

## LETTER OF ACCEPTANCE

Dear Author,

On behalf of International Symposia on Horticulture (ISH) 2018 committee, we would like to congratulate you that the abstract with

Title : The Agroecosystem Of Salak Gulapasih In New Development Areas In Bali  
Author : I Ketut Sumantra and Eka Martiningsih  
Presentation Method : Poster

**Has been accepted** to ISH 2018. Please kindly submit your abstract revised and full paper before the deadline and through your ISH account for the next review process.

The **selected paper will be published** in ISH 2018 proceeding by IOP publisher. Please ensure that your manuscript has been written with the following IOP format before submission. You can download the guidelines for author through this link <http://ish2018.hortind.net/index.php/author-guidelines-2/>.

For your information, we would like to remind you the important date of ISH 2018 and the list of registration fees

September 10, 2018 : Abstract Announcement II  
September 20, 2018 : Submission deadline for abstract revised  
October 20, 2018 : Submission deadline for full paper  
September 25-Nov 25, 2018 : Receipt of Presentation Materials and Poster

Participants	Early Bird Registration April 25 – September 25, 2018 (per paper)	Late Registration September 26 – November 25, 2018 (per paper)
Domestics	USD 45	USD 55
Foreign	USD 125	USD 150

For any details about ISH 2018, do not hesitate to contact us through ISH 2018 email [ishti.2018@gmail.com](mailto:ishti.2018@gmail.com). We look forward to seeing you in Kuta, Bali on November 27 – 30, 2018.

Sincerely Yours,

Organizing Committee



**INTERNATIONAL SYMPOSIA  
ON HORTICULTURE**

Dr. Yudi Sastro

International Symposia on Horticulture (ISH) 2018

# PROCEEDING

# International Symposia on Horticulture

Kuta Bali, Indonesia

November 27-30, 2018

*Emerging Challenges and Opportunities  
in Horticulture Supporting Sustainable  
Development Goals*



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# PROCEEDINGS OF INTERNATIONAL SYMPOSIA ON HORTICULTURE (ISH) 2018

“Emerging Challenges and Opportunities in  
Horticulture Supporting Sustainable Development  
Goals”

(Kuta, Bali, Indonesia 27-30 November 2018)

Indonesian Center for Horticulture Research and Development  
Indonesian Agency for Agricultural Research and Development  
Ministry of Agriculture Republic Indonesia

# Proceedings of International Symposia on Horticulture (ISH) 2018

## “Emerging Challenges and Opportunities in Horticulture Supporting Sustainable Development Goals”

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## Foreword

The International Symposia on Horticulture (ISH) was held for 4 days from 27 until 30 November 2018. This Symposia was organized by Indonesian Center for Horticulture Research and Development (ICHORD) under Indonesian Agency for Agricultural Research and Development (IAARD) Ministry of Agriculture, and was supported by Australian Center for International Agricultural Research (ACIAR), Indonesian Horticulture Association (PERHORTI) and Indonesian Agronomy Association (PERAGI). Theme of ISH was "Emerging Challenges and Opportunities in Horticulture Supporting Sustainable Development Goals". The outputs of the Symposia were (1) elevation a number of new ideas of horticulture innovation development, (2) spread information related to technology of horticulture innovation among horticulture scientists and practitioners, and (3) increase collaboration among the various parties to develop agri-horticulture networks.

This event was attended by approximately 200 participants from various institutions such as from Universities, Government Officers, Private Company, and also horticulture observers. They came from some countries, Indonesia, Japan, Philippines, Thailand, Malaysia, Brazil, Iran, India, South Korea, New Zealand, Ukraine and Germany. Around 132 participants were oral presenter and 71 participants were poster presenter. The symposia was enriched by 23 resource persons who shared their knowledge which were 10 from Indonesia; and 13 resources persons were from International Institution such as FAO, ACIAR, Agriculture Technology and Knowledge Extension Iran, Adelaide University, Queensland University, Humbolt University, Gent University, Sizuoka University, Leibniz University Hannover, CIRAD, and Sakata Seed Company.

This proceeding contains 5 main topics such as tropical and sub-tropical fruits, vegetables, ornamental plants, socio economics studies and integrated crop managements, which have been selected and reviewed by reviewers.

In this opportunity, I would like to deliver a highly appreciation to the resource persons for willingness to share their knowledge, to all participants and organizing committee for all their contributions. Hopefully this proceeding can bring benefits to all of us and for the development of horticulture innovations.

Thank you

**Dr. Ir. Hardiyanto, MSc**

Director of ICHORD and President of ISH 2018

## Welcome Remark



DIRECTOR OF ICHORD

International Symposia On Horticulture:

Emerging Challenges And Opportunities In Horticulture Supporting Sustainable Development Goal

November 27 - 30, 2018

Bali, Indonesia

- Honorable Director General of IAARD
- Honorable Colleagues in Ministry of Agriculture
- Honorable invited speakers
- Distinguished Guests and Participants
- Ladies and Gentlemen,

Good Afternoon,

Assalamu'alaikum Warahmatullahi Wabarakatuh,

First of all, let us say Grace to Allah SWT the Almighty God, for all His blessings so we could gather here in International Symposia on Horticulture. It is my pleasure to extend my warmest welcome to all of you to this important conference at the exotic island of Indonesia, Bali.

