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Nutrient management for both food security and environmental quality – status in Indonesia

SUSTAINABLE FERTILIZER MANAGEMENT

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Messages

- Application of chemical fertilizers in combination with bio-**organic fertilizer** is one of alternative method to achieve sustainable fertilizer management
- This alternative can reduce the **fertilization cost**, **reduce environmental pollution**, **improve** soil properties and **soil systems**, and **enhance crop** yields

AGRICULTURE SOILS IN INDONESIA

- LOW pH (4-5) – due to parent materials and high rainfall
- Al & Fe TOXICITY, LOW AVAILABLE P
- LEACHING OF NUTRIENTS (HIGH RAINFALL)
- **MOST AGRICULTURE SOILS IN INDONESIA HAVE BEEN DEGRADED, WITH LOW ORGANIC MATTER CONTENT**

73% AREA	-	ORGANIC MATTER < 2%
23% AREA	-	ORGANIC MATTER 2 -3%
4% AREA	-	ORGANIC MATTER > 4%

CHEMICAL FERTILIZERS USED

FOOD CROPS:

RECEIVE GOVERNMENT SUBSIDIZATION

- NATIONAL RECOMMENDATIONS
- REGIONAL RECOMMENDATIONS
- DISTRICT RECOMMENDATIONS
- **SUB-DISTRICT (KECAMATAN) RECOMENDATIONS – ISSUED BY THE MINISTRY OF AGRICULTURE**

PLANTATION CROPS:

- NOT SUBSIDIZED
- APPLICATIONS BASED ON SOIL AND PLANT ANALYSES

FERTILIZERS SUBSIDIZE FOR DIFFERENT SECTORS 2014

SUB-SECTORS	KIND OF FERTILIZER (TONS)				
	UREA	SP-36	ZA	NPK	ORGANIC
FOOD CROPS	2,481,552	520,639	514,103	1,362,272	595,989
HORTICULTURE	195,819	41,930	40,154	206,077	71,889
PLANTATION/small holder	521,113	136,461	224.922	389,288	109,859
ANIMAL HUSBANDRY	102,663	20,960	20,821	42,368	22,260
FISH CULTURE	116,853	40,010	-	-	-
TOTAL	**3,418,000**	760,000	800,000	2,000,000	800,000

FERTILIZATION

IN PRINCIPLE, FERTILIZER APPLICATION SHOULD BE:

- RIGHT DOSAGE/LEVELS
- RIGHT TIME
- RIGHT KIND OF FERTILIZERS
- RIGHT METHOD OF APPLICATION

IN REALITY - MANY PROBLEMS !

- DOSAGES VARY BY SUB-DISTRICT RECOMMENDATION
- NOT THE RIGHT TIME
- NPK VS. NEED NP-NK
- METHODS OF APPLICATION

CHEMICAL FERTILIZER CONSUMPTION (KG/HA)

COUNTRY	N	P	K	TOTAL	YIELD
USA	58	22	-	80	5400
FRANCE	126	43	-	169	7244
GERMANY	120	30	-	150	6470
CHINA	171	71	-	242	4756
INDONESIA	200-250	100	50-100	350-450	5000

NPK CONSUMPTION IN INDONESIA IS HIGHER
NUTRIENT-UPTAKE EFFICIENCY LOW

LOW SOIL ORGANIC MATTER (SOM)

WHY ?

- FARMERS RECOGNIZED ONLY CHEMICAL FERTILIZERS -- VERY HANDY AND SIMPLE, BUT THEY **ONLY SUPPLIED N, P, AND K**
- THEY FORGOT OR WERE RELUCTANT TO USE ORGANIC FERTILIZER
- SOILS WERE GOOD QUALITY TO BEGIN WITH, HIGH SOM, HIGH YIELDING
- BUT VERY INTENSIVE AGRICULTURE WAS PRACTICES, WITH 2-3 GROWING SEASONS/YEAR
- PLANT RESIDUES WERE BURNED OR REMOVED FOR ANIMAL FEEDING, OR FOR USE AS MATERIAL FOR MAKING PAPER, E.G.
- THIS MEANT REMOVAL OF NUTRIENTS, BOTH MACRO AND MICRO-NUTRIENTS

SOIL ORGANIC MATTER (SOM) IS THE SOUL OF SOILS

- **HIGH SOM MEANS GOOD SOIL; LOW SOM MEANS BAD SOIL**
- **SOM IMPROVE SOIL PROPERTIES**:

PHYSICAL PROPERTIES

WATER HOLDING CAPACITY, POROSITY, PORE DISTRIBUTION, SOIL AERATION, BULK DENSITY, SOIL STRUCTURE, ETC.

