



Nutrient Management for Sustainable Agriculture Development

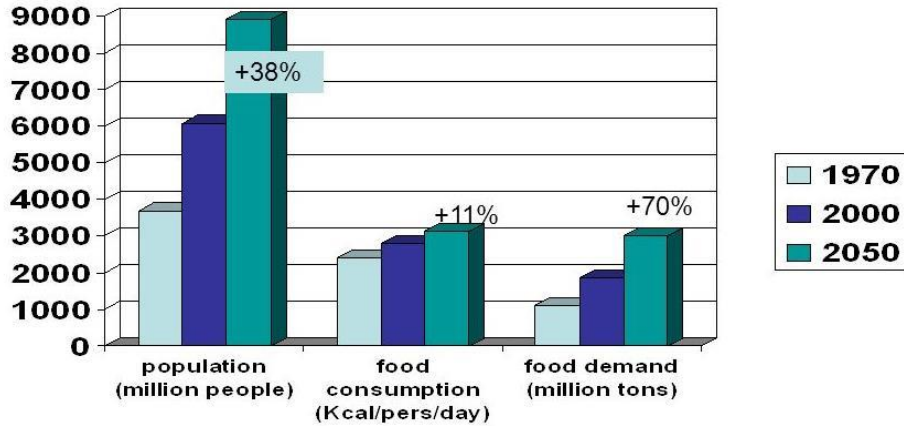
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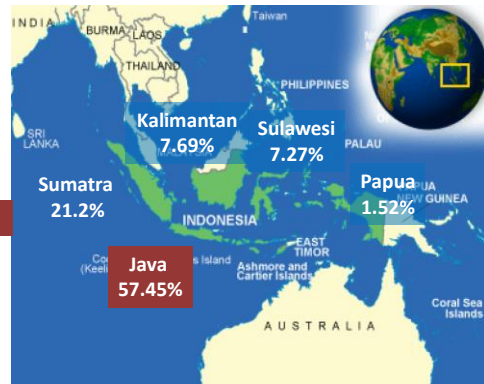
Outline of Presentation

- Introduction of agricultural problems
- Problems of soil fertility in varied ecosystems
- Problems of soil fertility in acid soils
- Balance fertilization
- Integrated nutrient management
- Experience in using Moroccan RPR for Maize and Oil Palm
- Conclusion

Food demand is growing as result of growth population, per capita food consumption (FAO)



POPULATION AND DISTRIBUTION



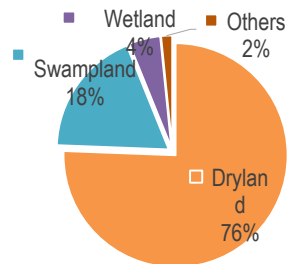
Country area
5.193.250 km²

PROBLEMS AND ISSUE RELATED TO SUSTAINABILITY OF AGRICULTURE

- Degradation of land resources, water and environmental (erosion, chemical, physical)
- Limitation of energy and fertilizer sources material (especially Phosphorus and Potassium)
- Inefficiency of fertilization
- Imbalanced fertilization
 - Intensive rice field: accumulation of P and K
 - Reformulation of NPK compound
 - Fertilizer management for upland (P fixation)
- Low in soil organic matter (73% of SOM are <2%)