This conference is organized by Indonesian Center for Horticulture Research and Development (ICHORD), Indonesian Agency for Agricultural Research and Development (IAARD), Ministry of Agriculture, the Republic of Indonesia.

Distinguished Guests and Participants,

The International Symposia on Horticulture is held starting today on 27th of November to 30th of November, 2018 with the following theme: "Emerging Challenges And Opportunities In Horticulture Supporting Sustainable Development Goal".

The four-days conference is aimed at capturing advance information and technology innovation to support horticulture sector development. We hope that this conference will provide discussion forum for national and international research scholars, policy makers, scientists, practitioners, extension agents, students and other professionals to address the challenges of horticulture innovation.

Five important issues will be discussed throughout the conference which include; (1) Promote the Exotic of Tropical and Sub Tropical Fruits to Enhance Competitiveness and Penetration into Modern Markets, (2) Modern and Urban Farming System for Healthy and Safety Vegetable Products; (3) Colouring the World with Ornamental Plant Innovations or Prosperity; (4) Implementation of Integrated Crop Managements to

Support Food Sovereignty Based on Bio-industry; and, (5) Emerging Trends of Horticulture Impacting Global Markets: The Socio Economic Studies.

Distinguished Guests and Participants,

This conference is attended by 37 international participants from 14 countries: France, United Kingdom, Ireland, Australia, Nigeria, Pakistan, Japan, Thailand, Malaysia, Philippines, Myanmar, Singapore, Vietnam, Cambodia, and 168 colleagues from all over Indonesia.

On the next 3 days, 10 invited papers and 205 supported papers will be presented, consisting of 132 oral and 71 poster presentations. Participants will also have the opportunity to visit one of IAARD project on Bioindustry in Bali during one day field trip on the third day.

Distinguished Guests and Participants,

Let me take this opportunity to express our high appreciation to our partners: ACIAR, PERHORTI, PERAGI for supporting this conference. I also would like to sincerely thank our honorable keynote and invited speakers and all participants for your active participation and support.

Last but not least, I would like to express my gratitude to the organizing committee whose endless dedication has been priceless to organize this event. I wish you all have a most successful conference and enjoy your stay in Bali.

Finally, I would like to kindly ask Sekretary General of IAARD to officialy open this conference.

Thank you.

Wassalamu'alaikum warohmatullahi wa barokatuh

Director of ICHORD

**Dr. Hardiyanto**

## Opening Remarks



Director General of IAARD-MOA

International Symposia on Horticulture:

Emerging Challenges And Opportunities In Horticulture Supporting Sustainable Development Goal

November 27 - 30, 2018, Bali, Indonesia

- Honorable invited speakers
- Honorable Colleagues in Ministry of Agriculture
- Distinguished Guests and Participants
- Ladies and Gentlemen,

Good Afternoon,

Assalammu'alaikum wa Ramatullahi wa Barakatuh,

I would like to begin by giving thanks to God Almighty Allah Subhanahu Wa Ta'ala; His blessings are evident as we gather here today to take part in "International Symposia On Horticulture: Emerging Challenges And Opportunities In Horticulture Supporting Sustainable Development Goals" in Kuta, Bali, Indonesia.

Distinguished Participants, Ladies and Gentlemen

According to United Nation projections, the world's population could reach 9.15 billion by 2050, creating a 60 percent increase in demand for food. Hence, the demand on sustainable and easy access to safe, fresh, nutritious, tasty, and convenient food to maintain a healthy and active lifestyle will also be increased.

In order to full fill the demand, Indonesian government, through Ministry of Agriculture, has set strategic targets to achieve food self sufficiency by: (1) increasing products value added, competitiveness, exports, and import substitution; (2) provision and improvement of bio-industrial raw materials and bioenergy; and (3) improvement of farmers welfare.

Distinguished Guests, Ladies and Gentlemen

Horticulture sector with its high economic value plays an important role to achieve the above goal. However, this sector still faces many challenges. Some of the issues we need to address are how to increase competitive advantages in horticulture products, and how to create an efficient and effective chain management from land to the airport or marketing centers. Another challenge is creating and maintaining strategic linkages in local, regional and international network.

In case of horticulture export development, there is growing concern about the safety of horticultural products. Exported products are often rejected by the importing countries due to the presence of

unwanted contaminants. Development of rapid, simple, and relatively accurate detection methods for contaminants as well as their prevention and elimination technologies is necessary.

Distinguished Guests, Ladies and Gentlemen

I applaud the collaboration of you all to convene this four-days event. From our discussion, I expect that we can share knowledge and information to strengthen horticulture development. I hope the results of this conference would become valuable references to address the emerging challenges and opportunities in horticulture to support sustainable development goals.

In this regard, I would like to invite all stakeholders to actively participate and support this important conference. With Bismillahirrahmanirohim, it is now my distinct pleasure to declare this symposium open. I wish you a fruitful and successful conference.

