Proceedings of the Soil Science Conference of Malaysia 2016

Soil Improvement for Sustainable Crop Production

5 - 7 April 2016
TH Hotel & Convention Centre,
Kuala Terengganu, Terengganu

Editors:

Adzemi Mat Arshad
Ahmed Osumanu Haruna
Rosazlin Abdullah
Che Fauziah Ishak
Christopher Teh Boon Sung
Jeyanny Vijayanathan
Wan Zaliha Wan Sembok

Jointly Organized by:

PERSATUAN SAINS TANAH MALAYSIA
MALAYSIAN SOCIETY OF SOIL SCIENCE

UNIVERSITI MALAYSIA TERENGGANU

PERSATUAN SAINS TANAH MALAYSIA

THE MALAYSIAN SOCIETY OF SOIL SCIENCE
(Inaugurated on 2nd April 1971, Reg. Number 985 Selangor)
Department of Land Management, Faculty of Agriculture, 43400,
UPM, Serdang, Selangor, Malaysia

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Date : 29th October 2015

Prof. Dr. M. Edi Armanto
Faculty of Agriculture
Sriwijaya University
Kampus Indralya, Jalan Palembang-Prabumilih
KM 32, Indralaya Ogan Ilir
South Sumatra.
Indonesia

Dear Prof. Dr. M. Edi Armanto,

RE: INVITATION AS A KEYNOTE SPEAKER FOR SOIL SCIENCE CONFERENCE OF MALAYSIA 2016
Date : 5-7 April 2016
Venue: Kuala Terengganu, Terengganu

I refer to the above.

2. The Malaysian Society of Soil Science in collaboration with Universiti Malaysia Terengganu (UMT) will organize the Soil Science Conference of Malaysia 2016 with the theme 'Soil Improvement for Sustainable Crop Production'. On behalf of the organizing committee, it is my great pleasure to invite you to present a keynote lecture in this conference. Your contribution is very much needed for the success of this conference.

3. If you have any further enquiries, please do not hesitate to contact the Secretariat at 09-668 4981 or 09-668 4980.

Thank you.
Best regards.

Yours truly,
(DR. SUHAIZAN LOB)
Scientific & Technical Sub-committee
'Soil Science Conference of Malaysia 2016'

UNIVERSITI MALAYSIA TERENGGANU

Certificate of Participation

This is to certify that

Prof. Dr. H.M. Edi Armanto

Hereby recognized for participation in

SOIL SCIENCE CONFERENCE OF MALAYSIA 2016
(SOILS 2016)

As Keynote Speaker

5 - 7 April 2016
TH Hotel & Convention Centre, Kuala Terengganu, Terengganu

Dr. Wan Rasidah Wan A. Kadir
President Malaysian Soil Science Society

Assoc. Prof. Dr. Amiza Mat Amin
Chairman SOILS2016

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EDITORIAL TEAM

Adzemi Mat Arshad
Ahmed Osumanu Haruna
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Wan Zaliha Wan Sembok

TECHNICAL TEAM

Suhaizan Lob
Nurul Azilla Muhammad
Ain Najwa Khairol Anwar

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BRIS SOILS IMPROVEMENT FOR SUSTAINABLE CROP PRODUCTION

Edi Armanto, H.M.[1], M.A. Adzemi[2] and E. Wildayana[1]
[1]Faculty of Agriculture, Sriwijaya University, South Sumatra, Indonesia
[2]School of Food Science and Technology, Universiti Malaysia Terengganu, 21030 Kuala Terengganu, Malaysia
E-mail: earmanto@yahoo.com

INTRODUCTION

:neral, the main problems for agricultural activities in BRIS soils can be summarized as e reports of Armanto et al. (2012, 2013, and 2014), Armanto and Adzemi (2013), and ıg others:

The continuous action of marine waves on the coastline (abrasion) may create dynamic coastal areas. The soils are constantly being eroded.

