BOOK II

PROCEEDING INTERNATIONAL WORKSHOP AND SEMINAR

"INNOVATION OF ENVIRONMENTAL FRIENDLY AGRICULTURAL TECHNOLOGY IN SUPPORTING SUSTAINABLE FOOD SELF-SUFFICIENCY"

Surakarta, 18-20 September 2018, Central Java

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Indonesian Agency for Agricultural Research and Development (IAARD)

International Workshop and Seminar
Innovation of Environmental-Friendly Agricultural Technology Supporting Sustainable Food Self-Sufficiency

Alila Hotel, Surakarta, Indonesia
September 18th-20th, 2018

PROCEEDING

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Preface

Some issues are considered in organizing this event, e.g. the increase ofsustainably crop production is challenged by healthy food productionby invasive plant pest and disease, land degradation, climate change, and residues of agro-chemical materials detected in agricultural soils leading to environmental contamination. Food sufficiency and quality should be achieved in agricultural development in the future. Especially in 2020, food security and safety are an important global issue in entering the era of global trade. All agricultural products must be safety so acceptable in world trade. Efforts to achieve and maintain self-sufficiency need good support facilities, utilize technological innovations and some resources with environmental friendly approach.

The objective of this event is (i) to explore recently available environmental friendly technologies to boost crop yield, (ii) to reveal best practice and best experience in sustainable management crop production, and (iii) to strengthen collaboration and networking on agricultural research and development for developing environmentally friendly technologies.

Ten scientists as thematic speakers from five countries gather to discuss subjects covering those objectives. This workshop is intended more than 150 both national and international scientists. Sequence agenda has been organized in this Workshop and Seminar, including plenary session, parallel sub-thematic discussions (1. Land management and good agricultural practices, 2. Pesticides residue and heavy metal managementin agriculture, 3. Adaptation and mitigation of climate change impacts, 4. Sustainable agriculture and food security), and field trips. During field trip, we will visit in two site which applied environmentally friendly management and workshop to demonstrate compost fertilizer manufactory.

I would like to acknowledge to all speakers, researchers/scientists and participants whom participated in the international workshop and seminar. We also thank to SMARTD for providing significant contribution to facilitate this activity. We hope that this will be a useful source of information in manage sustainable agricultural systems with environmentally friendly. Thanks for your attention.

Jakarta, November 2019
Director General, IAARD
Dr. Ir. Fadjry Djufry, M.Si

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Report Of Chair Organizing Committee

Assalamu'alaikum Warahmatullahi Wabarakatuh,

The honorable respectable:

1. Dr. M. Syakir, General Director of Indonesian Agency for Agricultural Research and Develoment, Ministry of Agriculture
2. Mr. F.X. Hadi Rudyatmo, Mayor of Solo City
3. Whom I respect keynote speakers:
   - Dr. Kazuyugi Yagi, from KMUT, Thailand
   - Prof. Ravi Naidu, from CSIRO Australia
   - Dr. Godefroy Grosjean, from CIAT Vietnam
   - Dr. Bjoern Roepke, from CropLife Asia
   - Prof. Akhmad Fauzi, from Bogor Agriculture University
   - Prof. Edhi Martono, from Gadjah Mada University
   - Prof. Gustan Pari, from Ministry of Environment and Forestry of Indonesia
   - Dr. dr. Suhartono, from Diponegoro University
   - Dr. Widyatmani Sih Dewi, from Sebelas Maret University
4. Dr. Ir. Prama Yufdy, M.Sc., Secretary of Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture
5. Prof. Dr. Ir. Dedi Nursyamsi, M.Agr., Director of Indonesian Center for Agricultural Land Resource Research and Development
6. And distinguished guests for the International Workshop and Seminar

Good morning and best wishes for us

Alhamdulilah, praise and thanks to Almighty God who has give us His blessings and Mercies so we can gather today in healthy and good condition.

