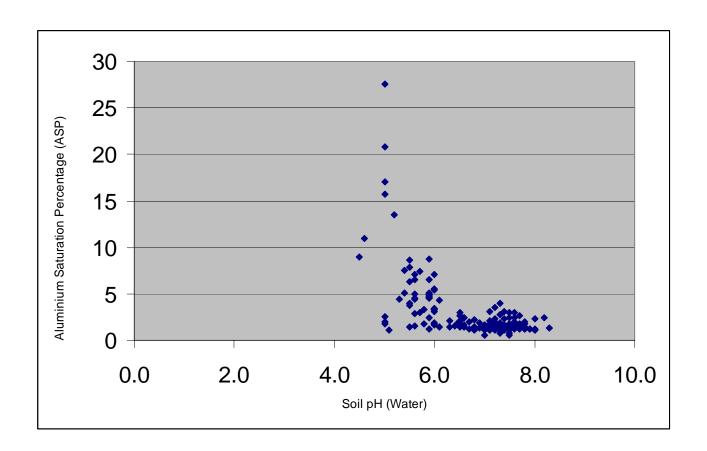
# Earthquake & Tsunami Emergency Support Project ETESP

## **Detailed Study of Irrigation Component Laboratory Data**



(April 2006)

## **SUMMARY**

#### INTRODUCTION

Previous investigation and study of available soil analytical data revealed very little and the study (ETESP "Irrigation Labdata" update of March 2006) was summarised as:

"Overall the soils for which data are available would appear to be <u>rather infertile</u>, quite often have <u>rather low fertility potential</u> and may well be <u>slightly saline</u> or, in some cases, <u>acidic in reaction</u>. Also, a general possible <u>deficiency of magnesium was indicated</u>".

The present study was undertaken following a "brainstorming" and "exchange of ideas" meeting held in Banda Aceh at the offices of Balai Pengkajian Teknologi Pertanian (BPTP) on 28<sup>th</sup> March 2006. This meeting did not produce any new ideas and all parties seemed to be working along the same lines to try and get agriculture in the tsunami devastated area back on course. One point that was discussed at length was the situation reported in connection with rice growth in more than one location. The report was that "the crop grew vigorously during the vegetative stage but it then failed to produce, or produce much, grain". In other words, at first farmers' hopes were raised then dashed when there was virtually no yield.

The present study looked at the available data in much more detail and utilised an updated form of the ETESP Labdata tool where the existing data from the Lotti study of irrigation schemes was compiled and collated in the Excel spreadsheet "LabData Collation". The following points were drawn as observations, conclusions and recommendations:

## **SOIL SALINITY**

The original ETESP Labdata report concluded that it would appear as though the soils of Aceh Utara were more heavily salinised than the other areas with an overall average EC (Electrical Conductivity) value of almost 2.3 dS/m whilst Singkil was the least effected with an average of just over 0.8 dS/m. This is a direct north south relationship and the level of precipitation is the most likely explanation. Aceh Utara, at the eastern end of the north coast has annual precipitation of about 1,365 mm (ETESP Report "Annual & Monthly Rainfall", October 2005) whilst Aceh Singkil must have about double that amount since it is located south of Aceh Barat Daya (3,300 mm) and in line with Simeulue (3,000+ mm) However, the important thing is that the salinities are negligible and no or very little long-lasting effect on the land should ensue – assuming there is active soil drainage and either very high rainfall and / or irrigation water to leach the salts (ETESP "Executive Summary", December 2005).

Recent work (ETESP "Executive Summary" 205) in Aceh Besar, Pidie and Bireuen has shown that the salinity status of many soils has changed in the year following the tsunami – some have become more saline whilst others have reduced levels through natural leaching. No further study of salinity has been done in this current report.

Table S.1 Overall Salinity in the Areas Studied - decreasing sort order

	ACEH UTARA	BIREUEN	ACEH JAYA	ACEH TIMUR	PIDIE	ACEH BESAR	SINGKIL
Salinity	2.28 dS/m	2.01 dS/m	1.64 dS/m	1.31 dS/m	1.06 dS/m	0.99 dS/m	0.82 dS/m
Salinity Class	SC1 Very slightly saline	SC1 Very slightly saline	SC1 Non-saline	SC1 Non-saline	SC1 Non-saline	SC1 Non-saline	SC1 Non-saline
Rainfall	1,365	1,613	2,649	2,222	1,889	1,668	3,000+
Irrigation	Little	Fairly extensive	Little	Little	Fairly extensive	Little	No

Note: SC – Salinity Class, refer ETESP Soil Salinity & Improvement Mobilisation Report, November 2005 Note: The salinity figures refer to areas inundated by the tsunami and subject of salinity survey

## **SOIL SODICITY**

There does <u>not seem to be a widespread soil sodicity problem</u> since <u>only about 10 - 11%</u> of the mineral soil samples collected in the irrigation schemes study proved to be 'sodic' – that is with ESP (Exchangeable Sodium Percent) >15%. In addition, the <u>level of sodicity that does exist is not high</u> and no sample had ESP in excess of 20%. One scheme which may have a problem is <u>Kreung Ateu in Aceh Jaya</u> since it proved to have several sites with sodic soils. The distribution of ESP levels in the various kabupaten, from where samples were taken, is shown in Table S.2 which is sorted in increasing number of sites sampled.

Aceh Timur, Singkil, Pidie and Aceh Utara show no "sodic" samples at all though Pidie and Aceh Utara have a few sites with very slight or low levels of ESP. Bireuen has one sodic site with the rest showing very low levels of ESP. Aceh Besar and Aceh Jaya have 19 and 13% respectively of the sampled sites noted as sodic whilst over 60% of the samples taken in these areas have ESP levels greater than 10%.

Table S.2 Distribution of ESP Levels of Mineral Soils

Kabupaten	Non-sodic		Very Slightly Sodic		Slightly Sodic	Sodic	Total samples		
	ESP <5%		ESP 5 – 9%		ESP 10 – 15%		ESP 15 – 20%		
	No	%	No	%	No	%	No	%	
Aceh Timur	0	0	2	100	0	0	0	0	2
Singkil	7	88	1	13	0	0	0	0	8
Pidie	0	0	8	89	1	11	0	0	9
Aceh Utara	1	8	12	92	0	0	0	0	13
Bireuen	5	38	7	54	0	0	1	8	13
Aceh Besar	0	0	13	41	13	41	6	19	32
Aceh Jaya	1	1	33	35	48	51	12	13	94

No obvious relationship could be seen or established between soil sodicity and precipitation level and / or irrigation supply since Aceh Jaya has relatively high rainfall, Aceh Besar has relatively low rainfall and little formal irrigation and Bireuen has relatively low rainfall but does have formal irrigation schemes. However the recent status of the efficiency of the irrigation schemes sampled is not known.

Only four of the sites were saline-sodic and normal, good irrigated agriculture with adequate leaching fraction should overcome the problem without any need for special amendments. The other sodic sites (Refer Table 3.2 for locations) could prove to be slightly more difficult to reclaim since they are classified as non-saline sodic and care should be taken to ensure that the situation is not made worse by totally leaching out the salinity without addition of sources of calcium, or magnesium, to replace the sodium on the soil exchange complex. The normal amendment would be the incorporation of gypsum (CaSO<sub>4</sub>) into the soil before leaching.

## **SOIL ACIDITY and ALUMINIUM SATURATION PERCENT**

There is <u>not a large soil acidity problem in the mineral soils</u> investigated and there are not many samples where soil reaction falls below about pH 5.5. (Table S.3). Normally aluminium saturation percentage (ASP) increases dramatically in mineral soils when the soil pH (water) falls to about 5.5. This relationship holds true for the data examined since the ASP increases from around 5% up to about 28% once pH falls below 6, but the number of samples where this happens is very limited. Very high values of ASP were not encountered and though the value of 28% is rated as "high" only 7 samples out of the total exceed ASP of 10%, which would be expected since these soils are normally flooded and used for padi cultivation. The relatively low number of low pH (acidic) soils, plus no obvious correlation between soil pH and sulphate levels, suggests that <u>overall there is not an acidity problem</u>.

Table S.3 Mineral Samples with pH 5.5 or Less

Kabupaten	Scheme	Site	Soil (O)	Lab	pН	Exchange	eable	Al
	/ Desa	No	Deposit (D)	Texture	H2O	Н	Al	Sat%
Singkil	Tana Bara	TB 2	0	CL	4.5	0.40	2.17	9
Singkil	Tana Bara	TB1	0	С	4.6	0.20	2.22	11
Aceh Jaya	Bunbun	BL N1	0	SL	5.0	0.62	0.18	2
Aceh Jaya	Panghuleu Harakat	PH D1	D	SL	5.0	0.58	0.22	2
Aceh Jaya	Blang Jempeuk	BJ B3	0	С	5.0	0.78	0.24	3
Pidie	Beuracan	Beuracan iron mix	M	SL	5.0	0.22	0.52	5
Singkil	Parakan Sulampi	PS 1	0		5.0	0.16	1.90	16
Singkil	Sidorejo	SD B1	0	С	5.0	0.24	3.22	17
Singkil	Sidorejo	SD A1	0	С	5.0	0.19	4.22	21
Singkil	Sidorejo	SD B1	0	С	5.0	0.24	3.55	28
Singkil	Sidorejo	SD A1	0	SCL	5.2	0.24	3.00	14
Bireuen	Paya Nie	PYN 2	D	CL	5.3	0.20	0.53	4
Bireuen	Peudada	PAD 25	0	С	5.4	0.42	0.62	5
Pidie	Cubo Trienggading	CT C1 mix	M	CL	5.4	0.42	0.75	7
Aceh Jaya	Bunbun	BL N7	0	SCL	5.5	0.43	0.18	1
Aceh Utara	Krueng Tuan	BKB7	0	CL	5.5	0.32	0.42	4
Bireuen	Paya Nie	PN 1	0	С	5.5	0.31	0.49	4
Aceh Utara	Krueng Tuan	BK6	0	CL	5.5	0.40	0.76	6
Aceh Jaya	Alue Monmata	MD 2	0	С	5.5	0.12	0.88	8
Pidie	Beuracan	Be C2 mix	М	CL	5.5	0.21	0.82	9

## **IRON TOXICITY**

According to the IRRI, iron toxicity is likely to occur in most mineral soils that do not attain pH 6.5 after flooding. As the bulk of the soils tested have pH of 6.5 or greater and, it is assumed that the pH of the more acidic samples would increase as and when the soil is flooded for padi cultivation, there is little risk of toxicity. However, <u>as a precaution it might be wise to monitor soil pH in the mineral soils deemed to have an acidity problem as and when those soils are flooded and puddled in preparation for padi use.</u> The sites involved are detailed in Table S.4 where the most acidic soils have the pH coloured blue and the higher ferrous iron levels coloured green – both in bold.

Table S.4 Acidic Mineral Soils with Possible Iron Toxicity Risk

Kabupaten	Scheme	Site	Soil (O)	Depth	Range	Lab	pН	Exchange	able	Fe	SO <sub>4</sub>
Kabupaten		No	Deposit (D)	From	To	Texture	H2O	Н	Al	ppm	ppm
Singkil	Tana Bara	TB 2	0	0	25	CL	4.5	0.40	2.17	111	199
Singkil	Tana Bara	TB 1	0	0	20	С	4.6	0.20	2.22	126	210
Aceh Jaya	Bunbun	BL N1	0	12		SL	5.0	0.62	0.18	60	593
Aceh Jaya	Panghuleu Harakat	PH D1	D	0	18	SL	5.0	0.58	0.22	98	925
Aceh Jaya	Blang Jempeuk	BJ B3	0	30		С	5.0	0.78	0.24	405	81
Singkil	Parakan Sulampi	PS 1	0	ND			5.0	0.16	1.90	77	135
Singkil	Sidorejo	SD B1	0	0	20	С	5.0	0.24	3.22	133	189
Singkil	Sidorejo	SD A1	0	10	50	С	5.0	0.19	4.22	175	201
Singkil	Sidorejo	SD B1	0	15	50	С	5.0	0.24	3.55	68	89
Singkil	Sidorejo	SD A1	0	0	10	SCL	5.2	0.24	3.00	154	190
Bireuen	Paya Nie	PYN 2	D	0	10	CL	5.3	0.20	0.53	119	122
Bireuen	Peudada	PAD 25	0	0	25	С	5.4	0.42	0.62	170	132
Pidie	Cubo Trienggading	CT C1 mix	M	0	30	CL	5.4	0.42	0.75	12.8	105
Aceh Jaya	Bunbun	BL N7	0	ND		SCL	5.5	0.43	0.18	16	430
Aceh Utara	Krueng Tuan	BKB7	0	0	25	CL	5.5	0.32	0.42	130	111
Bireuen	Paya Nie	PN 1	0	10	25	С	5.5	0.31	0.49	107	197
Aceh Utara	Krueng Tuan	BK6	0	0	25	CL	5.5	0.40	0.76	138	15
Aceh Jaya	Alue Monmata	MD 2	0	ND		С	5.5	0.12	0.88	75	24
Pidie	Beuracan	Be C2 mix	M	0	25	CL	5.5	0.21	0.82	88	123
Pidie	Beuracan	Be E2	0	0	25	CL	5.6	0.22	0.72	128	105
Singkil	Ujung Bawang	IUB 1	0	0	40	CL	5.9	0.42	0.90	201	91
Pidie	Cubo Trienggading	CTA3 mixed	M	0	30	С	6.0	0.27	0.33	109	122

## **IRON DEFICIENCY**

Iron deficiency is possible on flooded high pH soils that are low in organic matter. High soil pH has been assumed as a pH 8 or greater and the mineral soils with this feature are listed in Table S.5 where those with low organic matter have been highlighted and coloured (in the ratings used by ETESP organic carbon level of less that 1.2 is rated as low).

Table S.5 High pH or Alkaline Mineral Soils

	Scheme	Site	Soil (O)	S	Si	С	Lab	рН	Exchar	ngeable	Fe	S04	Org C	Total N	C:N
Kabupaten	/ Desa	No	Deposit (D)	%	%	%	Texture	H2O	Н	Al	ppm	ppm	%	%	
Aceh Jaya	Kr. Ateu	KD 10	D	67	11	22	SL	8.3	0.19	0.21	16	316	1.40	0.30	5
Aceh Jaya	Kr. Ateu	KAC4	D	86	0	14	LS	8.2	0.01	0.40	21	153	1.42	0.12	12
Aceh Besar	Geunteut Lamsujen	GL R2	D	91	6	3	S	8.0	0.27	0.32	18	150	1.01	0.30	3
Aceh Besar	Blang Luas	BL A2	D	82	4	14	LS	8.0	0.23	0.18	7	129	1.44	0.13	11
Aceh Jaya	Lambesoi	LS 10	D	22	44	34	CL	8.0	0.42	0.18	182	124	1.71	0.21	8
Aceh Besar	Geunteut Lamsujen	GL Q5	D	18	11	71	SiCl	8.0	0.02	0.18	5	3	2.80	0.15	19

As can be seen only one sample appears to fall into this possible risk category and hence this risk is considered as virtually non-existent. However, in the above table it can be seen that the levels of ferrous iron are actually generally rather low in these soils with:

- one sample GL Q5 in Aceh Besar being just above the deficiency rating with a level of 5 ppm, and
- one site BL A2 in Aceh Besar being rated as "low" with a value of 7 ppm

Most of the other sites are rated as having "moderate" level of iron whilst one site has a high rating with 182 ppm. Overall it is concluded that there does not appear to be a risk of iron deficiency.

#### **EXCHANGEABLE HYDROGEN**

There appears to be a very crude correlation with level of exchangeable hydrogen falling with increasing soil pH – which would be expected - but there is not a very clear relationship visible. The bulk of the samples have an exchangeable hydrogen level of 0.4 me/100g or less and these levels are rated low to very low and would cause no obvious problems.

## SOIL FERTILITY

Attempts were made to identify actual deficiencies and overall it is concluded that there is a problem with levels of magnesium. As can be seen in Table S.6, between 80 – 100% of the soils analysed had some deficiency indicated. It is obvious that soil analytical data should be made use of before applying fertilisers to ensure the "possible" deficiencies are rectified in the various locations. A blanket cover of a standard fertiliser packet is not recommended. In most cases magnesium would appear to be deficient.

Overall 20% of the soil samples tested show low to very low inherent soil fertility whilst, as stated above, most samples show some deficiency of one nutrient or the other. The fertility status of the poorest soils is given below Table S.6.

Table S.6 Deficiencies in Mineral Soils by Kabupaten

			Number	of Sample	es in each h	Kabupaten		
Deficiency	Aceh Jaya	Aceh Besar	Bireuen	Aceh Utara	Pidie	Singkil	Aceh Timur	Totals
Calcium	1	2		1	1			5
Slight calcium	4	2		3		1		10
Magnesium	3	1	8	6	4	4	2	28
Magnesium + possible Phosphorus	37	10	1	1	2			51
Slight magnesium	49	14	4	2	1	3		73
Potassium		3						3
Totals	94	32	13	13	8	8	2	170
Ratio of total samples	88%	84%	100%	100%	100%	89%	100%	87%

The total number of mineral soil samples analysed was 193 but several with suspect data have been excluded

## Fertility status of the most infertile soil samples:

- <u>Soil reaction or pH</u> very strongly and extremely acid soils have been highlighted as problems and about 50% of the <u>low inherent fertility soils have acidity problems</u>
- <u>Organic-C</u> (organic matter) the organic matter content of these poorly fertile soils would appear to be normal with no samples having low / very low or excessively high levels of organic carbon
- <u>Total-N</u> (Nitrogen) virtually all of the inherently infertile soils have low level of total nitrogen but only one sample has a very low level. Obviously all of these soils require nitrogenous fertiliser either mineral or via composts
- <u>C:N ratio</u> the low levels of nitrogen reported are reflected in the poor C:N ratio and, again, this will be improved with addition of nitrogenous material
- <u>Exchangeable Calcium</u> most of the samples show low levels of exchangeable calcium and a few show very
  low levels. Addition of superphosphate fertiliser would add calcium as would organic manures or liming
  materials or gypsum. Gypsum might be added in some cases if the soil required "cleaning-up" and the removal
  of sodium from the exchange complex
- <u>Exchangeable Magnesium</u> virtually every sample in this subset shows low to very low levels of exchangeable magnesium. Magnesium could be added as a magnesium rich mineral fertiliser or supplied via the application of dolomitic limestone if an amendment for acidity has to be applied
- Exchangeable Potassium levels of this nutrient appear to be acceptable and no specific requirement can be seen for any special fertiliser application
- Exchangeable Sodium none of the samples show low or very low levels of exchangeable sodium, which is to be expected. However, one or two samples do contain high to very high levels
- Cation Exchange Capacity (CEC) this is included to allow cross checking; CEC does not come into the inherent fertility scenario but does determine the fertility potential
- <u>Total Exchangeable Bases (TEB)</u> this is the sum of Exch-Ca, Exch-Mg, Exch-K plus Exch-Na and virtually all of the samples are noted as having low TEB and even some very low levels were noted
- Aluminium Saturation Percent ASP can be a problem but only a few of these samples are noted as having
  anything like excessive values. Generally the ASP problem vanishes or diminishes greatly once a soil is
  flooded
- Exchangeable Sodium Percent none of these poorly fertile soils have excessive exchangeable sodium since sodic soils are normally slightly alkaline to alkaline and all these soils are acidic to some degree
- Base Saturation this is the main measure used to determine inherent fertility and the starting point in the above exercise

## **MICRO-NUTRIENTS**

No micro-nutrient levels have been determined in the soil analyses available to ETESP for manipulation and study.

