface

[+ Open abstract](#) [View article](#) [PDF](#)

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[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 011003

Peer review statement

[+ Open abstract](#) [View article](#) [PDF](#)

Sustainable Agriculture and Rural Development

OPEN ACCESS 012001

Analysis on sustainability status of cocoa plantation smallholders

N Fairuzia, B Krisnamurthi and A Rifin

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012002

The perception of local cocoa farmers to the *swisscontact* program: economics, environment and social dimension

I Karim, D Fatmawaty, Anas and E Wulandari

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012003

Product flow pattern at cayyene pepper supply chain

R Indriani, R Darma, Y Musa, A N Tenriawaru and S Imran

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012004

The sundown of home economical cilongok village: case of coconut farm agriculture

A Arman, H Agustin, M Karim, O Kurniawan and B Purwandaya

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012005

The association of fecundity and morphometrics of mangrove snail *Terebralia palustris* Linnaeus 1967 in the mangrove ecosystem

A N Samsi, S B Andy Omar, A Niartiningsih and E Soekendarsi

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012006

Motivation of farmers to increase goats production

T G Rasyid, S T Rohani, M Aminawar and M Darwis

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012007

Internal and external factors of rice farming in the coastal area

Saadah, A Amrullah, Darwis, T Ibrahim, L Fudjaja, S Bulkis, A S Dzulhajrah and D P Wahyudi

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012008

Preliminary study of nitrite content in South Sulawesi uncleaned edible bird nest

B Yusuf, P Farahmida, A W Jamaluddin, M N Amir, R I Maulany and D K Sari

[+](#) [Open abstract](#) [View article](#) [PDF](#)

-
- OPEN ACCESS** 012009
Socioeconomic studies in the utilizing of livelihood capital to meet the needs of coastal communities
Darwis, Saadah, A Amrullah, T Ibrahim, S Bulkis and A S Dzulhajrah
[+](#) [Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012010
Path coefficient analysis for growth characters of sago palm related to trunk formation at three years after transplanting
D R Sari, L Asrul, R Sjahril and K Osozawa
[+](#) [Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012011
Histopathological Study of Kidney and Meat of Bungo Fish (*Glossogobius* sp) contaminated by Lead Metal (Pb) in Lake Tempe, Wajo Regency
A Risna, I Andriani, A Ashraf, S B A Omar and D K Sari
[+](#) [Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012012
Development strategy of rice farming in coastal area of Maros Regency
A Amrullah, Saadah, Darwis, T Ibrahim, N Busthanul, S Bulkis, A S Dzulhajrah and D A Putri
[+](#) [Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012013
Livelihood strategy in fulfilling household needs of coastal communities
D Rukmana, P Diansari, R A Nadja, Rahmadanih, I M Fahmid, Syahrullah and Akhsan
[+](#) [Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012014
Determination of birdwatching tourism locations for red-knobbed hornbill (*rhyticeros cassidix*) around lake Lindu, Lore Lindu National park, central Sulawesi
B Ardi and Fridollyn H. Suardi
[+](#) [Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012015
Analysis of the contribution of income in fulfilling household livelihoods of coastal communities
P Diansari, D Rukmana, R A Nadja, Rahmadanih, I M Fahmid and Syahrullah

[+ Open abstract](#) [View article](#) [PDF](#)

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012016

Pembollo': a concept of plant-based traditional medicine among kaluppini indigenous people

Nurbaya and Chandra

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012017

Farmers rasonality in doing land conversion

M S S Ali, R Bakri, D Rukmana, E B Demmallino, D Salman and Marsuka

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012018

Lethrinid fishes (Lethrinidae) of Wallacea region

M Afrisal, Irmawati, Nurjirana, Y Iwatsuki and A I Burhanuddin

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012019

Changes of Coral Reefs Condition in the Core Zones of Kapoposang Island MPA, Makassar Straits

T Arifin, R Rahmania, Yulius, D P Gunawan, N A Setyawidati, N Gusmawati and M Ramadhan

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012020

The composition of mollusks in mangrove ecosystem conservation area Bagek Kembar, West Lombok

D A Candri, L H Sani, H Ahyadi, B Farista and A Virgota

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012021

Sex ratio and first maturity size of matano ricefish (*Oryzias matanensis* Aurich, 1935) at Lake Towuti, South Sulawesi, Indonesia

A Rinandha, S B Aomar, J Tresnati, D Yanuarita and M T Umar

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012022

Sustainability land conversions in Tadokkong Village

R Bakri, MS S Ali, D Rukmana, E B Demmallino, D Salman and Marsuka

[+ Open abstract](#) [View article](#) [PDF](#)