Herewith I report that committee organizes a thematic International Workshop and Seminar at Solo, 18-20 September 2018 with theme "*Innovation of Environmental Friendly Agricultural Technology in Supporting Sustainable Food Self-Sufficiency*". Agricultural production in the future will be emphasized on productivity increase to support food security and product quality related to food safety. To realize it, there are some challenges, i.e. soil degradation, theinvasive organism of plant pest and disease and climate change. In the agricultural practices, most of theIndonesian farmers tend to use excessive agro-chemical materials (fertilizer and pesticide). Consequently, inefficient fertilizer and pesticide residue in soil could contaminate the environment.

In the future, innovative and environmentally friendly technology in agricultural practices should provide asolution to problems in food security and food safety. The current problems in agricultural production processes are soil contamination with heavy metals from various sources, high pesticides residues

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and some fertilizer pollution tothewater body. Hence, there is a need to bring together in innovative academics.

Good agricultural practices should be applied to promote environmentally friendly agriculture. The innovative technology is including remediation, reducing pesticide residue, utilization of microbes-plant accumulator to reduce heavy metals concentration, management of slow-release N fertilizer and intermittent water irrigation, low GHG emission rice cultivation and sustainable agriculture, will be discussed during the workshop.

We glad if in this chance General Director of IAARD can give important preface and we hope Mr Mayor of Solo City can open the International Workshop and Seminar.

We would like to acknowledge to all speakers, researchers/scientists and participants whom participated in the international workshop and seminar. We also thank to SMARTD for providing significant contribution to facilitate this activity. We hope that this will be a useful source of information in manage sustainable agricultural systems with environmentally friendly. Thanks for your attention.

Wabillahi taufiq walhidayah, Wassalamu'alaikum Warahmatullahi Wabarakatuh
Surakarta, September 18, 2018

Dr. Asep Nugraha Ardiwinata, M.Si.
Chairman of Committee

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Resume

INTERNATIONAL WORKSHOP AND SEMINAR "INNOVATION OF ENVIRONMENTAL FRIENDLYAGRICULTURAL TECHNOLOGY SUPPORTING SUSTAINABLE FOOD SELF-SUFFICIENCY"

Surakarta, 18-20 September 2018

International Workshop and Seminar with the theme "Innovation of Environmentally Friendly Agricultural Technology Supporting Sustainable Food Self-Sufficiency" were held in Alila Hotel Surakarta, Central Java, Indonesia, 18-20 September 2018. International Workshop and Seminar were attended by 202 participants, consisting of researchers, academicians from various universities, practitioners (entrepreneurs and local government), and stakeholders (Ministry of Agriculture). Participants and speakers were from Indonesia, Australia, Thailand, Singapore and Vietnam. The objectives of the workshops and seminars are (i) to collect and disseminate the research results of current achievements in environmentally friendly agricultural systems, (ii) to expose innovation of environmentally friendly agricultural technology to support sustainable food self-sufficiency, and (iii) to build communication between stakeholders (users and policy makers) and researchers and academicians in promoting environmentally friendly technology for agricultural development.

The International workshop and seminar were officially opened by Prof. Dr. Dedi Nursayamsi, Director of Indonesian Agricultural Land Resource Research and Development, on behalf of Director General of Indonesian Agricultural Research and Development. The seminar and workshop were presented in plenary session, oral presentation in parallel commissions, teleconference presentation from Russia, poster session, and fieldtrip. The invited keynote speakers were both from national (from Gadjah Mada University, Bogor Agricultural University,Ministry of Environment and Forestry, Diponegoro University, Sebelas Maret University) and International (from Australia, Singapore, Thailand, and Vietnam) with good reputation in a given topics.

International Workshop and Seminarraised four main issues as follows:

Pesticides residue and heavy metal management in Agriculture

Agricultural products and food that are hygienic, safe for consumption and contaminants free are the absolute prerequisite in the global free trade. In addition, we keep working to improve the productivity of strategic food commodities due to the increased of food demand and population growth.

The most common contaminants in soil, crop and water are heavy metals and organic substances. The primary focus issue is agricultural land,

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especially in Indonesia, long-term farming, heavy metal loading, pesticide residue and implications to soil quality, crop quality and human health.Distribution of soil degradation by chemical deterioration in Indonesia is lower than compared to Bangladesh and Thailand. However heavy metals contaminant in agricultural land should be managed. Heavy metals contaminants sources in Indonesian agriculture are industrial pollution, textile industry; other manufacturing industries, active and legacy mines, solid wastes, waste waters- applications); oil pollution (fossil fuels, old service stations etc);agricultural pollution (pesticides; fertilizers); and geogenic sources. Several of heavy metals contaminant in many countries including Indonesia are As, F, Cd, Se (China, India), Pb, Cu, Zn.