On some peat soils used for wetland rice production in SE Asian countries (*C. J. Hatten, private communication*) it has been found that rice has often grown fairly well but produced very little grain and this failure has been attributed to trace element deficiency - notably copper -. The micro-nutrient status of the NAD mineral soils should possibly be investigated with some urgency in case this is the cause of the failure of some crops to produce a yield. Similarly, field trials should be setup to test the application of various micro-nutrients.

However, it is suggested that any micro-nutrient studies are conducted via foliar analyses since there are so many interacting factors in soils which can affect the levels. In addition there is very poor agreement in literature and the deficiency levels quoted vary widely and depend on the exact extraction method used in the laboratory. A general statement in literature studied indicates that there are seldom deficiencies of micro-nutrients when soil pH is below 7 – as indicated above many of the soils investigated do have pH levels of 7 or less.

## **PEAT SOILS**

Of the 193 original samples taken there were 13 classified as peats and all the samples described as peat in origin are:

- Non-saline and non-sodic (Refer Table 3.9)
- Strongly, very strongly and extremely acidic in reaction with pH ranging from 5.10 to 3.00

- Most of the samples have a low level of Exchangeable-H<sup>+</sup> (<0.5 me/100g) three are moderately high (>0.5 <0.0 me/100g) though one sample is coded as high (2 5 me/100g) and three have very high levels (>5 me/100g)
- As would be expected in organic soils the exchangeable aluminium levels are not particularly high since aluminium is sourced in mineral materials and forms a complex with organic material and is taken out-of-play.
   Five samples have moderate level and only two noted as having high levels of Exch Al<sup>3+</sup>
- Four samples have extremely high levels of ferrous iron and three samples are considered to have what would be toxic levels of iron
- Levels of sulphate are generally moderate to high but one sample is noted as having high level and two samples are considered to contain toxic levels

The fertility status of peats soils is never easy to assess since there can be relatively high levels of several nutrients but features such as acidity render the soil an unsuitable medium for the growth of many plants.

- Organic carbon levels are high to very high
- Slightly over half the samples have low levels of nitrogen whilst most of the others fall into the moderate class
- Due to the high organic carbon levels more than half of the samples have unacceptable C:N ratios
- Generally the levels of the exchangeable cations calcium (Ca<sup>2+</sup>) and magnesium(Mg<sup>+</sup>) are low to very low and two samples also have low level of potassium (K<sup>+</sup>)
- Over half of the samples have low levels of total exchangeable bases (TEB) and generally the inherent fertility
  of the peat soils is extremely low with several base saturation (BS) levels below 35% but three samples show
  normal BS levels of 79 83%

Tropical peats have major problems of development and the consensus is that where more than 1.5 - 2m of peat materials overlie mineral material they should not be touched. Where peats are shallower and overlie riverine alluvium - and particular where it is intermixed with alluvial lenses - then there are better possibilities for successful agricultural development due to the mineral content.

The two major problems of tropical peat are the much <u>higher water contents</u> and the generally much <u>lower mineral contents</u>. The tropical climate also leads to much accelerated oxidation of the peat if the peat is drained. (If there was system of carbon taxation & credits applied internationally then no peat soils would be used for agriculture as peat oxidation and CO<sub>2</sub> production is so enormous).

Shallow peats have been successfully developed for oil palm and coconut production in Malaysia under very good estate management. But the economics of this can be very marginal, and such areas are the first to be abandoned when market conditions become difficult. Oil palm would generally be planted in holes excavated in the peat to help ensure that the roots reach the mineral soil more easily.

Where peat has been used for wetland rice production the rice has often grown fairly well <u>but produced very little grain</u>. This has been attributed to trace element - notably copper - deficiency. There are difficulties in applying the trace element cocktail to peat soil (fixation, etc) and foliar spraying is a specialist subject.

## **OVERALL**

- 1. It appears as though there is a deficiency of magnesium in most of the soils
- 2. All the soils sampled are infertile to a lesser or greater extent and specific fertiliser packages have to be designed to overcome the various deficiencies
- 3. There is not an overall sodicity problem with the samples tested
- 4. There is not a large residual salinity problem following the tsunami
- 5. There is not a large soil acidity and aluminium saturation problem but there are some rather acidic soils and liming materials are indicated as amendments for such soils if the pH does not revert to neutral when the soil is flooded and for padi use
- 6. The peat soils are very acidic, infertile and their use for agriculture should be avoided if at all possible, and
- 7. Failure of rice to produce grain after vigorous vegetative growth has been found to be due to "micro-nutrient" deficiency in particular copper. However this finding was for peat soils but the possibility of this being the reason for the same phenomenon in some of the NAD soils should be investigated

ETESP Agriculture component has compiled this report in the hope that it might assist other organisations save time in establishing the same or similar facts and assist in the designing of integrated, cooperative programmes that might assist answer the problems still facing agriculture in the tsunami damaged area.

## **CONTENTS**

SUMMARY	2
NTRODUCTION	
SOIL SALINITY	
Table S.1 Overall Salinity in the Areas Studied - decreasing sort order	2
SOIL SODICITY	
SOIL ACIDITY and ALUMINIUM SATURATION PERCENT  Table S.3 Mineral Samples with pH 5.5 or Less	
IRON TOXICITY Table S.4 Acidic Mineral Soils with Possible Iron Toxicity Risk	
IRON DEFICIENCY	4
Table S.5 High pH or Alkaline Mineral Soils	
EXCHANGEABLE HYDROGEN	4
SOIL FERTILITY	4
Table S.6 Deficiencies in Mineral Soils by Kabupaten	
MICRO-NUTRIENTS	5
PEAT SOILS	
DVERALL	(
INTEGRALICAL	,
. INTRODUCTION	
Table 1 Original Dataset Composition	
2. DATA MANIPULATION	
2.1 Aims and Introduction	
Table 2.1 Saline Sodic Soil Definitions	
2.1.2 Soil Acidity	
Table 2.2 Soil pH values for Strongly to Extremely Acidic Reaction	
Table 2.3 Low and Very Low TEB and BS Values and Ratings	10
2.2 Procedure	1
2.3 ETESP Labdata Collation	1.
Figure 2.1 ETESP Labdata Summary Tool	1
RESULTS	12
3.1 Introduction	12
3.2 ESP – Soil Sodicity in Mineral Soils	13
Table 3.1 Samples Classified as Sodic	
Table 3.2 Sodic Samples by Kabupaten	12
Figure 3.1 Soil pH (Water) versus Exchangeable Sodium Percentage	I S
3.3 Soil Acidity – Mineral Soils	13
3.3.1 Aluminium Saturation Percent (ASP)	
Figure 3.2 Soil pH (water) Versus ASP- Mineral Soils	
Figure 3.3 Soil pH (water) Versus Sulphate in Mineral Soils	14
3.3.3 Ferrous Iron Levels	13
Figure 3.4 Soil pH (Water) Versus Ferrous Fe Levels (ppm)	
Table 3.3 Adialo Millietai 30113 Willi Fussible Hult Tuxidity Risk	14

15
15
15
15
15
16
17
17
18
18
18
4.0
19
19
19
20
20
20
21
21
21
21
21
22
22
22
23
23
23
24
25
Zi
26
28
28
29
30
31
32
33
34
34
34
34
35
36
37
38
38
38
38
38
39
40

## 1. INTRODUCTION

As reported in the ETESP report "Interpretation of Laboratory Data for ETESP Irrigation Component' – update of March 2006 - the ETESP Soil Salinisation and Improvement Specialist was requested to "cast his eye" over the laboratory data being supplied to the Irrigation and Drainage component of ETESP. These data were sourced from the Northern Sumatra Irrigated Agriculture Sector Project, which closed in December 2005, with the laboratory analyses being carried out by C. Lotti and Associati, Consulting Engineers, Rome Italy.

ETESP Agriculture component was supplied a copy of the raw or semi processed soil data in mid December 2005 and the first rapid assessment was completed by late December 2005 and further manipulation and study in February with reporting finalised in March 2006.

The original dataset, in Microsoft Excel format, comprised the basic laboratory values for standard soil analyses as shown in Table 1. No data on soil phosphorus (Avail-P) or micronutrients were included.

**Table 1 Original Dataset Composition** 

		PSC		Salinity	Re	eaction /	Acidity		Risk facto	ors		Fertility	,		Exchan	geables	
Item	S	Si	С	EC	рН	рН	H+	Al <sup>3+</sup>	Fe	S	ОС	N	CEC	Ca	Mg	K	Na
Unit	%	%	%	mmhos/cm	H <sub>2</sub> O	KCI	me/100g	me/100g	ppm	ppm	%	%	Me/100g	Me/100g	Me/100g	Me/100g	Me/100g
									Ferrous	SO <sub>4</sub>		Total					

In total there were data items for just over 200 samples from 38 irrigation schemes falling within 7 separate Kabupaten.

Table 2 Areas with Schemes and Sample numbers

ACEH BESAR	ACEH JAYA	ACEH TIMUR	ACEH UTARA	BIREUEN	PIDIE	SINGKIL
38 samples	117 samples	2 samples	13 samples	13 samples	8 samples	12 samples
4 schemes	19 schemes	1 scheme	3 schemes	5 schemes	2 schemes	4 schemes
Names	Names	Names	Names	Names	Names	Names
Blang Luas	Alue Monmata	Julok Tunong	Krueng Tuan	Pandrah	Beuracan	Parakan Sulampi
Geunteut Lamsujen	Baba Awe		Pase Kanan	Pate Lhong	Cubo Trienggading	Sidorejo
Krueng Geupeu	Baba le		Pase Kiri	Paya Nie		Tana Bara
Krueng Kala	Blang Alue Gajah			Peudada		Ujung Bawang
	Blang Jempeuk			Samalanga		
	Bunbun					
	Jabie					
	Krueng Tunong					
	Kr. Ateu					
	Kuala Meurisi					
	Kulam Asan					
	Lambaro					
	Lambesoi					
	Meudheun					
	Meulha					
	Panghuleu Harakat					
	Rawa Krueng Itam					
	Seneubok Padang					
	Treng Lipeh					

Further study of the data was commenced following a "brain-storming" and "exchange-of-ideas" meeting in the offices of BPTP (Balai Pengkajian Teknologi Pertanian) Banda Aceh attended by staff of:

- BPTP (Balai Pengkajian Teknologi Pertanian)
- ACIAR (Australian Centre for International Agricultural Research)
- AusAID (Australian Aid organisation mainly CSIRO staff)
- ISRI (Indonesian Soil Research Institute)
- Aceh Rehabilitation & Reconstruction Programme, GTZ (German Aid Organisation)
- ETESP Agriculture Component, and
- Various NGOs including Mercy Corp

The notes made during the above meeting are presented as Appendix 1 to this report. The main reasons for the further study was due to the fact that the ACIAR team was of the opinion that soil sodicity might be a problem – a statement more or less rejected by ETESP at the meeting - this further study should prove or disprove the possibility of a problem due to sodic soils. Other features which might be limiting plant growth, development and fruiting are also considered.

## 2. DATA MANIPULATION

## 2.1 Aims and Introduction

The aim of the original study of these data was to manipulate the data and use that data to establish the fertility status and the risk factors presented by the chemical composition of the soils for each sample, site, scheme and kabupaten.

The main features being investigated this time comprise factors which might be able to explain the failure of crops to grow successfully on land which would appear to have recovered or been reclaimed following the tsunami inundation. There have been several reports of crops showing strong growth during the vegetative stage then failing to produce grain or fruit. The original study indicated that there was salinity to some degree in all study areas but excessive salinity did not exist. Basically the following features are investigated in this report:

- Soil sodicity, as reflected by ESP (Exchangeable Sodium Percentage)
- Soil acidity, as reflected by soil reaction (pH) and ASP (Aluminium Saturation Percentage), plus
- Low inherent fertility as reflected by low and very low BS (Base Saturation) and TEB (Total Exchangeable Bases)

## 2.1.1 Soil Sodicity

The current study followed the same procedures but using an updated version of the ETESP Labdata Summary tool which includes ratings for such items as ESP – exchangeable sodium percentage – and determines if the soil is "sodic" to any extent. The term "sodic" is used in preference to the older expression "alkali" since there has always been the possibility to confuse an "alkali" soil with an "alkaline" soil. Sodic (alkali) refers to the presence and amount of "sodium" attached to the soil exchange complex whilst "alkaline" refers to the reaction (pH) of the soil. The variously defined categories of soil sodicity being looked for are given in Table 2.1

**Table 2.1 Saline Sodic Soil Definitions** 

Name	EC	ESP		
	(Electrical Conductivity) dS/m	(Exchangeable Sodium)	Soil Reaction	Soil pH
Non-saline Non-sodic	<4	<15	Not strongly alkaline	<8.5
Saline Non-sodic	>4	<15	Not strongly alkaline	<8.5
Saline Sodic	>4	>15	Not strongly alkaline	<8.5
Non-saline Sodic	<4	>15	Usually strongly alkaline	>8.5

## 2.1.2 Soil Acidity

In addition, all soils that were strongly acidic to extremely acidic were paid special attention and correlations sought as to why they were so acidic. The obvious things being looked for being:

- exchangeable aluminium
- presence of peat, and
- possible correlations with high levels of sulphates and iron.

The acidity classes targeted for study are defined in Table 2.2

Table 2.2 Soil pH values for Strongly to Extremely Acidic Reaction

pH(water)	<4.00	4.00	4.50	4.60	5.00	5.10	5.50
Reaction	Ext Acid	Extremely Acid	Extremely Acid	Very Strongly Acid	Very Strongly Acid	Strongly Acid	Strongly Acid

## 2.1.3 Inherent Soil Fertility

Inherent fertility is the fertility of the soil as found in its natural condition in the field after the tsunami and before any additions of fertilisers or manures, unless of course farmers applied fertilisers or manures before the soils were sampled and did not advise the survey party that they had done so.

The total sum of the various major nutrient cations (Calcium, Magnesium, Potassium and Sodium) is known as the TEB (Total Exchangeable Bases) and is the normal measure of inherent fertility. In addition, the proportion of the soil's cation exchange capacity (CEC) occupied by the above cations is also used and this value is known as the Base Saturation (BS) and is expressed as a percentage. The critical values used for this study are shown in Table 2.3

Table 2.3 Low and Very Low TEB and BS Values and Ratings

TEB me/100g	0.01	2.99	3.00	7.49
Rating	Very Low	Very Low	Low	Low
BS %	0.01	34.99	35.00	49.99
Rating	Very Low	Very Low	Low	Low

## 2.2 Procedure

As previously reported the data set was studied to ensure that the units being reported were the internationally accepted norm – all apart from the salinity values appeared to be as expected and the salinity figures were converted to the now accepted EC (Electrical Conductivity) format of dS/m.

Next any obviously incorrect data items were either deleted or corrected, in some cases this was a matter of repositioning the decimal point which had been misplaced via a typographical error. Some values could not be corrected as they depended on other values and in such cases the "suspect" values were colour coded to ensure they were excluded once manipulation was undertaken.

The data were then added to an expanded version of the ETESP Agriculture component tool "ETESP Labdata Summary" sheet Version 4 which is an MS Excel spreadsheet with inbuilt functions which calculate other parameters from the data and apply ratings to the various outputs. The expanded spreadsheet used is named "ETESP Labdata Collation.XLS". The actual tool is described further in the original report (ETESP March 2006).

## 2.3 ETESP Labdata Collation

The format of this tool is that the data for each sample, site or horizon is entered and ratings automatically generate below the data. The type of material is designated by entering a "D" for deposits or sediments and an "O" for original soil – this data is contained in the original dataset.

Instructions on how to use the tool are contained on the "introduction" sheet which is the first page of the spreadsheet.

Figure 2.1 ETESP Labdata Summary Tool

			Country:	Indon	esia	Indor	esia													
			Location:	Suma	tra								S	aturatio	<b>n</b> s					
								Exchang	geable:	;				ASP	ESP	Base		Cation Ratios		Cation Ratios
Kabupaten	Scheme	Site	Soil (O)	Depth	Range		-	eq / 10	0g			Mg	K	Al	Na	BS				
Kabapaten	/ Desa	No	Deposit ( <b>D</b> )	From	To	Ca	Mg	K	Ma	CEC	TEB	SatZ	Satz	SatZ	SatZ	2	Ca/Mg	Rating	Mg/K	Rating
Aceh Besar	Blang Luas	BLG 13	0	ND		7.35	1.52	0.13	0.77	10.81	9.77	14	1	2	7	90	4.84	OK	11.63	K sli deficient
				Rating		Mod	Mod	Low	High	Low	Mod	ND	V Low	V Low	VSIi-sodic	V High				
Aceh Besar	Blang Luas	BLG 13	D	ND		6.5	1.11	0.09	0.7	9.59	8.40	12	- 1	2	7	88	5.86	Mg sli deficient	12.33	K deficient
				Rating		Mod	Low	V Low	High	Low	Mod	ND	V Low	V Low	VSIi-sodic	V High				
Aceh Besar	Blang Luas	BLD03B	D	30 -		8.73	1.7	0.1	0.86	13.16	11.39	13	- 1	1	7	87	5.14	Mg sli deficient	17.00	K deficient
				Rating		Mod	Mod	Low	High	Low	Mod	ND	V Low	V Low	VSIi-sodic	V High				
Aceh Besar	Geunteut Lamsujen	GL Q5	D	50 -		10.83	1.72	0.36	3.07	16.58	15.98	10	2	1	19	96	6.30	Mg sli deficient	4.78	OK
				Rating		High	Mod	Mod	Y High	Mod	High	ND	V Low	V Low	Sodic	V High				
Aceh Besar	Krueng Kala	KKD 4	D	ND		7.76	1.3	0.19	0.91	12.62	10.16	10	2	1	7	81	5.97	Mg sli deficient	6.84	OK
				Rating		Mod	Low	Low	High	Low	Mod	ND	V Low	V Low	VSIi-sodic	V High				
Aceh Besar	Krueng Kala	KK F2	D	0	12	7.76	1.3	0.39	0.91	12.49	10.36	10	3	1	7	83	5.97	Mg sli deficient	3.33	OK
				Rating		Mod	Low	Mod	High	Low	Mod	ND	V Low	V Low	VSIi-sodic	V High		•		•••••

## 3 RESULTS

#### 3.1 Introduction

The full output of results is not presented here but is contained in Appendix B as a series of tables. In this section there is a short presentation and discussion of findings or observations that have been determined by study of the data. Generally the data for the mineral soils and the organic soils (peat) are presented separately since these soils are so different. The more acidic mineral soils have a reaction range of pH 5.5 - 4.5 whilst the organic soils range from pH 5.1 - 3.0. The soils considered as acidic are all non-saline and non-sodic.

## 3.2 ESP - Soil Sodicity in Mineral Soils

The first step in this part of the study was to copy all the data for the soils which classified as "sodic" to a separate sheet and an extract of that sheet is shown below as Table 3.1. As can be seen this table only contains data from the mineral soils since none of the organic soils are sodic to any extent.