-
- OPEN ACCESS** 012023
Coffee agribusiness and income farmers
A N Tenriawaru, I Summase, R M Rukka, N M Viantika, M Arsyad, A Amiruddin and A B Hadman
[+](#) Open abstract [View article](#) [PDF](#)
-
- OPEN ACCESS** 012024
Bird diversity on small islands in Maluku
F S Latumahina, G Mardiatmoko and J Sahusilawane
[+](#) Open abstract [View article](#) [PDF](#)
-
- OPEN ACCESS** 012025
Development strategy of coffee agribusiness
I Summase, A N Tenriawaru, N M Viantika, A Amrullah, M Arsyad, A Amiruddin, A B Hadman and M Arhim
[+](#) Open abstract [View article](#) [PDF](#)
-
- OPEN ACCESS** 012026
Analysis of soybean farmers response on Pajale Special Efforts Implementation (UPSUS) program
Mahyuddin, Saadah, Darwis, N Lanuhu, P Diansari, A Anisa, A Sulili and A Wirdansyah
[+](#) Open abstract [View article](#) [PDF](#)
-
- OPEN ACCESS** 012027
Development of model for honey bee management in hasanuddin university educational forest
D Malamassam
[+](#) Open abstract [View article](#) [PDF](#)
-
- OPEN ACCESS** 012028
Analysis of soybean farmers income that involved and not involved in The Pajale Special Efforts Program (UPSUS)
N Lanuhu, Saadah, Mahyuddin, Darwis, P Diansari, A Sulili, A Wirdansyah and Nurlaela
[+](#) Open abstract [View article](#) [PDF](#)
-
- OPEN ACCESS** 012029
Hunting and trading activities of reticulated python (*Python reticulatus*) in South Sulawesi, Indonesia: A report from the field
D A Wahab, R I Maulany, Nasri and Nirsyawita
[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS	012030
Analysis of social forestry governance in Jeneberang I forest management unit	
A T Solie, Supratman, D Malamassam and Ridwan	
+ Open abstract View article PDF	
OPEN ACCESS	012031
Level of work day (human, animal, and machine) at each stage of rice farming in irrigated rice fields	
M Salam, D Rukmana, Mahyuddin, A N Tenriawaru, Akhsan and A F Riadi	
+ Open abstract View article PDF	
OPEN ACCESS	012032
Employment wage and wage system (human, animal and machine) at each stage of rice farming in irrigated rice fields	
D Rukmana, Mahyuddin, M Salam, A N Tenriawaru, Akhsan and A F Riadi	
+ Open abstract View article PDF	
OPEN ACCESS	012033
Difference use of labors in land area for each stage of rice farming in irrigated rice fields	
A N Tenriawaru, D Rukmana, Mahyuddin, M Salam and A F Riadi	
+ Open abstract View article PDF	
OPEN ACCESS	012034
Analysis of programs of activities development of forest areas with specific objectives (KHDTK) tabo-tabo south sulawesi	
A M Rafii, M Restu, Millang, S and M Muin	
+ Open abstract View article PDF	
OPEN ACCESS	012035
Leadership style of farmer group leaders	
M H Jamil, N Lanuhu, N Busthanul, E B Demmallino and I Melinda	
+ Open abstract View article PDF	
OPEN ACCESS	012036
Mangrove management collaboration in the Marusu coastal region of Maros regency	
Yusran and A Sabar	
+ Open abstract View article PDF	
OPEN ACCESS	012037

The dynamics of farmer groups in Tugondeng Village

M H Jamil, N Lanuhu, N Busthanul, E B Demmallino and I Melinda

[+](#) [Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012038

Leadership relations of the rice farmers' head group with group dynamics in Tugondeng Village

N Lanuhu, H Jamil, N Busthanul, E B Demmallino and I Melinda

[+](#) [Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012039

Pulu-mandoti value chain analysis in Enrekang Regency

N Busthanul, A N Tenriawaru, A Amrullah, Mahyuddin, Heliawaty and M N Akib

[+](#) [Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012040

An added value analysis of Pulu Mandoti rice agricultural commodities at farmers level

A Amrullah, A N Tenriawaru, N M Viantika, R Darma, Heliawaty and M N Akib

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012041

Development strategy of brown rice farming

Rahmadanih, R M Rukka, Saadah, M Arsyad, A Amiruddin, Sukmawati and A Anisa

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012042

Maximizing opportunities towards brown rice farming production

R M Rukka, Sukmawati, Rahmadanih, Saadah, M Arsyad, A Amiruddin, A Sulili and R Khaerati