BRIS soils are technically able to be managed for arable soils, but economically the production costs are highly expensive. More than 90 % of its land suitability is classified as marginally suitable (S_3) or not suitable (N) for almost all agricultural commodities

Conversion of agricultural BRIS soils is happening unstoppable, including the productive soils

Yield loss is high, especially at the time of production, harvest time, post-harvest and transportation

Agricultural infrastructure are still not enough implemented and it becomes constraints in the production process of agricultural commodities

Food diversity has not shown sufficient results, local communities are highly dependent on rice as a staple food

High agricultural production (probably) can be achieved, but farmers cannot survive just on depending of their agricultural sectors

Fluctuations of food prices are not well maintained, the profit margin is still small for the farmers, thus food crop farming business means "Low Profit + High Risk" (Wildayana et al., 2011a, 2011b)

Production inputs (fertilizer and seeds) subsidized by government are not really effective in terms of dose right, location right and type right

Farming institutional sector at village level is less developed on farmer's initiative (still a top down).

Some strategic researches are not focused to answer the main problems of BRIS soils, thus their contribution is still low to overcome in agriculture sector. Most of research is based on "Try and Error Approaches" and only for specific commodity as well as site-specific.

›bjective of this paper is to make and to analyze BRIS soils improvement for sustainable production *from perspectives of soil science*. This paper is expected to provide a useful nce for beneficiaries and stakeholders in land use planning of BRIS soils which are the appropriate, integrated, site-specific as well as implementable. We hope that the nation presented will be able also to provide a view or a new input to the user how soils should be managed that are effective, efficient and sustainable (Figure 1).

Agroecosystem Functions of BRIS Soils

Blum (2013) stated that there are two major functions of soil resources, namely *Ecological Functions* and *Non-Ecological Functions*. The ecological functions are divided into (1) *Functions of Biomass Production*, (2) *Functions of Storing, Filtering, Buffering and Transforming*, and (3) *Functions to Biodiversity Providers*. Three main non-ecological functions are associated with human activities outside the agricultural activities, which include land serves as (1) *Physical Media*, (2) *Sources of Energy and Raw Materials*, and (3) *Ecosystem Services*.

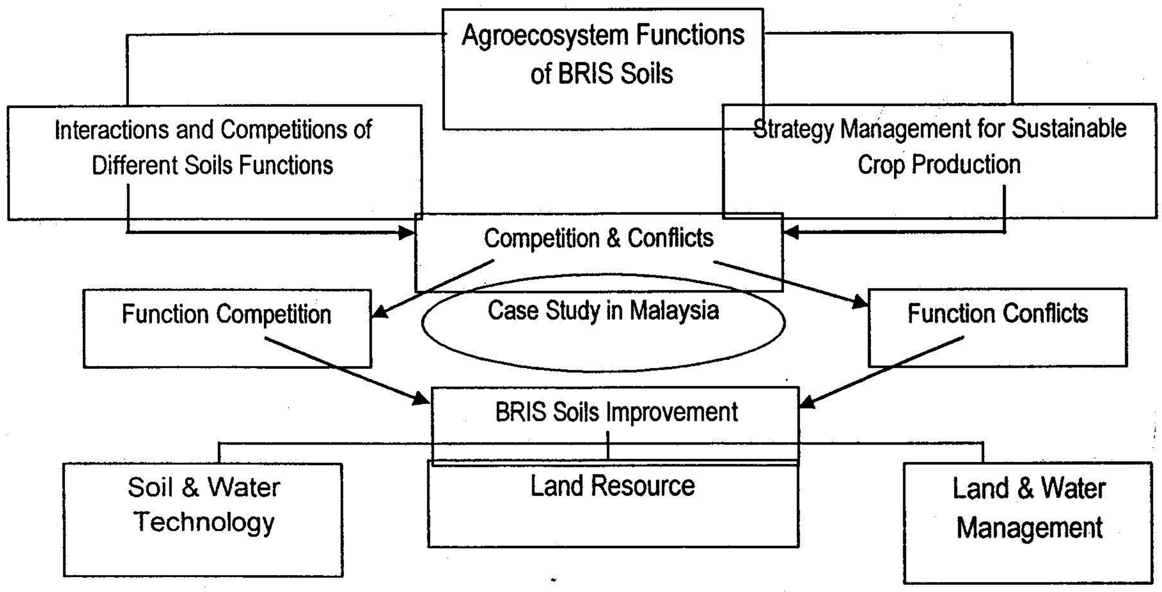

Figure 1. Framework of BRIS soils improvement for sustainable crop production

Interaction and Competition of Soil Functions

The land use functions of BRIS soils that have undergone many changes. In 1990, the ecological function of land resources was dominant (80.46 %) and decreased to 66.23 % in 2010 in accordance with the increase in activities and development of physical media. Non-ecological functions covered 19.54 % in 1990 and increased to 33.77 % in 2010, respectively (Table 1).

