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Analysis Across Sites (2008-09 DS) Initial Findings

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Objectives of the on-farm trials

- To quantify existing yield gaps in maize production (FFP vs NPK).
- To quantify attainable yield and yield responses to fertilizer N, P, and K (PK,NK,NP vs NPK).
- To quantify the contribution of Bio-N to indigenous N supply (PK vs PK+Bio-N)
- To evaluate the agronomic and economic performance of an “SSNM prototype” (SSNM vs FFP vs NPK).
- To evaluate whether Bio-N and organic matter application can replace urea as an N source (SSNM vs SSNM+Bio-N vs SSNM+OM).

Regional Overview

Region	Province	Remarks
1	Pangasinan	
2	Cagayan	
3	Tarlac/Pampanga	Data being processed
4a	Quezon	
4b	Occidental Mindoro	
5	Camarines Sur	
6	Iloilo	
7	Bohol	On-going
8	Leyte	On-going
9	Zamboanga Sur	Affected by heavy rain
10	Bukidnon	
11	Davao del Sur	On-going
12	South Cotabato	Data being processed
13	Agusan Sur	Affected by heavy rain
ARMM	Maguindanao	On-going
CAR	Kalinga Apayao	Affected by heavy rain

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Can we increase yield?

There are significant opportunities for increasing maize production in the Philippines!

Grain Yield		Mean	SD	Min	Lower quartile	Median	Upper quartile	Max
FFP	t/ha	5.9	2.1	2.6	4.8	5.7	9.3	9.8
NPK	t/ha	8.3	1.7	5.2	7.1	8.6	11.3	12.0

3-5 farms x 7 regions (*n*= 29, 2008-09 DS).

- Attainable yield (8.3 t/ha) was 2.4 t/ha or 41% greater than yield in farmers' fields (5.9 t/ha).
  - Lowest attainable yield was 5.2 t/ha
  - Highest attainable yield was 12.0 t/ha
- NPK treatments are useful for estimating attainable yield.

Attainable yield is the yield at ample nutrient supply (NPK treatments)

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How good was SSNM*?

We have something to offer to farmers! At least in terms of yield…

Grain Yield		Mean	SD	Min	Lower quartile	Median	Upper quartile	Max
FFP	t/ha	5.9	2.1	2.6	4.8	5.7	9.3	9.8
SSNM*	t/ha	6.9	1.6	4.6	5.3	7.1	9.8	10.1

3-5 farms x 7 regions (*n*= 29, 2008-09 DS).

- Yield with SSNM* (6.9 t/ha) was 1 t/ha greater than yield in farmers' fields (5.9 t/ha).

*Prototype based on data available prior to project

Can we do even better?

SSNM* gave better yield than farmers practice but we have to refine the recommendation!

Grain Yield		Mean	SD	Min	Lower quartile	Median	Upper quartile	Max
SSNM*	t/ha	6.9	1.6	4.6	5.3	7.1	9.8	10.1
NPK	t/ha	8.3	1.7	5.2	7.1	8.6	11.3	12.0

3-5 farms x 6 regions (*n*= 29, 2008-09 DS).

- The SSNM prototype needs to be improved
  - SSNM* was 17% lower than NPK
- It is difficult to develop SSNM only based on available information (it worked sometimes, sometimes not).
- Omission plots are very useful to obtain more accurate estimates of yield responses to fertilizer application.

*Prototype based on data available prior to project

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Yield benefit of Bio-N and OM?

Yes, but we need to improve strategies for Bio-N and OM application in combination with SSNM!

Grain Yield		Mean	SD	Min	Lower quartile	Median	Upper quartile	Max
FFP	t/ha	5.9	2.1	2.6	4.8	5.7	9.3	9.8
SSNM*	t/ha	6.9	1.6	4.6	5.3	7.1	9.8	10.1
SSNM*+Bio-N	t/ha	6.3	1.8	3.3	5.1	6.3	8.9	9.2
SSNM*+OM	t/ha	6.4	1.8	3.2	5.2	6.8	9.0	9.2

3-5 farms x 7 regions (*n*= 29, 2008-09 DS).

