PROCEEDINGS OF INTERNATIONAL SYMPOSIUM ON SOIL MANAGEMENT FOR SUSTAINABLE AGRICULTURE 2017

-PART 1-

INTERNATIONAL SYMPOSIUM ON SOIL MANAGEMENT FOR SUSTAINABLE AGRICULTURE 2017

ORGANIZER:
THE UNITED GRADUATE SCHOOL OF AGRICULTURAL SCIENCE, GIFU UNIVERSITY

-PART 2-

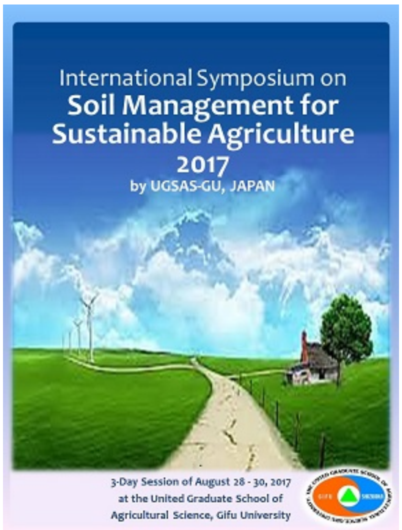
UGSAS-GU & BWEL JOINT POSTER SESSION ON AGRICULTURAL AND BASIN WATER ENVIRONMENTAL SCIENCES

CO-ORGANIZER:
GIFU UNIVERSITY REARING PROGRAM FOR BASIN WATER ENVIRONMENTAL LEADERS

AUGUST 28 - 30, 2017
6TH FLOOR, UGSAS BLDG. GIFU UNIVERSITY, JAPAN

International Symposium
on Soil Management for Sustainable Agriculture 2017

PROGRAM
–PART 1-



DAY ONE: Monday, August 28

Time: 9:30-19:30
Venue: Main Seminar Room (6F in UGSAS Building, Gifu University)
Master of Symposium: *Prof. Kohei Nakano (Gifu Univ.)*

Time Table

9:30-10:00 Registration

10:00-10:05 Opening Remarks
Prof. Masateru SENGE (Dean of UGSAS, Gifu Univ.)

10:05-10:10 Welcome Speech
Dr. Fumiaki SUZUKI (Executive Director and Vice President of Gifu Univ.)

10:10-10:50 Keynote Speech 01
Prof. Yasushi MORI (Okayama Univ.): Soil Physical Rehabilitation

10:50-11:30 Keynote Speech 02
Assist. Prof. Yuki KOJIMA (Gifu Univ.): Soil Water and Energy Dynamics

Session 1 —General Issue and Solution— Session Chair: *Prof. Muhajir Utomo (Lampung Univ.)*

11:30-11:55 01. *Prof. Isril BERD (Andalas Univ.)*

11:55-12:20 02. *Dr. Komariah (Sebelas Maret Univ.)*

12:20-12:30 Photo Session

12:30-13:40 Lunch Break (Light meals served)

Session 2 —Soil Science— Session Chair: *Assistant Prof. Keigo NODA (Gifu Univ.)*

13:40-14:05 01. *Prof. Muhajir UTOMO (Lampung Univ.)*

14:05-14:30 02. *Dr. Afandi (Lampung Univ.)*

14:30-14:55 03. *Mr. Didin Wiharso, M.Sc. (Lampung Univ.)*

14:55-15:20 04. *Dr. Nuyen Thi Hang NGA (Thuy Loi Univ.)*

15:20-15:30 Coffee Break

Session 3 —Watershed Management—Session Chair: *Associate Prof. Takeo ONISHI (Gifu Univ.)*

15:30-15:55 01. *Dr. Khandra Fahmy (Andalas Univ.)*

15:55-16:20 02. *Dr. Muhammad MAKKY (Andalas Univ.)*

16:20-16:45 — 03. *Dr. Eri Gas EKAPUTRA (Andalas Univ.)*

16:45-17:10 — 04. *Mr. Fadli IRSYAD, M.Sc. (Andalas Univ.)*

17:40-19:30 — Dinner Meeting (At Gifu University Restaurant (1))