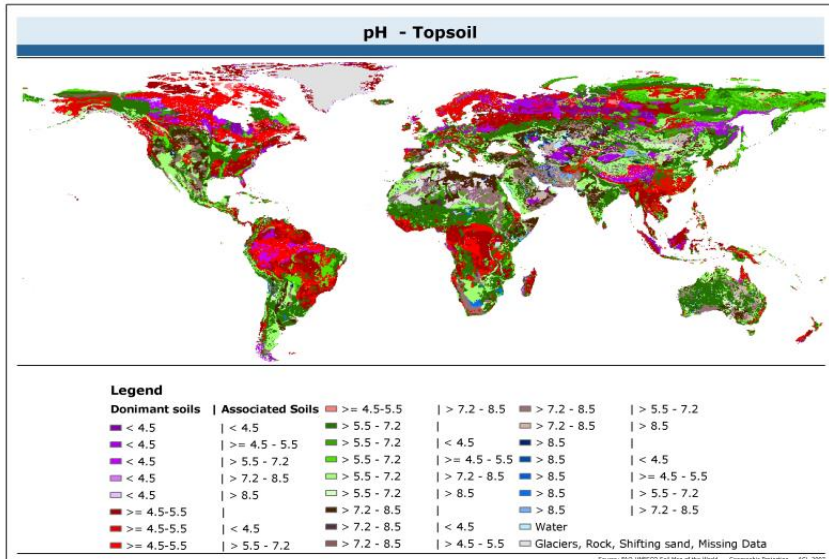
DISTRIBUTION OF AGRICULTURAL LAND BASED ECOSYSTEMS

Ecosystem	Ha	Acid	Non Acid
Dryland	144,473,211	107,357,633	37,115,579
Swampland	34,926,552	33,419,323	1,507,229
Wetland	8,638,537	5,684,231	2,954,306
Others	3,054,832		
Total	191,093,132	146,461,187	41,577,114
Percentage		76.64	28.39

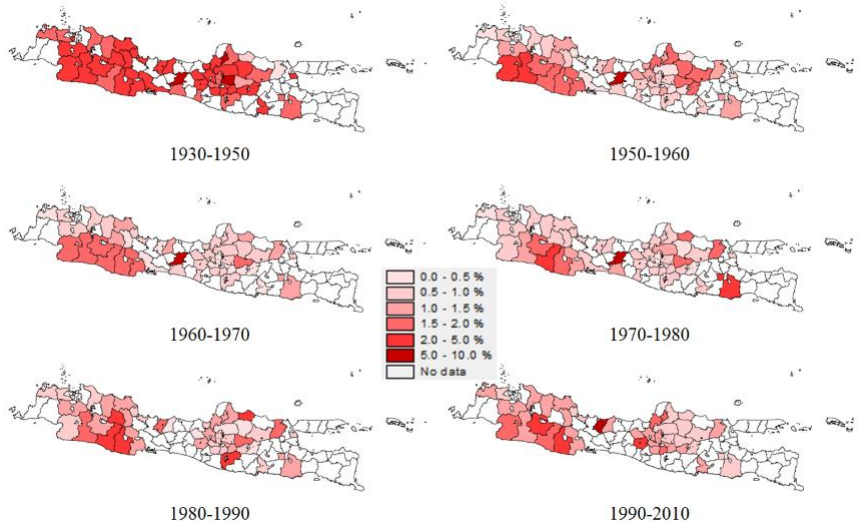


Upland acid soils is the dominant soil in Indonesia as well as in most Asia and African soils

DISTRIBUTION OF ACID SOILS (FAO)

