AESAP 2017
Agricultural Engineering for Sustainable Agriculture Production

# The 2nd International Conference

## Agricultural Engineering for Sustainable Agriculture Production

IPB International Convention Center , Bogor, 23-25 October 2017

The Role of Agricultural Engineering on Adaption to Climate Change Towards Sustainable Agriculture

**Organized by :**

**Department of Mechanical and Biosystem Engineering, Bogor Agricultural University (IPB)**
**Indonesian Society of Agricultural Engineers (ISAE) Bogor Chapter**

INSTITUT PERTANIAN BOGOR

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# AESAP 2017

## The 2nd International Conference on Agricultural Engineering for Sustainable Agriculture Production

*"The Role Of Agricultural Engineering On Adaptation To Climate Change Toward Sustainable Agriculture"*

IPB International Convention Center
Bogor, 23-25 October 2017

## Background

The main scope of this conference is to discuss the application of agricultural engineering on sustainable agriculture production. The main topic area include on farm and off farm activities in agricultural production. This conference invites expert from academic, business, government and community (ABGC) to comprehensively propose the role of agricultural engineering for sustainable agriculture production.

## Presentation

Postharvest and food engineering; Renewable Energy; Agricultural machinery; Land and water resources engineering; Agricultural structures and environmental engineering; Agriculture System and management; Agricultural informatics, Bioinstrumentation and Control.

## Important Date

- Abstract Submission : 31 July 2017
- Notification of Acceptance : 31 August 2017
- Full Paper submission : 30 Sept 2017
- Registration due date : 30 Sept 2017

## Publication

Selected Paper Would be Publish on IOP Conference Series: Earth and Environmental Science (indexed by Scopus), Others Would be Publish on AESAP Procedding 2017.

## Registration Fee

**National**

Student : *Early Bird* IDR 600,000 | *Late* IDR 750,000

Non Student : *Early Bird* IDR 1,000,000 | *Late* IDR 1,250,000

**International**

Student : *Early Bird* USD 200 | *Late* USD 250

Non Student : *Early Bird* USD 300 | *Late* USD 350

***Early Bird : 1 May-31August 2017***

***All item not include fee of IOP Publication***

## Payment Address

Account Name : Sri Endah Agustina
Account Number : 0219123720
Bank BNI Cabang IPB Bogor

## Keynote & Invited Speaker

**Dr. Ir. Andi Amran Sulaiman***
Agricultural Ministry of Republic Indonesia

**Prof. Dr. Ir. Herry Suhardiyanto***
Rector of Bogor Agricultural University

**Prof. Naoshi Kondo***
President of Japan Society of Agricultural Machinery

**Prof. Dr. Ir. CGPH (Karin) Schroen**
Wageningen University and Research

**Prof. Dr. Ir. Daniel Murdiyarso***
Center for International Forestry Research

**Dr. (HC) Ir. Fauzi Toha***
Sugar Agroindustry (Sugar Group)

**Ir. Widya Wiryawan***
Astra Agro Lestari

*Please note that above speakers are still under confirmation

## Secretariat

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## Organized by

- Indonesian Society of Agricultural Engineers (ISAE) Bogor Chapter
- Department of Mechanical and Biosystem Engineering, Bogor Agricultural University (IPB).

AESAP 2017 PERTETA TMB-IPB

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CONFERENCE PROGRAM

# The 2nd International Conference

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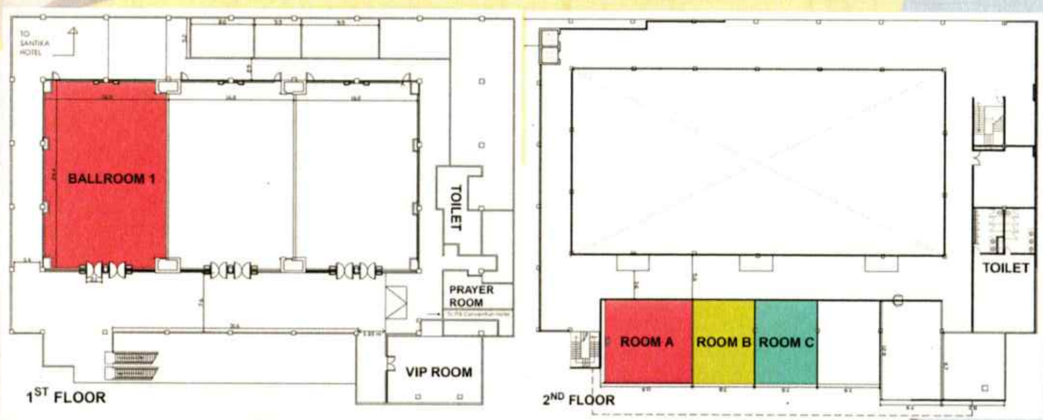
**YARI-IPB**