**Table 3.1 Samples Classified as Sodic** 

Irrigation Com	ponment Sites Class	ified as Sodic											Saturations	;			
						Exchange	ables						ASP	ESP	Base	Cation Ratios	Cation Ratios
Kabupaten	Scheme	Site	EC	pН			meq / 100g	]			Mg	K	Al	Na	BS		
Kabupaten	/ Desa	No	dS/m	H20	Ca	Mg	K	Na	CEC	TEB	Sat%	Sat%	Sat%	Sat%	%	Ca/Mg Rating	Mg/K Rating
Aceh Besar	Geunteut Lamsujen	GL Q5	0.59	7.5	9.36	1.31	0.60	2.94	16.33	14.21	8	4	2	18.0	87	7.15 Mg deficient with P inhibition	2.18 Mg sli deficient
Aceh Besar	Krueng Kala	KKE 10	0.84	7.3	6.04	0.97	0.29	2.10	11.54	9.40	8	3	1	18.2	81	6.23 Mg sli deficient	3.34 OK
Aceh Besar	Geunteut Lamsujen	GL Q5	0.29	8.0	10.83	1.72	0.36	3.07	16.58	15.98	10	2	1	18.5	96	6.30 Mg sli deficient	4.78 OK
Aceh Besar	Krueng Geupeu	KG I 2A	2.60	7.6	5.04	1.28	0.57	1.98	10.04	8.87	13	6	2	19.7	88	3.94 OK	2.25 Mg sli deficient
Aceh Jaya	Kuala Meurisi	TL 7	1.70	7.3	8.01	1.17	0.61	2.04	13.60	11.83	9	4	3	15.0	87	6.85 Mg sli deficient	1.92 Mg deficient
Aceh Jaya	Kr. Ateu	KA 8 Mean	4.85	6.5	6.91	1.65	0.33	1.76	11.39	10.65	14	3	2	15.5	94	4.18 OK	5.00 OK
Aceh Jaya	Lambesoi	LS N4	1.02	5.9	7.01	2.23	0.35	2.25	14.41	11.84	15	2	1	15.6	82	3.14 OK	6.37 OK
Aceh Jaya	Blang Jempeuk	BJ B3	5.50	7.4	9.74	1.29	0.35	2.51	15.80	13.89	8	2	1	15.9	88	7.55 Mg deficient with P inhibition	3.69 OK
Aceh Jaya	Kr. Ateu	KA 8	2.20	7.4	8.18	2.46	0.52	2.31	14.28	13.47	17	4	1	16.2	94	3.33 OK	4.73 OK
Aceh Jaya	Kr. Ateu	KA 8	8.10	6.0	6.24	1.63	0.24	1.74	10.73	9.85	15	2	2	16.2	92	3.83 OK	6.79 OK
Aceh Jaya	Treng Lipeh	KM C2	1.26	5.6	6.35	0.95	0.17	1.89	11.63	9.36	8	1	2	16.3	80	6.68 Mg sli deficient	5.59 OK
Aceh Jaya	Kr. Ateu	KA 14	0.90	7.3	6.54	1.34	0.49	1.84	11.30	10.21	12	4	1	16.3	90	4.88 OK	2.73 Mg sli deficient
Aceh Jaya	Karang Tunong	KTG1	4.50	7.0	8.21	1.97	0.80	2.49	15.18	13.47	13	5	1	16.4	89	4.17 OK	2.46 Mg sli deficient
Aceh Jaya	Blang Jempeuk	KJ 2	1.54	6.5	6.59	1.09	0.38	1.70	10.23	9.76	11	4	2	16.6	95	6.05 Mg sli deficient	2.87 Mg sli deficient
Aceh Jaya	Blang Alue Gajah	BUG I2	3.00	6.6	6.17	1.82	0.55	2.21	13.03	10.75	14	4	2	17.0	83	3.39 OK	3.31 OK
Aceh Jaya	Karang Tunong	KT H1	0.97	7.3	9.14	1.55	1.08	2.86	15.95	14.63	10	7	1	17.9	92	5.90 Mg sli deficient	1.44 Mg deficient
Aceh Jaya	Kr. Ateu	KA B	0.33	6.3	6.04	0.90	0.29	2.10	11.55	9.33	8	3	1	18.2	81	6.71 Mg sli deficient	3.10 OK
Bireuen	Samalanga	S1 0	6.33	6.0	2.23	0.71	0.65	1.55	10.14	5.14	7	6	3	15.3	51	3.14 OK	1.09 Mg deficient
		Mean	2.58	6.9	7.15	1.45	0.48	2.19	12.98	11.26	11	4	2	17	86	5.19 Mg sli deficient	3.54 <mark>OK</mark>
		Max	8.10	8.0	10.83	2.46	1.08	3.07	16.58	15.98	17	7	3	20	96	7.55 Mg deficient with P inhibition	6.79 <mark>OK</mark>
		Min	0.29	5.6	2.23	0.71	0.17	1.55	10.04	5.14	7	1	1	15	51	3.14 OK	1.09 Mg deficient

Of the total 207 samples only 18 are classified as being "sodic" and most of theses are "non-saline sodic" (refer Table 2.1 for definition) but there is some minor content of salt in all the samples as reflected by the EC figures shown below.

The presence of some salinity in the soil is important from the reclamation point of view since totally non-saline soils are much more difficult to reclaim than those with some salinity.

Table 3.2 Sodic Samples by Kabupaten

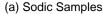
Kabupaten	Scheme	Site No	EC dS/nm	ESP	Classification
Aceh Besar	Geunteut Lamsujen	GL Q5	0.59	18.0	Non-saline sodic
Aceh Besar	Geunteut Lamsujen	GL Q5	0.29	18.5	Non-saline sodic
Aceh Besar	Krueng Geupeu	KG I 2A	2.60	19.7	Non-saline sodic
Aceh Besar	Krueng Kala	KKE 10	0.84	18.2	Non-saline sodic
Aceh Jaya	Blang Alue Gajah	BUG I2	3.00	17.0	Non-saline sodic
Aceh Jaya	Blang Jempeuk	BJ B3	5.50	15.9	Saline sodic
Aceh Jaya	Blang Jempeuk	KJ 2	1.54	16.6	Non-saline sodic
Aceh Jaya	Karang Tunong	KT H1	0.97	17.9	Non-saline sodic
Aceh Jaya	Karang Tunong	KTG1	4.50	16.4	Saline sodic
Aceh Jaya	Kr. Ateu	KA 14	0.90	16.3	Non-saline sodic
Aceh Jaya	Kr. Ateu	KA 8	2.20	16.2	Non-saline sodic
Aceh Jaya	Kr. Ateu	KA 8	8.10	16.2	Saline sodic
Aceh Jaya	Kr. Ateu	KA 8 Mean	4.85	15.5	Saline sodic
Aceh Jaya	Kr. Ateu	KA B	0.33	18.2	Non-saline sodic
Aceh Jaya	Kuala Meurisi	TL 7	1.70	15.0	Non-saline sodic
Aceh Jaya	Lambesoi	LS N4	1.02	15.6	Non-saline sodic
Aceh Jaya	Treng Lipeh	KM C2	1.26	16.3	Non-saline sodic
Bireuen	Samalanga	S1 0	6.33	15.3	Saline sodic

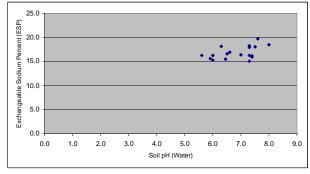
Some simple observations based on Tables 3.1 and 3.2 are listed below:

- Mean pH value of these sodic soils is 6.9 that is, soil reaction is neutral which is acceptable for most plant growth
- Aceh Jaya had most of the sodic samples (13), Aceh Besar had 4 and there was one sample from Bireuen
- Less than 9% of the samples taken for the irrigation study proved to be "sodic" that is sodicity is NOT a major problem

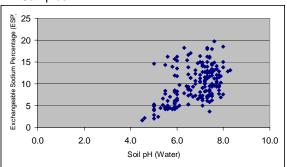
- For the sodic soils the range of ESP vales is from 15 20% as can be seen in Figure 3.1a that is, the "sodicity' level is relatively low. Study of figure 3.1b shows that the ESP levels for all samples are mainly between 4 15% with soil reaction of pH5 pH7.5
- The mean BS is 86% that is these soils have good inherent fertility, based on BS that is a very high rating However, the BS is high mainly because the CEC is so low so overall these sodic soils are not too fertile
- The mean TEB for these sodic soils is 11.26 me/100g that is "moderate" and the situation needs improving by appropriate fertilisation and addition of amendments such as organic manures
- The mean CEC for these sodic soils is 12.98 me/100g that is "low" and these soils have a low fertility potential and this would need to be boosted by additions of copious amounts of organic manures and composted materials since the CEC of such material is generally high and helps the soil
- Of the 18 samples 11 (60%) are noted as tsunami deposits and 7 samples (40%) are original soil material
- The 13 samples from Aceh Jaya came from a total of seven schemes and one scheme, Kreung Ateu, accounted for 5 of those samples suggesting that, perhaps, there is some sodicity problem within this scheme

Figure 3.1 Soil pH (Water) versus Exchangeable Sodium Percentage





## (b) All Samples



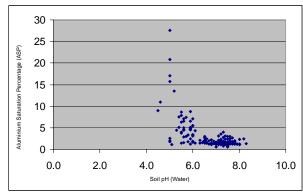
## 3.3 Soil Acidity - Mineral Soils

## 3.3.1 Aluminium Saturation Percent (ASP)

The norm is that aluminium saturation percentage (ASP) increases dramatically in mineral soils when the soil pH (water) falls to about 5.5. As can be seen in Figure 3.2 below this relationship holds for the data being examined since the ASP increases from around 5% up to about 28% once pH falls below 6. Explanation of the processes is presented in ETESP report "Soil Acidity and Aluminium".

However, with the samples being studied, very high values of ASP were not encountered and though the value of 28% is rated as high only 7 samples out of the total exceed ASP of 10%. Only 3.6% of the total mineral soil samples have an ASP level of moderate or worse - 10% ASP being the start of the moderate class of ASP.

Figure 3.2 Soil pH (water) Versus ASP- Mineral Soils



This indicates that there is NOT a problem with exchangeable aluminium in the mineral soils, which would be expected since these soils are basically non-hill soils, normally flooded and used for padi cultivation.

## 3.3.2 Sulphate Levels

There appears to be no clear relationship between soil pH (water) and the level of sulphate found in the mineral samples as can be seen in Figure 3.3. All that can be determined from Figure 3.3 is that most sulphate levels fall below 500 ppm which puts them in the low to moderate category. Only about 7 samples show values in excess of 1,000 ppm and are classified as having high sulphate levels.

## 3.3.3 Ferrous Iron Levels

Figure 3.4 shows a very broad, poor correlation between levels of ferrous iron and soil pH in that, the higher the pH (more alkaline the soil) then the lower is the level of ferrous iron. The highest concentration of samples is found between pH7 – pH8 and the level of ferrous iron is between 0 – 100 ppm and mostly less than 50 ppm. Definition of toxicity levels of ferrous iron is not good with some bodies claiming >40 ppm as toxic whilst others claim toxicity does not occur till levels reach 400

ppm. General advice is to accept the 400 ppm as the trigger level for toxicity. Soils possibly at risk are listed in Table 3.3 with an explanation given below.

Figure 3.3 Soil pH Versus Sulphate in Mineral Soils

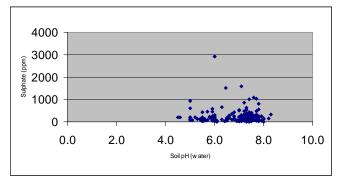
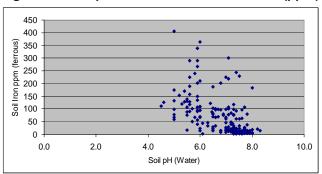


Figure 3.4 Soil pH Versus Ferrous Fe Levels (ppm)



**Table 3.3 Acidic Mineral Soils with Possible Iron Toxicity Risk** 

Kabupaten	Scheme	Site	Soil (O)	Depth	Range	Lab	pН	Exchange	eable	Fe	SO <sub>4</sub>
Kabupaten		No	Deposit (D)	From	To	Texture	H2O	Н	Al	ppm	ppm
Singkil	Tana Bara	TB 2	0	0	25	CL	4.5	0.40	2.17	111	199
Singkil	Tana Bara	TB 1	0	0	20	С	4.6	0.20	2.22	126	210
Aceh Jaya	Bunbun	BL N1	0	12		SL	5.0	0.62	0.18	60	593
Aceh Jaya	Panghuleu Harakat	PH D1	D	0	18	SL	5.0	0.58	0.22	98	925
Aceh Jaya	Blang Jempeuk	BJ B3	0	30		С	5.0	0.78	0.24	405	81
Singkil	Parakan Sulampi	PS 1	0	ND			5.0	0.16	1.90	77	135
Singkil	Sidorejo	SD B1	0	0	20	С	5.0	0.24	3.22	133	189
Singkil	Sidorejo	SD A1	0	10	50	С	5.0	0.19	4.22	175	201
Singkil	Sidorejo	SD B1	0	15	50	С	5.0	0.24	3.55	68	89
Singkil	Sidorejo	SD A1	0	0	10	SCL	5.2	0.24	3.00	154	190
Bireuen	Paya Nie	PYN 2	D	0	10	CL	5.3	0.20	0.53	119	122
Bireuen	Peudada	PAD 25	0	0	25	С	5.4	0.42	0.62	170	132
Pidie	Cubo Trienggading	CT C1 mix	M	0	30	CL	5.4	0.42	0.75	12.8	105
Aceh Jaya	Bunbun	BL N7	0	ND		SCL	5.5	0.43	0.18	16	430
Aceh Utara	Krueng Tuan	BKB7	0	0	25	CL	5.5	0.32	0.42	130	111
Bireuen	Paya Nie	PN 1	0	10	25	С	5.5	0.31	0.49	107	197
Aceh Utara	Krueng Tuan	BK6	0	0	25	CL	5.5	0.40	0.76	138	15
Aceh Jaya	Alue Monmata	MD 2	0	ND		С	5.5	0.12	0.88	75	24
Pidie	Beuracan	Be C2 mix	M	0	25	CL	5.5	0.21	0.82	88	123
Pidie	Beuracan	Be E2	0	0	25	CL	5.6	0.22	0.72	128	105
Singkil	Ujung Bawang	IUB 1	0	0	40	CL	5.9	0.42	0.90	201	91
Pidie	Cubo Trienggading	CTA3 mixed	M	0	30	С	6.0	0.27	0.33	109	122

According to Ponnamperuma (IRRI) iron toxicity is likely to occur in most mineral soils that do not attain pH 6.5 after flooding. As can be seen in Figure 3.4 the bulk of the soils tested have pH of 6.5 or greater and, it is assumed that the pH of the more acidic samples would increase as and when the soil is flooded for padi cultivation. However, <u>as a precaution it might be wise to monitor soil pH in the mineral soils deemed to have an acidity problem as and when those soils are flooded and puddled in preparation for padi use.</u> The sites involved are detailed in Table 3.3 where the most acidic soils have the pH coloured blue and the higher ferrous iron levels coloured green – both in bold.

Iron deficiency is possible on flooded high pH soils that are low in organic matter. Flooding a soil will reduce the pH of an alkaline soil and increase the pH of an acid soil, ie the pH of all soils except acid peats and those low in active iron, converges to the range 6.5 to 7.0.

High soil pH has been assumed as a pH greater than 8 and the mineral soils with this feature are listed in Table 3.4 where those with low organic matter have been highlighted and coloured (in the ratings used by ETESP organic carbon level of less that 1.2 is rated as low).

As can be seen only one sample appears to fall into this possible risk category and hence this risk is considered as virtually non-existent. However, in the above table it can be seen that the levels of ferrous iron are actually generally rather low in these soils with:

- one sample GL Q5 in Aceh Besar being just above the deficiency rating with a level of 5 ppm, and
- one site BL A2 in Aceh Besar being rated as "low" with a value of 7 ppm

Most of the other sites are rated as having "moderate" level of iron whilst one site has a high rating with 182 ppm. Overall it is concluded that there does not appear to be a risk of iron deficiency.

Table 3.4 High pH or Alkaline Mineral Soils

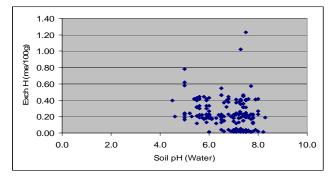
Kabupaten	Scheme	Site	Soil (O)	S	Si	С	Lab	pН	Exchai	ngeable	Fe	SO4	Org C	Total N	C:N
Kabupaten	/ Desa	No	Deposit (D)	%	%	%	Texture	H2O	Н	Al	ppm	ppm	%	%	
Aceh Jaya	Kr. Ateu	KD 10	D	67	11	22	SL	8.3	0.19	0.21	16	316	1.40	0.30	5
Aceh Jaya	Kr. Ateu	KAC4	D	86	0	14	LS	8.2	0.01	0.40	21	153	1.42	0.12	12
Aceh Besar	Geunteut Lamsujen	GL R2	D	91	6	3	S	8.0	0.27	0.32	18	150	1.01	0.30	3
Aceh Besar	Blang Luas	BL A2	D	82	4	14	LS	8.0	0.23	0.18	7	129	1.44	0.13	11
Aceh Jaya	Lambesoi	LS 10	D	22	44	34	CL	8.0	0.42	0.18	182	124	1.71	0.21	8
Aceh Besar	Geunteut Lamsujen	GL Q5	D	18	11	71	SiCL	8.0	0.02	0.18	5	3	2.80	0.15	19

## 3.3.4 Exchangeable Hydrogen

Figure 3.5 plots soil pH (water) against exchangeable hydrogen (H<sup>+</sup> in me/100g) and there appears to be a very crude correlation with level of exchangeable hydrogen falling with increasing soil pH – which would be expected – but there is not a very clear relationship visible.

The bulk of the samples have an exchangeable hydrogen level of 0.4 me/100g or less and these levels are rated low to very low and would cause no obvious problems.

## Figure 3.5 Soil pH Versus Exchangeable Hydrogen



## 3.4 Inherent Soil Fertility

#### 3.4.1 Use of base Saturation

Inherent, or existing, soil fertility is the natural fertility of the soil as it is found in the field before any amendments, in the form of fertilisers or manures, are added and it is determined from the laboratory analyses as reported by Lotti by using the base saturation (BS%) as a measure of inherent fertility. Inherent fertility must not be confused with fertility potential or how well the soil can hold any added nutrients – fertility potential is assessed using the cation exchange capacity (CEC). For the purposes of this exercise soil samples with a BS of less than 50% are considered to have poor inherent fertility, if BS is less than 35% the status is noted as very poor.

All samples of mineral soils meeting the above criteria are listed in Table 3.5 sorted in order of decreasing BS. Colour coding and 'emboldening" has been used to further highlight perceived problems. Generally "BLUE" has been denoted to poor fertility or serious problems whilst "RED" is used for very poor fertility or very serious problems.

In total 40 of the 195 mineral soil samples fall into this poor fertility category and, as can been seen below, there are 18 samples (9% of the mineral soils) noted as having poor inherent fertility and 22 (11%) with very poor fertility.