[+](#) [Open abstract](#) [View article](#) [PDF](#)

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012043

The social capital and innovative behaviors of the farmers in Bantaeng Regency

Heliawaty, M S S Ali, D Salman, M H Jamil, L Fudjaja, N Busthanul and Darwis

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012044

Institutional strengthening of women farmers group (KWT) in developing household food security

Rahmadanih, S Bulkis, A Amrullah, R M Rukka and N M Viantika

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012045

Soil classification for sustainable agriculture

D Yusnita, A Ahmad and M S Solle

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OPEN ACCESS

012046

Analysis of the relationship of soybean farmers response and income on The Pajale Special Efforts (UPSUS)

L Fudjaja, A N Tenriawaru, Mahyuddin, Saadah, Darwis, P Diansari, A Sulili and A Wirdansyah

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012047

Differences in characteristics of farmers who do and do not conduct a beef cattle business partnership system (*teseng*)

S T Rohani, A R Siregar, T G Rasyid, M Aminawar and M Darwis

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012048

Exploration study for corporate farming application readiness

A Amiruddin, E B Demmallino, H Jamil and S Hardianti

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OPEN ACCESS

012049

Strengthening sustainable agriculture through cocoa smallholders production

M Arsyad, A Nuddin, S Yusuf, Y Kawamura, B M Sinaga and R Khaerati

[+ Open abstract](#) [View article](#) [PDF](#)

Genetically Modified Foods, Food Safety, and Product Development

OPEN ACCESS

012050

Quality improvement of post-harvest red rice through grain germination

S M R R Amir, A N F Rahman and A Syarifuddin

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012051

Physical and proximate analysis of green banana cake premix flour

A N F Rahman, M Bilang and L N Ikawati

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012052

Shelf life study of *Bohu Cukke* using the Accelerated Shelf Life Testing (ASLT) method

R Latief, A N Farahdiba and A A N Amalia

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012053

The making of smart and active packaging on tuna fillet

A H Julyaningsih, R Latief and A Dirpan

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012054

Study of snack bar combination of banana flour (*Musa paradisiaca*) and mung bean flour blending as emergency food

M Mahendradatta, A Laga and N I U Nurhisna

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012055

The effect of solvent type and extraction duration on purple corn anthocyanin compounds (*Zea Mays* L)

K Sugiharto, A N F Rahman and Zainal

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012056

The effect of ultrasonication temperature on snakehead fish (*Channa striata*) dispersion

Rahmaniar, A Dirpan, M Mahendradatta, M Asfar and A B Tawali

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012057

Effect of temperature and humidity to the yield and quality of germinated rice (*Oriza sativa* L) produced

Nikmah, A N F Rahman and J Langkong

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012058

Enzymatic characterization of apple (*Malus. x Domestica*)

O S Hutabarat and H Halbwirth

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012059
Preparation of cookies from banana flour, soy flour, and Moringa leaf flour as an emergency food product
N W Hasan, T P Putri and Zainal
[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012060
Effect of the addition of honey on the growth of lactic acid bacteria in functional drinks of fermenting cassava stored at frozen temperatures
N Sari, M M Tahir and Zainal
[+](#) Open abstract [View article](#) [PDF](#)

Agricultural Engineering

OPEN ACCESS 012061
Predicting the impact of land-use change on soil erosion rate in Ussu sub-catchment area and sedimentation yield in Malili River
M Achmad, S Samsuar and H Mubarak
[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012062
Effect of canopy cover level on solar radiation for conservation plant photosynthesis under the stand of cocoa plants
Suhardi, M T Sapsal, R Sjahril and Samsuar
[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012063
Combine rice harvester performance test in Takalar Regency
Iqbal, Supratomo and A Azis
[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012064
Dynamic performance test of auger-type metering device for Variable Rate Fertilizer Applicator (VRFA)
A Azis, RPA Setiawan, W Hermawan and T Mandang
[+](#) Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012065
Effectiveness of "Butterfly" rotary sprinkler on dry land

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012066

Development of solar and gas hybrid energy bed dryer with implementing multivariable expert system controls

B Putra, A Waris and Iqbal

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012067

Land suitability evaluation for clove plants in Bacan Island

S Laban, M S Solle, A Ahmad and M Jayadi

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012068

Spatial analysis of landslide vulnerability in Enrekang District, South Sulawesi

A Ahmad, C Lopulisa, A M Imran, S Baja and M S Solle

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012069

Evaluation of land suitability for coffee plants based on fuzzy logic in Enrekang district