# CONFERENCE PROGRAM OF AESAP 2017

| First Day | Monday, 23 October 2017 | | | |
|---|---|---|---|---|
| 08.00—09.00 | Registration and Morning Coffee | | | |
| 09.00—10.00 | **Opening Ceremony and Plenary Session** (Venue: Ballroom, IICC) | | | |
| | **Greeting and Opening:** | | | |
| | Report from the Chairperson of Organizing Committee<br>*Dr. Ir. Desrial, M.Eng.* | | | |
| | Congratulatory Speech from YARI-IPB<br>*Mr. Hiroyasu Yukino, Manager of Business Creation Division - Yanmar* | | | |
| | Welcoming address from Rector of Bogor Agricultural University (IPB) (Continued with official opening):<br>*Prof. Dr. Ir. Herry Suhardiyanto, M.Sc* | | | |
| | **Keynote Speech:** Indonesian Government Policy for Promoting Sustainable Agriculture in Indonesia Indonesia<br>*Dr. Ir. Andi Amran Sulaiman, MP,* Minister of Agriculture, Republic of Indonesia | | | |
| 10.00—12.00 | **Plenary Session I**<br>Moderator: *Dr. Nanik Purwanti, S.TP, M.Sc.* | | | |
| | Applications of Microtechnology for Sustainable Food Production<br>*Prof. Dr. Ir. CGPH (Karin) Schroen (Wageningen University & Research)* | | | |
| | Climate Change and Its Impact on Agriculture<br>*Prof. Dr. Ir. Daniel Murdiyarso, MS (Center for International Forest Research - CIFOR)* | | | |
| | Application of Agricultural Engineering in Palm Oil Industry<br>Mr. Bambang Wijanarko (PT Astra Agro Lestari) | | | |
| | *Discussion* | | | |
| 12.00—13.00 | Lunch Break | | | |
| 13.00 – 14.40 | **Parallel Session I** (Venue: Meeting Room, IICC) | | | |
| | Ballroom | Room A | Room B | Room C |
| 14.40 – 15.00 | Coffee Break | | | |
| 15.00 – 16.40 | Parallel Session II (Venue: Meeting Room, IICC) | | | |
| | Ballroom | Room A | Room B | Room C |
| 18.00 – 20.00 | Gala Dinner and Cultural Night | | | |

| Second day | Tuesday, 24 October 2017 | | | |
|---|---|---|---|---|
| 08.00 – 09.00 | Registration | | | |
| 09.00—11.00 | **Plenary Session II:**<br>Moderator: *Dr. Ir. Y. Aris Purwanto, M.Sc.* | | | |
| | Food Sufficiency and Food Security in Indonesia<br>*Prof. Dr. Ir. Sutrisno, M.Agr. (Bogor Agricultural University)* | | | |
| | Advance Technology for Freshness Analysis of Fresh Produce<br>*Dr. Shinichiro Kuroki (Kobe University, Japan)* | | | |
| | Application of Agricultural Engineering in Sugar Industry<br>*Mr. Hadi Susanto (PT Sugar Group Company)* | | | |
| | Energy from and for Agriculture<br>*Ir. Sri Endah Agustina, MS (Head of ISAE Bogor Chapter)* | | | |
| 11.00—12.00 | Presentation – Student Design Competition Finalists | | | |
| 12.00—13.00 | Lunch Break | | | |
| 13.00 – 14.40 | **Parallel Session II** (Venue: Meeting Room, IICC) | | | |
| | Ballroom | Room A | Room B | Room C |
| 14.40 – 15.00 | Coffee Break | | | |
| 15.00 – 16.40 | Ballroom | Room A | Room B | Room C |

## FLOOR PLAN OF IICC



## Technical Session Schedule

Parallel : Session 1
Venue : **Ballroom**
Date : 23 October 2017

| Time | Agenda | |
|---|---|---|
| 13.00 - 13.20 | A1.1 | Measurement of Sorption Isotherm of Water by DVS Hydrosorb<br>***Yose Rizal Kurniawana***, *Y. Aris Purwanto, Nanik Purwanti, and Slamet Budijanto* |
| 13.20 - 13.40 | A1.2 | Development of Fuzzy Expert Control System For Temperature Controlling In Batch Dryer<br>***Dwi Santoso***, *Abdul Waris, and Mursalim* |
| 13.40 - 14.00 | A1.3 | Comparative analysis of quality and energy of primarycoffee processing in Gayo Arabica coffee production.<br>***Rahmat Pramulya***, *Tajuddin Bantacut, Erliza Noor, and Mohamad Yani* |
| 14.00 - 14.20 | A1.4 | Comparison in Proximate Accumulation of Rice Grainsfrom Different Branches within a Panicle during Rice GrainFilling.<br>***Rizky Tirta Adhiguna***, *Sutrisno, Sugiyono, and Ridwan Thahir* |
| 14.20 - 14.40 | A1.5 | Potency of Purple Sweet Potato's Anthocyanin as Biosensor for Detection of Chemicals in Food Products<br>***Anting Wulandari***, *Titi Candra Sunarti, Farah Fahma, and Erliza Noor* |
| 14.40 - 15.00 | Coffee Break | |

Parallel : Session 2
Venue : **Ballroom**
Date : 23 October 2017

| | | |
|---|---|---|
| 15.00 - 15.20 | A2.1 | Ultrasonic Technique for Grittiness Prediction of Salted Duck Egg<br>***Erawan S***, *Budiastra IW, and Subrata IDM* |
| 15.20 - 15.40 | A2.2 | Determination the Damage of Purple Sweet Potatoes Non-Destructively Using Ultrasonic Wave Characterization<br>***Sutrisno*** *and Fauzi Rizki Mz* |
| 15.40 - 16.00 | A2.3 | Effects Of Different Amplitudo On Selected Quality Attributes Of White Tea Extracts Obtained From Ultrasound Assisted Extraction (Uae) Techniques<br>***Asri Widyasanti***, *Selly Harnesa Putri, S. Rosalinda, and Tri Halimah* |
| 16.00 - 16.20 | A2.4 | Prediction of Caffeine Content in Java Preanger Coffee Bean by NIR Spectroscopy Using PLS and SMLR Method<br>***I Wayan Budiastra***, *Sutrisno, Sukrisno Widyotomo, and Putri Chandra Ayu* |