- Yield with SSNM* only (6.9 t/ha) was more than 0.5 t/ha greater than SSNM* in combination with Bio-N or OM application.
- Room for improvement by using a more accurate estimate of benefits from Bio-N and OM application.

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N contribution of organics?

Bio-N and OM contribute less than assumed.

Parameter	Unit	SSNM	SSNM+Bio-N	SSNM+OM
Yield	t/ha	6.8	6.2	6.4
AEN	kg/kg	21	25	23
Fertilizer N	kg/ha	133	88	109

3-5 farms x 6 regions (*n*= 26, 2008-09 DS).

- We have overestimated the assumed contribution of Bio-N and organic fertilizer to NPK supply:
  - Bio-N contribution is less than 46 kg N/ha (2 bags urea/ha)
  - N contribution from OM is insufficient to substitute 20% of recommended N rate with SSNM. It is currently assumed that 50% of P and 100% of K in OM is available in first season.
- The contribution of Bio-N and OM to indigenous N supply should be estimated based on yield response (not % reduction)

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Bio-N performance

Bio-N provides a yield increase of 0.4 t/ha in the absence of inorganic N.

Grain Yield		Mean	SD	Min	Lower quartile	Median	Upper quartile	Max
PK	t/ha	4.2	1.8	0.8	2.8	4.3	7.4	8.3
PK+Bio-N	t/ha	4.6	2.1	0.8	3.4	4.4	8.8	9.8

3-5 farms x 7 regions (*n*= 29, 2008-09 DS).

- The contribution of Bio-N is commonly assumed to be equivalent to 46 kg N/ha (2 bags of urea/ha) – this should be good for a yield increase of 1 t/ha.
- However, even in the absence of inorganic N (PK+Bio-N treatment), Bio-N probably only supplied 23 kg N/ha (equivalent to a yield increase of 0.5 t/ha).

Yield responses to fertilizer

- Wide range of yield responses to fertilizer N across regions (ranging from 2 to 6 t/ha or more). It is important to know the response to calculate meaningful N rates.
- Yield responses to fertilizer N were almost always greatest in NPK treatments.
  - We need to revise N strategies in SSNM (sometimes more N, sometimes change in timing of application, LCC use in decision making?)
  - What is a good N strategy in a less favorable rainfed environment? Needs more thinking.
- High yield responses to fertilizer P and K application of more than 1 t/ha are often only observed at yield levels of more than 7 t/ha.
  - Opportunity to reduce PK rates relatively more to N in low-input cost strategy.