Thank you

Wassalamu'alaikum wa rohmatullahi wa barokatuh

**Director General of IAARD**

## ISH 2018 Scientific Committees

1. Dr. Hardiyanto, MSc, Indonesian Center for Horticulture Research and Development
2. Dr. Bambang Sayaka, Indonesian Center for Agriculture Socio Economic and Policy Studies, Indonesia
3. Prof. Budi Marwoto, Indonesian Ornamental Crops Research Institute, Indonesia
4. Dr. Witono Adiyoga, Indonesian Vegetables Research Institute, Indonesia
5. Dr. Laksmiawati Prabaningrum, Indonesian Vegetables Research Institute, Indonesia
6. Dr. Agus Sutanto, Indonesian Tropical Fruits Research Institute, Indonesia
7. Prof. Dr.Ir. Irham, M.Sc., Universitas Gadjah Mada, Indonesia
8. Stefano De Faveri, Department of Agriculture and Fisheries (Queensland), Australia
9. Atsushi Koseki, Sakata Seed Corporation, Japan
10. Prakrit Somta, Ph.D, Kasetsart University, Thailand
11. Rima Setiani, M.M, Indonesian Center for Horticulture Research and Development, Indonesia
12. Rizka Amalia Nugrahapsari, M.Si, Indonesian Center for Horticulture Research and Development, Indonesia
13. Puspitasari, M.Si, Indonesian Center for Horticulture Research and Development, Indonesia
14. Rini Murtiningsih, Ph.D., Indonesian Center for Horticulture Research and Development, Indonesia
15. Dr. M. Sabran, Indonesian Center for Agricultural Biotechnology and Genetic Resource Research and Development, Indonesia
16. Dr. Dita Agisimanto, Indonesian Citrus and Subtropical Fruits Research Institute, Indonesia
17. Dr. Affandi, Indonesian Tropical Fruits Research Institute, Indonesia
18. Dr. Setyadjit, Indonesian Center for Agricultural Post Harvest Research and Development, Indonesia
19. Dr. Deden Derajat Matra, Bogor Agricultural University, Indonesia
20. Dr. Idha Widi Arsanti, Indonesian Agricultural Education Center, Indonesia
21. Dr. I Made Rai Yasa, Assessment Institution for Agricultural Technology Bali, Indonesia
22. Dr. Agus Muharam, Indonesian Center for Agricultural Technology Assessment and Development, Indonesia
23. Dr. Kurniawan Budiarto, Indonesian Ornamental Crops Research Institute, Indonesia
24. Dr. Syafaruddin Indonesian Industry and Freshner Crops Research Institute, Indonesia
25. Prof. Darda Efendi, Bogor Agricultural University, Indonesia
26. Hafith Furqoni, M.Si, Bogor Agricultural University, Indonesia
27. Dr. Yudi Sastro, Indonesian Center for Horticulture Research and Development, Indonesia
28. Dr. Nurul Humaida, Bogor Agricultural University, Indonesia
29. Dr. I Made Supartha, Udayana University, Indonesia
30. Dr. Noor Roufiq, Indonesian Center for Horticulture Research and Development, Indonesia



## ISH 2018 Speakers

International Speakers			
Name	Position	Institution	Country
Irene Kernot Ph.D	Research Program Manager for Horticulture	Australian Centre for International Agricultural Research	Australia
Prof. Randy Stringer	Lecture and Researcher	Adelaide University	Australia
Bahman Amiri Larijani, Ph.D	Director General of Agricultural and natural resources extension office related to Research, Education and Extension Organization (AREEO)	Iran Ministry of Agriculture	Iran
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# INTERNATIONAL SYMPOSIA ON HORTICULTURE

*Emerging Challenges and Opportunities in Horticulture  
Supporting Sustainable Development Goals*

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**PROMOTE THE EXOTICS OF TROPICAL AND SUB TROPICAL  
FRUITS TO ENHANCE COMPETITIVENESS AND PENETRATION  
INTO MODERN MARKETS**





## The Agroecosystem of Salak Gulapasir (*Salacca zalacca* var. *amboinensis*) in New Development Areas in Bali

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**Abstract.** This research was aimed to identify the agro ecosystem characteristics of salak Gulapasir (*Salacca zalacca* var. *amboinensis*) and the environmental factors affecting the yields and quality of the fruit. The research was conducted at Sub-district of Slemadeg Barat, and Sub-district of Pupuan, Survey was conducted in each location within the agro ecosystem zone of 400-500 m above sea level (asl), 501 – 600 m asl, 601-700 m asl and 701-800 m asl. Yields and quality of fruit from each area, was analysed using Randomized Complete Block Design (RCBD) with four replications. The analysis of ground water balance contents in each area was done using Thornthwaite and Mather methods (1957). The measurement of the physical and chemical characteristics of the soil was in accordance with the data required for the agroecosystem analysis. The results of the studies indicated that the monthly rain fall over a period of 10 years according to Oldeman method that the zones between 400-500 m asl and that of 501 – 600 m asl were classified as C2 agro climate zone, the zones between 601 – 700 m asl were categorized as B2, and the ones between 701 – 800 m asl belongs to B1. The results of the analysis of soil water contents indicate that the 400 – 500 m asl zones experience the highest water deficit (125.82 mm/year) while within the 701-800 m asl zones there was annual water surplus. The studies indicated that different agroecosystem zones truly affect yields and quality of fruit. The highest weight and quality of fruits are produced within the 501-600 m asl zones.