Parallel : Session 3
Venue : **Room A**
Date : 24 October 2017

| Time | | Agenda |
|---|---|---|
| 13.00 - 13.20 | A5.1 | Long Term Storage of Indigenous Banana Cultivar Raja Sere<br>***Crismas Sri Rejeki Saragih**, Y. Aris Purwanto, and Sutrisno* |
| 13.20 - 13.40 | A5.2 | Effect of Agitation in Alkalization Process to the Characteristics of Sodium Carboxymethylated Sago and Cassava Starches<br>***Titi Candra Sunarti,** Ridwan Fachrudin, Eka Ruriani and Indah Yuliasih* |
| 13.40 - 14.00 | A5.3 | Preparation of Multilayer Microcapsules from Nanofibrils of Soy Protein Isolate using Layer-by-Layer Method.<br>***Nanik Purwanti**, Warji, Sutrisno Suro Mardjan, Sri Yuliani, and Karin Schroën* |
| 14.00 - 14.20 | A5.4 | Effects of Aquadest Dillution in the Liquid Soap Making From Virgin Coconut Oil (VCO)<br>***Asri Widyasanti,** Cindy Almas Ramadha, and Sarifah Nurjanah* |
| 14.20 - 14.40 | A5.5 | Ongol-ongol' from Composite Flour of Taro, Banana cv Kepok, and Mung Bean'S Formula and its Storage Life<br>***Sunarmani,** Setyadjit, and Ermi Sukasih* |
| 14.40 - 15.00 | | Coffee Break |

Parallel : Session 4
Venue : **Room A**
Date : 24 October 2017

| | | |
|---|---|---|
| 15.00 - 15.20 | D2.1 | Performance Test of Fogging System for Cooling in a Tropical Naturally-ventilated Greenhouse<br>***Handarto,** Chay Asdak and Muhammad Saukat* |
| ✓ 15.20 - 15.40 | D2.2 | Horizontal-Ridges Water and Nutrients Balance under Potato-Tea Intercropping System<br>***K. Wijaya,** P.H. Kuncoro, Ardiansyah, E. Sumarni, and C. Arif* |
| 15.40 - 16.00 | D2.3 | Solar Powered Automated Pipe Water Management System, Water Footprint and Carbon Footprint in Soybean Production<br>***Satyanto Krido Saptomo** , Abang Zuhri Esmeralda, and M. Yanuar J. Purwanto* |
| 16.00 - 16.20 | D2.4 | Analysis of Groundwater Reserves in Dusun Ngantru Sekaran Village East Java<br>***N H Pandjaitan**, R S B Waspodo, T U Karunia, N Mustikasari* |

## D2.2

# Horizontal-Ridges Water and Nutrients Balance under Potato-Tea Intercropping System

**K. Wijaya*[,1], P.H. Kuncoro[1], Ardiansyah[1], E. Sumarni[1], and C. Arif[2]**

[1]Department of Agricultural Engineering, Jenderal Soedirman University, Indonesia.
[2]Department of Civil and Environmental Engineering, Bogor Agricultural University, Indonesia
Email: krissandi.wijaya@unsoed.ac.id*

***Abstract***

*Severe land and environment degradations due to conventionally potato cultivation on slopping-(vertical)-ridges in most Indonesian tropical highlands has stimulated the necessity to develop a sustainable farming system of the crop. However, there has been still little known on this specific issue scientifically. In this study, therefore, we focused on characterizing water and nutrients balance on contour-(horizontal)-ridges under potato tea intercropping system to confirm its applicability to support the optimum crop production while reducing soil erosion. The field experiment was carried out in the intercropping plots (3.5m x 3.5m) with different fertilizers (inorganic/IF-NPK and inorganic/IF-Petroganik) and mulches (plastic/PM, rice-straw/RM, and no-mulch/NM) applied. Thus, there were totally 6 treatments/plots combinations (IFPM-IFRM-IFNMOFPM-OFRM-OFNM) with 5 replications (5 horizontal-ridges) each. For each plot, the volumetric water content in a central horizontal-ridge at the depth of 10 and 20cm was monitored hourly using Decagon's 5TE/EC-5 moisture sensors and EM50/EM50b data logger. At the same depth, the 100cc undisturbed-core and plastic-disturbed samples were also sampled monthly for measurement of basic soil physical (dry bulk density and permeability) and chemical (Total-N and Total-P) properties, respectively. The results showed that water storage (ΔW) of IFPM, IFRM, IFNM, OFPM, OFRM, and OFNM were about -14.45, -23.00, -21.56, -13.27, -12.64, and -18.65 mm. For the same plots, the N-uptakes were about 128.86, 82.40, 125.20, 103.5, 110.16, and 95.95 kg ha-1, respectively, while the P-uptakes were about 45.34, 91.05, 44.50, 37.06, 33.64, 46.52 kg ha-1, respectively. Amongst others, IFPM was considerably most effective in maintaining water and nutrients dynamics in the soil.*

**Keywords:** *horizontal-ridge, organic fertilizer, potato-tea intercropping system, ricestraw mulch, water-nutrient balance*





## D2.3

# Solar Powered Automated Pipe Water Management System, Water Footprint and Carbon Footprint in Soybean Production

**Satyanto Krido Saptomo*[,1], Abang Zuhri Esmeralda[1], and M. Yanuar J. Purwanto[1]**

[1]Department of Civil and Environmental Engineering, Bogor, Indonesia
Email: saptomo.sk@gmail.com*