DAY TWO: Tuesday, August 29

Time: 9:00-17:40
Venue: Main Seminar Room (6F in UGSAS Building, Gifu University)
Master of Symposium: *Prof. Ken HIRAMATSU (Gifu Univ.)*

Time Table

9:00-9:30 — Registration

9:30-10:10 — Keynote Speech 03
Prof. Akira WATANABE (Nagoya Univ.): Soil Organic Matter Dynamics

10:10-10:50 — Keynote Speech 04
Assoc. Prof. Fumitoshi IMAIZUMI (Shizuoka Univ.): Erosion Control Engineering

10:50-11:00 — Coffee Break

Session 4 —Soil Biology & Microbiology— Session Chair: *Prof. Isril Berd (Andalas Univ.)*

11:00-11:25 — 01. *Dr. Retno Rosariastuti (Sebelas Maret Univ.)*

11:25-11:50 — 02. *Dr. Sudadi (Sebelas Maret Univ.)*

11:50-12:15 — 03. *Dr. Widyatmani Sih Dewi (Sebelas Maret Univ.)*

12:15-13:20 — Lunch Break (Light meals served)

Session 5 —Soil Chemistry— Session Chair: *Dr. Retno Rosariastuti (Sebelas Maret Univ.)*

13:20-13:45 — 01. *Prof. Fusheng Li (Guangxi Univ.)*

13:45-14:10 — 02. *Dr. Mujiyo (Sebelas Maret Univ.)*

14:10-14:35 — 03. *Ms. Dinh Thi Lan Phuong, M.Sc. (Tyui Loi Univ.)*

14:35-15:10 — Break & Preparation for Poster Presentation Session

15:10-17:00 — -PART 2- *Please refer to the next page for details.
UGSAS-GU & BWEL Joint Poster Session on
Agricultural and Basin Water Environmental Science

DAY THREE: Wednesday, August 30

Time: 10:00-17:00
Study Tour on Soil and Water Management

Visiting TANIGUMI Historic Temple and Local Irrigation System &
TOKUYAMA DAM with Underground Facility for Water Management

UGSAS-GU & BWEL Joint Poster Session on Agricultural and Basin Water Environmental Sciences

PROGRAM
–PART 2-

DAY TWO: Tuesday, August 29

Time: 15:10-17:00
Venue: Main Seminar Room (6F in UGSAS Building, Gifu University)

Time Table

15:10-16:45	Poster Presentation
16:45-16:55	Best Presentation Award ceremony
16:55-17:00	Closing remarks *Prof. Fusheng LI (Head of the Promotion Office of Gifu University Rearing Program for Basin Water Environmental Leaders (BWEL))*

Presenters

P01: Tran Duy Quan (UGSAS-GU)
P02: Ning Li (UGSAS-GU)
P03: Dina Istiqomah (UGSAS-GU)
P04: Akash Chandela (UGSAS-GU)
P05: Daimon Syukri (UGSAS-GU)
P06: Witchulada Yungyuen (UGSAS-GU)
P07: Panyapon Pumkaeo (Graduate School of Integrated Science and Technology, Shizuoka University)
P08: Arif Delviawan (Graduate School of Integrated Science and Technology, Shizuoka University)
P09: Siwattra Choodej (UGSAS-GU)
P10: Jobaida Akther (UGSAS-GU)
P11: Annisyia Zarina Putri (Graduate School of Applied Biological Sciences, Gifu University)
P12: Masaya Toyoda (Graduate School of Engineering, Gifu University; BWEL)
P13: Tharangika Ranatunga (UGSAS-GU; BWEL)
P14: Shuailei Li (Graduate School of Natural Science and Technology, Gifu University; BWEL)
P15: Ruoming Cao (Graduate School of Applied Biological Sciences, Gifu University; BWEL)
P16: Fenglan Wang (UGSAS-GU; BWEL)
P17: Diana Hapsari (UGSAS-GU; BWEL)
P18: Ran Song (Graduate School of Engineering, Gifu University; BWEL)
P19: Chen Fang (UGSAS-GU; BWEL)
P20: Guangyu Cui (Graduate School of Engineering, Gifu University; BWEL)
P21: Ali Rahmat (UGSAS-GU; BWEL)
P22: Junfang Zhang (Graduate School of Engineering, Gifu University; BWEL)
P23: Siyu Chen (UGSAS-GU; BWEL)
P24: Wenjiao Li (Graduate School of Engineering, Gifu University; BWEL)
P25: Huijuan Shao (UGSAS-GU; BWEL)