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The effects of colchicine concentration and soaking time on formation of leaves and roots of katokkon (*Capsicum chinense* Jacq.) in vitro

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Effect of chemical and organic fertilizers on growth and yield of two roselle (*Hibiscus sabdariffa* L.) cultivars
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Food security and sustainable agriculture
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Growth and production of lowland rice (*Oryza sativa* L.) with water management systems on the application of various combination of fertilizers and planting systems
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Response of chili (*Capsicum annuum* L.) to bioslurry fertilization and enrichment of *Trichoderma asperellum* on planting media

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Growth and production of three rice varieties (*Oryza sativa* L.) in saline stress condition following halopriming and hydropriming treatment

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Effectiveness of soil tillage and Arbuscular Mycorrhizal (AM) fungi inoculation on fruit development of the cocoa plant (*Theobroma cacao* L.)

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Growth and production of chili (*Capsicum annuum* L.) on the application of *Trichoderma* sp. and *Azolla* liquid organic fertilizer

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Growth and production of Katokkon (*Capsicum chinense* Jacq) chili plants in lowland applied with gibberellins and liquid organic fertilizer

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Enrichment of organic complex compounds of coconut water and mungbean extract in chrysanthemum (*Chrysanthemum morfolium* L.) tissue culture media

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Production of Indol-3-Acetic Acid (IAA) by fungal isolates of taro (*Colocasia esculenta* var. *antiquorum*) rhizosphere

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The use of organic plus materials on the growth of sugarcane "Bulu Lawang" variety

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The effectiveness of the land suitability analysis approach as a determinant of a sustainable cocoa (*Theobroma cacao*. L) productivity improvement strategy in East Luwu Regency

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The effectiveness of biofilter and density of different stocking in aquaponic recirculation systems in the integration of tilapia (*Oreochromis niloticus* L.) and pakchoy plants (*Brassica rapa* L.)

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Flowering of *Chrysanthemum* sp. in pot at various concentrations of corn extract and paclobutrazol

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Green leafhopper (*Nephotettix virescens* Distan) biotype and their ability to transfer tungro disease in South Sulawesi, Indonesia

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Populations of *Aphis gossypii* on different pepper cultivars, fertilized with different rates of NPK

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Application of *Beauveria bassiana* (Bals.) Vuil. (Hypocreales: Cordycipitaceae) in rice seed and its effect on mortality of green leaf hopper, *Nephotettix virescens* (Distant) (Homoptera: Cicadellidae)

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Population dynamics of melon fly *Zeugodacus cucurbitae* Coquillett (Diptera: Tephritidae) and damage level of fruits based on phenology and altitude

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Effectiveness of nylon exclusion net for preventing chili fruit damage by the oriental fruit fly, *Bactrocera dorsalis* Hendel (Diptera: Tephritidae)

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Effectiveness of *Beauveria bassiana* Vuill. isolate on various culture media and its pathogenicity against *Tribolium castaneum*

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Reactions of banana plantlets *Musa acuminata* L. to extracellular polysaccharides from *Ralstonia zyzygii* subsp. *celebensis* causal agent of blood diseases

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Gorontalo local rice plant response which planted with the lowland system and upland system

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Wilt disease of banana (*Fusarium oxysporum* f. sp. *cubense*): Grouping of isolates in their physiological races

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The capability of *Trichoderma asperellum* in suppressing vascular streak diseases on five different cocoa clones

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Testing chitinase and p1-3, glucanase produced by native *Trichoderma* isolates obtained from South Sulawesi

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Testing cutinase produced by native *Trichoderma* isolate and its persistence in pod and flower surfaces on cocoa tree in South Sulawesi

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Identification fruit fly species associated with watermelon plants (*Citrullus lanatus* (Thunb.) Matsum. & Nakai) in South of Sulawesi, Indonesia

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Virulence and genetic diversity of Phytophthora isolates associated with cocoa pod rot

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Molecular identification of bacteria causing grain rot disease on rice

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Product flow pattern at cayenne pepper supply chain

R Indriani¹, R Darma², Y Musa³, A N Tenriawaru² and S Imran¹

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IOP Conference Series: Earth and Environmental Science, Volume 486, 2nd International Conference on Food Security and Sustainable Agriculture in the Tropics 2 September 2019, Makassar, Indonesia

ria.indriani@ung.ac.id

¹ Department of Agribusiness, Faculty of Agriculture, Gorontalo State of University, Indonesia

² Department of Social-Economics, Faculty of Agriculture, Universitas Hasanuddin, Indonesia

³ Department of Agronomy, Faculty of Agriculture, Universitas Hasanuddin, Indonesia