Cd contaminant in Indonesia is quite low (0,04-0.15 mg kg^{-1}) than other countries. Cd is readily taken up by plants even when present in low amounts-bioaccumulation can be high. Management of cadmium contaminant strategy is needed. Management strategies for cadmium are detailed understanding of the chemistry of cadmium, loading in soils, crop type, implementation of strategies that minimise plant uptake. Several technology friendly agriculture can used such as: liming, bio-char application, organic amendment, addition of Zn, in situ remediation phytoremediation.

Pesticides were and still are used throughout Indonesian in agriculture. From farmers to agricultural decision makers, all still believe that pesticides can not be separated from agriculture. With the existence of tropical disease insect vectors, pesticides are also very popular pest control, farmer mindset is pesticide *as medicine for plants*. Although the intensive use of pesticides in the 1950s, its impact had been recognized since late 1970s, a mere twenty years after. Despite the implementation of eco-friendly yield increased in rice production, the National Integrated Pest Management Program was still in lack of success, the use of pesticides among farmers are still high.

Pesticide use in agriculture, public health, animal health, fisheries (aquaculture, preservation, park, roadsides. The massive use of pesticides in this country resulted residues in soils, water, crop, and animals. The persistence of the first commonly used pesticides in the past, i.e. organochlorine or chlorinated hydrocarbon, isstill observed in soils. In addition, other residues of pesticides observed in soils and crops are aldrin, endrin, dieldrin, chlordane, DDT, endosulfan, heptachlor, lindan.

The consequences of pesticides residue in soils arethe Indonesian export of agricultural product was rejected in other countries. Therefore, the government (Indonesian Agricultural Quarantine Agency) shoulduse the same testmethod using by foreign countries to detect the presence of pesticides infruits and vegetables.

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The importance of residual analysis, like qualitatively or quantitatively to obtain spatial and temporal pesticide residue data. Pesticide residue analysis methods can be done but the cost is high. This problem needs solution the evolving cost of analysis. The green revolution technology that has been used as basis for agricultural development must be transformed into bio-revolution in an effort to increase productivity of agricultural crops while maintaining environmental quality. The release of pesticides should pass risk assessment includes hazard / toxicity, exposure, risk characteristics, risk management (including risk management and profit analysis. Risk assessment elements are hazard estimation and exposure. Monitoring the environment through risk assessment and risk management of the use of pesticides and heavy metals is urgently needed.

People living in agricultural areas are at risk of being exposed to various toxic substances, such as pesticides and heavy metals like lead (Pb) .People exposure pollutantsoccured directly, through their involvement in agricultural activities, or indirectly through contact with the environment contaminated by pesticide residues in water, air, soil, agricultural or food products

Exposure to pesticides and lead was a risk factor for various types of health problems specifically related to hormonal dysfunction and the quality of fetal or child growth and development

Adaptation and mitigation technologies in agricultural sector

The impact of climate change on agriculture is becoming more intense in recent years. A strategic action should be conducted in order to reduce the negative impact and high loss in quantity and quality of agricultural products. Research on mitigating climate change focuses on developing technologies to reduce greenhouse gas (GHG) emissions from croplands. Soil organic carbon stock change should be modeled based on long-term field experiments over the country todevelop options to increase soil carbon sequestration. It was demonstrated that methane and nitrous oxide emissions from rice cultivation can be reduced about 30% in Japan by prolongmid-season drainage. The effects of alternative wetting and drying (AWD) were also tested in the Southeast Asian countries. The effect of alternate wetting and drying significantly reduce methane emission in rice field, however it could increase nitrous oxide. Further research is needed to find technology which reduces both GHGs emissions.