CONTENTS

— PART 1 — KEYNOTE SPEECHES

— PART 2 —

UGSAS-GU & BWEL Joint Poster Session on Agricultural and Basin Water Environmental Sciences

Conservation Analysis of Kuranji Watershed using SWAT Application

oFadli IRSYAD, Eri Gas EKAPUTRA
(Faculty of Agricultural Technology, Andalas University)

SUMMARY

Land degradation is a major cause of high runoff compared to other factors. Changes in land use occurring in an area cause a change in the catchment area conditions and may cause changes in runoff. If runoff occurs during minor rain and infiltration of water into large soil, then water is first stored in soil that will increase ground water availability. The Kuanji watershed is one of the watersheds in Padang City with an area of 202.7 km^2 and consists of 5 sub-catchments. This research was conducted on Kuranji watershed which geographically located at 100°20'31.20 "- 100°33'50.40" E and 00°55'59.88 "- 00°47'24" S. This research was conducted in March - June 2013. This study has used ArcSWAT 12 application. Initial stages in this research are data collection, SWOT analysis in Kuranji watershed, and determination of conservation area of Kuranji watershed. Results of research using ArcSWAT for Kuranji watershed were more than 3000 HRUs. The largest runoff was 84 mm with an area of 75.195 ha, and spread in four sub-districts (Pauh, Padang Utara, Nanggalo, and Koto tengah). The recommended conservation areas are Limau Manih (81.56 ha), Lambung Bukit (42.27 ha), Gunung Sarik (86.32 ha), Kuranji (60.20 ha), and Lubuk Minturun (64.45 ha)

Introduction

Land use changes that occur in a region has impacts on condition of the catchment area directly or indirectly (Poyatos et al., 2003; Turkelboom et al., 2008). Furthermore, these condition cause changing in surface flow, this influence to the condition of the river (outlet) on the watershed (Baker et al., 2013; Ghaffari et al., 2010; Niehoff et al., 2002). Land use change is the main cause of high runoff compared to other factors. If the forests within a watershed were converted into a settlement, the peak river flow will increase from 6 to 20 times. The number depends on the type of forest and the type of settlement (Kodoatie et al., 2008). The land slope factor, soil type and vegetation above contribute in determining the amount of runoff and water that can be stored into the soil through infiltration process (Turkelboom et al., 2008).

The Kuanji watershed is one of the watersheds in Padang City with an area of 202.7 km^2 and consists of 5 sub-catchments. According to Arsyad (2006), the slope of the land is closely related to the erosion. The higher the slope, the infiltration of rainwater into the soil becomes smaller, so the surface runoff and erosion becomes larger. In this study, a conservation simulation of watershed discharge was conducted using SWAT Application (Arnold et al., 1994). Geographic information system (GIS) data are analyzed using the Arc-GIS application Arc Interfaces software for Soil and Water Assessment Tool (Arc-SWAT 12). The application can calculate the influence of climate parameters on the amount of discharge from a stream, sedimentation, chemical transport of agricultural land and other uses in the management of a watershed over a period of time. This study aims to analyze the critical areas of Kuranji watershed for reference by government and related agencies in conducting conservation activities. Soil and water conservation activities in the Kuranji watershed can minimize runoff and erosion occurring in the watershed

Material and Method

The SWAT (Soil and Water Assessment Tool) application is a model to analyze a river or basin condition, developed by Dr. Jeff Arnold for USDA, Agricultural Research Service (ARS). SWAT was developed to predict the impacts of land management practices on water, sediment and chemical yields in watersheds with different types of soil, land use and management over long periods of time (Neitsch et al., 2004).