**Keywords:** *Salak Gulapasir, new area, development, agroecosystem.*

### 1. Introduction

There are a number of varieties for Salak Bali, depending on fruit characters (forms, aroma, taste and skin colour) or locations where the fruits are cultivated (Darmadi et al., 2002; Sumantra et al., 2016). Until today, there are two varieties of Salak Bali, i.e. according to the Decree of the Indonesian Minister of Agriculture on Salak Bali (SK.No.585/Kpts/TP.240/7/94) and Salak Gulapasir (SK.No.584/Kpts/TP.240/7/94). Salak Gulapasir has high quality because its sweet taste even the fruits are still young, thick flesh and the price is four times of Salak Bali. This fruit is considered ideal to meet both the domestic market and export (Anonymous, 2004) and also as agro-industry and agro-tourism (Sumantra et al., 2017 and Sumantra and Anik Yuesti 2018).

The success of Karangasem in developing Salak Gulapasir inspired other areas not only in Bali but also from other island to cultivate this commodity. When initially it started in Karangasem, it has now been spread out to Tabanan, Buleleng, Badung and Bangli. From these four areas, Tabanan has the biggest area of plantation mainly in the sub-district of Pupuan and West Slemadeg (Sumantra et al., 2016; Sumantra et al., 2012).

A problem faced by farmers in the new areas of development especially in Tabanan is low yields and quality resulting in low selling prices. The results of initial studies show that the weight of individual fruit

<sup>1</sup>, bunches<sup>-1</sup>, total number of individual fruit<sup>-1</sup> and volume of bunches<sup>-1</sup> are 39.91 g<sup>-1</sup>, 779.85 gram<sup>-1</sup>, 35,6 ml respectively or more equals 7.11 %, 31.64%, 24.43% and 25% if compared to Salak Gulapasir from Sibetan, Karangasem. The skin colour of Salak Gulapasir from Tabanan tend to be brownish black while the ones from Sibetan tend to be blackish brown. Another problem faced by farmers in the new areas is traditional method cultivation. There is no intensive method of fertilizing while water supplies mainly depends on the rain fall (Ashari, 2002; Sukewijaya et al., 2009). As a result the quality is rather low and fails to meet the criteria of good quality fruit with relevance to its form, size, taste and flesh thickness (Sumantra and Labek 2015).

The cause of low quality of Salak Gulapasir in the new areas have not been known whether it is due to the effects of agroecosystem factors or plant genetic factor because the breeding of Salak Gulapasir is conducted generatively as well as due to cultivation technology itself (Sumantra and Labek 2012). The performance and produce are influenced by environmental factors particularly micro climate and endogenic factors such as carbohydrate contents, nutrient status and growth hormone (Bernier et al., 1985; Kinet et al., 1985; Leopold & Kriedemann, 1975). Climate affects almost all aspects of farming activities. The need for accurate climate information is getting more strategic to support agricultural activities. Therefore, one way of handling salak quality is by undertaking serious studies on a number of factors such as land and climate as well as to adjust agricultural patterns in accordance with local climate condition. The adjustment should be based on identification, understanding or accurate interpretation of land and climate in each agroecosystem location. Therefore, in identifying locations with their specifically local climate suitable for salak cultivation requires comprehensive interpretation of land and climate.

This research aimed to identify agroecosystem characteristics of Salak Gulapasir in new development areas as well as factors affecting its yields and quality. The results of the studies can be used to determine accurate cultivation techniques (fertilising, water management and shade trees), to improve product competitiveness and to preserve land caring capacity.

## **2. Methodology**

The agro ecosystem studies of Salak Gulapasir was conducted in new area of development in some villages in Tabanan district such as Kebon Jero, Anggesari, Munduk Temu, Pajahan, Bangsing and Sarinbuana, during harvest season of December-April 2015. The objects under studies were Salak Gulapasir trees approximately aged 8 years, located in Salak development centre in the sub-district of West Slemadeg and Pupuan in Tabanan within the agroecological zones of 400 – 800 m asl. The agroecosystem locations were determined using purposive sampling techniques in 16 locations each for 16 salak trees. The equipment used to conduct the studies are 60 CSX GPS maps, thermometer, hygrometer, Light photometer, soil moisture tester, borer, spade, hoe, rope, measuring tape, scale, oven and laboratory equipment for soil and fruit quality analysis.

The research used survey methods, including collection of secondary data, field observation to identify agroecosystem boundaries, sample observation, soil and plant organ sampling and laboratory analysis. In order to know the difference of fruit yields and quality in each agroecosystem zone, study were used single factor Randomized Completely Block design with 4 replications. On basis of area spread, the agroecosystem zones of Salak Gulapasir were divided into 4 zones, i.e., 400 – 500 m asl; 501 – 600 m asl; 601 – 700 m asl; and 701 – 800 m asl.