CHEMICAL PROPERTIES

NUTRIENT SUPPLY (MACRO-MICRO NUTRIENTS), CEC, BUFFERING CAPACITY, NUTRIENT AVAILABILITY, ETC.

BIOLOGICAL PROPERTIES

STIMULATE GROWTH OF BENEFICIAL SOIL ORGANISMS, SOIL BIODIVERSITY, POPULATION OF SOIL ORGANISMS

ENHANCING SOIL ORGANIC MATTER IS THUS VERY IMPORTANT FOR IMPROVING SOIL PROPERTIES

CHEMICALS FERTILIZERS VS. ORGANIC FERTILIZER

COMPLEMENTARY

• N-P-K	MORE NUTRIENTS
• HIGH NUTRIENT CONTENT	LOW NUTRIENT CONTENT
• **PARTLY CHEMICAL**	PHYSICS-CHEM-BIOLOGY

BOTH FERTILIZERS ARE BEST USED TOGETHER FOR OPTIMIZING RESULTS

NOTE THAT ORGANIC FERTILIZERS ARE NOT *ALTERNATIVES* OR *SURROGATES* FOR USING CHEMICAL FERTILIZER

THEIR FUNCTION OF ORGANIC FERTILIZER IS TO IMPROVE SOIL PROPERTIES AND FUNCTIONING OF SOIL SYSTEMS, WHICH IS MORE THAN JUST ADDING NUTRIENTS TO THE SOIL

FERTILIZER APPLICATION IN INDONESIA

- **1965-1970**

FIRST INTRODUCTION OF **CHEMICAL/INORGANIC/ARTIFICIAL FERTILIZERS** TO INDONESIAN FARMERS (UREA/TSP-SP-36/KCl)

SOILS WERE GOOD, WITH HIGH SOIL ORGANIC MATTER, GIVING SIGNIFICANT INCREASES OF YIELD, WITH LITTLE OR NO USE OF ORGANIC FERTILIZERS

- **1970 -2000**

UREA, TSP/SP-36, KCl WERE PROMOTED

LESS OR NO USE OF ORGANIC FERTILIZER

UNBALANCED FERTILIZER APPLICATION, NO MICRONUTRIENTS

ENVIRONMENTAL POLLUTION PROBLEMS

PEST AND DISEASE PROBLEMS INCREASED

LEVELING OFF OF YIELDS

INCREASE OF FERTILIZER PRICE (GOVERMENT SUBSIDY 18 T IDR)

FERTILIZER APPLICATION IN INDONESIA (continued)

- **2000 – UP TO NOW**:

SOILS HAVE BECOME DEGRADED, LOW YIELDS, LOW NUTRIENT UP-TAKE EFFICIENCY

NEED FOR NPK FERTILIZER + ORGANIC FERTILIZERS

NEED FOR GOOD QUALITY OF ORGANIC FERTILIZER

NEED FOR BIO-FERTILIZERS

BIO-ORGANIC FERTILIZER = ORG. FERTILIZER + BIOFERTILIZER

NEED FOR A NATIONAL PROGRAM FOR PROMOTING OF THE USE OF ORGANIC FERTILIZERS TOGETHER WITH CHEMICAL FERTILIZERS

REDUCE DOSAGES OF CHEMICAL FERTILIZERS; USE ORGANIC/BIO-ORGANIC FERTILIZER, BUT THE TOTAL COST OF FERTILIZERS SHOULD BE THE SAME OR LESS

STRONG SUPPORT FROM GOVERMENT

PROMOTION OF USING PLANT RESIDUES OR ORGANIC FERTILIZER (INCENTIVE FOR NO PLANT RESIDUE BURNING, PLANT CHOPPER AID TO FARMER GROUPS)

SUBSIDIES FOR ORGANIC FERTILIZER (DIRECT FERTILIZER AID TO FARMERS)