***Abstract***

*An automatic water management system for agriculture land was developed based on mini PC as controller to manage irrigation and drainage. The system was integrated with perforated pipe network installed below the soil surface to enable water flow in and out through the network, and so water table of the land can be set at a certain level. The system was operated by using solar power electricity supply to power up water level and soil moisture sensors, Raspberry Pi controller and motorized valve actuator. This study aims to implement the system in controlling water level at a soybean production land, and further to observe water footprint and carbon footprint contribution of the soybean production process with application of the automated system. Water level of the field can be controlled around 19 cm from the base. Crop water requirement was calculated using Penman-Monteith approach, with productivity of soybean 3.57ton/ha, total water footprint in soybean production is 872.01 $m^3$/t. Carbon footprint was calculated due to the use of solar power electric supply system and during the soybean production emission was estimated equal to 1.85 kg of $CO^2$.*

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**Keywords:***Automatic Control, Drainage, Irrigation, Raspberry Pi, Water Requirement*

# Horizontal-Ridges Water and Nutrients Balance under Potato-Tea Intercropping System

**K. Wijaya[1], P.H. Kuncoro[1], Ardiansyah[1], E. Sumarni[1], C. Arif[2]**
[1]Department of Agricultural Engineering, Jenderal Soedirman University, Indonesia.
[2]Department of Civil and Environmental Engineering, Bogor Agricultural University, Indonesia
Email: krissandi.wijaya@unsoed.ac.id*

***Abstract***

*Severe land and environment degradations due to conventionally potato cultivation on slopping-(vertical)-ridges in most Indonesian tropical highlands has stimulated the necessity to develop a sustainable farming system of the crop. However, there has been still little known on this specific issue scientifically. In this study, therefore, we focused on characterizing water and nutrients balance on contour-(horizontal)-ridges under potato-tea intercropping system to confirm its applicability to support the optimum crop production while reducing soil erosion. The field experiment was carried out in the intercropping plots (3.5m x 3.5m) with different fertilizers (inorganic/IF-NPK and inorganic/IF-Petroganik) and mulches (plastic/PM, rice-straw/RM, and no-mulch/NM) applied. Thus, there were totally 6 treatments/plots combinations (IFPM-IFRM-IFNM-OFPM-OFRM-OFNM) with 5 replications (5 horizontal-ridges) each. For each plot, the volumetric water content in a central horizontal-ridge at the depth of 10 and 20cm was monitored hourly using Decagon's 5TE/EC-5 moisture sensors and EM50/EM50b data logger. At the same depth, the 100cc undisturbed-core and plastic-disturbed samples were also sampled monthly for measurement of basic soil physical (dry bulk density and permeability) and chemical (Total-N and Total-P) properties, respectively. The results showed that water storage ($\Delta W$) of IFPM, IFRM, IFNM, OFPM, OFRM, and OFNM were about -14.45, -23.00, -21.56, -13.27, -12.64, and -18.65 mm. For the same plots, the N-uptakes were about 128.86, 82.40, 125.20, 103.5, 110.16, and 95.95 kg $ha^{-1}$, respectively, while the P-uptakes were about 45.34, 91.05, 44.50, 37.06, 33.64, 46.52 kg $ha^{-1}$, respectively. Amongst others, IFPM was considerably most effective in maintaining water and nutrients dynamics in the soil.*

***Keywords:*** *horizontal-ridge, organic fertilizer, potato-tea intercropping system, rice-straw mulch, water-nutrient balance*

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**Abstract**. Severe land and environment degradations due to conventionally potato cultivation on slopping-(vertical)-ridges in most Indonesian tropical highlands has stimulated the necessity to develop a sustainable farming system of the crop. However, there has been still little known on this specific issue scientifically. In this study, therefore, we focused on characterizing water and nutrients balance on contour-(horizontal)-ridges under potato-tea intercropping system to confirm its applicability to support the optimum crop production while reducing soil erosion. The field experiment was carried out in the intercropping plots (3.5m x 3.5m) with different fertilizers (inorganic/IF-NPK and inorganic/IF-Petroganik) and mulches (plastic/PM, rice-straw/RM, and no-mulch/NM) applied. Thus, there were totally 6 treatments/plots combinations (IFPM-IFRM-IFNM-OFPM-OFRM-OFNM) with 5 replications (5 horizontal-ridges) each. For each plot, the volumetric water content in a central horizontal-ridge at the depth of 10 and 20cm was monitored hourly using Decagon's 5TE/EC-5 moisture sensors and EM50/EM50b data logger. At the same depth, the 100cc undisturbed-core and plastic-disturbed samples were also sampled monthly for measurement of basic soil physical (dry bulk density and permeability) and chemical (Total-N and Total-P) properties, respectively. The results showed that water storage (ΔW) of IFPM, IFRM, IFNM, OFPM, OFRM, and OFNM were about -14.45, -23.00, -21.56, -13.27, -12.64, and -18.65 mm. For the same plots, the N-uptakes were about 128.86, 82.40, 125.20, 103.5, 110.16, and 95.95 kg ha$^{-1}$, respectively, while the P-uptakes were about 45.34, 91.05, 44.50, 37.06, 33.64, 46.52 kg ha$^{-1}$, respectively. Amongst others, IFPM was considerably most effective in maintaining water and nutrients dynamics in the soil.