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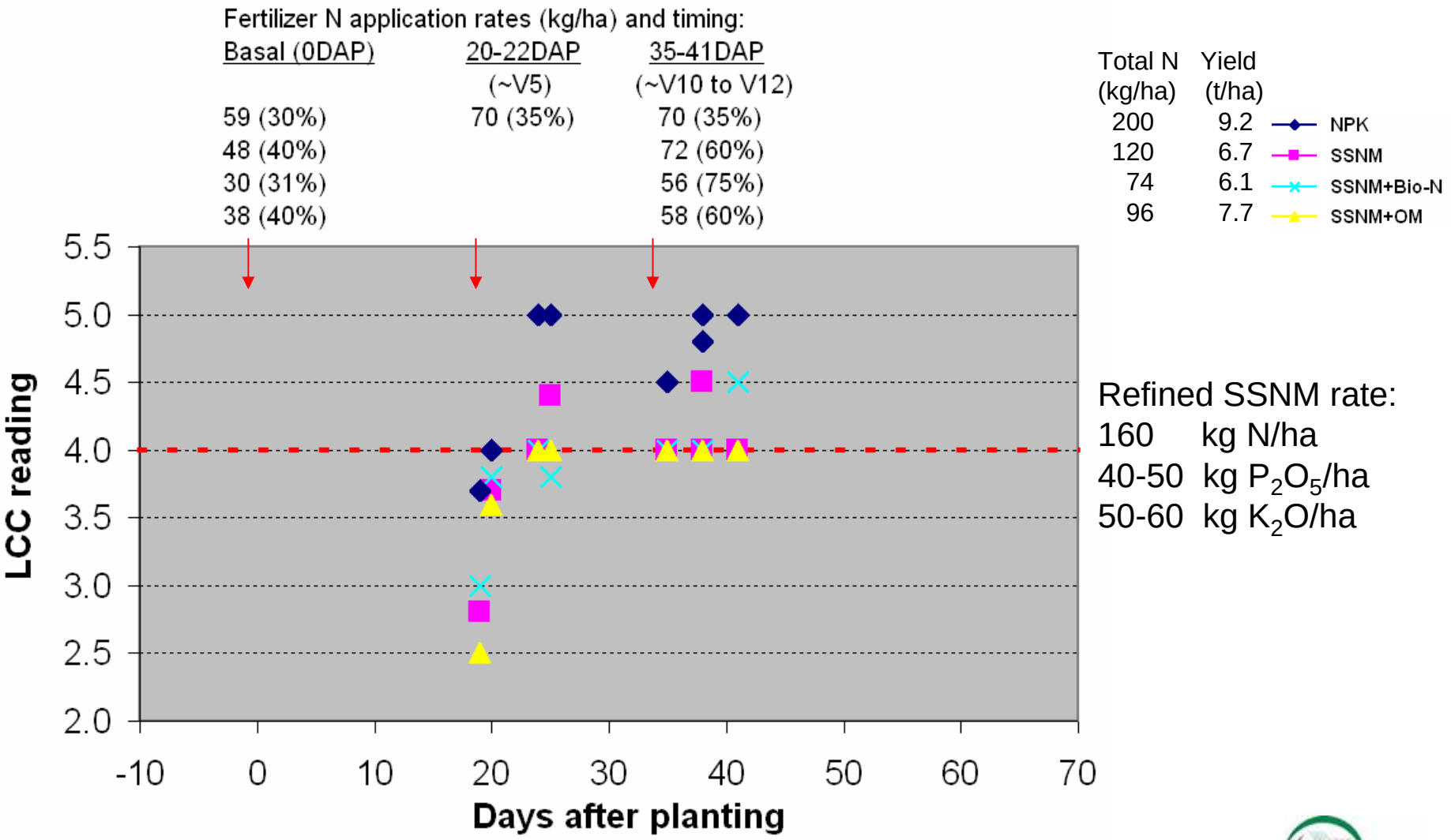
Are LCC readings useful?



Refined SSNM rate:
160 kg N/ha
40-50 kg P_2O_5/ha
50-60 kg K_2O/ha

Are LCC readings useful?

- Yes, LCC readings help detect N deficiencies and explain data in treatments.
  - Careful with interpretation because leaf N and plant biomass determine N need.
- LCC is a valuable diagnostic tool in farmer participatory evaluation.
- Proposal to take LCC readings in NPK, FFP, 0N, and all SSNM treatments.

Who cares about yield...

- It's the economics!
- Performance indicators of SSNM are
  - Input cost (where cash flow is low)
  - profit (revenue minus fertilizer cost)
- There's a need to provide farmers with options particularly where the risk of crop failure is high (flooding; drought):
  - Lower input (cost), good yield, good profit
  - Higher input, high yield, high profit