To further identify possible or perceived nutrient problems the following factors have also been added to the table since they are all part and parcel of fertility:

- <u>Soil reaction or pH</u> very strongly and extremely acid soils have been highlighted as problems, about 50% of the low inherent fertility soils have acidity problems
- Organic-C (organic matter) the organic matter content of these suspect soils would appear to be normal with no samples having low / very low or excessively high levels of organic carbon
- <u>Total-N</u> (Nitrogen) virtually all of the inherently infertile soils have low level of total nitrogen but only one sample has a very low level. Obviously all of these soils require nitrogenous fertiliser either mineral or via composts
- <u>C:N ratio</u> the low levels of nitrogen reported are reflected in the poor C:N ratio and, again, this will be improved with addition of nitrogenous material
- <u>Exchangeable Calcium</u> most of the samples show low levels of exchangeable calcium and a few show very low levels. Addition of superphosphate fertiliser would add calcium as would organic manures or liming materials or gypsum. Gypsum might be added in some cases if the soil required "cleaning-up" and the removal of sodium from the exchange complex
- <u>Exchangeable Magnesium</u> virtually every sample in this subset shows low to very low levels of exchangeable magnesium. Magnesium could be added as a magnesium rich mineral fertiliser or supplied via the application of dolomitic limestone if an amendment for acidity has to be applied
- <u>Exchangeable Potassium</u> levels of this nutrient appear to be acceptable and no specific requirement can be seen for any special fertiliser application
- <u>Exchangeable Sodium</u> none of the samples show low or very low levels of exchangeable sodium, which is to be expected. However, one or two samples do contain high to very high levels and are marked accordingly

- <u>Cation Exchange capacity (CEC)</u> this is included to allow cross checking but CEC does not come into the inherent fertility scenario
- <u>Total Exchangeable Bases (TEB)</u> this is the sum of Exch-Ca, Exch-Mg, Exch-K plus Exch-Na and virtually all of the samples are highlighted as having low TEB and even some very low levels were noted
- Magnesium Saturation Percent this is a non-standard presentation but could prove useful
- Potassium Saturation Percent this is a non-standard presentation but could prove useful
- <u>Aluminium Saturation Percent</u> ASP can be a problem but only a few of these samples are noted as having anything like excessive values. Generally the ASP problem vanishes or diminishes greatly once a soil is flooded
- <u>Exchangeable Sodium Percent</u> none of these poorly fertile soils have excessive exchangeable sodium since sodic soils are normally slightly alkaline to alkaline and all these soils are acidic to some degree
- Base Saturation this is the main measure used to determine inherent fertility and the starting point in this exercise