SWAT Simulation on Kuranji Watershed

SWAT model allows performing a partial watershed analysis. SWAT model describes the interaction of each smallest element of the watershed that is in the form of HRU (Hydrological Response Unit). The HRU describes the hydrological response occurring in one unit area. The division of HRU is based on overlay of soil characteristics, land use, and land slope. The SWAT model analyzes the overall HRU in the watershed, to describe the watershed condition thoroughly but can analyze the watershed conditions from the smallest element of HRU. The stages in SWAT analysis are as follows:

1. Watershed delineation

   The Kuranji River Basin was made by Automatic Watershed Delineation method in SWAT application. The DEM map of the Kuranji watershed area with a resolution of 30 m x 30 m was used as input to present the elevation difference from each point to see the direction of surface water flow. The flow of the formed river will form a watershed.

2. Hydrological Response Unit (HRU)

   The hydrological region was formed by the manufacture of Hydrological Response Unit (HRU) in SWAT applications. Input data in the form are land use maps, soil map and the slope of the land. The slope used in determining the HRU is divided into several divisions according to Arsyad (2006) ie < 3; 3-8; 8-15; 5-30; 30-45; > 45. The threshold of the percentage of total area used for land use (10%), soil type (5%), and Slope (5%) has a percentage of area smaller than the threshold specified to be ignored.

3. SWAT simulation

   At this stage the input data used is the simulation period of 2010-2015. The data files include climate station data (.txt), daily rainfall data files (*.pcp), daily temperature (*.tmp) and weather generator files (*.wgn) files.

4. Visualization of simulation results.

   At the stage of visualization the desired output parameters can be displayed in ArcSWAT, in the form of color gradations.

SWAT model on Kuranji watershed can be used as a guideline for conservation. Because the simulation results will illustrate the condition of HRU from Kuranji watershed related to runoff, erosion, evapotranspiration and ground water recharge that happened. Thus can be determined area / HRU that need to be done to minimize the conservation of runoff, erosion and destructive power of water. The simulation result also aims to determine the location / area of the watershed that needs to be conserved.

Kuranji River Conservation Area Analysis

The land slope, soil type and vegetation factor in an HRU are instrumental in determining the amount of runoff that occurs and the amount of water that can be stored into the soil through infiltration process. If runoff occurs during minor rain and infiltration of water into large soil, then water is first stored in the soil that will increase groundwater availability. If the infiltration rate is small then surface flow will increase, this may result in increased erosion, increase rapid river discharge, and rising energy damaged of water. So the focus of the conservation effort in the Kuranji watershed is the increase of water storage into the soil.

In this activity there were several alternatives to increase water storage ability, but not to eliminate the hydrological function. The effort is an appropriate targeted reforestation. Tree planting should be targeted in order to affect the condition of Kuranji watershed. The location of HRUs that has a large influence on runoff and high water damage has been used as a working area in land conservation scenarios in terms of landuse, slope, soil, channel, and others.

Result and Discussions

1. Geographical Condition of Kuranji Watershed

Kuranji is geographically located at 100°20'31.20 "-100°33'50.40" East Longitude and 00°55'59.88 "-00°47'24" South Latitude. Kuranji watershed has an area 202 km2 with a main river length of 32.41 km and a river density of 1.36 / km. This watershed has several sub-basins, among others: (1) Kuranji Sub-basin (An area of 19.86 km2, the main river length of 14.66 km); (2) Belimbing sub-basin (An area of 62.64 km2 with the main river length 17.08 km) ; (3) Air Sungkai sub-basin (An area of 6 km2 with length of main river 3.63 km); (4) Padang Janiah Sub-Basin (An area of 82.26 km^2 with a main river length of 18.86 km); And (5) Limau Manih sub-basin (an area of 31,93 km2 with length of main river 16,42 km).

2. Climate Condition

Climatic conditions in the Kuranji watershed is an area with tropical climatic conditions where rainfall is high enough between 3500-4000 mm/year of climatic conditions in the Kuranji watershed can be seen in Table 1.

3. Soil Condition

Soil characteristics for Kuranji watershed are grouped into 4 types of soils based on FAO 1974 (in Neitsch, 2005) (Table 2).

4. Land Use

Land use in Kuranji watershed has changed significantly. Based on the data of land use obtained from Rupa Bumi Indonesia in 2014, the land use condition as in Table 3 is obtained.