The analysis of land water balance used Thornthwaite and Mather analysis method (1957). Analysis on climate condition was the average of monthly temperature and the data on the average of monthly rain fall during the normal period of 2001 – 2010 from the 4 post in the research areas. In calculating the water balance the following input data were required: rain fall (R), potential evapotranspiration (ETP),



ground water contents in the field capacity (FC), ground water contents at permanent wilting point (PWP). The ETP value was calculated using the following equation.

$$ETP = 1,6 F (10 T/l)^{\alpha}$$

Notes:

$$I = \text{Heat accumulation index in one year} = (T/5)^{1.54}$$

$$T = \text{Average temperature (}^{\circ}\text{C)}$$

$$F = \text{Length of day lights}$$

$$\alpha = \text{value determination: } \alpha = 675 \times 10^{-9} \times I^3 - 771 \times 10^{-7} \times I^2 + 1792 \times 10^{-5} \times I + 0.49239$$

The steps of calculating area water balance using Thornthwaite dan Mather method (1957) are as follows:

- Filling in the column for average of monthly rain fall (R).
- Filling in the column for potential evapotranspiration (ETP).
- Filling in the R-ETP column. This value is required to determine the period of water deficit and surpluses.
- The negative value of the above steps is accumulated every month known as the accumulation of potential water loss (APWL) which is the total amount of lack of rain fall for Filling in the column for average and is entered the right column.
- Filling in the column for ground water contents (GWC), where ground water contents can be at the maximum level during a certain period where R-ETP has negative value. If the R-ETP value is negative, the ground water contents is then determined based on Soil Moisture Retention Table which depends on the value of field capacity of the researched areas.
- Filling in the dKAT column (change of ground water contents). The change of ground water contents is the difference of ground water content between one period and the one before ( $KA_{Ti} - KA_{Ti-1}$ ). The positive dKAT value shows an increase in ground water contents.
- Filling in Actual Evapotranspirational column (ETA), when the water fall reaches or surpasses the potential evapotranspirational value then  $ETA = ETP$ . If the rain fall is lower than the potential evapotranspiration, the lands begins to dry out and that ETA is smaller than ETP, which in this condition the value of  $ETA = R + dKAT$ .
- Filling in the deficit column with the formula  $ETP - ETA$ . Deficit means that the decrease of water contents required for potential evapotranspirational. Therefore, water deficit is the difference between the potential evapotranspirational value with the actual value ( $ETP - ETA$ ). The deficit value is the total amount of water to be added to fulfill the need of potential evapotranspiration.
- Filling in the surplus column with  $R-ETP-dKAT$ . After the ground water deposit reaches the Field Capacity (FC), the rain fall surplus is calculated as the value of rain fall minus potential evapotranspiration and change of ground water contents.

The observation and measurement of physical land characteristics in the field is in accordance with the needs of the data to perform an agro ecosystem analysis for salak. The data includes drainage system, rock condition and threat of flooding and land texture (Djaenudin *et al.*, 2000).

The land fertility is determined through an analysis of soil sample taken from the different plots of composite salak plantations. The composite land sample from 8-10 drilling point, taken from each agroecosystem sub-zone is considered to have similar characteristics representing an area of 1 - 5 ha. There are three steps to determine the status of land fertility: (1) land surveys, (2) analysis of soil sample, and (3) interpretation of the results of soil analysis. The soil sampling technique was conducted using drill to 0 - 40 cm deep. The soil sample was analysed in the laboratory by calculating the percentage of sand, dust and clay using straw method; soil pH, organic materials used Black and Walky methods,

salinity level used conduct meter, CEC used  $\text{NH}_4\text{OAc}$  method, and macronutrient level: N total used Kyedall method;  $\text{P}_2\text{O}_5$  and  $\text{K}_2\text{O}$  used Bray I methods.

The observation and measurement of Salak plantation in the field was as follows: bunch weight<sup>-1</sup>, individual fruit weight<sup>-1</sup> and total fruits in a bunch<sup>-1</sup>. The fruit quality as follows: fruit volume, flesh thickness, contents of sugar, and acid content.

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

#### **3.1. Characteristics of Climate and Land**

The average annual rainfall indicates that the 400-500 m asl zones can be classified as the C2 agroclimatic zone according to Oldeman classification characterized by 6 months of wet and 3 months of dry climate. The average of annual rainfall is 2466.66 mm, with the highest rainfall was in December (369.55 mm) and the lowest in July (43.71 mm). The average temperature is 23.39 °C with the highest temperature of 24.41°C in March and the lowest in August (22.25°C) with humidity between 84.96 – 90.92%.

The 501-600 m asl zones are categorized as C2 agro climatic type with an average annual rainfall of 2564.96 mm, the highest rainfall being in December (380.87 mm) and the lowest in August (38.51 mm). The average temperature is 22.42 °C with highest in February (23.70°C) and the lowest in Agustus (21.26°C) and humidity between 87 and 91.5 %.

The 601-700 m zones are categorized as B2 agro climatic type with 9 months of wet and 3 months of dry climate. The average annual<sup>-1</sup> rainfall is 2887.83 mm with the highest rainfall in November (449 mm) and the lowest in July (57.7 mm). The average temperature is 21.61°C, the highest being in March (22.47°C) and the lowest in August (20.5°C) and humidity between 84 and 92 %.