Table 3.5 Mineral Soils with Poor to Very Poor Inherent Fertility

Singill   Ujung Bawang   5.9   4.00   0.19   21   2.88   0.57   0.71   0.62   0.29   4.78   6   7   9   6   46     Aceh Ulara   Pase Kiri   6   0   3.23   0.22   15   2.64   0.61   0.57   0.59   9.52   4.41   6   6   7   7   6   64     Polie   Beuracan   6.1   2.12   0.12   18   2.87   0.17   0.61   0.99   10.23   4.64   2   6   4   10   45     Aceh Ulara   Pase Kanan   6.0   2.78   0.18   15   2.99   0.40   0.55   0.67   10.21   4.61   4   5   5   5   7   4.5     Bireuen   Pate Ihong   6.0   3.47   0.17   20   2.80   0.49   0.56   0.63   10.14   4.88   5   6   5   5   7   4.5     Bireuen   Pate Ihong   6.0   3.47   0.17   20   2.80   0.49   0.56   0.63   10.14   4.88   5   6   5   5   5   7   4.5     Bireuen   Pate Ihong   5.5   2.77   0.12   2.80   0.49   0.56   0.63   10.14   4.88   5   6   5   5   5   7   4.5     Bireuen   Pate Ihong   5.5   2.77   0.12   2.80   0.49   0.56   0.63   10.14   4.88   5   6   5   5   5   5   4.4     Aceh Jaya   Alue Monmata   5.5   2.77   0.12   2.23   2.73   0.70   0.55   0.86   11.13   4.86   6   5   8   8   44     Aceh Jaya   Alue Monmata   5.5   3.78   0.12   3.2   2.88   0.55   0.71   0.62   10.99   4.76   5   6   4   6   6   4     Aceh Jaya   Karang Tuong   7.0   1.34   0.15   9   9.02   1.52   1.23   2.94   3.61   3.14   1.71   4   3   0   8   41     Pidie   Beuracan   5.9   3.45   0.19   18   0.59   3.00   0.56   0.50   11.00   4.74   2.7   5   5   5   5   43     Aceh Jaya   Krueng Tuan   5.5   3.08   0.19   10.20   6.05   0.81   0.92   11.33   4.46   5   7   5   5   5   43     Bireuen   Samalanga   5.8   3.35   0.20   1.7   2.93   0.38   0.75   0.51   12.09   4.57   3   6   3   4   38     Pidie   Cubo Triengading   5.4   2.40   0.11   2.2   1.23   2.50   0.50   0.60   0.60   0.01   3.78   6   6   7   7   5   8   39     Bireuen   Paya Nile   5.5   3.78   0.18   1.90   0.62   0.60   0.60   0.01   3.78   6   6   7   7   5   8   39     Bireuen   Paya Nile   5.5   3.78   0.18   1.90   0.50   0.60   0.60   0.01   3.78   6   6   7   7   5   3   4   3     Bireuen   Paya Nile	Kabupaten	Scheme	рН	Org C	Total N	C:N	Exch	angeabl	es Catio	ns etc	me/	100g	Mg	K	ASP	ESP	Base
Singkil   Ujung Bawang   5.9   4.00   0.19   21   2.88   0.57   0.71   0.62   10.29   4.78   6.6   7. 9   6.46     Aceh Ulara   Pase Kiri   6.0   3.23   0.22   15   2.64   0.61   0.57   0.59   9.52   4.41   6   6   7   6   46     Polite   Beuracan   6.1   2.12   0.12   18   2.87   0.17   0.61   0.99   10.23   4.44   2   6   6   4   10   45     Aceh Ulara   Pase Kanan   6.0   2.78   0.18   15   2.99   0.40   0.55   0.67   10.21   4.61   4   5   5   5   7   4.5     Bireuen   Pate Lhong   6.0   3.47   0.17   20   2.80   0.49   0.56   0.63   10.14   4.8   5   6   5   5   7   4.5     Bireuen   Pate Lhong   6.0   3.47   0.17   20   2.80   0.49   0.55   0.67   10.21   4.61   4   5   5   5   7   4.5     Bireuen   Pate Lhong   5.5   2.77   0.12   2.80   0.49   0.56   0.63   10.14   4.8   5   6   5   5   5   7   4.5     Bireuen   Pate Lhong   5.5   2.77   0.12   2.80   0.49   0.55   0.63   10.14   4.8   5   6   5   5   5   4.4     Aceh Laya   Alue Monmata   5.5   2.77   0.12   2.21   2.73   0.70   0.55   0.86   11.13   3.44   5   5   5   8   8   44     Aceh Laya   Alue Monmata   5.5   2.77   0.12   2.80   0.55   0.71   0.62   10.99   4.76   5   6   4   6   6   4   3     Aceh Laya   Karang Tunong   7.0   1.34   0.15   9   9.02   1.52   1.23   2.73   0.11   0.4   1.74   4   3   0   8   41     Pidle   Cubo Tirenggading   5.9   2.78   0.25   11   2.18   0.55   0.81   0.92   11.33   4.46   5   7   5   8   39     Bireuen   Samalanga   5.8   3.35   0.20   17   2.93   0.38   0.75   0.51   1.299   4.57   3   6   3   4   38     Pidle   Cubo Tirenggading   6.0   2.45   0.11   2.18   0.55   0.81   0.92   1.33   4.46   5   7   5   8   39     Bireuen   Peudata   5.9   4.47   0.26   17   2.90   0.50   0.60   0.60   0.01   0.37   8   6   7   7   5   8   39     Bireuen   Paya Nile   5.5   3.78   0.18   1.79   0.50   0.60   0.60   0.01   3.78   6   6   7   7   3   4   4   4   4   4   5   7   4   4   3   4   4   7   4   4   3   4   4   7   4   4   3   4   4   7   4   4   3   4   4   4   4   4   4   4													Mg	K	Al	Na	BS
			H2O	%	%			Mg	K	Na		TEB	Sat%	Sat%	Sat%	Sat%	Sat%
Pide   Beuracan   6.1   2.12   0.12   0.18   2.87   0.17   0.61   0.99   10.23   4.64   2.   6.6   4   10   4.5     Aceh Ulara   Pase Kanan   6.0   2.78   0.18   15   2.87   0.17   0.65   0.07   10.21   4.61   4.   5   5   5   7   4.5     Bireuen   Pale Ihong   6.0   3.47   0.17   20   2.80   0.49   0.55   0.63   10.14   4.8   5   6   5   5   7   4.5     Bireuen   Pandrah   5.6   4.78   0.22   2.2   3.88   0.59   0.31   0.62   12.33   5.40   5   0   5   3.3   5   5   5   4.4     Bireuen   Pandrah   5.5   2.77   0.12   23   2.73   0.70   0.55   0.66   11.13   4.84   6   5   6   5   6   44     Pide   Beuracan   5.9   3.78   0.12   32   2.88   0.55   0.71   0.62   10.99   4.76   5   6   4   6   6   4     Aceh Juara   Pase Kanan   5.9   3.78   0.12   32   2.88   0.55   0.71   0.62   10.99   4.76   5   6   4   4   6   6   4     Pidle   Cubo Tirenggading   7.0   1.34   0.15   0.55   0.81   0.95   3.00   0.55   0.81   0.92   11.33   4.46   5   7   5   5   8   8   44     Pidle   Cubo Tirenggading   5.8   3.35   0.20   17   2.93   0.38   0.75   0.51   12.09   4.77   3.44   7   4   8   3.9     Pidle   Cubo Tirenggading   5.8   3.35   0.20   17   2.93   0.38   0.75   0.51   12.09   4.57   3.3   6   6   7   7   7   3.8     Pidle   Cubo Tirenggading   5.0   2.45   0.15   0.18   2.13   0.19   0.50   0.81   0.95   0.95   0.95   0.95   0.95   0.95     Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.56   0.46   0.53   12.46   4.55   4   4   7   4   3.7     Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.56   0.46   0.53   12.46   4.55   4   4   4   4   4   3.7     Bireuen   Paya Nie   5.6   3.40   0.16   2.12   0.19   0.59   0.05   0.55   0.55   1.15   0.48   0.5	Singkil	Ujung Bawang	5.9	4.00	0.19	21	2.88	0.57	0.71	0.62	10.29	4.78	6	7	9	6	46
Aceh Ultara   Pase Kanan   6.0   2.78   0.18   0.15   2.99   0.40   0.55   0.67   10.21   4.61   4.4   5.   5.   7.   4.55	Aceh Utara	Pase Kiri	6.0	3.23	0.22		2.64	0.61	0.57	0.59		4.41	6	6	7	6	46
Bireuen   Pate Lhong   6.0   3.47   0.17   20   2.80   0.49   0.56   0.63   10.14   4.48   5   6   5   6   4.48	Pidie	Beuracan	6.1	2.12	0.12	18	2.87	0.17	0.61	0.99	10.23	4.64	2	6	4	10	45
Bireuen   Pandrah   5.6   478   0.22   22   3.88   0.59   0.31   0.62   12.33   5.40   5.5   3   5.5   5.5   44   Aceh Jaya   Alue Monmala   5.5   2.77   0.12   23   2.73   0.70   0.55   0.86   11.13   4.84   6   5.5   8   8   44   Aceh Jaya   Pase Kanan   5.9   3.78   0.12   32   2.88   0.55   0.71   0.62   10.09   4.76   5   6   4   6   6   43   4.66   43   4.	Aceh Utara	Pase Kanan	6.0	2.78	0.18	15	2.99	0.40	0.55	0.67	10.21	4.61	4	5	5	7	45
Aceh Jaya   Alue Monmata   5.5   2.77   0.12   23   2.73   0.70   0.55   0.86   11.13   4.84   6   5   8   8   44     Pidie   Beuracan   5.9   3.78   0.12   32   2.88   0.55   0.71   0.62   10.99   4.76   5   6   4   6   6   43     Aceh Jaya   Rarang Tunong   7.0   1.34   0.15   9   9.02   1.52   1.23   2.94   36.13   14.71   4   3   0   0   8   41     Pidie   Cubo Trienggading   5.9   2.78   0.25   11   2.18   0.55   0.81   0.92   11.33   4.46   5   7   5   5   8   3     Aceh Jaya   Karang Tunong   7.0   1.34   0.15   9   9.02   1.52   1.23   2.94   36.13   14.71   4   3   0   0   8   41     Pidie   Cubo Trienggading   5.9   2.78   0.25   11   2.18   0.55   0.81   0.92   11.33   4.46   5   7   5   8   39     Bireuen   Samalanga   5.8   3.35   0.20   17   2.93   0.38   0.75   0.51   12.09   4.57   3   6   3   4   38     Pidie   Cubo Trienggading   5.4   2.40   0.11   22   1.90   0.62   0.60   0.66   10.01   3.78   6   6   7   7   38     Bireuen   Peudada   5.9   4.47   0.26   17   3.00   0.56   0.46   0.53   12.46   4.55   4   4   4   7   4   3.7     Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.56   0.46   0.53   12.46   4.55   4   4   4   4   4   3.7     Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.56   0.46   0.53   12.46   4.55   4   4   4   4   4   3.7     Aceh Ultara   Pase Kiri   5.6   2.87   0.17   17   2.33   0.55   0.56   0.56   0.56   11.34   4.00   5   5   5   5   3   3     Aceh Ultara   Pase Kiri   5.6   3.78   0.17   21   2.74   0.52   0.60   0.50   0.50   11.34   4.00   5   5   5   5   3   3    Birquen   Pasa Nimanga   5.9   3.78   0.17   21   2.74   0.52   0.60   0.50   0.50   11.34   4.00   5   5   5   5   3   3    Aceh Ultara   Pase Kiri   5.6   3.78   0.17   21   2.74   0.52   0.60   0.50   0.50   11.34   4.00   5   5   5   5   5   3   3    Birquen   Pasa Kiri   5.6   3.78   0.17   21   2.74   0.52   0.60   0.50	Bireuen	Pate Lhong	6.0	3.47	0.17	20	2.80	0.49	0.56	0.63	10.14	4.48	5	6	5	6	44
Pidie   Beuracan   5.9   3.78   0.12   32   2.88   0.55   0.71   0.62   10.99   4.76   5   6   4   6   43     Acch Layar   Pase Kanan   5.9   3.45   0.19   18   0.59   3.00   0.56   0.59   11.00   4.76   2.7   5   5   5   5   43     Acch Jaya   Karang Tunong   7.0   1.34   0.15   9   9.02   1.52   1.23   2.94   3.01   4.71   4   3   0   8   41     Pidie   Cubo Trienggading   5.9   2.78   0.25   11   2.18   0.55   0.81   0.92   11.33   4.46   5   7   5   8   3.99     Acch Layar   Krueng Tuan   5.5   3.08   0.19   16   2.08   0.50   0.81   0.92   11.33   4.46   5   7   5   8   3.99     Acch Larar   Krueng Tuan   5.5   3.08   0.19   16   2.08   0.50   0.81   0.92   11.33   4.46   5   7   5   8   3.99     Acch Larar   Krueng Tuan   5.5   3.08   0.19   16   2.08   0.50   0.81   0.92   11.33   4.46   5   7   5   8   3.99     Acch Larar   Krueng Tuan   5.5   3.08   0.19   16   2.08   0.50   0.81   0.92   11.33   4.46   5   7   5   8   3.99     Pidie   Cubo Trienggading   5.4   2.40   0.11   2.2   1.90   0.62   0.60   0.66   10.01   3.78   6   6   6   7   7   3.88     Pidie   Cubo Trienggading   5.9   4.77   0.26   17   3.00   0.56   0.46   0.53   12.46   4.55   4   4   7   4   3.79     Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.56   0.46   0.53   12.46   4.55   4   4   7   4   3.79     Bireuen   Samalanga   5.9   3.32   0.19   17   2.50   0.61   0.45   0.55   11.55   1.15   4   5   5   5   3.68     Acch Utara   Pase Kiri   5.6   2.87   0.17   17   2.33   0.55   0.56   0.56   0.55   11.55   4   4   5   5   5   3   5     Singkii   Sidorejo   5.0   3.55   0.17   21   2.74   0.52   0.60   0.46   10.22   3.48   5   6   7   7   5   3.48     Bireuen   Pase Kiri   5.7   3.87   0.17   12   2.74   0.52   0.60   0.46   10.22   3.48   5   6   7   5   5   3   3     Bireuen   Pase Kiri   5.7   3.87   0.17   12   2.74   0.52   0.60   0.55   0.55   0.12   0.46   0.55	Bireuen	Pandrah	5.6	4.78	0.22	22	3.88	0.59	0.31	0.62	12.33	5.40	5	3	5	5	44
Aceh Ulara   Pase Kanan   S.9   3.45   0.19   18   0.59   3.00   0.56   0.59   11.00   4.74   27   5   5   5   5   43	Aceh Jaya	Alue Monmata	5.5	2.77	0.12	23	2.73	0.70	0.55	0.86	11.13	4.84	6	5	8	8	44
Aceh Jaya   Karang Tunong   7.0   1.34   0.15   9   9.02   1.52   1.23   2.94   36.13   14.71   4   3   0   8   41     Pidle   Cubo Trienggading   5.9   2.78   0.25   11   2.18   0.55   0.81   0.92   11.33   4.46   5   7   5   8   39     Aceh Ulara   Krueng Tuan   5.5   3.08   0.19   16   2.08   0.50   0.81   0.95   11.25   4.34   4   7   4   8   3.99     Bireuen   Samalanga   5.8   3.35   0.20   17   2.93   0.38   0.75   0.51   12.09   4.57   3   6   3   4   38     Pidle   Cubo Trienggading   5.4   2.40   0.11   22   1.90   0.62   0.60   0.66   10.01   3.78   6   6   6   7   7   3.8     Pidle   Cubo Trienggading   6.0   2.45   0.15   16   2.12   0.19   0.59   0.76   10.01   3.66   2   6   3   8   3.7     Bireuen   Peudada   5.9   4.77   0.26   17   3.00   0.56   0.46   0.53   12.46   4.55   4   4   7   4   3.7     Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.56   0.46   0.53   12.46   4.55   4   4   4   4   4   4   3.7     Bireuen   Samalanga   5.9   3.22   0.19   17   2.33   0.55   0.56   0.56   0.55   11.55   4   5   5   5   3.6     Aceh Ulara   Pase Kiri   5.6   2.87   0.17   17   2.33   0.55   0.56   0.56   0.56   11.34   4.00   5   5   5   3   5   35     Aceh Ulara   Pase Kiri   5.6   3.40   0.16   2.1   1.90   0.52   0.60   0.46   10.23   3.48   5   6   7   5   34     Aceh Ulara   Pase Kiri   5.7   3.87   0.17   2.32   2.30   0.50   0.55   0.56   0.56   11.34   4.00   5   5   5   5   8   35     Aceh Ulara   Pase Kiri   5.0   3.55   0.17   21   2.14   0.52   0.60   0.50   1.20   4.36   4   5   5   5   5   8   35     Aceh Ulara   Pase Kiri   5.7   3.87   0.17   2.32   2.30   0.50   0.50   0.50   0.40   0.22   3.48   5   6   7   5   34     Aceh Ulara   Pase Kiri   5.7   3.87   0.17   2.18   2.47   0.48   0.50   0.50   1.20   4.36   4   5   5   5   5   8   35     Bireuen   Parakan Sulampi   5.9   3.01   0.14   22   2.00   0.59   0.65   0.85   12.12   4.09   5   5   5   7   7   7   34     Aceh Ulara   Rarea   Parakan Sulampi   5.0   3.78   0.17   2.18   0.50   0.50   0.50   0.50   0.50   0.50   0.	Pidie	Beuracan	5.9	3.78	0.12	32	2.88	0.55	0.71	0.62	10.99	4.76	5	6	4	6	43
Pidie   Cubo Trienggading   5.9   2.78   0.25   11   2.18   0.55   0.81   0.92   11.33   4.46   5   7   5   8   39     Aceh Diara   Krueng Tuan   5.5   3.08   0.19   16   2.08   0.50   0.81   0.95   11.25   4.34   4   7   4   8   39     Bireuen   Samalanga   5.8   3.35   0.20   17   2.93   0.38   0.75   0.51   12.09   4.57   3   6   6   3   4   38     Pidie   Cubo Trienggading   5.4   2.40   0.11   22   1.90   0.62   0.60   0.66   10.01   3.78   6   6   6   7   7   38     Pidie   Cubo Trienggading   6.0   2.45   0.15   16   2.12   0.19   0.59   0.76   10.01   3.66   2   6   3   8   37     Bireuen   Peudada   5.9   4.47   0.26   17   3.00   0.56   0.46   0.53   12.46   4.55   4   4   7   4   4   37     Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.56   0.46   0.53   12.46   4.55   4   4   4   4   4   37     Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.56   0.46   0.53   12.46   4.55   4   4   4   4   4   37     Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.55   0.56   0.56   0.56   0.55   11.55   4.11   5   4   5   5   5   3.6     Aceh Timur   Juliok Tunong   5.9   2.76   0.15   18   1.93   0.51   0.55   0.56   0.56   0.56   11.34   4.00   5   5   5   5   8   35     Pidie   Beuracan   5.6   3.40   0.16   221   1.90   0.52   0.60   0.46   0.02   3.48   5   6   7   5   3.4     Aceh Timur   Juliok Tunong   5.7   3.01   0.14   22   2.00   0.59   0.65   0.56   11.34   3.80   4   4   4   3   3   4   34     Aceh Timur   Juliok Tunong   5.7   3.01   0.14   22   2.00   0.59   0.50   0.50   11.34   3.80   4   4   4   3   3   4   34     Aceh Ulara   Pase Kiri   5.7   3.87   0.17   23   2.30   0.50   0.50   0.50   11.34   3.80   4   4   5   6   5   5   3.3     Aceh Ulara   Racean Sulampi   5.0   3.12   0.17   21   2.74   0.52   0.60   0.50   11.34   3.80   4   7   4   6   6   5   3.3     Aceh Ulara   Racean Sulampi   5.0   3.78   0.17   23   2.20   0.50   0.50   0.50   11.34   3.80   4   7   4   6   6   5   3.3     Bireuen   Pale Lhong   5.9   4.01   0.16   25   2.08   0.50   0.50   0.50   11.3	Aceh Utara	Pase Kanan	5.9	3.45	0.19	18	0.59	3.00	0.56	0.59	11.00	4.74	27	5	5	5	43
Pidie   Cubo Trienggading   S.9   2.78   0.25   11   2.18   0.55   0.81   0.92   11.33   4.46   5   7   5   8   39     Aceh Ulara   Krueng Tuan   5.5   3.08   0.19   16   2.08   0.50   0.81   0.95   11.25   4.34   4   7   4   8   39     Bireuen   Samalanga   5.8   3.35   0.20   17   2.93   0.38   0.75   0.51   12.09   4.57   3   6   6   3   4   38     Pidie   Cubo Trienggading   S.4   2.40   0.11   22   1.90   0.62   0.60   0.66   10.01   3.78   6   6   6   7   7   38     Pidie   Cubo Trienggading   6.0   2.45   0.15   16   2.12   0.19   0.59   0.76   10.01   3.66   2   6   3   8   37     Bireuen   Peudada   5.9   4.47   0.26   17   300   0.55   0.46   0.53   12.46   4.55   4   4   7   4   37     Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.56   0.46   0.53   12.46   4.55   4   4   7   4   4   4   37     Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.56   0.46   0.53   12.46   4.55   4   4   7   4   4   4   4   37     Bireuen   Pase Kiri   5.6   2.87   0.17   17   2.50   0.61   0.45   0.55   0.15   1.55   4.11   5   4   5   5   5   3     Aceh Ulara   Pase Kiri   5.6   2.87   0.15   18   1.93   0.51   0.55   0.56   0.56   0.56   11.34   4.00   5   5   5   5   8   35     Pidie   Beuracan   5.6   3.40   0.16   21   1.90   0.52   0.60   0.46   0.50   11.34   4.00   5   5   5   5   8   35     Pidie   Beuracan   5.0   3.55   0.17   21   2.74   0.52   0.60   0.50   12.90   4.36   4   5   5   5   8   35     Aceh Ulara   Pase Kiri   5.7   3.87   0.17   23   2.30   0.50   0.50   0.50   1.20   0.43   4   5   5   5   7   7   34     Aceh Ulara   Pase Kiri   5.7   3.87   0.17   23   2.30   0.50   0.50   0.50   1.34   3.80   4   4   4   3   4   34     Aceh Ulara   Pase Kiri   5.7   3.87   0.17   21   2.74   0.52   0.60   0.50   1.34   3.80   4   4   5   5   5   5   3   3    Aceh Ulara   Pase Kiri   5.7   3.87   0.17   23   2.30   0.50   0.50   0.50   0.50   1.34   3.80   4   4   5   5   5   5   3   3   3    Aceh Ulara   Krueng Tuan   5.6   3.78   0.17   21   2.00   0.59   0.50   0.50   0.50   1.34   3.80	Aceh Jaya	Karang Tunong	7.0			9	9.02							3	0	8	
Aceh Utara         Krueng Tuan         5.5         3.08         0.19         16         2.08         0.50         0.81         0.95         11.25         4.34         4         7         4         8         39           Bireuen         Samalanga         5.8         3.35         0.20         17         2.93         0.38         0.75         0.51         12.09         4.57         3         6         3         4         38           Pidie         Cubo Trienggading         6.0         2.45         0.15         16         2.12         0.19         0.59         0.76         10.01         3.66         2         6         3         8         37           Bireuen         Peudada         5.9         4.47         0.26         17         3.00         0.56         0.46         0.53         12.46         4.55         4         4         7         4         37           Bireuen         Paya Nile         5.5         3.78         0.18         21         3.00         0.56         0.46         0.53         12.46         4.55         4         4         7         4         4         37           Bireuen         Samalanga         5.9         <		Cubo Trienggading	5.9	2.78	0.25	11	2.18	0.55	0.81	0.92	11.33	4.46	5	7	5	8	39
Bireuen   Samalanga   5.8   3.35   0.20   17   2.93   0.38   0.75   0.51   12.09   4.57   3   6   3   4   38     Pidie   Cubo Trienggading   5.4   2.40   0.11   22   1.90   0.62   0.60   0.66   10.01   3.78   6   6   7   7   38     Pidie   Cubo Trienggading   6.0   2.45   0.15   16   2.12   0.19   0.59   0.76   10.01   3.66   2   6   3   8   37     Bireuen   Peudada   5.9   4.47   0.26   17   3.00   0.56   0.46   0.53   12.46   4.55   4   4   7   4   37     Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.56   0.46   0.53   12.46   4.55   4   4   7   4   4   37     Bireuen   Samalanga   5.9   3.32   0.19   17   2.50   0.61   0.45   0.55   11.55   4.11   5   4   5   5   5   36     Acch Ultara   Pase Kiri   5.6   2.87   0.17   17   2.33   0.55   0.56   0.56   0.51   11.34   4.00   5   5   5   3   5     Fidie   Beuracan   5.6   3.40   0.16   21   1.90   0.52   0.60   0.46   10.22   3.48   5   6   7   5   34     Acch Ultara   Pase Kiri   5.7   3.87   0.17   21   2.74   0.52   0.60   0.55   11.25   3.80   4   4   3   4   34     Acch Ultara   Pase Kiri   5.7   3.87   0.17   21   2.74   0.52   0.60   0.50   12.90   4.36   4   5   2.8   4   34     Acch Ultara   Pase Kiri   5.7   3.87   0.17   23   2.30   0.50   0.50   0.50   11.34   3.80   4   4   3   4   34     Acch Ultara   Pase Kiri   5.7   3.87   0.17   23   2.30   0.50   0.50   0.50   11.34   3.80   4   4   3   4   34     Singkii   Parakan Sulampi   5.0   3.12   0.17   18   2.47   0.48   0.61   0.50   12.12   4.06   4   5   16   4   33     Bireuen   Pate Lhong   5.9   3.74   0.16   22   2.08   0.59   0.55   0.85   12.12   4.06   4   5   16   4   33     Bireuen   Pate Lhong   5.6   3.78   0.25   15   2.8   0.50   0.50   0.50   11.34   3.30   4   6   5   5   3   3    Bireuen   Pate Lhong   5.6   3.78   0.25   15   2.8   0.50   0.50   0.50   11.34   3.90   4   6   5   5   3   3    Bireuen   Pate Lhong   5.6   3.78   0.25   15   2.20   0.56   0.51   0.55   12.01   3.82   5   4   6   5   5   3   3    Bireuen   Pate Lhong   5.6   3.78   0.25   15   2.20   0.56		- 00 0											4	7		8	
Pidie   Cubo Trienggading   5.4   2.40   0.11   22   1.90   0.62   0.60   0.66   10.01   3.78   6   6   7   7   38     Pidie   Cubo Trienggading   6.0   2.45   0.15   16   2.12   0.19   0.59   0.76   10.01   3.66   2   6   3   8   37     Bireuen   Peudada   5.9   4.47   0.26   17   3.00   0.56   0.46   0.53   12.46   4.55   4   4   7   4   37     Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.56   0.46   0.53   12.46   4.55   4   4   4   4   4   37     Bireuen   Samalanga   5.9   3.32   0.19   17   2.50   0.61   0.45   0.55   11.55   4.11   5   4   5   5   5   36     Aceh Ulara   Pase Kiri   5.6   2.87   0.17   17   2.33   0.55   0.56   0.56   0.56   11.34   4.00   5   5   3   5   35     Pidie   Beuracan   5.6   3.40   0.16   21   1.90   0.52   0.60   0.46   10.22   3.48   5   6   7   5   34     Sighil   Sidorejo   5.0   3.55   0.17   21   2.74   0.52   0.60   0.50   11.20   3.48   5   6   7   5   34     Singkil   Parakan Sulampi   5.7   3.87   0.17   23   2.30   0.50   0.50   0.50   11.20   4.09   5   5   7   7   7   34     Aceh Ulara   Pase Kiri   5.7   3.87   0.17   23   2.30   0.50   0.50   0.50   11.15   3.81   4   6   5   5   33     Bireuen   Pate Lhong   5.9   4.01   0.16   22   2.08   0.50   0.50   0.50   11.15   3.81   4   6   5   5   33     Bireuen   Pate Lhong   5.7   4.01   0.16   22   2.08   0.52   0.66   0.53   11.84   3.79   4   6   4   4   3   4     Bireuen   Pate Lhong   5.5   3.47   0.16   22   2.08   0.52   0.66   0.53   11.84   3.79   4   6   4   4   3   4     Bireuen   Pate Lhong   5.5   3.47   0.16   22   2.08   0.52   0.66   0.51   11.55   3.81   4   6   5   5   32     Bireuen   Pate Lhong   5.5   3.47   0.16   22   2.08   0.52   0.66   0.51   0.55   12.04   3.82   5   4   6   5   5   32     Bireuen   Pate Lhong   5.5   3.47   0.16   20   2.00   0.56   0.51   0.55   12.04   3.82   5   4   5   5   5   32     Bireuen   Pate Lhong   5.5   3.40   0.21   16   1.90   0.60   0.70   0.55   12.04   3.82   5   4   5   5   5   32     Bireuen   Paya Nie   5.5   3.40   0.21   16   1.90   0.6	Bireuen	Samalanga	5.8	3.35			2.93	0.38	0.75	0.51		4.57	3	6	3	4	38
Pidie   Cubo Trienggading   6.0   2.45   0.15   16   2.12   0.19   0.59   0.76   10.01   3.66   2   6   3   8   37	Pidie		5.4	2.40	0.11	22		0.62	0.60	0.66	10.01	3.78	6	6	7	7	
Bireuen   Peudada   S.9   4.47   0.26   17   3.00   0.56   0.46   0.53   12.46   4.55   4   4   7   4   37	Pidie	00 0				16		0.19			10.01		2	6	3	8	37
Bireuen   Paya Nie   5.5   3.78   0.18   21   3.00   0.56   0.46   0.53   12.46   4.55   4   4   4   4   4   37		33 3															
Bireuen   Samalanga   5.9   3.32   0.19   17   2.50   0.61   0.45   0.55   11.55   4.11   5   4   5   5   36     Aceh Utara   Pase Kiri   5.6   2.87   0.17   17   2.33   0.55   0.56   0.56   0.56   11.34   4.00   5   5   3   5   35     Aceh Timur   Julok Tunong   5.9   2.76   0.15   18   1.93   0.51   0.55   0.95   11.20   3.94   5   5   5   5   8   35     Pidie   Beuracan   5.6   3.40   0.16   21   1.90   0.52   0.60   0.46   10.22   3.48   5   6   7   5   34     Aceh Timur   Julok Tunong   5.7   3.01   0.14   22   2.00   0.59   0.65   0.85   12.12   4.09   5   5   7   7   34     Aceh Utara   Pase Kiri   5.7   3.87   0.17   23   2.30   0.50   0.50   0.50   0.50   11.34   3.80   4   4   3   3   4   34     Singkil   Parakan Sulampi   5.0   3.12   0.17   18   2.47   0.48   0.61   0.50   12.12   4.06   4   5   16   4   33     Bireuen   Pate Lhong   5.9   4.01   0.16   25   2.08   0.50   0.71   0.52   1.155   3.81   4   6   5   5   3.3     Bireuen   Padada   5.4   4.00   0.19   21   2.00   0.54   0.76   0.63   12.24   3.93   4   6   5   5   3.3     Bireuen   Pate Lhong   5.6   2.99   0.20   15   2.20   0.56   0.51   0.55   12.01   3.82   5   4   6   5   5   3.2     Pidie   Beuracan   5.5   3.07   0.16   19   1.80   0.44   0.36   0.43   9.55   3.03   5   4   9   5   5   5   3.3     Bireuen   Pate Lhong   5.9   4.01   0.17   24   2.20   0.56   0.51   0.55   12.01   3.82   5   4   6   5   5   3.2     Bireuen   Pate Lhong   5.9   4.01   0.17   24   2.20   0.56   0.51   0.55   12.01   3.82   5   4   6   5   5   3.2     Pidie   Beuracan   5.5   3.07   0.16   19   1.80   0.44   0.36   0.43   9.55   3.03   5   4   9   5   3.2     Aceh Utara   Krueng Tuan   5.5   3.40   0.21   16   1.90   0.60   0.70   0.55   12.01   3.82   5   4   6   5   5   3.2     Aceh Utara   Krueng Tuan   5.5   3.40   0.21   16   1.90   0.60   0.70   0.56   0.51   0.55   12.01   3.82   5   4   6   5   5   3.2     Aceh Utara   Krueng Tuan   5.5   3.40   0.21   16   1.90   0.60   0.70   0.56   0.51   0.55   12.01   3.82   5   4   6   5   5   3.2     A															4	4	
Aceh Utara         Pase Kiri         5.6         2.87         0.17         17         2.33         0.55         0.56         0.56         11.34         4.00         5         5         3         5         35           Aceh Timur         Julok Tunong         5.9         2.76         0.15         18         1.93         0.51         0.55         0.95         11.20         3.94         5         5         5         5         8         35           Pidle         Beuracan         5.6         3.40         0.16         21         1.90         0.52         0.60         0.46         10.22         3.48         5         6         7         5         34           Singkil         Sidorejo         5.0         3.55         0.17         21         2.74         0.52         0.60         0.50         12.90         4.36         4         5         28         4         34           Aceh Utara         Pase Kiri         5.7         3.01         0.14         22         2.00         0.50         0.50         11.34         3.80         4         4         3         4         34           Singkil         Pasakan Sulampi         5.0         3.12		, ,															
Aceh Timur         Julok Tunong         5.9         2.76         0.15         18         1.93         0.51         0.55         0.95         11.20         3.94         5         5         5         8         35           Pidie         Beuracan         5.6         3.40         0.16         21         1.90         0.52         0.60         0.46         10.22         3.48         5         6         7         5         34           Singkil         Sidorejo         5.0         3.55         0.17         21         2.74         0.52         0.60         0.50         12.90         4.36         4         5         28         4         34           Aceh Utara         Pase Kiri         5.7         3.87         0.17         23         2.30         0.50         0.50         0.50         11.34         3.80         4         4         3         4         34           Aceh Utara         Pase Kiri         5.7         3.87         0.17         18         2.47         0.48         0.61         0.50         11.34         3.80         4         4         3         4         34           Singkil         Pate Lhong         5.9         4.01																	
Pidle   Beuracan																_	
Singkil         Sidorejo         5.0         3.55         0.17         21         2.74         0.52         0.60         0.50         12.90         4.36         4         5         28         4         34           Aceh Timur         Julok Tunong         5.7         3.01         0.14         22         2.00         0.59         0.65         0.85         12.12         4.09         5         5         7         7         34           Aceh Utara         Pase Kiri         5.7         3.87         0.17         23         2.30         0.50         0.50         0.50         4.06         4         4         3         4         34           Singkil         Parakan Sulampi         5.0         3.12         0.17         18         2.47         0.48         0.61         0.50         12.12         4.06         4         5         16         4         33           Bireuen         Pate Lhong         5.9         4.01         0.16         25         2.08         0.50         0.71         0.52         11.55         3.81         4         6         5         5         33           Aceh Utara         Krueng Tuan         5.6         3.78         0.25													_				
Aceh Timur         Julok Tunong         5.7         3.01         0.14         22         2.00         0.59         0.65         0.85         12.12         4.09         5         5         7         7         34           Aceh Utara         Pase Kiri         5.7         3.87         0.17         23         2.30         0.50         0.50         11.34         3.80         4         4         3         4         34           Singkil         Parakan Sulampi         5.0         3.12         0.17         18         2.47         0.48         0.61         0.50         12.12         4.06         4         5         16         4         33           Bireuen         Pate Lhong         5.9         4.01         0.16         25         2.08         0.50         0.71         0.52         11.55         3.81         4         6         5         5         33           Aceh Utara         Krueng Tuan         5.6         3.78         0.25         15         2.18         0.50         0.88         0.82         13.35         4.38         4         7         4         6         5         33           Bireuen         Paya Nie         5.3         3.47 <td></td> <td>28</td> <td></td> <td></td>															28		
Aceh Utara         Pase Kiri         5.7         3.87         0.17         23         2.30         0.50         0.50         11.34         3.80         4         4         3         4         34           Singkil         Parakan Sulampi         5.0         3.12         0.17         18         2.47         0.48         0.61         0.50         12.12         4.06         4         5         16         4         33           Bireuen         Pate Lhong         5.9         4.01         0.16         25         2.08         0.50         0.71         0.52         11.55         3.81         4         6         5         5         33           Aceh Utara         Krueng Tuan         5.6         3.78         0.25         15         2.18         0.50         0.88         0.82         13.35         4.38         4         7         4         6         5         5         3.3           Bireuen         Peudada         5.4         4.00         0.19         21         2.00         0.54         0.76         0.63         12.24         3.93         4         6         5         5         3.2           Bireuen         Paya Nie         5.6																	
Singkil         Parakan Sulampi         5.0         3.12         0.17         18         2.47         0.48         0.61         0.50         12.12         4.06         4         5         16         4         33           Bireuen         Pate Lhong         5.9         4.01         0.16         25         2.08         0.50         0.71         0.52         11.55         3.81         4         6         5         5         33           Aceh Utara         Krueng Tuan         5.6         3.78         0.25         15         2.18         0.50         0.88         0.82         13.35         4.38         4         7         4         6         53           Bireuen         Peudada         5.4         4.00         0.19         21         2.00         0.54         0.76         0.63         12.24         3.93         4         6         5         5         32           Bireuen         Paga Nie         5.3         3.47         0.16         22         2.08         0.52         0.66         0.53         11.84         3.79         4         6         4         4         32           Bireuen         Pate Lhong         5.5         3.07													_			4	
Bireuen         Pate Lhong         5.9         4.01         0.16         25         2.08         0.50         0.71         0.52         11.55         3.81         4         6         5         5         33           Aceh Utara         Krueng Tuan         5.6         3.78         0.25         15         2.18         0.50         0.88         0.82         13.35         4.38         4         7         4         6         33           Bireuen         Peudada         5.4         4.00         0.19         21         2.00         0.54         0.76         0.63         12.24         3.93         4         6         5         5         32           Bireuen         Paya Nie         5.3         3.47         0.16         22         2.08         0.52         0.66         0.53         11.84         3.79         4         6         4         4         32           Bireuen         Pate Lhong         5.6         2.99         0.20         15         2.20         0.56         0.51         0.55         12.01         3.82         5         4         6         5         32           Bireuen         Pate Lhong         5.9         4.01 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>4</td><td></td></t<>																4	
Aceh Utara         Krueng Tuan         5.6         3.78         0.25         15         2.18         0.50         0.88         0.82         13.35         4.38         4         7         4         6         33           Bireuen         Peudada         5.4         4.00         0.19         21         2.00         0.54         0.76         0.63         12.24         3.93         4         6         5         5         32           Bireuen         Paya Nie         5.3         3.47         0.16         22         2.08         0.52         0.66         0.53         11.84         3.79         4         6         4         4         32           Bireuen         Pate Lhong         5.6         2.99         0.20         15         2.20         0.56         0.51         0.55         12.01         3.82         5         4         6         5         32           Pidle         Beuracan         5.5         3.07         0.16         19         1.80         0.44         0.36         0.43         9.55         3.03         5         4         9         5         32           Bireuen         Pate Lhong         5.9         4.01         0.1													-			5	
Bireuen         Peudada         5.4         4.00         0.19         21         2.00         0.54         0.76         0.63         12.24         3.93         4         6         5         5         32           Bireuen         Paya Nie         5.3         3.47         0.16         22         2.08         0.52         0.66         0.53         11.84         3.79         4         6         4         4         32           Bireuen         Pate Lhong         5.6         2.99         0.20         15         2.20         0.56         0.51         0.55         12.01         3.82         5         4         6         5         32           Pidie         Beuracan         5.5         3.07         0.16         19         1.80         0.44         0.36         0.43         9.55         3.03         5         4         9         5         32           Bireuen         Pate Lhong         5.9         4.01         0.17         24         2.20         0.56         0.51         0.55         12.04         3.82         5         4         5         5         3.2           Aceh Utara         Krueng Tuan         5.6         3.14         0.		, ,															
Bireuen         Paya Nie         5.3         3.47         0.16         22         2.08         0.52         0.66         0.53         11.84         3.79         4         6         4         4         32           Bireuen         Pate Lhong         5.6         2.99         0.20         15         2.20         0.56         0.51         0.55         12.01         3.82         5         4         6         5         32           Pidle         Beuracan         5.5         3.07         0.16         19         1.80         0.44         0.36         0.43         9.55         3.03         5         4         9         5         32           Bireuen         Pate Lhong         5.9         4.01         0.17         24         2.20         0.56         0.51         0.55         12.04         3.82         5         4         9         5         32           Aceh Utara         Krueng Tuan         5.5         3.40         0.21         16         1.90         0.60         0.70         0.56         12.05         3.76         5         6         6         5         31           Bireuen         Paya Nie         5.6         3.14         0.						_								6			
Bireuen         Pate Lhong         5.6         2.99         0.20         15         2.20         0.56         0.51         0.55         12.01         3.82         5         4         6         5         32           Pidie         Beuracan         5.5         3.07         0.16         19         1.80         0.44         0.36         0.43         9.55         3.03         5         4         9         5         32           Bireuen         Pate Lhong         5.9         4.01         0.17         24         2.20         0.56         0.51         0.55         12.04         3.82         5         4         5         5         32           Aceh Utara         Krueng Tuan         5.5         3.40         0.21         16         1.90         0.60         0.70         0.56         12.05         3.76         5         6         6         5         31           Bireuen         Paya Nie         5.6         3.14         0.16         20         2.00         0.56         0.59         0.51         12.13         3.66         5         5         5         4         30           Aceh Jaya         Kr. Ateu         7.0         1.35																_	
Pidie         Beuracan         5.5         3.07         0.16         19         1.80         0.44         0.36         0.43         9.55         3.03         5         4         9         5         32           Bireuen         Pate Lhong         5.9         4.01         0.17         24         2.20         0.56         0.51         0.55         12.04         3.82         5         4         5         5         32           Aceh Utara         Krueng Tuan         5.5         3.40         0.21         16         1.90         0.60         0.70         0.56         12.05         3.76         5         6         6         5         31           Bireuen         Paya Nie         5.6         3.14         0.16         20         2.00         0.56         0.59         0.51         12.13         3.66         5         5         5         4         30           Aceh Jaya         Kr. Ateu         7.0         1.35         0.08         17         0.35         1.52         0.23         0.77         10.81         2.87         14         2         2         7         27           Singkil         Sidorejo         5.0         3.77         0		,															
Bireuen         Pate Lhong         5.9         4.01         0.17         24         2.20         0.56         0.51         0.55         12.04         3.82         5         4         5         5         32           Aceh Utara         Krueng Tuan         5.5         3.40         0.21         16         1.90         0.60         0.70         0.56         12.05         3.76         5         6         6         5         31           Bireuen         Paya Nie         5.6         3.14         0.16         20         2.00         0.56         0.59         0.51         12.13         3.66         5         5         5         4         30           Aceh Jaya         Kr. Ateu         7.0         1.35         0.08         17         0.35         1.52         0.23         0.77         10.81         2.87         14         2         2         7         27           Singkil         Sidorejo         5.0         3.77         0.19         20         2.00         0.57         0.66         0.54         18.90         3.77         3         3         17         3         20           Singkil         Tana Bara         4.6         5.06													_				
Aceh Utara         Krueng Tuan         5.5         3.40         0.21         16         1.90         0.60         0.70         0.56         12.05         3.76         5         6         6         5         31           Bireuen         Paya Nie         5.6         3.14         0.16         20         2.00         0.56         0.59         0.51         12.13         3.66         5         5         5         4         30           Aceh Jaya         Kr. Ateu         7.0         1.35         0.08         17         0.35         1.52         0.23         0.77         10.81         2.87         14         2         2         7         27           Singkil         Sidorejo         5.0         3.77         0.19         20         2.00         0.57         0.66         0.54         18.90         3.77         3         3         17         3         20           Singkil         Tana Bara         4.6         5.06         0.17         30         2.01         0.57         0.89         0.43         20.23         3.90         3         4         11         2         19           Singkil         Sidorejo         5.0         3.57         <													_				
Bireuen         Paya Nie         5.6         3.14         0.16         20         2.00         0.56         0.59         0.51         12.13         3.66         5         5         5         4         30           Aceh Jaya         Kr. Ateu         7.0         1.35         0.08         17         0.35         1.52         0.23         0.77         10.81         2.87         14         2         2         7         27           Singkil         Sidorejo         5.0         3.77         0.19         20         2.00         0.57         0.66         0.54         18.90         3.77         3         3         17         3         20           Singkil         Tana Bara         4.6         5.06         0.17         30         2.01         0.57         0.89         0.43         20.23         3.90         3         4         11         2         19           Singkil         Sidorejo         5.0         3.57         0.16         22         2.14         0.56         0.56         0.42         20.33         3.68         3         3         21         2         18           Singkil         Sidorejo         5.2         3.50         0.													-				
Aceh Jaya         Kr. Ateu         7.0         1.35         0.08         17         0.35         1.52         0.23         0.77         10.81         2.87         14         2         2         7         27           Singkil         Sidorejo         5.0         3.77         0.19         20         2.00         0.57         0.66         0.54         18.90         3.77         3         3         17         3         20           Singkil         Tana Bara         4.6         5.06         0.17         30         2.01         0.57         0.89         0.43         20.23         3.90         3         4         11         2         19           Singkil         Sidorejo         5.0         3.57         0.16         22         2.14         0.56         0.56         0.42         20.33         3.68         3         3         21         2         18           Singkil         Sidorejo         5.2         3.50         0.18         19         1.65         0.56         0.76         0.55         22.15         3.52         3         3         14         2         16																	
Singkil         Sidorejo         5.0         3.77         0.19         20         2.00         0.57         0.66         0.54         18.90         3.77         3         3         17         3         20           Singkil         Tana Bara         4.6         5.06         0.17         30         2.01         0.57         0.89         0.43         20.23         3.90         3         4         11         2         19           Singkil         Sidorejo         5.0         3.57         0.16         22         2.14         0.56         0.56         0.42         20.33         3.68         3         3         21         2         18           Singkil         Sidorejo         5.2         3.50         0.18         19         1.65         0.56         0.76         0.55         22.15         3.52         3         3         14         2         16		, ,											-	_			
Singkil         Tana Bara         4.6         5.06         0.17         30         2.01         0.57         0.89         0.43         20.23         3.90         3         4         11         2         19           Singkil         Sidorejo         5.0         3.57         0.16         22         2.14         0.56         0.56         0.42         20.33         3.68         3         3         21         2         18           Singkil         Sidorejo         5.2         3.50         0.18         19         1.65         0.56         0.76         0.55         22.15         3.52         3         3         14         2         16																	
Singkil         Sidorejo         5.0         3.57         0.16         22         2.14         0.56         0.56         0.42         20.33         3.68         3         3         21         2         18           Singkil         Sidorejo         5.2         3.50         0.18         19         1.65         0.56         0.76         0.55         22.15         3.52         3         3         14         2         16		,		-													
Singkil         Sidorejo         5.2         3.50         0.18         19         1.65         0.56         0.76         0.55         22.15         3.52         3         3         14         2         16																	
																_	
- SILLIKII - ETALIA 1987 -	Singkil	Tana Bara	4.5	4.44	0.10	26	2.22	0.57	0.76	0.33	24.23	3.85	2	3	9	2	16