R Indriani *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **486** 012003

<https://doi.org/10.1088/1755-1315/486/1/012003>

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Abstract

Cayenne pepper as an agricultural commodity has distinctive characteristics that are not available every time are difficult to store for a long time and prices tend to fluctuate. The implication is that chilies require a treatment such as supply chain management well and post-harvest treatment such as dried or mixed material for processing industries. This study aims to describe the pattern of product flow in the cayenne supply chain in Gorontalo. The study used the survey method and sampling using a purposive sampling technique to farmers and traders. Data analysis used descriptive analysis and Hayami added-

value analysis. The results of the research show that the product flow pattern in the cayenne supply chain is a product distribution in the form of fresh cayenne pepper and dried cayenne pepper. Farmers sell fresh cayenne through collector traders, wholesalers, market traders and directly to retailers. While processing and distributing dried cayenne by retailers. The added value created by every kg of fresh cayenne pepper is Rp 1,126,688 or 90.27% of the production value. Hayami's additional analysis shows that the added value in every one kg of dried chili is Rp. 7,400 or 59.20% of the value of the product. The rate of profit is 58.1% of the value of production, meaning that every 100 kg of production value will be obtained as much as 58.1 kg of profit.

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Product flow pattern at cayenne pepper supply chain

R Indriani¹, R Darma², Y Musa³, A N Tenriawaru², and S Imran¹

¹Department of Agribusiness, Faculty of Agriculture, Gorontalo State of University, Indonesia

²Department of Social-Economics, Faculty of Agriculture, Universitas Hasanuddin, Indonesia

³Department of Agronomy, Faculty of Agriculture, Universitas Hasanuddin, Indonesia

E-mail: ria.indriani@ung.ac.id

Abstract. Cayenne pepper as an agricultural commodity has distinctive characteristics that are not available every time are difficult to store for a long time and prices tend to fluctuate. The implication is that chilies require a treatment such as supply chain management well and post-harvest treatment such as dried or mixed material for processing industries. This study aims to describe the pattern of product flow in the cayenne supply chain in Gorontalo. The study used the survey method and sampling using a purposive sampling technique to farmers and traders. Data analysis used descriptive analysis and Hayami added-value analysis. The results of the research show that the product flow pattern in the cayenne supply chain is a product distribution in the form of fresh cayenne pepper and dried cayenne pepper. Farmers sell fresh cayenne through collector traders, wholesalers, market traders and directly to retailers. While processing and distributing dried cayenne by retailers. The added value created by every kg of fresh cayenne pepper is Rp 1,126,688 or 90.27% of the production value. Hayami's additional analysis shows that the added value in every one kg of dried chili is Rp. 7,400 or 59.20% of the value of the product. The rate of profit is 58.1% of the value of production, meaning that every 100 kg of production value will be obtained as much as 58.1 kg of profit.

1. Introduction

Cayenne pepper is a strategic commodity [1] and the main vegetable commodity in Gorontalo Province with a harvest area of 2,606 Ha with a production of 25,126 tons [2]. For the people of Gorontalo, chili can be likened to butter for the Dutch because it is used as a sauce, cooking spices, and as an appetite enhancer. The characteristics of cayenne pepper that is not durable and is always consumed fresh make it must be available at all times [3].

Cayenne as an agricultural commodity has a characteristic that is not available at all times is difficult to store for a long time and prices tend to fluctuate. Besides cayenne pepper has a high level of damage caused by pests and diseases so that farmers often experience losses in the form of production down or crop failure. The implication is that chili requires treatment such as good supply chain management and post-harvest treatment such as dried or mixed material for the processing industry [4]. Processed chili products consist of two forms, namely: semi-processed processed products and processed products. Semi-processed



processed products are made to anticipate if production is abundant, so the selling price of cayenne pepper is very low. This product is sold for home industrial purposes such as in the manufacture of chips, instant noodle industry, canned food and other foods such as dried chilies, chili powder, and chili paste. While processed products such as chili sauce, chili sauce, and shredded chili [5].

The supply chain is a network of companies that work to create and deliver a product to the end-users together [6]. A supply chain is an entire network related to the activities of a firm that links suppliers, factories, warehouses, stores, customers. There are three aspects that must be regulated in the supply chain mechanism, namely: material flow from upstream to downstream, financial flow and information flow from upstream to downstream [6–8]. Based on the supply chain concept, there are three stages in material flow. Raw materials are distributed to manufacturers to form a physical supply system, manufacturers process raw materials, and finished products are distributed to end customers to form physical distribution systems. Material flow patterns indicate that raw materials are distributed to suppliers and manufacturers who do the processing so that the finished goods are ready to be distributed to customers through distributors. Product flow occurs from suppliers to information. The request from the customer is translated by the distributor and the distributor conveys to the manufacturer, then the manufacturer distributes the information to the supplier [8]. The success of the food supply chain depends on the strong and effective interaction between the ingredients supplier, the main packaging material provider, repackers, printing companies, intermediary traders and other suppliers [6,9].