The 700 – 800 m zones categorized as B1 agroclimatic type with 9 months of wet and 1 month of dry climate. The average annual<sup>-1</sup> rainfall is 4207.63 mm with the highest rainfall in January (701.49 mm) and the lowest in July (87.96 mm). The average temperature is 21.43 °C, the highest being in February (22.77 °C) and the lowest in August (20.33°C) and humidity between 86 and 93%.

In the 400-700 m zones the land is categorized as Typic Eutrudepts formed by the main Tufa, lava sediment of mountain of Buyan, Beratan and Batur. Typic Hapludand category of land is found at 700-800 m formed by main Tufa, lava sediment of buyan, beratan and batur.

Table 1 shows the physical characteristics of land affecting root growth of the plant which include texture, drainage system and root depth. At the depth of 80-100 cm the land contains clay and dust. There are no rocks visible on the surface with a slope between 1 and 8%. The other quality including nutrient retention such as CEC, alkali saturation, c-organic is considered high to very high (Table 1), soil pH is considered acidic (5.61 – 5.84).

The result of soil analysis regarding the contents of N, P and K shows that the total N contents is low in the four different locations, P contents is very low in the 400 – 500 m, 600 – 700 m, and 700 – 800 m asl zones, and it is low in the 500 – 600 m zones. The K contents is low in the 400 – 500 m and 700 – 800 m asl zones while it is average in the 500 – 600 m and 600 – 700 m asl zones (Table 1).

Table 1. Characteristics of salak land in various agroecosystem

No.	Measurement	Agroecosytem Zone (m asl)			
		400-500	501-600	601-700	701-800
1	Average annual temperature (t) (in °C)	23.82 (s1)	22.75 (s1)	22.12 (s1)	21.49 (s2)
	Water availability (w)				
	- Rainfall (in mm)	2369.86 (s2)	2439.20 (s2)	2865.6 (s2)	4070.4 (s3)
2	Roots growth media (r)				
	- Drainage system	Good	Good	Good	Good
	- Bulk density (g.cm <sup>-3</sup> )	0.995	0,952	0.980	0.880
	Land texture				
	- Sand	25.53	22.63	36.10	34.41
	- Dust	50.76	51.71	42.74	47.84
	- Clay	23.61	25.66	21.15	14.93
	Notes:	clay dusty	Clay dusty	Clay dusty	Clay dusty
	- Soil depth (in cm)	87 (s1)	87 (s1)	100 (s1)	100 (s1)
3	Nutrient retention (f)				
	-CEC (me/100 g)	27.20 (h)	33.65 (h)	34.87 (h)	37.13 (h)
	-Base saturation (%)	70.66 (vh)	71.11 (vh)	70.75 (vh)	70.57 (vh)
	-pH (H <sub>2</sub> O)	5.76 (ra) (s2)	5.61 (ra) (s2)	5.84 (ra) (s2)	5.70 (ra) (s2)
	-C-organic (%)	3.28 (h)	3.26 (h)	4.24 (h)	4.44 (h)
4	Nutrient availability (n)				
	-N total (%)	0.185 (l)	0.182 (l)	0.165 (l)	0.182 (l)
	-P <sub>2</sub> O <sub>5</sub> (ppm)	8.64 (vl)	10.24 (l)	8.47 (vl)	8.75 (vl)
	-K <sub>2</sub> O (ppm)	11.01 (l)	24.52 (m)	20.15 (m)	14.10 (l)
5	Salinity (c)				
	-Salinity (mmhos/cm)	1.19 (r) (s1)	0.96 (sr)(s1)	1.20 (r) (s1)	1.22 (r) (s1)

Notes: h: high; vh: very high; ra: rather acid; l : low; vl : very low; m : medium; s1 : very relevant; s2 : quite relevant; s3: marginally relevant (Djaenudin *et al.*, 2000)

### 3.2. Water Availability

The results of water content analysis in each zone show a significant difference during surplus and deficit periods. The 601-700 and 701-800 m zones have longer surplus period compared to the zone 400-500 and 501-600 m zones. The results of analysis show that the higher the zones the shorter the deficit period. In the 701-800 zones water surplus happens through the year. The deficit period in the 400-500 m zones takes place in June, July and August with a total deficit of 125,81 mm. The deficit period in the 501-600 m zones happens in June, July and August with a total deficit of 93.84 mm, while in the 601-700 m zones the deficit period is in July and August with a total of deficit of 56.9 mm. The low water deficit is due to low Evapotranspiration (ETP) (Figure 1-4).

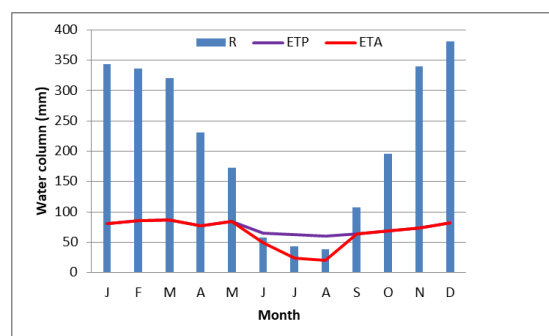
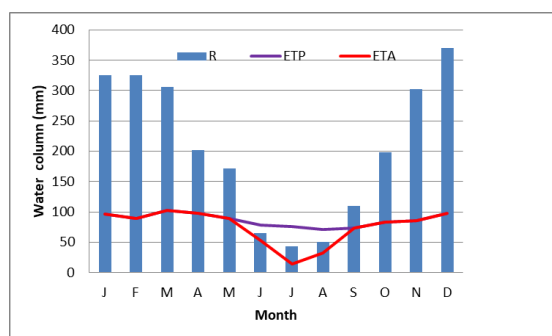


Fig. 1. Rain fall, ETP, ETA zone 400-501 m asl. Fig.2. Rain fall, ETP and ETA zone 501-600 m asl.