Table 3.6 was compiled to try and get some idea of the location of these apparently rather infertile soils. As can be seen, in Table 3.7 most of the sites are found on the north or east coasts with infertile soils in all but Aceh Besar.

Table 3.6 Poor Inherent Fertility by Kabupaten and Scheme

Kabupaten	Scheme	Site	pН	Org C	Total N	C:N			Me	1	100g		Mg	K	Al	Na	BS
		No	H2O	%	%		Ca	Mg	K	Na	CEC	TEB	Sat%	Sat%	Sat%	Sat%	%
Aceh Jaya	Alue Monmata	MD 2	5.5	2.77	0.12	23	2.73	0.70	0.55	0.86	11.13	4.84	6	5	8	8	44
Aceh Jaya	Kreung Tunong	KTG1	7.0	1.34	0.15	9	9.02	1.52	1.23	2.94	36.13	14.71	4	3	0	8	41
Aceh Jaya	Krreung Ateu	KA A5	7.0	1.35	0.08	17	0.35	1.52	0.23	0.77	10.81	2.87	14	2	2	7	27
Aceh Timur	Julok Tunong	JT B2	5.9	2.76	0.15	18	1.93	0.51	0.55	0.95	11.20	3.94	5	5	5	8	35
Aceh Timur	Julok Tunong	JT B7	5.7	3.01	0.14	22	2.00	0.59	0.65	0.85	12.12	4.09	5	5	7	7	34
Aceh Utara	Krueng Tuan	BK6	5.5	3.40	0.21	16	1.90	0.60	0.70	0.56	12.05	3.76	5	6	6	5	31
Aceh Utara	Krueng Tuan	BK7	5.6	3.78	0.25	15	2.18	0.50	0.88	0.82	13.35	4.38	4	7	4	6	33
Aceh Utara	Krueng Tuan	BKB7	5.5	3.08	0.19	16	2.08	0.50	0.81	0.95	11.25	4.34	4	7	4	8	39
Aceh Utara	Pase Kanan	PKM B5	5.9	3.45	0.19	18	0.59	3.00	0.56	0.59	11.00	4.74	27	5	5	5	43
Aceh Utara	Pase Kanan	PKNI	6.0	2.78	0.18	15	2.99	0.40	0.55	0.67	10.21	4.61	4	5	5	7	45
Aceh Utara	Pase Kiri	PKR A3	5.7	3.87	0.17	23	2.30	0.50	0.50	0.50	11.34	3.80	4	4	3	4	34
Aceh Utara	Pase Kiri	PKR B4	5.6	2.87	0.17	17	2.33	0.55	0.56	0.56	11.34	4.00	5	5	3	5	35
Aceh Utara	Pase Kiri	PKR B5	6.0	3.23	0.22	15	2.64	0.61	0.57	0.59	9.52	4.41	6	6	7	6	46
Bireuen	Pandrah	PD 1	5.6	4.78	0.22	22	3.88	0.59	0.31	0.62	12.33	5.40	5	3	5	5	44
Bireuen	Pate Lhong	PL 1	5.9	4.01	0.16	25	2.08	0.50	0.71	0.52	11.55	3.81	4	6	5	5	33
Bireuen	Pate Lhong	PL 13	5.6	2.99	0.20	15	2.20	0.56	0.51	0.55	12.01	3.82	5	4	6	5	32
Bireuen	Pate Lhong	PL13	6.0	3.47	0.17	20	2.80	0.49	0.56	0.63	10.14	4.48	5	6	5	6	44
Bireuen	Pate Lhong	PL2	5.9	4.01	0.17	24	2.20	0.56	0.51	0.55	12.04	3.82	5	4	5	5	32
Bireuen	Paya Nie	PN 1	5.5	3.78	0.18	21	3.00	0.56	0.46	0.53	12.46	4.55	4	4	4	4	37
Bireuen	Paya Nie	PYN 2	5.3	3.47	0.16	22	2.08	0.52	0.66	0.53	11.84	3.79	4	6	4	4	32
Bireuen	Paya Nie	PYN 2	5.6	3.14	0.16	20	2.00	0.56	0.59	0.51	12.13	3.66	5	5	5	4	30
Bireuen	Peudada	PAD 25	5.4	4.00	0.19	21	2.00	0.54	0.76	0.63	12.24	3.93	4	6	5	5	32
Bireuen	Peudada	PAD D3	5.9	4.47	0.26	17	3.00	0.56	0.46	0.53	12.46	4.55	4	4	7	4	37
Bireuen	Samalanga	S6	5.9	3.32	0.19	17	2.50	0.61	0.45	0.55	11.55	4.11	5	4	5	5	36
Bireuen	Samalanga	S7	5.8	3.35	0.20	17	2.93	0.38	0.75	0.51	12.09	4.57	3	6	3	4	38
Pidie	Beuracan	Be C2 mix	5.5	3.07	0.16	19	1.80	0.44	0.36	0.43	9.55	3.03	5	4	9	5	32
Pidie	Beuracan	Be E2	5.6	3.40	0.16	21	1.90	0.52	0.60	0.46	10.22	3.48	5	6	7	5	34
Pidie	Beuracan	BE F3 mix	6.1	2.12	0.12	18	2.87	0.17	0.61	0.99	10.23	4.64	2	6	4	10	45
Pidie	Beuracan	Beuracan I	5.9	3.78	0.12	32	2.88	0.55	0.71	0.62	10.99	4.76	5	6	4	6	43
Pidie	Cubo Trienggading	CT C1 mix	5.4	2.40	0.11	22	1.90	0.62	0.60	0.66	10.01	3.78	6	6	7	7	38
Pidie	Cubo Trienggading	CT I1 mix	5.9	2.78	0.25	11	2.18	0.55	0.81	0.92	11.33	4.46	5	7	5	8	39
Pidie	Cubo Trienggading	CTA3 mix	6.0	2.45	0.15	16	2.12	0.19	0.59	0.76	10.01	3.66	2	6	3	8	37
Singkil	Parakan Sulampi	PS 1	5.0	3.12	0.17	18	2.47	0.48	0.61	0.50	12.12	4.06	4	5	16	4	33
Singkil	Sidorejo	SD A1	5.2	3.50	0.18	19	1.65	0.56	0.76	0.55	22.15	3.52	3	3	14	2	16
Singkil	Sidorejo	SD A1	5.0	3.57	0.16	22	2.14	0.56	0.56	0.42	20.33	3.68	3	3	21	2	18
Singkil	Sidorejo	SD B1	5.0	3.55	0.17	21	2.74	0.52	0.60	0.50	12.90	4.36	4	5	28	4	34
Singkil	Sidorejo	SD B1	5.0	3.77	0.19	20	2.00	0.57	0.66	0.54	18.90	3.77	3	3	17	3	20
Singkil	Tana Bara	TB 1	4.6	5.06	0.17	30	2.01	0.57	0.89	0.43	20.23	3.90	3	4	11	2	19
Singkil	Tana Bara	TB 2	4.5	4.44	0.17	26	2.22	0.57	0.66	0.40	24.23	3.85	2	3	9	2	16
Singkil	Ujung Bawang	IUB 1	5.9	4.00	0.19	21	2.88	0.57	0.71	0.62	10.29	4.78	6	7	9	6	46

**Table 3.7 Location of the More Infertile Mineral Soils** 

Kabupaten	Scheme	Infertile Samples	Infertile Samples in Kabupaten	Number of Mineral Soils Analysed by Kabupaten	% of Total Samples with Noted Deficiencies
Bireuen	Pate Lhong	4	12	13	92
	Paya Nie	3			
	Peudada	2			
	Samalanga	2			
	Pandrah	1			
Aceh Utara	Krueng Tuan	3	8	13	62
	Pase Kiri	3			
	Pase Kanan	2			
Singkil	Siderojo	4	8	9	89
•	Tana Bara	2			
	Parakan Sulampi	1			
	Ujung Bawang	1			
Pidie	Beuracan	4	7	8	88
	Cubo	3			
	Trienggading				
Aceh Jaya	Alue Monmata	1	3	107	2.8
•	Kreung Tunong	1			
	Kreung Ateu	1			
Aceh Timur	Julok Tunong	2	2	2	100
Aceh Besar		0		38	0

As most intensive irrigated agriculture exists on the north or east coast it is possible that this is the reason for the lower fertility level and most of the nutrients have been extracted by cropping and hence depleted. However, it is just possible that since the north and east coast received a less violent flood and that flood was often trapped for longer on the land more

nutrients were leached out by the sea water. Whatever the cause or explanation of the "lower" fertility of these soils special attention must be paid to ensuring that adequate amounts of the appropriate fertilisers are employed as amendments to help get the soils back into agricultural production.

One nutrient that was not checked via soil analyses is phosphorus, neither Available-P nor Total-P was determined in the laboratory studies. However, most reports from farmers and field staff are that when the soil has apparently recovered there is vigorous vegetative growth – this could be an indication that levels of soil phosphorus are adequate since phosphorus is mainly responsible for root growth. However, reports from the field then indicate that after the vigorous vegetative grow there is no grain filling or fruit production – this is not likely to be due to lack of phosphorus but due to some of the possible deficiencies reported above. However, if after correcting the indicated deficiencies crops still fail to produce grain or fruit the possibility of micro-nutrient deficiencies should be investigated.