## 1. Introduction

Potato is typically a "cool weather crop" that has an economically-promising market sell. To meet an accommodative and optimum growing temperature of 18 to 20°C especially in the hot-tropical climate regions like Indonesia, potato is usually cultivated in the highlands […]. Conventionally, long-term use of vertical-ridge (slopping-ridge) system with intensive chemical fertilizer and pesticide applications is carried out for the cultivation [2].

Such practices, however, may accelerate land and environment degradations at the cultivating sites or even surrounding areas. The vertical-ridge system of potato lands at the upper stream of Serayu watershed in Central Java of Indonesia has been found to cause severe runoff and soil losses [5] as well as sedimentation [6] along with the occurrence of water contamination due to the chemical applications. Instead of the vertical-ridge system, a horizontal-ridge (contour-ridge) system has been introduced for potato lands that enables to reduce the either of runoff and soil losses regardless the land slope levels [2, 5, 7]. Nevertheless, less crop yield was noticed [2] owing to the possible water logging nearby the ridges that may alter soil aeration and drainage conditions [...].

Tea, an annual crop with suitable canopy and deep roots system, has advantages of reducing soil erosion, enhancing soil quality and improving an optimum surrounding microclimate [....]. Further, the tea has been introduced as an intercrop with either other annual or seasonal crop [.....] that may give benefit economically [....]. With shed tolerance, especially young tea crop [intercropping system, tea and its potent to be introduced as intercropping system].

On the other hand, organic fertilizer is well-known as soil amendments to improve the soil water and nutrient balance. The organic fertilizer improves water retention, aeration status, cation exchange capacity, and nutrients available for plant (Khan et al., 2000; Johnson et al., 2006) [9, 12, 13]. Further, it reduces nutrient leaching, while creating a higher crop uptake of nutrients (...).

Nevertheless, a potential of the organic fertilizer and biochar applications to overcoming the entailing problems of the possible occurring water logging upon the horizontal-ridge system has yet been paid less attention. Accordingly, this study aimed to clarify efficacy of the organic fertilizer and biochar applications on the improvement of soil water and nutrient balance over a horizontal-ridge system.

## 2. Materials and Method

### *2.1. Land preparation*

The research site was located at Serang agricultural highland in Central Java province of Indonesia (7°14'31'' S, 109°16'50''E) with a typical soil of Andisol (Table 1). A horizontal-ridge system (Figure 1) was developed over 10 targeted plots sized 3 x 3 $m^2$ of each. Of the each plot, 0.6 m height plastic sheet, of which 20 cm was embedded into the field, was vertically installed along the plot edges and used as a fence to localize the rainfall and sedimentation by runoff. Along with this, an acrylic box equipped with a cover was placed at a certain point of the plot bottom and used as a sediment collector (Figure 1). Upon these 10 targeted plots, inorganic and organic fertilizers were applied for the first 5 and the rest 5 plots, respectively. The inorganic fertilizer used was NPK with the rate of N, $P_2O_5$, and $K_2O$ as 146, 310, and 288 kg $ha^{-1}$, respectively. The organic fertilizer used, on the other hand, was a local commercial product (Table 2) with the rate set for 20 ton $ha^{-1}$ in order to meet an equivalent rate of NPK with those of the inorganic fertilizer used. Along with these fertilizers treatment, wood and rice-husk biochars (Table 2) were applied for two rates: 5 and 10 ton $ha^{-1}$ (both were sieved through 5 mm screen prior to the application to maintain the homogeneity that affect the water and nutrients holding capacity) Plots without biochar applied were taken as the control (Figure 2). Finally, potato crop was sowed upon the all plots following the ridges within 0.5 m interval (Figure 1).

### *2.2. Soil sampling and measurement*

At the center of research site, a mini-weather station (Davis Instrument Corp.) was installed to record daily climate data up to 75 days after sowing (DAS): rainfall rate, temperature, relative humidity, solar radiation, and wind speed/direction (Figure 1). Assuming the root zone of potato crop typically takes about 15-20 cm depth, an EC-5 sensor (Decagon Devices Inc.) connected to EM50 data logger was installed at the center of each plot within 15 cm soil depth for daily data recording of volumetric water content ($\theta$). The installed sediment collector was used to collecting runoff, of which the volume was determined after the rainfall ceased. The collected runoff was then oven dried at 105° for 24 hours to determining the volume of soil loss.

Based on the material budget theory as in Hillel (1998), water balance in soil may be written as:

$$\Delta S_w = P_w + I_w - R_w - Pc_w - ET_w \qquad (1)$$

where: $\Delta S_w$ is the total water stored (mm); while $P_w$, $I_w$, $R_w$, $Pc_w$, and $ET_w$ are the stored or depleted water by rainfall, irrigation, runoff, percolation, and evapotranspiration, respectively. In this study, $\Delta S_w$ was assessed from the daily measured $\theta$, whereas $ET_w$ was estimated from the climate data using Penman-Monteith method. Precipitation was inferred from the rainfall data, while irrigation was set to be zero in particular. By recalling the data of runoff and the equation (1), percolation was then could be determined.

Nutrient balance, on the other hand, could be expressed as (Hillel, 1998):

$$\Delta S_n = P_n + I_n + F_n - R_n - Pc_n - Up_n \quad (2)$$

where: $\Delta S_n$ is the total nutrient stored (kg $ha^{-1}$); while $P_n$, $I_n$, $F_n$, $R_n$, $Pc_n$, and $Up_n$ are the stored or depleted nutrient by precipitation, irrigation, fertilizer, runoff, percolation, and crop usage, respectively. For the balance analysis of either Nitrogen (N) or phosphorus (P), storage value of these two were determined using Kjeldahl and Colorimetric method, respectively.