Example: Region 5

Parameters	Treatments				
	FFP	SSNM	SSNM+Bio-N	SSNM+OM	NPK
Yield (t/ha)	5.7	6.7	6.1	7.7	9.2
Yield difference (t/ha)		1.0	0.4	1.9	3.4
Yield difference (%)		16.9	7.0	34.0	60.1
Fertilizer N (FN, kg N/ha)	63	120	74	96	200
Fertilizer P (FP, kg P_2O_5/ha)	17	50	50	36	120
Fertilizer K (FK, kg K_2O/ha)	17	50	50	25	120
Difference in N rate (%)		90	17	52	217
Difference in P rate (%)		194	194	112	606
Difference in K rate (%)		194	194	47	606
Estimated N from organic source (kg/ha)	3	0	46	24	0
Estimated P_2O_5 from organic source (kg/ha)	14	0	0	64	0
Estimated K_2O from organic source (kg/ha)	2	0	0	31	0
OM (ie. chicken manure) applied (kg/ha)		-	-	1355	-
Bio-N applied (# of packets/ha)		-	6.0		-
Cost of N from inorganic source (PhP/ha)	4,996	9,517	5,869	7,613	15,861
Cost of P_2O_5 from inorganic source (PhP/ha)	1,889	5,556	5,556	4,000	13,333
Cost of K_2O from inorganic source (PhP/ha)	1,133	3,333	3,333	1,667	8,000
Cost of Bio-N (PhP/ha)	-	-	360	-	-
Cost of OM (PhP/kg)	-	-	-	4,065	-
Total Fertilizer cost (PhP/ha)	8,018	18,405	15,117	17,345	37,194
Plant spacing	70 x 20	70 x 20	70 x 20	70 x 20	70 x 20
Plant popn (plants/ha)	71,400	71,400	71,400	71,400	71,400
Seed cost (PhP/ha)	6,000	6,000	6,000	6,000	6,000
Farmgate price of corn (Php/kg)	12.00	12.00	12.00	12.00	12.00
Gross benefit (Php/ha)	68,753	80,361	73,563	92,117	110,100
Total variable cost* (PhP/ha)	14,018	24,405	21,117	23,345	43,194
Net benefit (PhP/ha)	54,734	55,956	52,445	68,772	66,906
Difference in net benefit (PhP/ha)		1,222	(2,289)	14,038	12,172
Difference in net benefit (%)		2.2	-4.2	25.6	22.2

Greater yield with SSNM*, but same profit!

Maximum profit with OM (pH) or NPK at higher input costs.

Apply lime to increase pH in all treatments except for FFP and OM.

Agronomic and economic performance

Parameter	Unit	FFP	$SSNM_{prot}$	NPK	SSNM-FFP	%
Yield	t/ha	5.9	6.9	8.3	1.0	17%
AEN	kg/kg	21.6	20.1	20.5	-1.5	-7%
Fertilizer N	kg/ha	107	133	200	26	24%
Fertilizer P_2O_5	kg/ha	22	54	120	32	145%
Fertilizer K_2O	kg/ha	21	46	120	25	119%
Revenue	Php/ha	67,767	81,353	97,104	13,586	20%
Fertilizer cost	Php/ha	12,071	19,770	38,009	7,699	64%
Seed cost	Php/ha	5,297	5,349	5,349	52	1%
Gross benefit	Php/ha	52,399	56,234	53,747	3,835	7%

3-5 farms x 7 regions (*n*= 29, 2008-09 DS).
Farm gate prices: 12 Php/kg grain; 272 PhP/kg seed; 73.4 PhP/kg fertilizer N; 125.7 PhP/kg fertilizer P_2O_5; 68.2 PhP/kg fertilizer K_2O

Technical issues

- Site selection
- Plant spacing
- Timing of application
- Revise rates for WS, DS
- Proposal to take LCC readings in NPK, FFP, 0N, and (for decision making?) in all SSNM treatments.
- Liming, other nutrient constraints

Dissemination issues

- Delivery models (Techno demo? Farmer-trader partnerships? FFS?)
- Farmer participatory evaluation
- Extrapolation to larger area (domain based on soil type, other factors)

Communication

- **Please inform us if you would like to divert from agreed practices (e.g. due to problems with availability of fertilizer sources).**
- **Please let us know, if you need assistance (data, field visit, etc).**

Very promising results with room for further improvement.

GREAT JOB,
GREAT RESULTS,
CONGRATULATIONS!

Project Information

Data in this presentation are owned by the ***National Initiative on Site-Specific Nutrient Management (SSNM) for Maize in the Philippines***.

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