MINISTRIAL REGULATION FOR CHEMICAL FERTILIZERS, ORGANIC FERTILIZERS, BIOFERTILIZERS, AND SOIL AMENDMENTS (GUIDANCE FOR PRODUCERS AS WELL AS FOR FARMERS -- MINISTRIAL REGULATION NO. 28 YEAR 2009 AND NO. 70 YEAR 2011

2005-2011 MINISTRY OF AGRICULTURE

HAVE BEEN REGISTERED:

- 1,477 CHEMICAL FERTILIZERS
- 533 ORGANIC FERTILIZERS
- 126 BIOFERTILIZERS
- 162 SOIL AMENDMENTS

SOURCE: PPI, 2011

PUPUK ORGANIK (KOMPOS) Dies IPB (1993)

MEMPERBAIKI SIFAT FISIK, KIMIA DAN BIOLOGI TANAH

PROF DR ISWANDI ANAS IPB 2011

11 JUNE 2010

STRATEGY FOR FUTURE FERTILIZATION

REDUCE DOSAGE OF CHEMICAL FERTILIZERS COMBINE WITH ORGANIC FERTILIZERS

- INCREASE NUTRIENTS UP-TAKE EFFICIENCY
- IMPROVE SOIL QUALITY (PHYSICAL, CHEMICAL AND BIOLOGICAL PROPERTIES OF SOILS)
- MAKE SOIL SYSTEMS BETTER
- INCREASE CROP YIELD,
- REDUCE ENVIRONMENTAL POLLUTION
- REDUCE FERTILIZER SUBSIDIES 2013 **(18 T IDR)**

FNCA BIOFERTILIZER MEETING IN KUALALUMPUR 25-29 FEBRUARY 2008

PRODUCTION OF BIO-ORGANIC FERTILIZERS IN CHINA

Year	No. of enterprises	**Total production (1000 t)**	Types of products	Registered products
1995	110	**100**	4	-
1997	180	**400**	7	8
1999	280	**900**	8	59
2001	350	**1,500**	9	149
2003	450	**2,000**	11	286
2005	480	**500**	11	NA
2006	500	**2,500**	11	498

• Data provided by the Center of Supervision, Inspection and Testing of Biofertilizer Quality of MOA

NUMBER OF STRAINS USING FOR BASES FOR BIOFERTILIZERS IN CHINA

- Free-living N-fixing bacteria > 40
- Associated N-fixing bacteria 106
- Rhizobia >3000
- Phosphate-solubilizing strains ~ 80
- Phosphate-decomposing strains > 15
- Silicate bacteria V > 30
- PGPR 150~200
- Antagonistic strains V ~300
- Pesticides degraders ~300

(Fan, 2008)

Effect of Bio-organic Fertilizer in Combination with Chemical Fertilizer on Rice Yield

Fertilization	Conv.	SRI	Ave-
			ton h
Without	4,50f	5,69d	5,10d
100% Inorganic	**6,13c**	**7,75a**	**6,94a**
75% Inorg+200 kg Bio-Org-fert	5,55d	6,49b	6,02b
50% Inorg+200 kg Bio-Org-Fert	**6,01c**	**7,94a**	**6,79a**
50% Inorg	4,98e	6,09c	5,53c
Average	5,43b	6,79a	

Effect of Fertilization on NPK Up-take by Rice Plant

Treatments	Nutrient Up-take		
	N	P	K
Fertilization			
NONE	0,093c	0,011c	0,102c
100% NPK	0,274b	0,031b	0,258b
75% NPK + 200 kg Bio-Org-Ferts	0,298b	0,033b	0,242b
50% NPK+ 200 kg Bio-Org-Ferts	0,381a	0,049a	0,374a
50% NPK	0,164c	0,019c	0,161bc

Urea = 250 kg ha^{-1}, SP-36 = 75 kg ha^{-1}, KCl = 50 kg ha^{-1}); Bio-Organic Fertilizer (BIOST= 200 kg ha

Conclusions

- Application of chemical fertilizers in combination with bio-organic fertilizer is one of alternative method to achieve sustainable fertilizer management
- This alternative can reduce the fertilization cost, reduce environmental pollution, improve soil properties and soil syatems, and enhance crop yields