The value of $\Delta S_n$ that further also taken as the total nutrient of N or P was assessed using a slight amount of disturbed soil sample (about 50 g) taken from 15 cm depth of each plot at 0, 15, 45, and 75 DAS within five replications. Still using the same samples, available nutrient of N and P could be derived with the help of Kjeldahl and Colorimetric method, respectively. In this case, the values of total and available nutrients were determined for a cumulative of 0-15, 16-45, and 46-75 DAS period.

The value of $P_n$ was determined using 10 mm rainfall sample for five replications those randomly taken before the rain ceased, whereas the value of $I_n$ was set to be zero as no irrigation performed. The value of $F_n$ was preliminary determined from the 20 g sample of N or $P_2O_5$ fertilizer, while the value of $Up_n$ was determined from the crop sample taken at 75 DAS; both for five replications likewise. The number of $R_n$ was calculated from about 20 g sample of the sediment collected at 15, 45, and 75 DAS within three replications. The value of $Pc_n$ was then could be inferred from the equation (2).

Along with these measurements above, undisturbed soil samples were taken from each plot using 100 $cm^3$ core sampler (5 cm in diameter and 5 cm height) at 15 cm soil depth within five replications. This sampling was conducted after 15, 45, and 75 DAS as to represent the initial, growing, and maturing stage of potato cultivating period. The sample was weighed, and then water saturated for the measurement of saturated hydraulic conductivity ($K_s$) using falling head method. Subsequently, the sample was oven-dried at 105°C for 24 hours to determine the value of mass water content ($w$) and dry bulk density ($\rho_b$), by which the value of related $\theta$ could be calculated from.

AESAP 2017
Bogor, 23 - 25 October 2017

# HORIZONTAL RIDGES-WATER AND NUTRIENTS BALANCE UNDER POTATO-TEA INTERCROPPING SYSTEM

K. Wijaya[1*], P.H. Kuncoro[1], Ardiansyah[1], E. Sumarni[1], and C. Arif[2]
[1]Department of Agricultural Engineering, Jenderal Soedirman University (UNSOED), Indonesia
Department of Civil and Environmental Engineering, Bogor Agricultural University (IPB), Indonesia

## INTRODUCTION
## POTATO vs. LAND DEGRADATION

- **POTATO** is an important and a promising-market-sells commodity
- **HIGH DEMAND** and **LOW SUPPLY** of the commodity encourages an intensive **CONVENTIONAL POTATO CULTIVATION** in Tropical Highlands

⇩

**SLOPPING (VERTICAL)-RIDGE SYSTEM, INORGANIC FERTILIZERS/PESTICIDES**

⇩

**SOIL EROSION** on site, **LAND & ENVIRONMENTAL DEGRADATION** in surrounding watershed

## INTRODUCTION (continue)
## NEED FOR THE SUST. CULTIVATIONS

- Development of the **APPROPRIATE CULTIVATION TECHNIQUES** is essential

⇩

**CONTOUR (HORIZONTAL)-RIDGE SYSTEM, ORGANIC FERTILIZERS/AMENDMENTS and MULCHING**

"Effective to reduce soil erosion up to 50-70% (Wijaya et al., 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015a, 2015b), **BUT** yet un-optimal for the yield of the potato, might be due to waterlogged on the ridge profile"

⇩

- **AGROFORESTRY SYSTEM** potent to be an alternative way to solve the problem

## INTRODUCTION (continue)
## TEA, as an INTERCROP (AGROFORESTRY)

- An annual crop with suitable canopy (land coverage) and deep roots system
- Has advantages in reducing soil erosion, enhancing soil quality, and improving surrounding microclimate
- Has been introducing to be an intercrop to other crops incld. vegetables with good benefits, either environmentally or economically

⇩

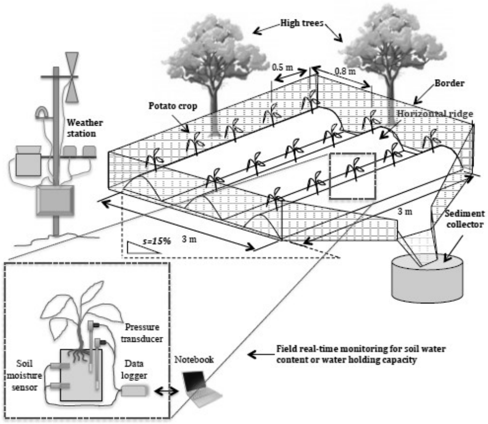
- However, **the application of the tea to be an intercrop in potato cultivation with horizontal-ridge system** as well as **the impact on field materials balance** or potato productivity has not been widely understood yet.