5. SWAT Simulation

Watershed delineation

The depiction of the watershed requires DEM data in its processing. In this study the DEM data used had a resolution of 30 x 30 m.

Table 1 Climate Condition in Kuranji Watershed

Month	Temp (°C)	RH (%)	Rainfall (mm/m)	ET (mm/m)	Wind (m/s)	Radiation (Mj/m^2)
Jan	26,5	83,5	31,04	110,0	2,1	14,6
Feb	26,3	84,7	30,42	101,2	2,1	14,2
Mar	26,6	83,5	34,40	123,0	2,1	16,3
Apr	26,9	83,1	29,62	119,0	1,8	16,1
May	27,0	82,8	25,88	121,3	1,5	16,0
June	26,6	81,6	29,27	109,8	1,6	15,1
July	26,3	79,9	34,58	122,8	1,7	16,2
August	26,3	78,7	26,35	132,0	1,7	17,5
Sep	26,7	78,0	27,00	136,3	1,7	18,6
Oct	26,9	79,0	19,98	136,3	1,8	18,0
Nov	26,8	80,8	20,57	120,4	1,9	16,4
Dec	26,6	82,2	29,87	113,0	2,1	15,4

Table 2. Soil characteristics of kuranji watershed

Soil Type	Area (ha)	Perscentage (%)
Vertisol	12146,756	54,09
Phaeozem	6778,852	30,19
Andosol	1708,922	7,61
Ferralsols	1822,707	8,12
Total	22065,269	100

Table 3 Land use condition

Land use	Area (ha)
airport	118,78
Primary Dryland Forest	12128,61
Water Body	63,34
Secondary Dryland Forests	124,08
Field	0,1
Mixed Forest	1542,07
Settlement	1542,72
Rice fields	5318,57
Shrubs	1162,11
Total	22000.38

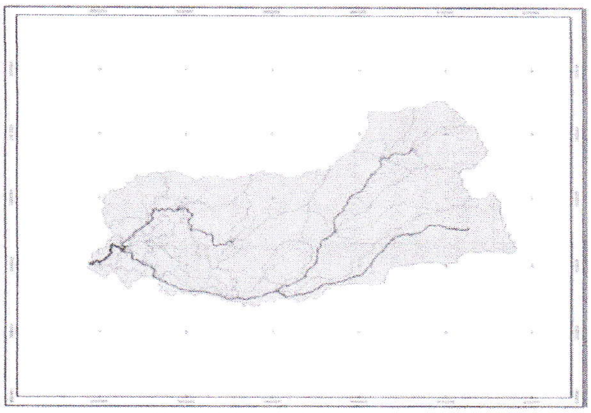


Fig. 1 Kuranji Watershed

This is intended for SWAT processing in a more detailed kuranji watershed and closer to real conditions in the field. The delineation of watershed was done by Automatic Watershed Delineation method. The results of Kuranji River Basin depiction can be seen in Figure 1. Based on the delineation result, the total watershed area is 21795.364 ha with five sub-catchments.

Hydrological Response Unit (HRU)

The hydrological region is formed by the manufacture of Hydrological Response Unit (HRU) in SWAT applications. The threshold of the percentage of total area used for land use (10%), soil type (5%), and Slope (5%) has a percentage of area smaller than the threshold specified to be ignored. The results of this process for Kuranji watershed were 2034 HRU.

SWAT Analysis Results

At this stage the input data used was the simulation period of 2015. The data files include climate station data (.txt), daily rainfall data files (.pcp), daily temperature (.tmp) and weather generator files (.wgn) files.

6. Analysis of Kuranji Watershed Conservation Using SWAT Applications

SWAT model on Kuranji watershed can be used as a guideline for conservation. This is because the simulation results will illustrate the condition of HRU from Kuranji watershed related to runoff, erosion, evapotranspiration and ground water recharge that happened. Thus can be determined area / HRU that need to be done to minimize the conservation of runoff, erosion and destructive power of water. The simulation result also aims to determine the location / area of the watershed that needs to be done conservation, so that conservation is done on target (Irsyad, 2011).

Based on the simulation results in Kuranji watershed, the location with high runoff distribution, this can be seen in Figure 2.