Table 1. The land use function changes in BRIS soils, 1990-2010 (%)

No	Land use function	Year of 1990*/	Year of 2010**/
1.	A. Ecological Functions		
	Biomass Production	15.10	10.88
	Storing, Filtering, Buffering and Transforming	50.15	47.76
	Biodiversity Providers	15.21	7.59
	Total A (%)	80.46	66.23
2.	B. Non-Ecological Functions		
	Physical Media	13.50	29.36
	Sources of Raw Materials	4.98	3.50
	Cultural Heritage	1.06	0.91
	Total B (%)	19.54	33.77
	Total A + B (%)	100.00	100.00

Note: */ Prediction was interpreted on the basis of Google map 2010

General conflicts of soil functions in landuses of BRIS soil resources occur in three main components, namely competition in land (space), object and time. The three forms of conflicts are integrated and interconnected each other. Thus it is very important to find out what factors are the most dominant in the conflicts which led to the specific conflict based on carrying capacity, capability and suitability of land resources for sustainable crop production. Land use conflicts are natural, inevitable, rational, reasonable and even desirable as well as planned under certain conditions. We need only to keep "such conflicts in harmony and balanced condition" in order to support human life. The common causes of the conflict are induced by "dominant differences" in terms of the *"Information Sufficiency"* and *"Sources of information"*. Both components will give character and view specifically in terms of *perception, main goals, value and belief, mindset, competition of scarce land resources, and rejection (refusal) or loss of recognition or status.*

Strategy Management for Sustainable Crops Production

The five pillars of sustainability are the basic principles and the foundation on which sustainable planning of land resource is being developed. Now, international agreement has determined and achieved on the indicators of sustainable planning of land resource (Table 2 and 3). Management of BRIS soils aims to regulate the use of soils to obtain optimal production, and at the same time maintaining the sustainability of the BRIS soils. The management of BRIS soils requires a careful planning, utilization and application of appropriate technology, well-balanced land development and right management of land and water. Three tips of BRIS soils management priorities, namely:

Table 2. Five pillars of sustainable planning of BRIS soils

No	Pillars	Explanations
1.	Productivity	to maintain or to increase production or production services
2.	Security	to reduce the level of risk in production
3.	Protection	to protect natural resources and prevent degradation of soil and water quality
4.	Viability	to be economically viable
5.	Acceptability	to be socially accepted by society and farmers

Source: Dumanski et al. (1998).

Adjust with the Nature, not Against the Nature

The principle of adjusting with the nature in the operational forms is intended with the "Principle of Comparative Advantage" and the "Principle of Time Advantage".

Cultivations of BRIS Soils is recommended if We Have Already Complete Information

This approach is recommended because BRIS soils are fragile and very susceptible to development touch. Without the appropriate science and technology, thus cultivation of BRIS soils is useless and wastes time and natural resource. The most important needed information is all of the contact experience with BRIS soils. The cultivation principle with a secret understanding of BRIS soils mean *"benefit"*, so that the nature of BRIS soils can be managed wisely and can follow human desire.

Table 3. Physical indicators of sustainable planning of BRIS soils

No	Periods	Physical indicators
1.	Short term	Ten sets of indicators must be developed in the short term, i.e. water and nutrients holding capacity, soil suitability, soil capability, nutrient balance, yield trends and variability, landuse intensity, land degradation, water quality, landuse diversity and land cover
2.	Long term	Five sets of indicators, requiring longer-term research, on the themes of soil and land quality, agro-biodiversity, land cover, forest land quality, and land contamination as well as pollution.
3.	Being developed	Four sets of indicators are being developed by working groups, i.e. crop suitability, soil fertility, soil productivity, and crop productivity

Source : McBratney et al. (2014)

Completing Information about BRIS Soils

Completing information about BRIS soils should be carried our as early as possible and sustainable. This is due to the changing dynamics of the ecological balance of the BRIS soils ecosystem which is strongly associated with changes among ecosystems, therefore: (1) Trials and research actions need to be implemented, and (2) Evaluation and monitoring of the BRIS soil properties and/or character needs to be measured.