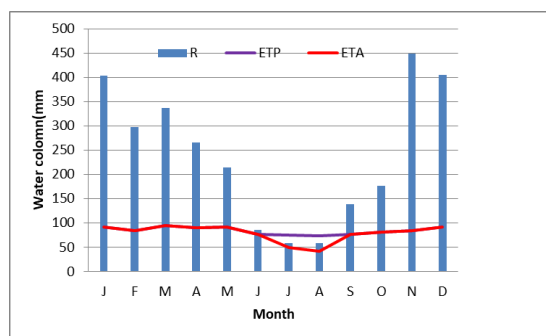


Fig. 3. Rain fall, ETP,ETA zone 601-700 m asl.

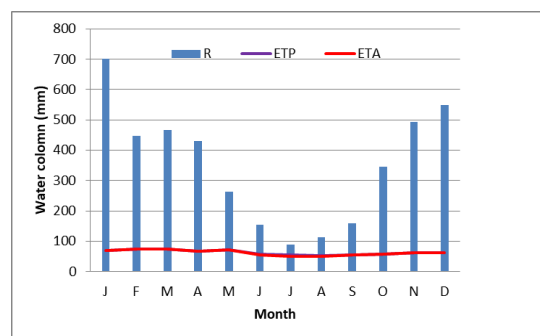


Fig.4.Rain fall,ETP and ETA zone 700-800 m asl.

Naturally, the flowers of salak Gulapasisir trees appear three to four times per year (Sumantra et.al. 2014). Flowering and pollination of fruit crops is influenced by environmental factors, particularly the microclimate such as temperature, humidity, light intensity and rainfall (Sumantra et.al., 2012). Rai et. al. (2010) found that fruit yield in Gulapasisir salak trees has a positive correlation with humidity, but a negative correlation with sunlight intensity. It means that the plants only need portion of sunlight. In fact, they need 50-70% sunlight (Sukawijaya et.al., 2019). Therefore, sunlight reduction is essential in Gulapasisir salak tree plantation. The shade trees and salak trees together will form a certain agro-ecosystem in the area.

Our inventory on types of shade trees in Gulapasisir salak tree farming system in the new development area in Bali found that each agro-ecosystem zone has different types of shade trees. The plant species was commonly used as building material and for land conservation such as Sengon (*Albisia falcate*), Suren (*Toona sureni* Merr) and Gempinis (*Melia azedarach* L.) largely dominate the zone 600-800 m asl. Commercial fruits like Mangosteen (*Garcinia mangostana* L.), Durian (*Durio zibethinus* Murr), and jackfruit (*Artocarpus heterophylla* L.) as shade trees were found in the zone 400-600 m asl. Crop species used in industry such as clove (*Eugenia aromatic* OK) was found in the zone 501-800 m asl. The different in crop species in the agro-ecosystems are strongly influenced by ecological conditions, its economic benefits and its purpose of natural resources conservation.

The results of the research showed that there were different light intercepts, humidity and temperature under salak trees. The 501-600 m zone shows that the percentage of light intercepts is the highest (80.23%) and the lowest is in the 400-500 m zone (77.73%). The temperature and humidity shows the opposite, i.e. the highs the agroecosystem zone of 400-500 to 700-800 m the temperature is lower and the humidity is higher (Table 2).

Table 2. Average sunlight intensity, temperature and humidity under salak trees in difference agro ecosystem zones

No	Parameter	Zone agroecosystem (m asl)			
		400-500	501-600	601-700	701-800
1	Sunlight intensity				
	Above salak trees (lux meter)	375.83	398.66	391.75	392.66
	Under salak trees (lux meter)	85.63	78.73	78.25	78.33
	Sunlight intercepts (%)	77.73	80.23	79.31	79.98
2	Temperature under the tree (°C)	28.14	26.24	24.28	24.13
3	RH under the tree (%)	75.33	79.12	88.45	89.50

### 3.3. Yields of Salak Gulapasisir

Salak Gulapasisir grow in the 400 – 800 m asl zone can normally bear fruits but they different in quantity (Table 3). The fruits weight in the 501 – 600 m asl zone is 1.76 kg tree<sup>-1</sup>, while in the 400 – 500 m asl

and 700 – 800 m asl zones is only 1.22 kg and 1.42 kg <sup>tree<sup>-1</sup></sup> respectively. The high weight is found in the 501-600 m asl zone with more fruits in every bunch<sup>-1</sup>, higher fruit weight<sup>-1</sup>, higher bunch weight<sup>-1</sup>.