The supply chain is more emphasized in the material and information flow series, while supply chain management emphasizes efforts to integrate supply chain assemblies [10,11]. Agricultural product supply chain management represents overall management of processing, distribution, marketing, to the desired product reaches the consumers, which aims to make the entire system efficient and effective, minimizing the costs of transportation, and distribution to the inventory of raw materials, semi-finished materials, and finished goods [6,8,12].

In the agricultural commodity system, there is a commodity flow that flows from upstream to downstream, which starts from the farmer and ends at the end consumer and gets treatments such as processing, preserving and transferring to add a user or cause added value. This relates to the nature of agricultural products that are perishable (easily damaged) and bulky owned by agricultural products [13]. The concept of added value to agriculture is when an item gets treated both during the production process or distribution to consumers so with these activities, consumers spend more money on goods they buy. The purpose of the added value is to measure the remuneration received by businesses and employment opportunities that can be created by the commodity system [14]. Added value is related to the supply chain principle because by adding value to an agricultural product, the commodity will be more easily accepted by the broad market [15].

Several studies on flow in the supply chain have been carried out, including research about the supply chain concept which consists of three (3) stages in material flow, namely: raw material flow, financial flow and flow information, which is used to evaluate cassava supply chain flow in Central Java [7]. The material supply chain of cayenne pepper in Tomohon City [16]. Analyzed the flow of material downstream from the cereal supply chain in France [12]. Therefore, the study aims to describe the pattern of product flow in the supply chain of cayenne pepper in Gorontalo.

2. Methods

The research method used was a survey method. Sampling technique using purposive sampling method with the object of research is farmers and traders of cayenne pepper. Data needed in this study are primary data and secondary data. Primary data were obtained from observations and direct interviews with 30 farmers and 40 cayenne pepper traders. While secondary data sourced from the Ministry of Agriculture of the Republic of Indonesia. This research was carried out for from January-October 2018 in Gorontalo Province,

The flow of fresh cayenne products starts from farmers to consumers as follows:

1) Farmers → Wholesalers → Traders in Isimu and Palu City

Cayenne pepper farmers in Randangan Pohuwato Subdistrict distribute their crops in the form of fresh cayenne pepper to Wholesalers in the district capital. This is often done by farmers when abundant chili yields, this usually occurs in the 1st harvest until the 6th harvest. Wholesalers buy cayenne pepper to intention to resell outside the city, namely to large traders outside the city in Isimu and Palu City. Delivery of fresh cayenne pepper to Palu from Randangan approximately 1,200 kg, this is only done at any time if there is demand. Delivery of cayenne pepper to Palu by road can be taken approximately 8-10 hours by inter-provincial bus. Then the wholesalers in Palu sent cayenne pepper to Samarinda via the port for 2 nights. While shipping cayenne pepper to out-of-town traders in Isimu takes about 4 hours by road using a pick-up car rented by a large trader. Delivery of cayenne pepper to out-of-town traders in Isimu to send the cities of Manado and Bitung is done every day around 1,300 kg a day, except holidays. After cayenne pepper is bought by an out-of-town trader in Isimu, then out-of-town trader hires people to sort cayenne pepper, ie separating cayenne pepper whose quality is not good to fresh. In the sorting process, there is usually a depreciation of about 5 kg in 1 sack containing 55 kg of cayenne pepper. After sorting, then put in a sack. The results of the remaining sort are taken back by traders out of town in Isimu to be dried for a week. The result of drying cayenne pepper then becomes dry chilies that can be resold when the supply of cayenne pepper on the market decreases. The cayenne pepper is then stored for 1-2 days in a storage warehouse then the next day it is sent to big traders outside the city in the cities of Manado and Bitung. Delivery of cayenne pepper from Isimu to the cities of Manado and Bitung is reached by road about 8-10 hours by pick-up car. While shipping to Surabaya and Biak (through Isimu's big traders in Gorontalo Regency) is not every day, only if there is demand, where the demand is up to 2,000 kg. Delivery of cayenne pepper to Surabaya and Biak by plane.

2) Farmers → Large traders → Out-of-town traders (Manado and Bitung).