## 3.4.2 Use of Exchangeable Cation Ratios

In the data listed in Table 3.6 two features show relatively strongly – low levels of exchangeable calcium and magnesium. To further check this the Ca:Mg and Mg:K ratios, as defined by FAO, have been studied as a check on the possible deficiencies of either or both calcium and / or magnesium. The output of this study is presented in a series of tables in Appendix C and summarised in Table 3.8.

Table 3.8 Deficiencies in Min	eral	S	oils	by	/ Ka	bupaten
						Number

			Number	of Sample				
Deficiency	Aceh Jaya	Aceh Besar	Bireuen	Aceh Utara	Pidie	Singkil	Aceh Timur	Totals
Calcium	1	2		1	1			5
Slight calcium	4	2		3		1		10
Magnesium	3	1	8	6	4	4	2	28
Magnesium + possible Phosphorus	37	10	1	1	2			51
Slight magnesium	49	14	4	2	1	3		73
Potassium		3						3
Totals	94	32	13	13	8	8	2	170
Ratio of total samples	88%	84%	100%	100%	100%	89%	100%	87%

Tables 3.7 and 3.8 cannot be directly compared since 3.8 lists all the samples from the sites displaying some indication of a nutrient deficiency whilst 3.7 lists the most infertile samples from the various sites. However, study of the two tables makes it clear that there are nutrient deficiency problems in virtually all of the soil samples analysed with an overall 87% of the mineral samples indicating some deficiency.

The major plant nutrient that "triggers" a deficiency signal in most cases is magnesium and it is obvious that this possible problem must be addressed. Further soil sampling and laboratory analyses should be carried out and farmer field trials testing various applications of magnesium bearing fertilisers and composts should be designed and setup. A good research agronomist should be consulted in the design and there must be full integration with Dinas Pertanian staff in any such trials.

Although soil phosphorus (Avail-P) was not included in the soil analyses programme the ratio of Ca:Mg does often pinpoint a possible problem due to soil phosphorus being inhibited. There are over 50 samples where this has happened and the possibility of has been "flagged" and a deficiency of Avail-p should be considered. The explanation for or cause of inhibition of "P" is normally due to high levels of free carbonate in the soil when calcium phosphate forms and this compound is rather insoluble and hence the "P" becomes unavailable for plant growth. No data on free CaCO<sub>3</sub> levels in the soils are available but it is just vaguely possible that this possible deficiency occurs in areas with limestone geology. At this time the resources are just not available to check if this is the case or even possible. However, it is suspected that this "trigger" has activated simply because the magnesium level is so low in comparison to the calcium level – it is 20% lower than in the normal magnesium deficient samples.

#### 3.5 Micro-Nutrients

Unfortunately, no micro-nutrient analyses were conducted on the samples under study and, with the lack of any obvious reasons for the failure of some soils to produce yields after showing strong vegetative growth, it must be considered a possibility that there might be some micro-nutrient deficiency.

However, a literature search suggested that micro-nutrient deficiency is rare when soil reaction is neutral to acidic – that is with pH <7 and, since the bulk of the soil samples tested have pH in this range, deficiency would not be expected. Availability is normally reduced when soil pH >8.0.

One phenomenon that has been raised in the tsunami area is that of rice showing strong vegetative growth then failing to produce a yield at all or only a much reduced yield. In a private communication (C.J.Hatten) ETESP was advised of a

similar happening on peat soils used for padi and the reason was eventually established as due to micro-nutrient deficiency, notably copper. It is emphasised that this was on peat soils but the possibility of a deficiency should be investigated on the mineral soils in the NAD area since copper deficiency can be exacerbated by:

- Sandy soil textures naturally have low levels of all nutrients
- High iron levels can induce copper deficiency
- High zinc levels
- · High Organic content, and
- High levels of soil phosphorus reduces concentration of copper in roots and leaves and heavy application of phosphate fertilisers can induce copper deficiency

Sand contents of the NAD soils have, in many places, been increased by sandy sediment addition, ferrous iron levels are generally quite high, organic contents are relatively high in some soils but no data are available on zinc or phosphorus levels.

Micro-nutrient levels are better investigated via foliar analysis since there are so many interacting factors involved in the soil which can affect levels. For example, it is indicated that soil copper level is possibly affected by Nitrogen, Iron, Magnesium, Molybdenum, Phosphorus and Zinc. Also, soil deficiency levels are quoted in literature as ranging from 0.2 – 100 ppm depending on the extraction method used. Indicative ranges for foliar levels are much better documented and the following concentrations of copper would be expected in mature leaves:

<4 ppm - deficient</li>5 - 20 ppm - sufficient

>20 - excessive or toxic

## 3.6 Organic Soil Samples

#### 3.6.1 Introduction

Study of the laboratory data for the peat soil samples actually reveals very little useful information as compared to the study of the mineral soil data. Several factors were plotted against each other but no or very few meaningful relationships were seen or imagined and hence very little data is presented in this section.

The peat soil samples were located in irrigation schemes in two kabupaten only – Singkil and Aceh Jaya with one scheme in Singkil and four in Aceh Jaya. Two tables are presented below:

- Table 3.9 presents the salinity and acidity data for the peat soils, whilst
- Table 3.10 presents the fertility data

## 3.6.2 Peat Soil Features

Data for the peat samples is presented in Tables 3.9 and 3.10; all the samples described as peat in origin are:

- Non-saline and non-sodic
- Strongly, very strongly and extremely acidic in reaction with pH ranging from 5.10 to 3.00
- Many of the samples have low level of Exchangeable-H<sup>+</sup> (<0.5 me/100g) three are moderately high (>0.5 and <2.0 me/100g) though one sample is coded as moderately high (colour code blue) and three are colour coded red with high levels (>5 me/100g)
- As would be expected in organic soils the exchangeable aluminium levels are not particularly high with five samples
  having moderate level (blue) and only two noted as having high level (red)r
- Four samples have extremely high levels of ferrous iron (blue) and three samples are considered to have what would be toxic levels of iron (red)
- Levels of sulphate are generally moderate to high but one sample is noted as having high level (blue) and two samples are considered to contain toxic levels (red)

The fertility status of peats soils is never easy to assess since there can be relatively high levels of several nutrients but features such as acidity render the soil an unsuitable medium for the growth of many plants.

- Organic carbon levels are high to very high and are coded blue and red respectively
- Over half the samples have low levels of nitrogen (blue code) whilst most of the others fall into the moderate class
- Due to the high organic levels more than half of the samples have unacceptable C:N ratios
- Generally levels of the exchangeable cations calcium and magnesium are low to very low and two samples also have low level of potassium
- Over half of the samples have low levels of total exchangeable bases (TEB) and generally the inherent fertility of the peat soils is extremely low with several base saturation (BS) levels below 35% (red) but three samples show normal BS levels of 79 – 83%

Austi

Table 3.9 Salinity and Acidity Data for the peat Soil Samples

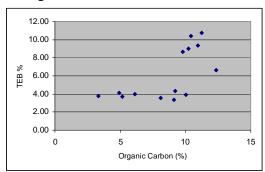
Kabupaten	Scheme	Site	EC	pН	pН	pН			Fe	$SO_4$
				•		•	Exchan	geable		
	/ Desa	No	dS/m	H2O	KCI	diff	Н	Al	ppm	ppm
Singkil	Ujung Bawang	UB A4	1.05	4.30	4.00	0.30	0.35	1.55	320	360
Singkil	Ujung Bawang	UB A4	0.76	4.00	3.40	0.60	0.23	2.55	144	289
Singkil	Ujung Bawang	UB B5	1.05	4.30	4.00	0.30	0.35	2.12	251	368
Aceh Jaya	Alue Monmata	MO2 (PAM2)	0.30	5.10	4.30	0.80	0.13	0.26	23	74
Aceh Jaya	Kulam Asan	LBG1	0.34	4.00	3.60	0.40	4.04	0.56	8	140
Aceh Jaya	Rawa Krueng Itam	Gambut KH12	0.47	4.30	3.70	0.60	0.70	0.93	681	3534
Aceh Jaya	Rawa Krueng Itam	Gambut KH7	1.72	4.50	3.90	0.60	0.65	0.75	707	232
Aceh Jaya	Rawa Krueng Itam	KH12	0.30	4.00	3.50	0.50	5.19	0.30	55	200
Aceh Jaya	Seneubok Padang	Gambut RK 1	1.44	4.00	3.10	0.90	0.37	0.86	272	1466
Aceh Jaya	Seneubok Padang	Gambut SP C1	3.00	3.00	2.30	0.70	0.49	0.93	780	7198
Aceh Jaya	Seneubok Padang	SP 0 - 70 peat	1.18	4.10	3.50	0.60	0.80	0.24	232	829
Aceh Jaya	Seneubok Padang	SPC2 peat	0.40	4.10	3.50	0.60	5.42	0.22	23	321
Aceh Jaya	Seneubok Padang	SPJ2	0.35	4.10	3.40	0.70	6.22	0.32	76	126

As stated earlier no meaningful correlations could be established between the various data-items for the peat soils.

The best near-correlation was between organic matter level and the total exchangeable bases (TEB); this is shown in Figure 3.6.

Basically most of the samples show a straight / level line relationship but six samples do show an increase in TEB with percentage of organic matter.

Figure 3.6 Organic Carbon versus TEB for Peat Soils



**Table 3.10 Fertility Data for the Peat Soil Samples** 

Kabupaten	Scheme	Site	Org C	Total N	C:N	meq / 100	meq / 100	meq	meq	meq / 100	meq / 100	BS
				IN		7 100	7 100	100g	100	100	7 100	
		No	%	%		Ca	Mg	ĸ	Na	CEC	TEB	%
Singkil	Ujung Bawang	UB A4	10.01	0.18	56	2.00	0.59	0.89	0.43	30.33	3.91	13
Singkil	Ujung Bawang	UB A4	9.12	0.17	54	1.89	0.51	0.44	0.50	24.66	3.34	14
Singkil	Ujung Bawang	UB B5	8.12	0.19	43	1.99	0.59	0.67	0.34	42.76	3.59	8
Aceh Jaya	Alue Monmata	MO2 (PAM2)	12.34	0.22	56	4.76	1.30	0.39	0.19	22.49	6.64	30
Aceh Jaya	Kulam Asan	LBG1	4.90	0.15	33	2.12	0.67	0.57	0.77	24.21	4.13	17
Aceh Jaya	Rawa Krueng Itam	Gambut KH12	9.78	0.63	16	6.22	0.85	0.30	1.26	18.21	8.63	47
Aceh Jaya	Rawa Krueng Itam	Gambut KH7	10.93	0.65	17	7.06	1.00	0.40	0.91	18.85	9.37	50
Aceh Jaya	Rawa Krueng Itam	KH12	9.22	0.14	66	2.23	0.72	0.73	0.67	30.22	4.35	14
Aceh Jaya	Seneubok Padang	Gambut RK 1	11.26	0.66	17	6.56	2.24	0.78	1.13	13.64	10.71	79
Aceh Jaya	Seneubok Padang	Gambut SP C1	10.22	0.63	16	4.82	2.43	0.23	1.55	10.84	9.03	83
Aceh Jaya	Seneubok Padang	SP 0 - 70 peat	10.41	0.64	16	6.29	2.45	0.28	1.35	13.08	10.37	79
Aceh Jaya	Seneubok Padang	SPC2 peat	6.12	0.12	51	2.04	0.78	0.57	0.58	24.35	3.97	16
Aceh Jaya	Seneubok Padang	SPJ2	5.14	0.18	29	2.05	0.55	0.56	0.51	20.31	3.67	18

## 4. CONCLUSIONS and RECOMMENDATIONS

## 4.1 Soil Salinity

As stated in the original ETESP Labdata report it would appear as though the soils of Aceh Utara were more heavily salinised than the other areas with an overall average EC (Electrical Conductivity) value of almost 2.3 dS/m whilst Singkil was the least effected with an average of just over 0.8 dS/m. This is a direct north south relationship and the level of precipitation is the most likely explanation. Aceh Utara, at the eastern end of the north coast has annual precipitation of about 1,365 mm (ETESP Report "Annual & Monthly Rainfall", October 2005) whilst Aceh Singkil has about double that amount since it is located south of Aceh Barat Daya (3,300 mm) and in line with Simeulue (3,000+ mm) However, the important thing is that the salinities are negligible and no or very little lasting effect on the land should ensue – <u>assuming there is active soil drainage</u> and either <u>very high rainfall and / or irrigation water to leach the salts</u> out of the soil and into the drainage system, which would then remove the saline leachate from the site (ETESP "Executive Summary", December 2005).

Before any plans are made to install reclamation programmes it needs to be established just when the samples were taken for measurement of salinity. Recent work ("Executive Summary" 205) by ETESP in Aceh Besar, Pidie and Bireuen has shown that the salinity status of many soils has changed in the year following the tsunami – some have become more saline whilst others have reduced through leaching and the presence of even minimal drainage system. In the individual summaries of the schemes in the original ETESP "Labdata" report (ETESP March 2005) it is stated that salinity needs to be re-measured after any civil engineering works to rehabilitate or build new irrigation and drainage systems. Any reclamation leaching would then be designed based on the most recent data available. The likelihood is that well managed water application under normal irrigation will remove the residual salinity and no programme of reclamation leaching will be required except in areas have become significantly more saline since the samples were taken by Lotti; such sites could be found in then situation as described as Scenario 4 in ETESP Scenarios update March 2006.

No further study of salinity has been done in this current report.

Table 4.1 Overall Salinity in the Areas Studied - decreasing sort order

	ACEH UTARA	BIREUEN	ACEH JAYA	ACEH TIMUR	PIDIE	ACEH BESAR	SINGKIL
Salinity	2.28 dS/m	2.01 dS/m	1.64 dS/m	1.31 dS/m	1.06 dS/m	0.99 dS/m	0.8.2 dS/m
Salinity Class	SC1 Very slightly saline	SC1 Very slightly saline	SC1 Non-saline	SC1 Non-saline	SC1 Non-saline	SC1 Non-saline	SC1 Non-saline
Rainfall	1,365	1,613	2,649	2,222	1,889	1,668	3,000+
Irrigation	Little	Fairly extensive	Little	Little	Fairly extensive	Little	No

Note: SC – Salinity Class, refer ETESP Soil Salinity & Improvement Mobilisation Report, November 2005

Note: The salinity figures refer to areas inundated by the tsunami and subject of salinity survey

## 4.2 Soil Sodicity

There does not seem to be a soil sodicity problem since <u>only about 10 - 11%</u> of the mineral soil samples collected in the irrigation schemes study proved to be 'sodic' – that is with ESP (Exchangeable Sodium Percent) >15%. One scheme which may have a problem is <u>Kreung Ateu in Aceh Jaya</u> since it proved to have several sites with sodic soils. The distribution of ESP levels is shown in Table 4.2 which is sorted in increasing number of sites sampled.

**Table 4.2 Distribution of ESP Levels of Mineral Soils** 

Kabupaten	Non-sodic		Very Slightly Sodic		Slightly Sodic		Sodic		Total samples	% of Total Samples in
	ESP <5%		ESP 5 – 9%		ESP 10 – 15%		ESP 15 – 20%			Kabupaten
	No	%	No	%	No	%	No	%		
Aceh Timur	0	0	2	100	0	0	0	0	2	1
Singkil	7	88	1	13	0	0	0	0	8	5
Pidie	0	0	8	89	1	11	0	0	9	5
Aceh Utara	1	8	12	92	0	0	0	0	13	8
Bireuen	5	38	7	54	0	0	1	8	13	8
Aceh Besar	0	0	13	41	13	41	6	19	32	19
Aceh Jaya	1	1	33	35	48	51	12	13	94	55

Austi

Aceh Timur, Singkil, Pidie and Aceh Utara show no sodic samples at all though Pidie and Aceh Utara have a few of the sites with very slight or low levels of ESP. Bireuen has one sodic site with the rest showing very low levels of ESP. Aceh Besar and Aceh Jaya have 19 and 13% respectively of the sampled sites noted as sodic whilst over 60% of the samples taken in these areas have ESP levels greater than 10%.

Only four of the sites were saline-sodic and normal, well managed irrigated agriculture with adequate leaching fraction should overcome the problem without any need for special amendments. The other sodic sites could prove to be slightly more difficult to reclaim since they are classified as non-saline sodic and care should be taken to ensure that the situation is not made worse by totally leaching out the residual salinity without addition of sources of calcium, or magnesium, to replace the sodium. The normal amendment would be the incorporation of gypsum (CaSO<sub>4</sub>) into the soil before leaching. In the worst case scenario soil dispersion could occur if all the basic cations of calcium and magnesium are leached out and replaced with sodium but this is most unlikely in the existing situation.

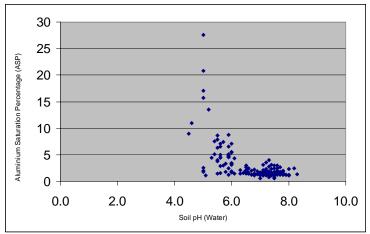
## 4.3 Soil Acidity

There is not a large soil acidity problem in the mineral soils investigated and, as shown in Figure 4.1 there are not many samples where soil reaction fell below about pH 5.5.

The norm is that aluminium saturation percentage (ASP) increases dramatically in mineral soils when the soil pH (water) falls to about 5.5. As can be seen in Figure 4.1, this relationship holds true for the data being examined since the ASP increases from around 5% up to about 28% once pH falls below 6, but the number of samples where this happens is very few.

Very high values of ASP were not encountered and though the value of 28% is rated as "high" only 6 samples out of the total exceed ASP of 10%.

Figure 4.1 Soil pH (water) Versus ASP- Mineral Soils



Only 3.6% of the total mineral soil samples have an ASP level of moderate or worse - 10% ASP being the lower limit of the moderate class of ASP. This indicates that there is NOT a problem with exchangeable aluminium in the mineral soils, which would be expected since these soils are basically non-hill soils, normally flooded and used for padi cultivation. The relatively low number of low pH (acidic) soils, plus no correlation between soil pH and sulphate levels, suggests that overall there is not an overall acidity problem.

## 4.4 Soil Fertility

Inherent, or existing, soil fertility is the natural fertility of the soil as it is found in the field before any amendments, in the form of fertilisers or manures, are added and it is determined from the laboratory analyses as reported by Lotti by using the base saturation (BS%). Inherent fertility must not be confused with fertility potential or how well the soil can hold any added nutrients – fertility potential is assessed using the cation exchange capacity (CEC).

For the purposes of this exercise soil samples with a BS of less than 50% are considered to have poor inherent fertility, if BS is less than 35% the status is noted as very poor and basically only the soil with poor and very poor inherent fertility soils are discussed here.

There do seem to be fertility problems with the soils investigated – mineral and peat soils. Of the 190 odd samples of mineral soil analysed 40 of them indicate soils with poor or very poor inherent fertility. The infertility problem appears to be worst along the north coast but much less so in Aceh Jaya on the west coast. Of the soils sampled in Aceh Timur 100% were infertile, 92% in Bireuen, followed by Pidie 88%, and Aceh Utara 62%. In Aceh Singkil on the lower west coast 89% of samples were infertile.

