Indonesia's Experience on Improved Nutrient and Manure Management

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Coverage

- Background
- Nutrient Sources
- Conventional and Improved Nutrient Use
- Manure management: how to improve
- Benefits and synergies
- Challenges and how to fill the gaps

Background

Indonesia's agricultural systems vary in terms of:

- **Management systems** (traditional vs modern management),
- **Farm size**, from a fraction of hectare under annual food crop to hundreds of hectares under large plantations
- **Farmers' socio-economic backgrounds**,
- **Bio-physical** circumstances (humid tropical to semi-arid; 0 to >1500 m asl.)
- **Farming systems**

Main Farming Systems

Farming Systems	Nutrient Management		Vulnerability to CC
	Organic	Chemical	
Paddy rice (7.5 Mha)	Low-Medium inputs	Medium to high inputs	Very high (rainfed) - Vulnerable
Annual upland food and veg. crops (9.6 Mha)	Low-medium	Low medium	Very high
Agroforestry (27 Mha)	Low-medium	Low-medium	**Low - Moderate**
Perennial tree crops plantation (16 Mha)	Low-high	Low-high	**Low - Moderate**
Animal husbandry	n.a.	n.a.	High

Nutrient sources

Organic matter

- Manure
- Crop residues (rice straw, corn stalk, palm frond, etc.)
- Composts
- Green manure
- Legume cover crops
- Bio-fertilizers

Chemical fertilizers

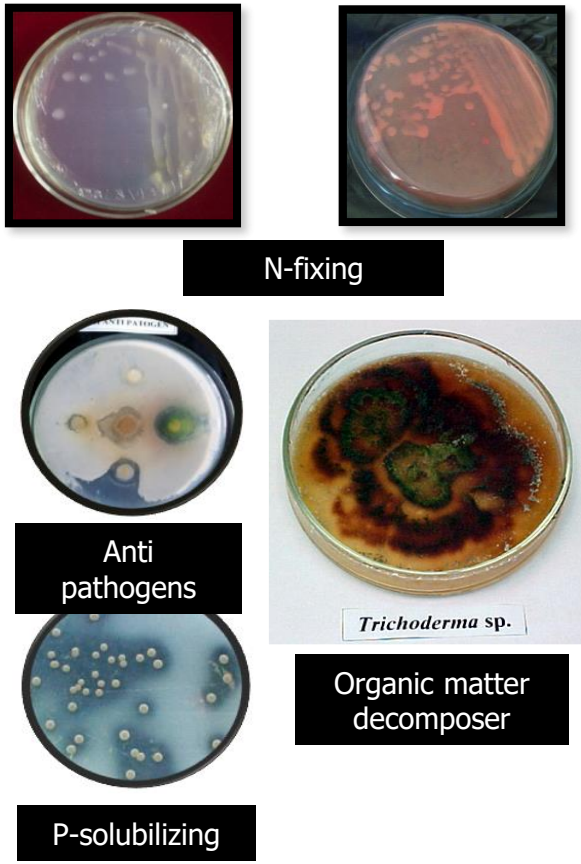
- Urea
- Ammonium sulphate (ZA) for calcareous soils
- NPK
- SP-36, TSP, Rock Phospate
- KCl

➢ Farmers' knowledge of the role and application of these nutrient sources vary

➢ Sometimes competitive use of organic manure off-farm

Increasing Roles of Biofertilizers

- **N-fixing** bacteria → Reduce chemical N fertilizer application
- **P-Solubilizing** microbes → Increase soil P availability, reduce P fertilizer requirement
- Organic matter **decomposers** → Speed up composting, reduce C/N ratio, and reduce soil NO_3^- fixation
- **Plant growth promoters** → increase root development and nutrient uptake