Cayenne pepper farmers in Anggrek and Kwandang Subdistrict, in North Gorontalo District, directly distribute their harvests to large traders in the Pontolo Plot the capital of the Regency. Large traders then send them to out-of-town traders in the cities of Manado and Bitung. Delivery of cayenne pepper from Kwandang to Manado and Bitung ranges from 4,000 kg a day or an average of 1,333 kg which is carried out every day except holidays and holidays. Delivery of cayenne pepper to the cities of Manado and Bitung by road can be taken approximately 8-10 hours by using a pick-up car rented by a wholesaler for at Rp 150,000 a sack. Out-of-town traders in Manado and Bitung supply cayenne pepper from North Gorontalo to Manado Wanea Market and Biri Giriyan Market, as well as supermarkets in the city. The quality types of cayenne pepper are also distinguished from class I for supermarkets and class II for sale in the market.

3) Farmers → Collector Traders → Large Traders → Out-of-Town Traders (Manado and Bitung).

Cayenne pepper farmers in Anggrek, Kwandang, and Sumalata districts of the North Gorontalo Regency sell their production to collectors who often pick up directly to farmers. Collecting traders in Anggrek and Kwandang Districts then sell it to Large Traders in the Pontolo Plot with a transaction volume of around 1,593 kg a day or an average of 318.6 kg a day. Delivery of cayenne pepper by collectors is done every day using a motorcycle with a distance of approximately 15-20 minutes. Meanwhile, collecting traders in Sumalata Sub-District send cayenne pepper to Large Traders in the Pontolo Plot using a pick-up car or city transportation car with a distance of approximately 4 hours by road.

Wholesalers hire people to sort cayenne pepper, usually, there is a shrinkage of about 5 kg in 1 sack containing 55 kg of cayenne pepper. After sorting, then put in a sack. The results of sorting the remaining cayenne pepper that was not sent were taken by the sorter. Cayenne pepper in a sack is then stored for 1 day

then the next day it is sent to big traders outside the city in the cities of Manado and Bitung. Delivery of cayenne pepper from Kwandang to Manado and Bitung ranges from 4,000 kg or an average of 1,333 kg a day which is carried out every day except holidays and holidays. Delivery of cayenne pepper to the city of Manado and Bitung by land which can be taken approximately 8-10 hours by using a pick-up car as well as channel 2.

4) Farmers → Collector Traders → Large Traders → Out-of-Town Traders → Retailers in Gorontalo City → Consumers, Agro-Industry and Restaurants.

Collector traders often pick fresh cayenne pepper directly to farmers in Randangan Pohuwato District. Then sell it to Wholesalers in the district capital with a transaction volume of around 900 kg a day or an average of 300 kg a day. Delivery of cayenne pepper by collectors is done every day using a motorcycle with a distance of approximately 15-20 minutes. Wholesalers buy cayenne pepper intending to resell outside the city, to large traders outside the city in Gorontalo City. Pohuwato-Gorontalo City takes about 4 hours by road using a pick-up car. Delivery of cayenne pepper to out-of-town traders in Gorontalo City is done every day around 500 kg a day, except holidays and holidays. Out-of-town traders in Gorontalo City buy cayenne pepper from wholesalers in Pohuwato Regency to resell to retailers in the Central Market of Gorontalo City. Out-of-town traders in Gorontalo City to the Central Market by motorcycle or *bentor* with a distance of 15 minutes. Then retailers in Gorontalo Central Market sell fresh cayenne pepper to consumers, agro-industries, and restaurants, which are carried out every day around 90 kg or an average of 22.5 kg. Agroindustry processes cayenne pepper into Sambal Sagela and leaves it in a gift shop in Gorontalo City. While retailers, besides selling fresh cayenne peppers, also sell no-stalk cayenne pepper and dried cayenne pepper. Where consumers are restaurants and meatballs sellers.

5) Farmers → Collector Traders → Reseller Traders → Consumers.

The harvest of cayenne farmers is directly picked up by collectors at the location. Then the retailer buys cayenne pepper to the collecting trader with a purchase of 350 kg or an average of 116.7 kg every 2-3 days which then takes it to the local market with a distance of 15-30 minutes. Retailers bring cayenne pepper that has been packaged in sacks using *bentor* to the Orchid Market, Molingkapoto, Moluo, Gentuma, Randangan, and Marisa.

6) Farmers → Retailers → Consumers.