Management approach of BRIS soils are divided into three main components, namely (1) the Technology of Water Management (macro and micro water management), (2) Technologies of Land Management (soil minimum tillage, fertilization and liming), and (3) Technology Crop Management (cropping system, *surjan* system, selection of crops resistant to acidity, water shortage and fluctuating water conditions).

Based on ecological principles that BRIS soils improvement for sustainable crop production reflects two main things: 1). How BRIS soils (natural-biological) can be harvested its benefit from the field continuously and profitably, and 2). How is BRIS soil resource that can be harvested on time, right quantity, right quality and space, so as it is not to damage the BRIS soils.

BRIS Soils Improvement for Sustainable Crop Production

Approaches of soil science to be applied will include namely soil and water technology, land resource analyses and planning and land and water management as summarized in Figure 2.

Soil and Water Technology

Some BRIS soils and water technology are already distributed at least among scientists for sustainable crop production, namely:

1. Use of Mulching (plastic, natural grass and plant residues) and do not burn the soil biomass (Armanto *et al.,* 2013)
2. To fertilize soils with NPK and organic fertilizers (By-products of palm oil industry; Palm Oil Mill Sludge Cake, POMSC). POMSC (EFB = Empty Fruit Bunches and POME = Palm Oil Mill Effluent). Animal manure (cow, goat, sheep and poultry), compost and green manure
3. The Use of Fine Materials (clay, river mud, deposit or sediments, ponds reservoirs, sludge and mud etc.)
4. Use of Impermeable Layer (plastic sheets, asphalt, bitumen, clay, compaction and cement) (Armanto, 2014, Rajiman, 2010)

5. Use of Wind Breaker (Temporary, weaved bamboo, weaved coconut palm leaves, oil palm leaves, nylon net and plastic sheets; Permanent, coconut tree, oil palm tree, pine (*rhu*), acacia, *petai* china, *sengon*, *lamtoro*, *turi* flowers, *casuarinas* (*cemara laut*) and pandanus.
6. Use of Soil Ameliorants (asphalt emulsion, latex, latex skim, agricultural lime, rock phosphate, zeolite, clay, river mud, deposit or sediments and organic material) (Armanto, 2005)
7. Planting of Alley Cropping (Plants in the alley is usually the green manure legume crop or tree) (Sjarkowi et al., 2007)
8. Hydrology and Irrigation (use of wells, *perigi*, use of plastic sheets planted in soils at depth of 30 cm as containers and sprinkler irrigation)
9. To make terraces and mix mineral subsoils to BRIS soil to improve water and nutrient holding capacity.