## OBJECTIVE

- **To characterize water and nutrients balance on contour-(horizontal)-ridges under potato-tea intercropping system** to confirm its applicability to support the optimum crop production while reducing soil erosion

## METHODOLOGY

- Experimental site: Kaligua village, Brebes, Central Java with 6 plots (@3 m x 5 m); *slope*: 15%; ridge dimension (width x height): 30 cm x 40 cm; crop interval: 80 cm x 50 cm
- Field samples collection: 0, 22, 43, 71, and 85 days after sowing (DAS)
  - ✓ Soil physical prop. (depth: 10 & 20 cm)
  - ✓ Runoff and soil loss
  - ✓ Crop growth parameters
  - ✓ Microclimate parameters

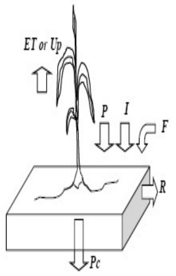


## METHODOLOGY (continue)
# DATA ANALYSIS

- Data analysis:
  - ✓ Soil-volumetric water content and dry bulk density → gravimetric and dielectric method
  - ✓ Evapotranspiration (ET) → Penman-Monteith method
  - ✓ Soil-, Eroded soil-, and Uptake-N and P content → Kjeldahl and colorimetric method
  - ✓ Water and nutrients balance:

$$\Delta S_w = P_w + I_w - R_w - Pc_w - ET_w \quad (1)$$

$$\Delta S_n = P_n + I_n + F_n - R_n - Pc_n - Up_n \quad (2)$$

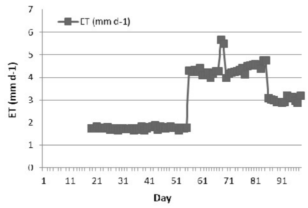


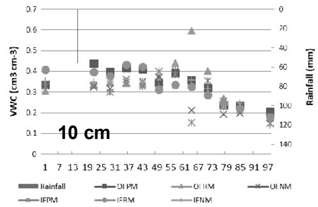

Agriculture-hydrological concept:

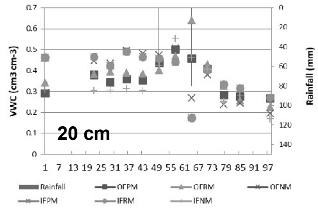
Incoming water and nutrient:
- Precipitation (P)
- Irrigation (I)
- Fertilizer (F) - *esp. for nutrient balance
-

Outgoing water and nutrient:
- Surface runoff (R)
- Infiltration/percolation (Pc)
- Evapotranspiration (ET)
- Plant uptake (Up) - *esp. for nutrient balance

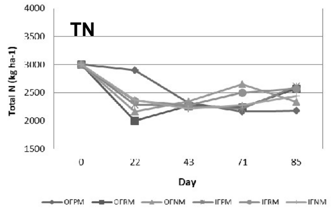
## RESULTS
# ET & VOLUMETRIC WATER CONTENT