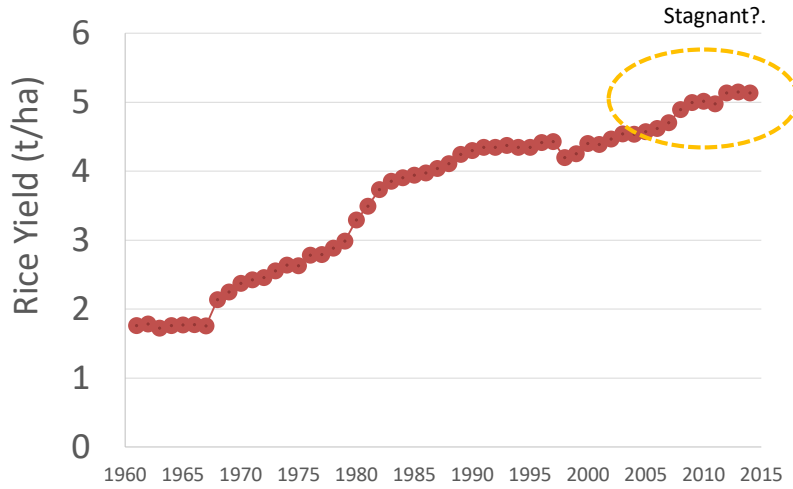


The evolution of organic C content for the top 10 cm soil in Java

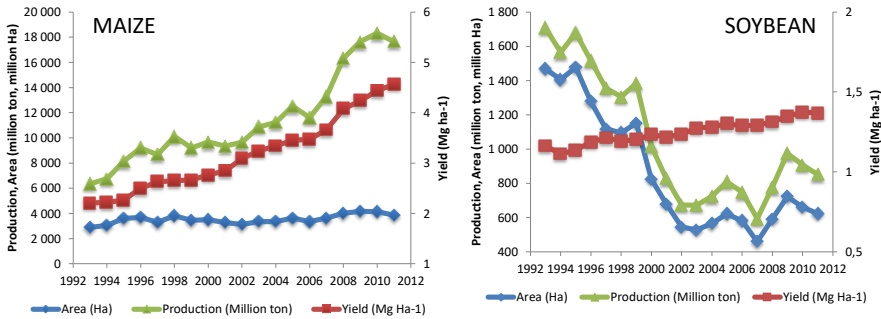


Source: Sulaeman et al. 2010

Increasing rice productivity Role: new rice variety, fertilization, irrigation facility, IPNM



General of harvested area, production and yield of Maize and Soybean (1993-2011)



Problems in Intensive Rice Fields

- P & K high in Java
- S & Zn for alkaline soils
- Si for weathered soils



- Use straight and soluble fertilizer
- Reformulation of NPK
- Apply micronutrient, beneficial element, etc



Problems in Upland (acid soils)

- Low in soil fertility
- Acid soil (pH <5)
- Phosphorus fixation

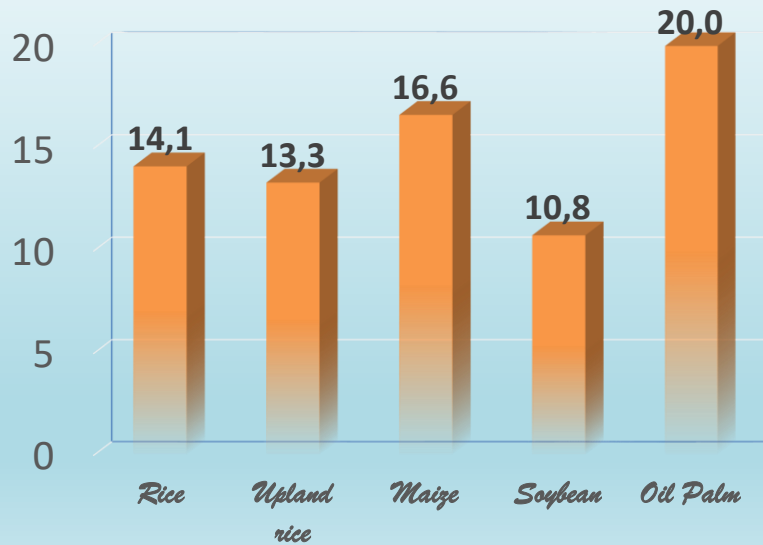


- Organic matter
- Lime
- Functional microbe
- Direct application of Reactive Phosphate Rock (DAPR)



The use of water soluble-P fertilizers on acid soils is costly and inefficient

FERTILIZER COMPONENT OF PRODUCTION COST (%)



FERTILIZATION OF OIL PALM PLANTATION

To keep good yields and sustained OP, fertilizer input are necessary and typically constitute 40-50% of total field upkeep cost



Problems In Adopting Balance Fertilization

- Fertilizer used by farmer are still below the requirement
- The recommendation rate are not followed by farmer
- There is no interesting incentives for the farmers
- In other side, fertilizer subsidy was provided by government as initiation program
- Therefore, the increasing harvest area and improving irrigation system are now applied



FERTILIZER MANAGEMENT IN IMPROVING SOIL FERTILITY AND PRODUCTION

Intensive rice fields: - Soluble fertilizer (NPK or Straight Fertilizer)
- Reformulation of NPK Fertilizer

Upland acid soil : Rock Phosphate, Organic Matter, N, K Fertilizer

Integrated Plant Nutrient Management

Key factor:

- Balance fertilization, correct limited nutrient factor to improve yield
- Combined organic and inorganic fertilization
- Soil chemical, physical and biological conservation
- Plant rotation, variety selection
- Pest and disease protection
- Environmentally safe technology



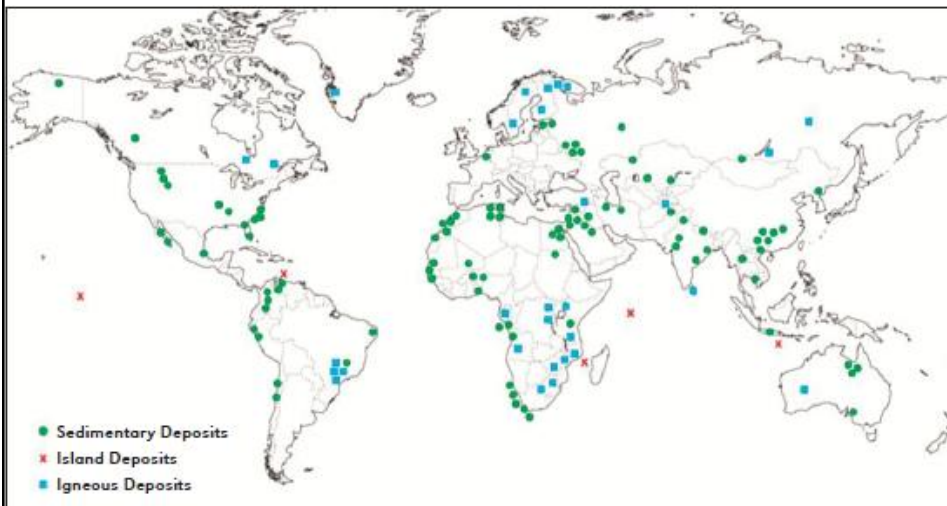
Research on Moroccan RPR

Phosphate Rock Deposited and Production

Reserve estimates for the world's top 10 PR reserve holders and their percent of world reserves held (Source: USGS Mineral Commodity Summary, 2013)

Country	Reserves, 2012 BD	World Total (%)
Morocco	50,000	75
China	3,700	6
Algeria	2,200	3
Syria	1,800	3
Jordan	1,500	2
South Africa	1,500	2
United States	1,400	2
Russia	1,300	2
Peru	820	1
Saudi Arabia	750	1
Others	2,268	3
World total (rounded)	67,000	100

WORLD PHOSPHATE ROCK RESOURCES (SOURCE: IFDC)



Three Types of Phosphate Rocks



Guano PRs (Namibia, Madagascar, Nauru)
Good quality PRs and practically behave as water soluble P
Now, very limited quantities, almost no more available



Igneous PRs (South Africa, Zimbabwe, Zambia) are coarse crystalline, quite un-reactive and unsuitable for direct use in crop production



Sedimentary PRs deposited in areas formerly underseas comprised of microcrystalline particles with large specific surface areas. Large variation in chemical composition and reactivity. 80% of the world PR reserves and the most appropriate PRs for direct application

SOME ISSUES

- No simple worldwide accepted system classifying PRs according to solubility tests, CA and FA are the most widely used test to assess PRs solubility and potential for direct application as follows:
- Potential for direct solubility in % total P₂O₅ application

Solubility in % total P₂O₅

	Citric Acid (CA)	Formic Acid (FA)
High	> 9.4	> 13.0
Medium	6.0-9.4	7.0-13.0
Low	< 6.0	< 7.0

Total content and solubility of RP in some countries

PRs	Total content (%)		Solubility in % total P_2O_5	
	P_2O_5	CaO	CA	FA
Niger	30.8	47.6	19.2	38.7
Senegal	36.5	44.8	19.8	38.7
Mali	27.9	43.1	29.7	47.3
Togo	35.4	36.4	19.1	36.7
Brasil*	37.1	n.a	3.5	3.9
USA	32.5	n.a	8.5	8.2
China	19.2	35.5	8.9	11.7
Morocco	32.1	52.1	29.9	56.4

* Igneous PR

OCP /IAARD Project on use of Moroccan reactive rock phosphate on Maize and Oil Palm (2013-2015)