Cayenne pepper farmers bring their harvest directly to retailers in the Anggrek Market, Molingkapoto, Moluo, Gentuma, Randangan, and Marisa. This is done because the farmers harvest volume is only a little; this is done at the 7th and 8th harvest when the cayenne pepper yield starts to decrease in number, so farmers prefer to sell directly to retailers in the market, so they can quickly get profits. The transaction volume of farmers to retailers is 196 kg or an average of 23.3 kg. Farmers bring cayenne pepper that has been packaged in sacks using *bentor* or motorcycle with a distance of 15 minutes by road.

7) Farmers → Market Traders → Retailers → Consumers.

Farmers' harvests are directly picked up by market traders at the location with an average purchase of 200 kg per day. Then the market traders bring cayenne pepper that has been packaged in sacks to the market namely Pasar Anggrek, Molingkapoto, Moluo, Gentuma to be sold directly to retailers. The means of transportation used is a *bentor* by road with a distance of 15-20 minutes.

In general, the flow of fresh cayenne products in Gorontalo Province is based on the availability; the sale of cayenne pepper depends on the amount of supply available in farmers and traders. The product flow is very smooth to get out of town, especially the cities of Manado and Bitung because it is supported by

adequate transportation and road infrastructure. Most of the respondent farmers prefer to sell to collecting traders (40%) even though the sales volume is not as big as that of the large traders. This is due to the bonds between farmers and collectors, namely in terms of loans, both in the form of money and production facilities. The relationship between farmers and collectors is a habit where farmers do not have enough capital and knowledge to market chilies directly to consumers. Traders usually have enough capital to run their business and have a large network of traders who become partners [17].

When the production of cayenne pepper increases and the price of cayenne pepper falls, many farmers in Gorontalo allow the cayenne pepper to rot and do not harvest the results, but at the level of wholesalers and retailers, they store and dry the cayenne for 1-2 weeks. When prices rise, they then sell it in the form of dried cayenne pepper. The commodity of dried cayenne pepper often appears when the price of cayenne pepper is expensive and rare to be obtained in the market. The added value of processing cayenne pepper into dry chilli in Gorontalo can be seen in table 1.

Table 1. Analysis of hayami added value for dry cayenne pepper in Gorontalo, 2018.

No.	Variable	Value
1	Output (kg a day)	25.00
2	Raw materials input (kg a day)	100.00
3	Labor input (HOK day)	3.43
4	Conversion Factor	0.25
5	Labor coefficient	0.03
6	Product Price (Rp a day)	50,000.00
7	Labor wages (Rp/HOK)	4,000.00
Revenue dan Profit (Rp a kg cayenne pepper)		
8	Price of raw materials input (Rp/kg)	5,000.00
9	Other input contributions (Rp/kg)	100.00
10	Product Value (Rp/Kg)	12,500.00
11	Added Value (Rp/Kg)	7,400.00
	Added value ratio (%)	59.20
12	Labor income (Rp/Kg)	137.20
	Share of labor (%)	1.85
13	Profit (Rp/Kg)	7,262.80
	Profit rate (%)	58.10

Source: Primary data Analysis, 2018

Table 1 explains that with raw materials an average of 100 kg/day produces Dry Chillies as much as 25 kg a day. The processed products are sold at an average price of Rp 50,000 a kg. The conversion factor value is 0.25 so the value of the product is Rp. 12,500/kg. The added value in every one kg of dried chillies is Rp 7,400 or 59.20% of the product value. The profit level of this processing is 58.10% of the product value, which is Rp. 7,262/kg. The advantage of Hayami's value-added analysis is that it can be seen the amount of added value, and the amount of remuneration to the owners of production factors and can be applied outside the processing sub-system, such as marketing activities [13,18,19].

4. Conclusion

The product flow pattern in the supply chain of cayenne peppers is the distribution of products in the form of fresh cayenne and dried cayenne. Generally, the flow of fresh cayenne products in Gorontalo is based on availability, where the sale of cayenne pepper depends on the amount of supply available in farmers and traders. The product flow is very smooth to get out of town, especially the cities of Manado and Bitung because it is supported by adequate transportation and road infrastructure. Most of the respondent farmers prefer to sell to collectors (40 percent) even though the sales volume is not as big as at large traders, the rest through large traders (26.67 percent), market traders (10 percent) and directly to retailers (23.33 percent). The flow of dried cayenne products in the form of processing and selling of dried cayenne pepper is directly carried out by retailers to consumers in the market. The added value created from every kilogram of fresh cayenne pepper is Rp 1,126,688 or 90.27% of the production value. Hayami's added value analysis shows that the added value in every one kg of dried chilies is Rp 7,400 or 59.20% of the product value. The profit rate is 58.1% of the production value; it means that every 100 kg of production value will produce a profit of 58.1 kg.

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