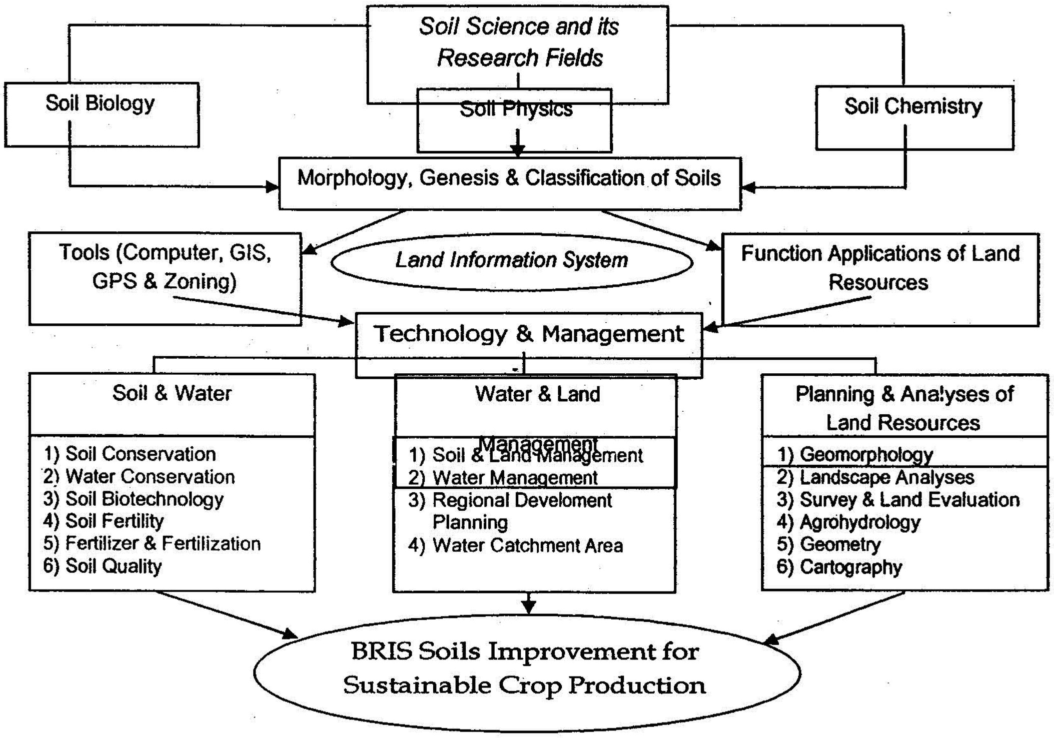

Figure 2. Interrelationship between study fields of soil science (Armanto, 2003a, 2003b)

Land Resource Analyses and Planning

The emphasis of this approach is on ability of experts to analyze soil and land resource planning, among others, to analyze soil dynamics, processes, genesis, morphology, classification and spatial planning. It is expected to give birth to planners and analysts of land resource. Various subjects support this approach, such as geomorphology, landscape analysis, survey and land evaluation, agro hydrology, geometry and cartography:

Topic 1. Location (Question: WHAT is ....?)
Topic 2. Conditions (Question: WHERE ....?)
Topic 3. Tendency (Question: WHAT HAS CHANGED SINCE ..?)
Topic 4. Pattern (Question: WHAT THE SPATIAL PATTERN THERE ..?)
Topic 5. Modeling (Question: WHAT IF ....?)

Land and Water Management

This approach integrates the both above approach, i.e. soil experts can manage land and water resources on the basis of soil and water technologies to improve the land productivity. Management package of BRIS soils can offer alternatives how to encourage users in order to behave economical, efficient, optimal and sustainable. So that the benefits of soil resources can be extracted for public welfare and environmental functions maintained continuity. In general, BRIS soils management package can be done with this approach:

Sensitive Model Development

At least two major tasks that can be solved by the application of sensitive models, namely: to understand the dependence of the system to predict the likely impact of the use of land resources that may arise and to get a large parameter that may arise in a system based on a specific observation point.

Systems Analysis, Modeling and Simulation Models

Utilization and system simulation models are required for: (1) to make planning policy of landuse, (2) to express elements of the system dynamics, the basic structure and the properties of an element, (3) to explore and to reveal knowledge processing and simulation systems, evaluation of qualitative information about the structure of the system and its relation to the environment, (4) to make modeling and simulation of dynamic systems is part of the planning of land for development purposes, and (5) there are many other goals to be achieved in accordance with what we want to the existence of land resources.

CONCLUSIONS AND SUGGESTION

Based on the results of research and literature review, it can be concluded as follows:

1. BRIS soils has two main functions, i.e. ecological functions and non-ecological functions
2. Land use conflicts are natural, inevitable, rational, reasonable and even desirable as well as planned under certain conditions. We need only to keep "such conflicts in harmony and balanced condition" in order to support human life;
3. The common causes of the conflict are induced by "dominant differences" in terms of the *"Information Sufficiency"* and *"Sources of information"*. Both components will give character and view specifically in terms of *perception, main goals, value and belief, mindset, competition of scarce land resources, and rejection (refusal) or loss of recognition or status;*
4. Three tips of BRIS soils management priorities for sustainable crop production, namely: (i) Adjust with the Nature, not Against the Nature, (ii) Cultivations of BRIS Soils is recommended if We Have Already Complete Information, (iii) Completing Information about BRIS Soils
5. BRIS soils improvement for sustainable crop production can be operationally done through: (a) Soil and Water Technology, (b) Land Resource Analyses and Planning, (c) Land and Water Management

6. Package of land resource management can be implemented with two ways, namely the development of sensitive models and analysis systems, modeling, and model simulation.

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