- Oil Palm Estate, Wilmar Group
- Location: Siak, Riau
- 8 years old

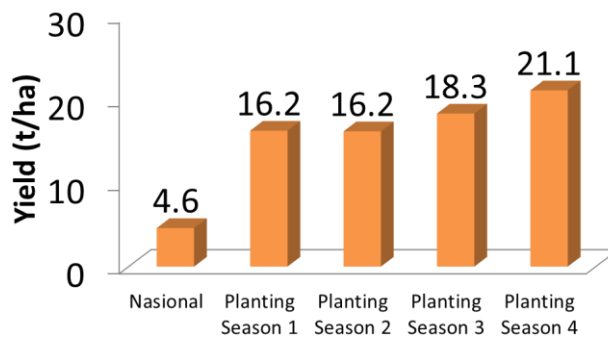
- Maize Farm at ISRI Exp. Station
- Location: Taman Bogo, Lampung

- Oil Palm Estate, PT. CPKA, Tanah Laut, South Kalimantan, 5 years

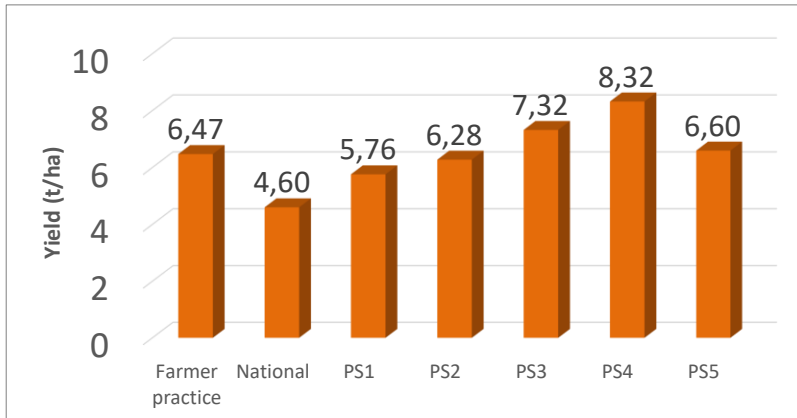
OCP /IAARD Project on use of Moroccan reactive rock phosphate on Maize, Lampung



Yield of maize under application of Moroccan RPR for 5 PS in Oxisol, South Kalimantan

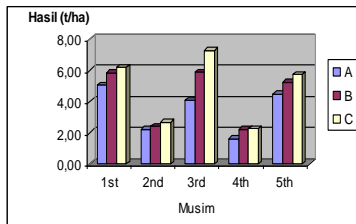


Yield of maize under application of Moroccan RPR for 5 PS in Ultisol, Lampung

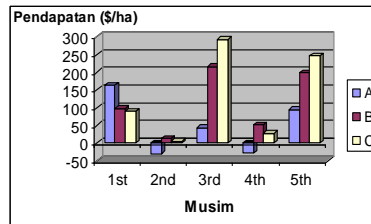


Experience in using RPR for maize (IMPHOS-ISRI, 2001-2002)

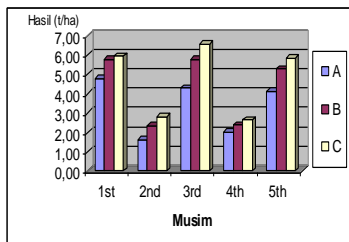
Yield Maize, Ultisol, SK



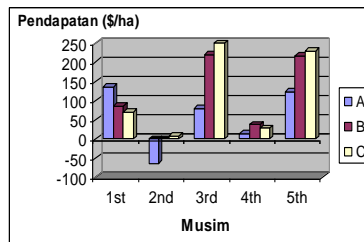
Farmer income



Yield Maize, Oxisols, SK



Farmer income



Result

- Under P-deficient acid soil conditions in, direct application of reactive PR showed significant positive responses on Maize yield
- This study suggests that phosphate rock could be an effective and efficient P source of fertilizer especially its residual effects
- Economic analyses showed the farmer benefit much higher by using RPR