Improved Nutrient Management Strategies: Co-Benefits and Synergies

Strategies	Benefits/Co-benefits	
	Adaptation	Co-benefits
Balanced fertilization and **site specific recommendation**: e.g. Soil Test Kits, Cropping calendar	Balanced nutrients requirement, increase fertilizer use efficiency, better crop vigor, more resistant to diseases, higher production,	Lower N_2O and lower CO_2 emissions, lower eutrophication and water pollution,
Integrated nutrient management: Combining all available (especially local) sources	Higher efficiency, better crop growth and production	Less leaching, lower water pollution, and lower indirect N_2O emission, more biodiverse soil biota
Higher use of organic matter	Improved soil physical, chemical and biological properties	Increased soil C stock, increase soil biota diversity

Improved Nutrient Management Strategies: Co-Benefits and Synergies

Improved management systems	Benefits/Co-benefits	
	Adaptation	Co-benefits
Biofertilizer	Improved nutrient availability	Lower needs for chemical fertilizers
Soil conditioners (lime, organic matter, biochar, vermiculite, etc.)	Improved soil fertility for problem soils such as acid soils, peat soils, ex-mining areas: • Increase soil pH, • Increase CEC • Neutralize toxic elements • Improve soil structure	Increased crop growth and production, increase carbon storage, increase soil biodiversity

Soil Test Kit for Site specific fertilizer recommendation

Soil N, P, K, pH extractant,
Nutrient color chart
Leaf color chart for N
Fertilizer recommendation chart

Status **N** tanah	**Dosis N pada tanah (kg N/ha)***	
	(+) Jerami	(-) Jerami
Rendah	115	138
Sedang	92	115
Tinggi / Sangat Tinggi	92	92

Integrated Cropping Calendar

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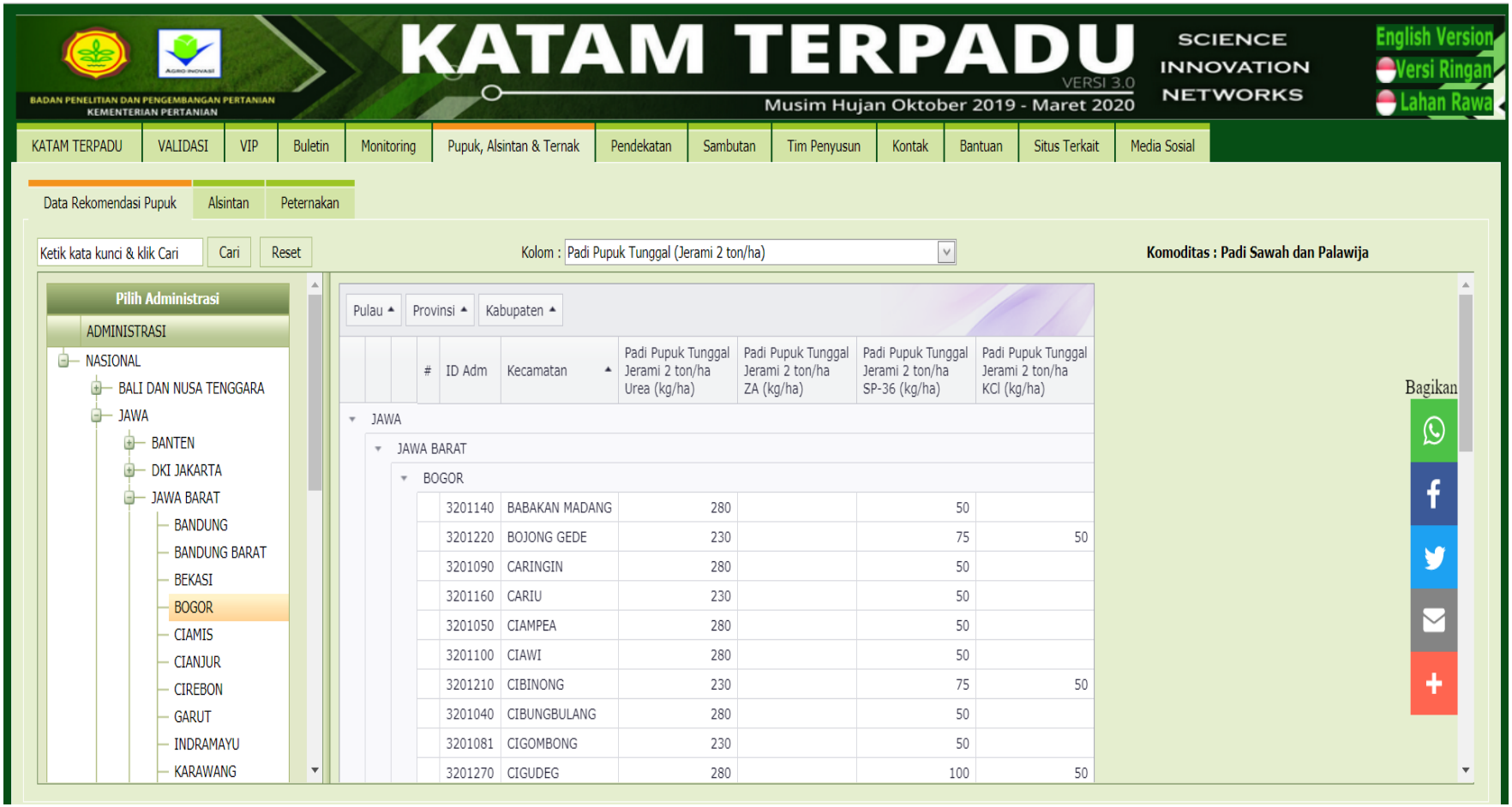
From a cropping calendar, evolved to fertilizer & crop variety recommendations package for **6,982 Subdistricts**