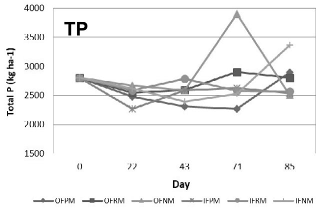


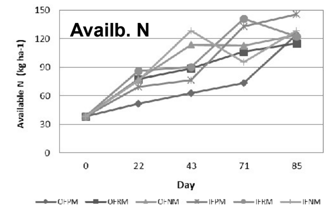



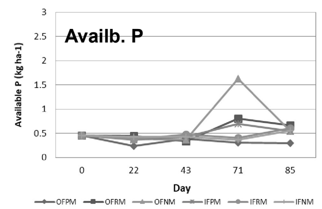




## RESULTS
# SOIL N & P

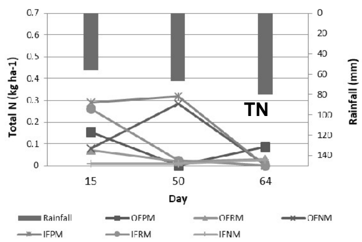


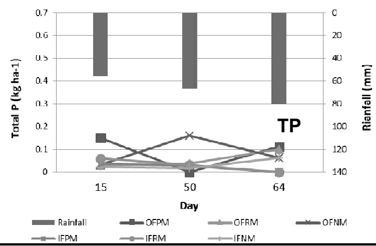



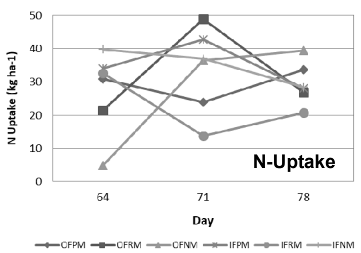



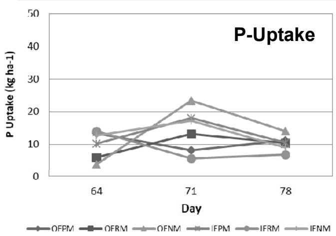

## RESULTS
# ERODED SOIL-N & -P



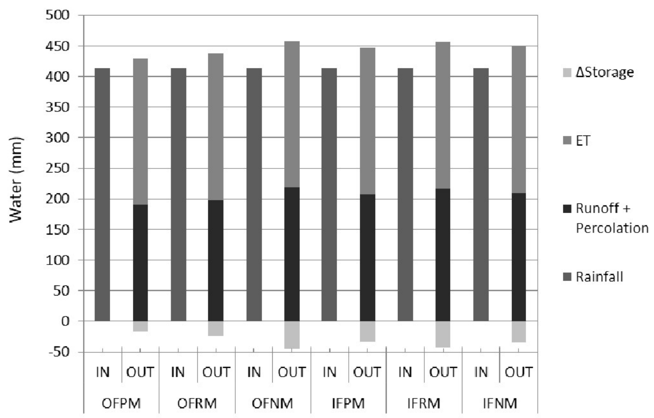




## RESULTS
# UPTAKE-N & -P



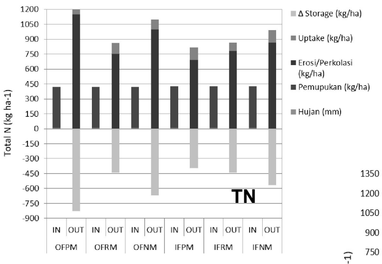



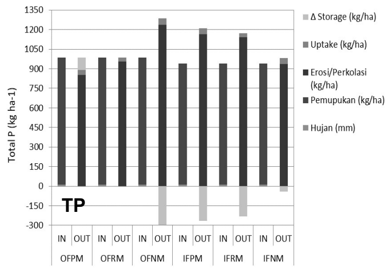

## RESULTS
# WATER BALANCE



**RESULTS**

# NUTRIENTS BALANCE




# DISCUSSION

- Under tea-crop intercropping system, the horizontal ridge soil with organic fertilizer-rice-straw mulch (OFRM) treatment had highest VWC amongst others
- Also, the OFRM was considered to be most effective combination to maintain N-P content within the underlined-covered soils
- Accordingly, the OFRM might improve the soil N-P availability or might enhance its uptake by potato crop
- The organic fertilizer-plastic (OFPM) and rice-straw mulch (OFRM) was better in storing soil water as well as nutrients as compared than others

# CONCLUSIONS

- The organic fertilizer-rice-straw mulch (OFRM) combination might be one of the appropriate options for sustainable potato farming under horizontal ridge and tea intercrop

# FURTHER RESEARCH

- Spatio-temporal variability of soil physic-chemical properties in relation to the productivity of potato crop

# *Thank you!*

**The 2nd International Conference on Agricultural Engineering for Sustainable Agriculture Production (AESAP 2017)**

**IPB International Convention Center, Bogor – Indonesia**
**23 – 25 October 2017**

Department of Mechanical and Biosystem Engineering, Faculty of Agricultural Engineering and Technology, Bogor Agricultural University, Bogor, Indonesia 16680
hone: +62-251-8620480; 8623026; E-mail: aesapcon@gmail.com; Website: www.aesap-conference.org

Subject: Acceptance Letter

Bogor, September 15th 2017

To:
**Dr Krissandi Wijaya**
Dept. of Agricultural Engineering
Universitas Syahkuala (UNSOED)
Indonesia

Dear Dr Krissandi Wijaya,

We are pleased to inform you that your abstract entitled "**Horizontal-Ridges Water and Nutrients Balance under Potato-Tea Intercropping System**" with authors **K. Wijaya, P.H. Kuncoro, Ardiansyah, E. Sumarni, C. Arif** is accepted for oral presentation in the upcoming The 2nd International Conference "The Role of Agricultural Engineering on Adaption to Climate Change towards Sustainable Agriculture" which will be held on October 23-25th 2017 in IPB International Convention Center, Bogor, West Java, Indonesia.

Accordingly, we would like to request you kindly prepare your full paper by following our full paper format (attached) and send it to us by 30th September 2017. In accordance with oral presentation, we would like you to prepare your oral presentation material in power point slides for 15 minutes and 5 minutes discussion.

To be officially included in the program, please transfer your registration fee through bank transfer and sending us the transfer receipt along with the full paper to aesapcon@gmail.com. Kindly visit our official website page www.aesap-conference.org for further details of payment.

Thank you for your kind attention and we look forward to welcoming you in Indonesia. Should you require further information and assistance, please do not hesitate to contact us.

Yours sincerely,

Dr. Ir. Desrial, M.Eng
Chairman

AESAP 2017
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# Certificate of Appreciation

## KRISSANDI WIJAYA

is recognized for outstanding contribution as presenter in

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October, 23-25 2017

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# SURAT TUGAS

Nomor : 6742/UN23.01/DL.07/2017

Dekan Fakultas Pertanian Unsoed memberikan tugas kepada :

| No. | Nama / NIP | Judul Makalah |
|---|---|---|
| 1. | Krissandi Wijaya, S.TP.,M.Agr.,Sc.,Ph.D.<br>19771009 200604 1 001 | Horizontal-Ridges Water and Nutrients Balance under Potato-Tea Intercropping System |
| | Purwoko Hari Kuncoro,S.TP.,M.Agr.Ph.D.<br>19761028 200604 1 002 | |
| | Dr. Eni Sumarni, S.TP., M.Si.<br>19790808 200212 2 001 | |
| 2. | Ardiansyah, S.TP., M.Si., Ph.D.<br>19790122 200501 1 002 | Biomass Development in SRI Field under Unmaintained Alternate Wetting-Drying Irrigation |
| | Dr. Asna Mustofa, S.TP., MP.<br>19690803 200312 1 001 | |
| 3. | Arief Sudarmaji, ST.,MT.,Ph.D.<br>19770501 200604 1 002 | Vapor Measurement System of Essential Oil Based on MOS Gas Sensors Driven with Advanced Temperature Modulation Technique |
| | Ir. Agus Margiwiyatno, MS., Ph.D.<br>19620222 198702 1 001 | |

Untuk mempresentasikan Makalah pada kegiatan The 2nd International Conference on Agricultural Engineering for Sustainable Agriculture Production (AESAP 2017) akan dilaksanakan pada :

| | | |
|---|---|---|
| Hari/tanggal | : | Senin s.d Rabu / 23 s.d 25 Oktober 2017 |
| Tempat | : | International Convention, Bogor |

Surat Tugas ini dibuat untuk dilaksanakan dengan penuh tanggung jawab.

Tanggal : 20 Oktober 2017

Dekan,

Dr. Ir. Anisur Rosyad, M.S.
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