On farm site in Taman Bogo, Lampung





**FIELD DAY : USE OF REACTIVE Moroccan ROCK PHOSPHATE
Pleihari, South Kalimantan, 8 June, 2014**



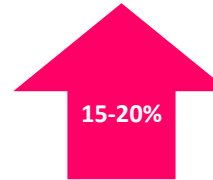
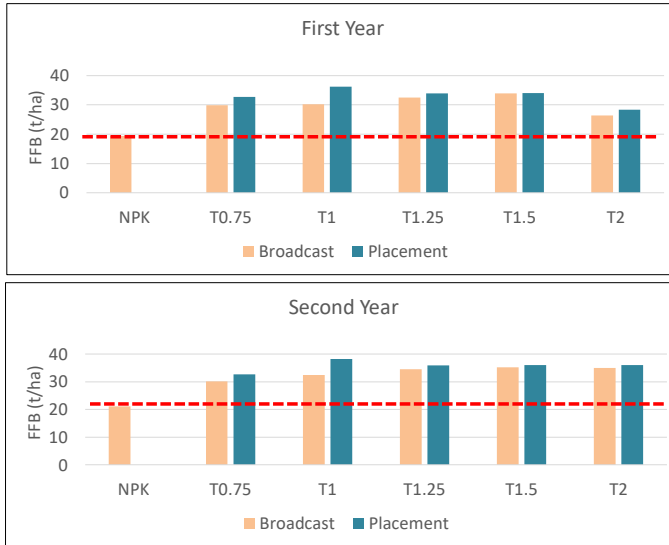




OCP /IAARD Project on use of Moroccan reactive rock phosphate for Oil Palm in Riau and South Kalimantan

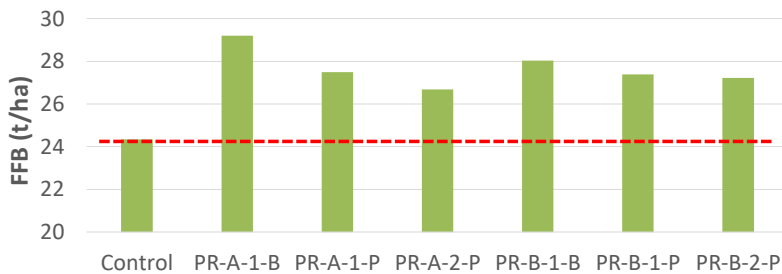


Response of Oil Palm on Application of Moroccan RPR (Teractiv)



Number of FFB and weight of FFB (production) of Oil Palm for a year under application of Moroccan PR in Pelalawan, Riau

Treatment	Number of FFB/ha	Weight of FFB/ha
Control	1.170 a	24,343 a
PRA-1Y1B	1.469 a	29,204 a
PRA-1Y1P	1.222 a	27,489 a
PRA-2Y2P	1.456 a	26,679 a
PRB-1Y1B	1.443 a	28,033 a
PRB-1Y1P	1.235 a	27,387 a
PRB-2Y2P	1.32 a	27,224 a



Result

- Application of Teractiv and PR (A, B) increased FFB of OP
- The method of RPR application between broadcast and pocket system were not different in weight of FFB
- Time for application of RPR between once a year or split into twice a year were not different in weight of FFB
- There is no significance different between PR A and PR B in weight of FFB

On farm site in Pelalawan, Riau Province







OCP/ IAARD Farmer field day, South Kalimantan



CONCLUSION

- ❖ Improving technologies in sustainable nutrient management by increasing efficient use of fertilizer are highly required
- ❖ Soluble fertilizer (NPK compound or straight fertilizer) are suitable for intensive rice fields
- ❖ Recommended technology for upland acid soils are:
 - Apply manure and lime
 - Apply Reactive Phosphate Rock as P source fertilizer
- ❖ Application of RPR increased yield of maize and oil palm
- ❖ Residual effect of RPR could be seen up to 4-5 planting season for maize
- ❖ Financial analyses showed the most efficient technology in upland acid soils by applying 1 ton/ha RPR at once
- ❖ Reactive phosphate rock such as Moroccan PR are recommended source of phosphorus nutrient in acid upland soils based on long term research (1990-2002, 2013-2015)