Table 3. Average fruits per bunch, number of fruits per tree, fruit weight per bunch, and fruit weight per tree in different agroecosystem zone

Agroecosystem zone (m asl)	Total Fruits		Fruit weight		
	Bunch <sup>-1</sup>	Harvest-tree <sup>-1</sup>	Fruit <sup>-1</sup> (g)	Bunch <sup>-1</sup> (g)	Tree <sup>-1</sup> (kg)
400 – 500	17.90 b	1.74 a	34.94 b	688.78 b	1.22 b
501 – 600	21.89 a	1.99 a	42.86 a	857.38 a	1.76 a
601 – 700	19.95 ab	1.62 a	39.75 ab	791.21 ab	1.53 ab
701 - 800	18.20 b	1.74 a	37.54 b	675.12 b	1.42 ab
LSD 5 %	2.82	-	3.74	119.95	0.48
CV (%)	8.55	8.38	5.45	9.50	8.96

Notes: In the same column, the numbers followed by the same letter was not significant difference at LSD 5%.

The results of the research was in line with the studies taken by Sumantra et al. (2014), Purnomo and Sudaryono (1994) that the presentation of fruit weight, flesh weight and flesh thickness is affected by the area and altitude. Cultivar Gulapasir grown in the medium area 500 -600 m asl, demonstrates higher weight and size compared with other altitude, taste of salaks is sour if they are grow in more than 600 m asl (Sumantra et al., 2014).

The 501- 600 m asl zone is an ideal zone to grow salaks. In this zone the environmental factors including climate is much better that the other zones. This can be seen from the nutrient availability especially P and K which higher than the other zones. This nutrient availability affects the process of translocation, photosynthesis, flower development and fruit formation (Gardner et al., 1991). On the other hand, in the 501-600 zone there is a higher sunlight intercepts (80.23%) compared to the one in 400-500, 601-700 and 701-800 m zones with a sunlight intercept value of 77.73%, 79,31% and 79.98% respectively. A high intercept value means that sunlight is optimally used to perform photosynthesis which is a positive impact on flower development. This condition will affect the establish and fruits development (21.89 fruit bunch<sup>-1</sup>). The high intercepts value in 501-600 m zone is also related to the role of the shade plants of 10 m<sup>-2</sup> with 13 different species. The result of this study are in line with the findings of Sumantra et al. (2014) that the salak Gula Pasir cultivar grown in 400 – 600 m asl shows higher grade of fruit and flesh if compared with in high land > 600 m asl. It's means at an altitude of 400-600 m asl. is an ideal agroecosystem condition for zalacca plants. But the limiting factors are lack of rain water especially in June, July and August and it is necessary to supply adequate water during the dry season.

#### 4. Conclusion

The results of the research can be concluded as follows:

1. Every agroecosystem zone shows different periods of water surplus and deficit. In the 601-700 and 701-800 m zones there is longer period of water surpluses compared to the 400-600 m zones. In the 400-600 m zones the deficit period was in June, July and August with a total deficit of 125.81 mm (400-500 m) and 93.84 mm (501-600 m).
2. Agroecosystem zone has a real effect on the yields of Salak Gulapasir. The 500-600 m zones are the most ideal zones to obtain a high quality yields of Salak Gulapasir.
3. Limiting factors of salak Gulapasir in the new areas depend on the agroecosystem zones. In the 400-600 m zones the limiting factors are lack of rain water (June, July, August), level of soil pH,

nutrient status especially NPK. In the 701-800 m zones the limiting factors are soil pH, nutrient status, too high rain falls and too low temperature.

Salak Gulapasir cultivation can sustain in the new areas it is necessary to improve and modify the environment as follows:

1. It is necessary to perform intensive care of the plants by regulating the number of midribs and intense shading to produce an ideal condition for sunlight intercept (80.23%).
2. It is necessary to build a drainage system in high rain fall zones to stimulate perfect root growth and plants physiological process.
3. The improvement of soil chemical characteristics such as pH and availability of adequate nutrients with add of limestone and using both organic and anorganic fertilizers.
4. It is necessary to supply adequate water during the dry season especially in the months of water deficit in June, July, August. It is during these months the plants develop their fruit for "Gadu season" and develop their flowers for major harvest.

## 5. Acknowledgments

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# PROCEEDING

## International Symposia on Horticulture

The International Symposia on Horticulture (ISH) was held for 4 days from 27 until 30 November 2018. This Symposia was organized by Indonesian Center for Horticulture Research and Development (ICHORD) under Indonesian Agency for Agricultural Research and Development (IAARD) Ministry of Agriculture, and was supported by Australian Center for International Agricultural Research (ACIAR), Indonesian Horticulture Association (PERHORTI) and Indonesian Agronomy Association (PERAGI). Theme of ISH was “Emerging Challenges and Opportunities in Horticulture Supporting Sustainable Development Goals”. The outputs of the Symposia were (1) elevation a number of new ideas of horticulture innovation development, (2) spread information related to technology of horticulture innovation among horticulture scientists and practitioners, and (3) increase collaboration among the various parties to develop agrihorticulture networks. This proceeding contains 5 main topics such as tropical and sub-tropical fruits, vegetables, ornamental plants, socio economics studies and integrated crop managements, which have been selected and reviewed by reviewers.

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