The result of simulation for erosion in Kuranji watershed is obtained by several locations with a relatively large erosion level with the distribution can be seen in Figure 3.

Reforestation / tree planting should be targeted so that conservation is done correctly affect the condition of Kuranji watershed.

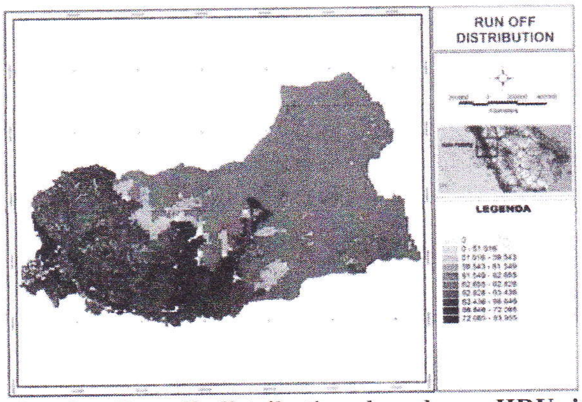


Fig. 2 Runoff distribution based on HRU in Kuranji Watershed

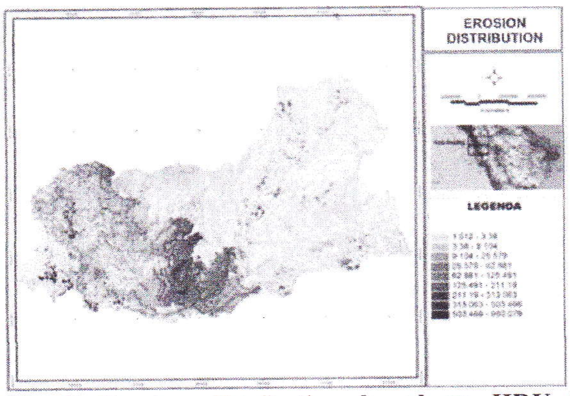


Fig. 3 Erosion distribution based on HRU in Kuranji Watershed

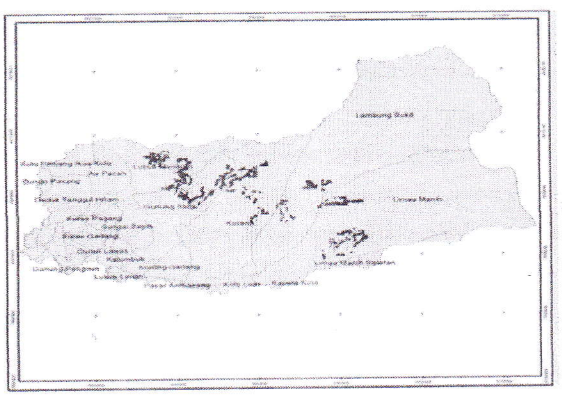


Fig. 4 Conservation site in Kuranji watershed

Table 4 Conservation site in Kuranji Watershed

Sub-District	Area (ha)
Limau Manih	81,56
Lambung Bukit	42,27
Gunung Sarik	86,32
Kuranji	60,20
Lubuk Minturun	64,45
Total	**334,80**

The location of HRUs that has a large influence on runoff and high water damage has been used as a working area in land conservation scenarios in terms of land use, slope, soil, channel, and others. The result of location determination based on slope and landuse that need to be done reforestation obtained some location in middle part of DAS. The location of reforestation can be seen in Figure 4.

The location of conservation activities is located in several sub-districts in Kuranji watershed. This can be seen in Table 4. The location has a slope of> 45 and has open land cover, grass and shrubs, the location is also very risky due to landslides resulting from runoff and carrying capacity Land to low surface slides.

Conclusion

The Kuranji watershed has a total basin area of 21795,364 ha with five sub-catchments. SWAT analysis result for Kuranji watershed was obtained by DAS HRU as much as 2,034 HRU. The largest runoff is 84 mm with an area of 75.195 ha, and spread in four sub-districts (Pauh, Padang Utara, Nanggalo, and Kototengah). The recommended conservation areas are Limau Manih (81.56 ha), Lambung Bukit (42.27 ha), Gunung Sarik (86.32 ha), Kuranji (60.20 ha), and Lubuk Minturun (64.45 ha).

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