Other activity has been conducting to encounter the climate change in agricultural sector. It is called Climate Smart Agriculture (CSA). The CSA is built by three main component i.e. increase productivity and agriculture income; enhance resilience to climate change (adaptation action) and reduce GHGs emission (mitigation action) to realize sustainability in agriculture. The CSA is highly context specific, it mean that no one size fit all solution. Key factor

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to success on CSA is a planning properly include understanding the context and challenges of the agriculture sector at various scales and evaluating of financial implications for farmer and economic return for society. It might need pilot project, particularly for new technologies and practices. The important thing should be considered about CSA is intervention related to policy objectives.

Agricultural sectors must become climate-smart to successfully tackle current food security and climate change challenges. Climate-smart agriculture is a pathway towards development and food security built on three pillars: increasing productivity and incomes, enhancing resilience of livelihoods and ecosystems (adaptation option) and reducing greenhouse gas emissions through appropriate mitigation technologies. CSA planning is important to understand the context and challenges of the agriculture sector at various scales, to evaluate financial implications for farmers and economic return for society, to Pilot might be necessary, especially for new technologies and practices, and to keep in mind the bigger picture and how CSA interventions will related to long-term policy objectives.

Trends in temperature readings from around the world show that global warming is taking place. Agriculture is clearly among the culprits of climate change and this sector is also a victim. The impacts of climate change including higher temperatures, more extreme weather, and worsening disease and pest problems could significantly reduce the yields of crops. Adaptation and mitigation is needed to tackle the negative effects on yields. The improvement of yield productivity and quality is one of the adaptation strategies through weather forecast, CO_2 elevated experiments for rice and modeling in response to climate change for evaluating future production. Shift cultivation area is predicted to be happened in the future. Soil management that conserves soil carbon; restoration of degraded lands; improved pest & disease management; high-yielding agroforestry; secure and equitable rights and access to financial services; effective input and product markets; learning processes and knowledge management are the approaches that covered in climate-smart agriculture (CSA).

CSA is an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. CSA aims to tackle three main objectives: sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions, where possible. Long-term experiments with continuous organic matter application in Japan demonstrated that soil carbon stock and yield increased. In order to meet the increasing demand for rice production of the world, rice paddies will continue to be an important CH_4 source in the near future. Alternative water managementin irrigated rice

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paddies in Southeast Asia is one of the researches focus to mitigate greenhouse gas emission from paddy fields. New technologies and practices of climate change adaptation and mitigation will be related to long-term policy objectives if the intervention could understand the context and challenges of the agriculture sector at various scales, there is financial implications for farmers and economic return for society, then innovative financial services and support need to be put into place as well as targeted incentives (fiscal reform, climate smart subsidies, etc.).

Linkage between economy and sustainable agriculture

There is lack of synergy between economic aspects and agriculture sustainability. Economic valuation plays a crucial role to synergy economic and agriculture. Economic valuation could avoid undervaluation of agriculture ecosystem which lead to massive land conversions and degradation. Economic valuation is a pivotal part of food and agriculture by ensuring food availability through ecosystem services such as water provision, soil quality and soil fertility, and agriculture services to reduce poverty. Thus, the economic valuation should be considered and implemented.

Sustainability of food self-sufficiency must be maintained, even though we face severe threat of climate change, land degradation, and reduced productive land. Technological innovation in agro-technologies will be key factors to satisfy future food demand. We be more severe with developed adaptation and mitigation technology. The combination of biochar and other organic matter sources in agricultural practices could promote sustainable agriculture

Policy and recommendations

Regulation are crucially needed for pesticides and heavy metals in soil, water and crops. Government Institution to control production, distribution, monitoring the use of pesticide should be at the high ranking level, not only form as a commission. Strengthening the implementation of regulations related to the supervision of pesticide distribution, pesticide use, and strict food safety. Strategy to prevent environmental degradation is recommended to support sustainable agriculture management and carbon sequestration, e.g. regulation to stop/reduce pollution and degradation, giving insentive for farmers using organic fertilizer(biochar-compost-liquid smoke), and applying good agricultural practices (using low emission cultivars, intermittent irrigation, agro-forestry practices and biochar applications) are recommended to support sustainable agriculture management. Quantification of risk assessment and risk management for pesticides and heavy metal pollutants is crucially implemented.

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