Animal husbandry

Livestock	Population in 2018 (k head)	Holding (head)	Manure management
Beef cattle	17,050	1-hundreds	Solid storage, dry lot, daily spread, **anaerobic digestion**, composting
Dairy cattle	550	1-hundreds	Solid storage, dry lot, daily spread, **Anaerobic digestion**, composting
Sheep	17,398	5-100	Dry lot, daily spread, composting
Goat	18,721	5-100	Dry lot, daily spread, composting
Poultry	2,444,000	5-thousands	Dry lot, **composting**

Manure management Co-benefits

Management	Extent of practice	Benefits (adaptation)	Co-benefits
Liquid/Slurry, Pit storage	**	Better distribution to the field	High CH_4 emission
Solid storage	****	Better distribution	Low GHG emission
Dry lot	***	Better distribution	Low GHG emission
Daily spread (grazing)	****	Uneven distribution	Easy management, low emissions
Anaerobic Digestion	*	Expensive investment, high labor	Source of renewable energy
Composting	***	Better nutrient availability	Low GHG emissions

Examples of improved systems

- **Crops – Livestock Integration**

Residues as feed

- Food Crops: rice, maize
- Perennial crops: palm oil, rubber, coffee, cocoa, sugarcane

- Ruminant: cattle, buffalo, goat and sheep
- Poultry: duck, local chicken

Manure and urine

- **Fertigation** (especially for sandy soils and water scarcity areas)

- **Closing yield gap, e.g. for oil palm plantation**

Type of plantation	Area	Current FFB Yield	Attainable FFB yld	Exploitable Yld	Extra FFB prodxn potential	Land saving
	(Million ha)	t/(ha.yr)	t/(ha.yr)	% of attainable yld	Million t	million ha
Large plantations (59%)	5.8	19.7	31.8	38	70	3.55
Smallholders (41%)	4.1	15.3	28.9	47	55	3.59
Indonesia	9.9	17.9	30.9	42	125	6.98

If we can increase yield to 70-80% of potential yield:

- We can produce extra 125 Mt extra FFB (about 25 Mt CPO)
- Increase farmers income
- Avoid about 7 Mha OP plantation expansion
- Significantly reduce GHG emissions

Goals and assessment

- The goal is maintenance of food security and increasing farmers' income
- We will **include adaptation** and co-benefit assessment in our next reporting

Challenges and Future Needs

How to speed up and scale up the implementation

- Capacity building, especially for remote and resource poor farmers.
- Regional scale pilots to develop, implement and evaluate improved nutrient and manure management
- Technology exchange, not only between Annex 1 and Non-Annex 1 countries, but also among Non Annex 1 countries
- Other means of implementations