The reason for the various infertilities has not been established but the following possibilities are presented for consideration:

- Through over-use and inadequate fertilisation / manuring the soil nutrient levels in the most heavily exploited soils could have been depleted – if this is the case carefully designed fertiliser packages have to be compiled and applied
- The soils might always have had poor inherent fertility level and could be associated with the parent material from which the soils were formed. Study of the geological map might give some clues to the pattern as might study of any archival soil data that can be located
- Lower inherent fertility is more easily explained in the very high rainfall areas since the high level of precipitation tends to leach-out the more soluble nutrients leaving the soils infertile

Overall the more infertile mineral soils had the following features:

- <u>Soil reaction or pH</u> very strongly and extremely acid soil reaction, about 50% of the low inherent fertility soils have acidity problems
- <u>Organic-C</u> (organic matter) the organic matter content of these suspect soils would appear to be normal with no samples having low / very low or excessively high levels of organic carbon
- <u>Total-N</u> (Nitrogen) virtually all of the inherently infertile soils have low level of total nitrogen but only one sample has a very low level. Obviously all of these soils require nitrogenous fertiliser either mineral or via composts
- <u>C:N ratio</u> the low levels of nitrogen reported are reflected in the poor C:N ratio and, again, this will be improved with addition of nitrogenous material
- <u>Exchangeable Calcium</u> most of the samples show low levels of exchangeable calcium and a few show very low levels. Addition of superphosphate fertiliser would add calcium as would organic manures and liming materials or gypsum. Gypsum might be added in some cases if the soil required "cleaning-up" and the removal of sodium from the exchange complex
- <u>Exchangeable Magnesium</u> virtually every sample in this subset shows low to very low levels of exchangeable magnesium. Magnesium could be added as a magnesium-rich mineral fertiliser or supplied via the application of dolomitic limestone if an amendment for acidity has to be applied
- <u>Exchangeable Potassium</u> levels of this nutrient appear to be acceptable and no specific requirement can be seen for any special fertiliser application
- <u>Exchangeable Sodium</u> none of the samples show low or very low levels of exchangeable sodium, which is to be expected in the present situation post-tsunami. However, one or two samples do contain high to very high levels
- <u>Cation Exchange capacity (CEC)</u> this is included to allow cross checking but CEC does not come into the inherent fertility scenario. However, if the low inherent fertility soils have low or very low CEC improving their fertility status is more difficult as added nutrients can be easily lost via leaching from irrigation or rainfall
- <u>Total Exchangeable Bases (TEB)</u> this is the sum of Exch-Ca, Exch-Mg, Exch-K plus Exch-Na and virtually all of the samples are highlighted as having low TEB and even some very low levels were noted
- <u>Aluminium Saturation Percent</u> ASP can be a problem but only a few of these samples are noted as having anything like excessive values. Generally the ASP problem vanishes or diminishes greatly once a soil is flooded
- <u>Exchangeable Sodium Percent</u> none of these poorly fertile soils have excessive exchangeable sodium since sodic soils are normally slightly alkaline to alkaline and all of these soils are acidic to some degree
- Base Saturation this is the main measure used to determine inherent fertility and the starting point in this exercise
  and levels in these samples were low to very low

Table 4.2 Deficiencies in Mineral Soils by Kabupaten

			Number	of Sample	s in each l	Kabupaten		
Deficiency	Aceh Jaya	Aceh Besar	Bireuen	Aceh Utara	Pidie	Singkil	Aceh Timur	Totals
Calcium	1	2		1	1			5
Slight calcium	4	2		3		1		10
Magnesium	3	1	8	6	4	4	2	28
Magnesium + possible Phosphorus	37	10	1	1	2			51
Slight magnesium	49	14	4	2	1	3		73
Potassium		3						3
Totals	94	32	13	13	8	8	2	170
Ratio of total samples	88%	84%	100%	100%	100%	89%	100%	87%

The total number of mineral soil samples analysed was 193 but several with suspect data have been excluded

Attempts were made to identify actual deficiencies and overall it is concluded that there is a problem with levels of magnesium. As can be seen Table 4.2, between 80 – 100% of the soils analysed had some deficiency indicated. It is obvious that soil analytical data should be made use of before applying fertilisers to ensure the "possible" deficiencies are rectified in the various locations. A blanket cover of a standard fertiliser packet is not recommended. In most cases magnesium would appear to be deficient.

On some peat soils used for wetland rice production (C.J. Hatten, private communication) where rice has often grown fairly well but produced very little grain the failure has been attributed to trace element - notably copper - deficiency. There are difficulties in applying the trace element cocktail to the soil (fixation, etc) and foliar spraying is a specialist subject. The micro-nutrient status of the NAD soils should possibly be investigated.

#### 4.5 Micro Nutrients

It is suggested that micro nutrient status should be investigated and that foliar rather than soil analyses should be employed.

## 4.6 Organic Soils

Of the 193 original samples taken there were 13 classified as peats and all the samples described as peat in origin are:

- Non-saline and non-sodic (Refer Table 3.9)
- Strongly, very strongly and extremely acidic in reaction with pH ranging from 5.10 to 3.00
- Most of the samples have a low level of Exchangeable-H<sup>+</sup> (<0.5 me/100g) three are moderately high (>0.5 <2.0 me/100g) though one sample is coded as high (2 5 me/100g) and three have very high levels (>5 me/100g)
- As would be expected in organic soils the exchangeable aluminium levels are not particularly high since aluminium
  is sourced in mineral materials and forms a complex with organic material and is taken out-of-play. Five samples
  have moderate level and only two noted as having high levels of Exch Al<sup>3+</sup>
- Four samples have extremely high levels of ferrous iron and three samples are considered to have what would be toxic levels of iron
- Levels of sulphate are generally moderate to high but one sample is noted as having high level and two samples are considered to contain toxic levels

The fertility status of peats soils is never easy to assess since there can be relatively high levels of several nutrients but features such as acidity render the soil an unsuitable medium for the growth of many plants.

- Organic carbon levels are high to very high
- Slightly over half the samples have low levels of nitrogen whilst most of the others fall into the moderate class
- Due to the high organic carbon levels more than half of the samples have unacceptable C:N ratios
- Generally the levels of the exchangeable cations calcium (Ca<sup>2+</sup>) and magnesium(Mg<sup>+</sup>) are low to very low and two samples also have low level of potassium (K<sup>+</sup>)
- Over half of the samples have low levels of total exchangeable bases (TEB) and generally the inherent fertility of the peat soils is extremely low with several base saturation (BS) levels below 35% but three samples show normal BS levels of 79 – 83%

Tropical peats (unlike many temperate peat soils) have major problems of development. The consensus is that where more than 1.5 - 2m of peat materials overlie mineral material they should not be touched and certainly not used for smallholder management. Where peats are shallower there are better possibilities for wetland development, but with very careful management.

The two major problems of tropical peat are the much higher water contents and the generally much lower mineral content. The tropical climate also leads to much accelerated oxidation of the peat if the peat is drained. (If there was system of carbon taxation & credits applied internationally then no peat soils would be used for agriculture as peat oxidation and CO<sub>2</sub> production is so enormous).

Where peat has been used for wetland rice production the rice has often grown fairly well <u>but produced very little grain</u>. This has been attributed to trace element - notably copper - deficiency. There are difficulties in applying the trace element cocktail to peat soil (fixation, etc) and foliar spraying is a specialist subject.

Where peat material overlies riverine alluvium - and particular where it is intermixed with alluvial lenses - then there are better possibilities for successful agricultural development due to the mineral content.

Shallow peats have been successfully developed for oil palm and coconut production in Malaysia under very good estate management. But the economics of this can be very marginal, and such areas are the first to be abandoned when market conditions become difficult. Oil palm would generally be planted in holes excavated in the peat to help ensure that the roots reach the mineral soil more easily.

**Table 4.3 Summary of Possible Deficiencies** 

																Exchan	geables				Sat	uration F	ercenta	ges			Cat	ion Ratios	Cat	tion Ratios
Deficiency		Value	S	Si	С	EC	pН	Exch		Fe	SO <sub>4</sub>	Org C	Total N	C:N			meq / 100	g			Ca	Mg	K	Al	Na	BS				
	Samples		%	%	%	dS/m	H20	Н	Al	ppm	ppm	%	%		Ca	Mg	K	Na	CEC	TEB	Sat%	Sat%	Sat%	Sat%	Sat%	%	Ca/Mg	Rating	Mg/K	Rating
Calcium		Mean	53	32	18	1.84	6.7	0.21	0.35	104	146	2.78	0.20	17	1.24	5.58	18.85	0.97	12.19	26.64	10	44	136	3	8	198	0.22	Ca deficient	6.44	OK
	5	Max	91	57	32	2.18	8.0	0.33	0.52	228	279	6.47	0.30	40	2.13	9.06	92.00	1.90	14.20	104.24	18	65	662	5	13	750	0.32		11.16	1
		Min	23	6	3	1.40	5.0	0.02	0.18	18	22	1.01	0.08	3	0.35	1.52	0.23	0.53	10.81	2.87	3	14	2	2	5	27	0.14		0.10	
Calcium		Mean	57	27	24	1.12	6.6	0.25	0.51	58	182	3.10	0.21	15	4.70	2.04	0.55	1.30	13.20	8.59	37	17	4	3	10	68	2.35	Ca sli deficient	5.73	OK
(Slight)	10	Max	92	48	45	2.60	7.4	0.43	3.00	154	430	5.53	0.42	20	8.05	2.69	0.93	2.36	22.15	13.30	52	23	8	14	15	91	2.99		13.45	
		Min	10	2	3	0.35	5.2	0.15	0.16	14	23	1.41	0.14	7	1.65	0.56	0.20	0.55	10.19	3.52	7	3	1	1	2	16	1.00		0.74	
		-		•						-					•			•		•								!		
Magnesium		Mean	54	21	26	1.88	7.0	0.22	0.23	66	282	2.03	0.23	9	8.14	0.88	0.49	1.24	12.60	10.76	64	7	4	2	10	85	10.01	Mg deficient with P inhibition	2.40	Mg sli deficient
+ possible Pinhibition	51	Max	97	61	69	8.40	7.9	0.78	0.56	405	2931	5.77	0.46	18	10.95	1.46	1.49	2.94	16.54	15.32	82	10	10	5	18	100	22.23		9.86	
		Min	4	0	1	0.10	5.0	0.01	0.16	2	14	0.31	0.08	3	2.12	0.17	0.11	0.39	8.75	3.66	21	2	1	1	4	37	7.15		0.28	
Magnesium		Mean	50	22	28	1.45	6.6	0.23	0.48	77	216	2.51	0.20	14	6.14	1.08	0.56	1.23	13.12	9.02	47	8	4	4	9	69	5.42	Mg sli deficient	2.83	Mg sli deficient
(Slight to deficient)	100	Max	95	74	73	13.64	8.0	1.02	4.22	339	1594	6.60	1.00	33	10.83	1.97	1.23	3.07	36.13	15.98	72	14	11	28	20	100	7.08		17.00	
		Min	2	0	1	0.20	4.5	0.01	0.09	2	3	0.21	0.08	1	1.80	0.44	0.09	0.40	9.04	3.03	9	2	1	0	2	16	3.06		0.51	
																				1								I.		
Potassium		Mean	66	12	22	0.37	7.5	0.02	0.19	10	111	0.71	0.12	6	8.06	2.07	0.19	1.06	12.74	11.38	63	16	1	2	8	89	4.03	OK	11.23	K sli deficient
(Slight)	3	Max	84	23	29	0.58	7.7	0.03	0.22	22	271	0.81	0.15	7	9.40	2.74	0.26	1.29	14.67		68	19	2	2	10	92	4.84		11.69	
				2	13	0.14	7.3	0.01	0.17	3	2	0.56	0.08	5	7.35	1.52	0.13	0.77	10.81	9.77	58	14	1	1	7	85	3.43		10.54	
												3.00		Ů			2.10	2.77		1		-					2.10	!		
Peat Soils		Mean				0.93	4.21	1.80	1.00	263	1093	8.63	0.34	35	3.72	1.09	0.54	0.77	22.22	6.11	21	7	3	5	5	35	3.75	OK	2.77	Mg sli deficient
	14	Max				3.00	5.10	6.22	2.55	780	7198	12.34	0.66	66	7.06	2.45	0.89	1.55	42.76	10.71	48	22	6	14	14	83	7.32		10.57	Ĭ
		Min				0.30	3.00	0.13	0.22	8	74	3.31	0.12	16	1.89	0.51	0.23	0.19	10.84	3.34	5	1	2	1	1	8	1.98		0.66	

## Appendix A Coordination Meeting with AusAID and ACIAR

Place: BPTP Offices, Banda Aceh

Date: 28<sup>th</sup> March 2006

Purpose: Brain-storming and pooling of ideas and activities focusing on possible interventions in post-tsunami

NAD west coast areas to assist re-establishing farming

Participants: Dr Ian Willett, Research Programme Manager, ACIAR, Canberra

Dr Chris Smith, CSIRO Land and Water Scientist, Canberra

Dr Achmad Rachman, Director, Indonesian Soil Research institute, Bogor

Mr David Ellis, CSIRO Land and Water Scientist, Adelaide

Dr Peter Slavich, NSW DPI Scientist, Alstonville (ACIAR Team Leader for NAD Salinity Project)

Helmut Krist, Aceh Rehabilitation & Reconstruction Programme, GTZ

Tan Bok Than, Agricultural Economist, ETESP Agriculture

Austin Hutcheon, Soil Desalinisation & Improvement, ETESP Agriculture

Various BPTP staff and NGO representatives including Mercy Corp

#### Points Discussed:

 ETESP missed some of the presentation of the existing ACIAR project carried out in NAD on the north and east coasts, this was the EM38 salinity survey. ETESP has utilised the data from this survey and the ACIAR staff were pleased that we had done so

- 2. Currently ACIAR were re-equipping the soils laboratory at BPTP and offering further training to the staff with the promise that the laboratory would be able to meet any requirements in the NAD area for soil analyses
- 3. Pak Tan presented a brief outline of what ETESP Agriculture was doing and hoped to do, but there was no opportunity to raise the question of "livestock" as was hoped since the team was composed of researchers only
- 4. Austin Hutcheon gave a brief summary of what he had achieved, the conclusions reached and the outputs compiled as a result of ETESP soils and land studies. Basically the ACIAR team had no more ideas than ETESP already has concerning land drainage and soil improvement but the ACIAR team:
  - · had not considered the negative effects of housing IDPs in barracks away from their land or villages
  - did appreciate the need to consider the wider (downstream) effects of any drainage rehabilitation that was attempted
  - did appreciate that in some places the land had been improved as a result of deposition of material by the tsunami as well as problems caused by the sandier deposits
  - appreciated that farmers were already monitoring the status of their land and its recovery status by keeping a close note on natural vegetative growth
  - made note of the comment that in some west coast areas Dinas Pertanian did NOT want more research done unless they were actively involved as previous researchers did not supply any feedback
- 5. Lengthy discussions then took place around the subject of land recovery, fertility and the fact that some crops grew very well in the vegetative stages but totally failed to produce any grain or fruit. The causes for this situation could be:
  - Some continuing level of salinity
  - Nutrient imbalances and / or deficiencies
- 6. ETESP pointed out that all laboratory data manipulation and analyses carried out by ETESP to date indicated a possible deficiency of magnesium (Mg) in the various soils. ACIAR responded that this seemed strange since sea water contains relatively large amounts of Mg and that marine deposits should / could be quite well supplied with Mg. Points to consider arising from the above include:
  - ETESP has concluded that generally there are not many "marine" deposits; what came from the sea was mainly sand deposits and sands would not have had much Mg, or any other nutrient or element, absorbed or adsorbed in/ on them. Most finer textured deposits comprise redistributed topsoils
  - Has anyone actually tested the sea-water off the NAD area? What are the contents of the various dissolved salts? Perhaps the main salt really is sodium (chloride) and salinisation of the soils came

Austin Hutcheon BSc MSc www.geocities.com/Austin-supermi

- from the infiltration of the sea-water and very little salinisation came from the sediments since the sediments were mainly redistributed topsoils relocated by the tsunami flood
- If the main salt is / was Na then the infiltration of the sea flood-water would have led to most of the exchangeable plant nutrients (Ca, Mg and K) being replaced on the exchange complex by Na leaving a saline soil and leaching out the Ca, Mg and K as well as other, soluble nutrients such as nitrogen and phosphorus
- Does any agency have a collection of pre-tsunami soil analytical data that can be sued as a "benchmark" to allow comparison with the situation post-tsunami? All the analyses that ETESP have checked (refer ETESP Labdata Summary, interpretation of Laboratory data for ETESP irrigation Component) have been passed over to the ACIAR team so they could, if they so wish, start compiling a pre and post-tsunami database to try and establish if there is now a obvious nutrient problem
- In some areas, where cropping has resumed, yields are already restored to close to pre-tsunami
  levels suggesting there is no obvious, major problem with the macro nutrients. However, if in some
  areas where desalinisation has been achieved the yields do not recover and study of the analytical
  data suggest few or no macro-nutrient problems then some investigations should be taken and micronutrient levels should be studied
- In the light of a study of the post-tsunami fertility status and levels of nutrients there is every case for the fertiliser recommendations that are currently in place to be reviewed to ensure all the necessary nutrients are included. However, care must be taken when dealing with the west coast especially if there is a need to change from wetland (padi) to dryland (palawija etc) cropping since the west coast soils (particularly upland soils and low lying soils derived from the uplands) have a known acidity problem which develops as the soils dry and pH falls and Aluminium saturation percentage increases. Fertilisers that acidify the soil must be applied only where there is no risk of natural soil acidification.

After the meeting ETESP Agriculture discussed with ACIAR team members what had been done and compiled by ETESP to date and digital copies of all reports and manipulated data were left with the team for use in planning and on future studies that may undertaken by ACIAR. This includes the ETESP Agriculture "Scenarios", Aceh Besar, Pidie and Bireuen Kabupaten and Banda Aceh Kota reports that utilised the ACIAR data and ETESP land reclamation tools etc.

# **Appendix B Data Collation Tables**

Table B.1 ETESP LabData Collation – Aceh Besar

			Location: 5	Sumatra	A	ldd Date in l	WHITE box	xes by Sampi	le or Horizon																S	aturations				
																							Exchangeables			ASP	ESP	Base	Cation Ratios	Cation Ratios
	Scheme / Desa	Site No		Depth From	Range To	S Si % %	C %	Lab Texture	EC dS/m	pH H2O	pH KCI	pH diff	Exchangeable H	Al	Fe ppm	SO <sub>4</sub> ppm	Avail P ppm	Avail K ppm	Org C %	Total N %	C:N	Ca	meq / 100g	Mg Sat% Sa	t%	Al Sat%	Na Sat%	BS %	Ca/Mg Rating	Mg/K Rating
Aceh Besar Blang Luas	is BLG	13	0	ND Rating		66 11	23	SCL	0.14 Non Sal	7.3 Neutral	6.4 ND	0.90 ND		0.18 V Low	2.8 Defic	2.2 ND			0.56 V Low	0.08 V Low			1.52 0.13 0.77 10.81 9.77 Mod Low High Low Mod	14 ND VI	ow.	2 V Low	7 VSIi-sodic	90 V High	4.84 OK	11.69 K sli deficient
Aceh Besar Blang Luas	s BLG	13	D	ND Pating		83 1	16	SL	0.20 Non Sal	7.4 Noutral	6.6 ND	0.80 MD	0.03	0.16 V Low	20.8 Mod / OK	5.4 ND			0.53 V Low	0.09 V Low	6 Mod	6.5	1.11 0.09 0.7 9.59 8.40 Low V Low High Low Mod	12 ND V.I	OW.	2 V Low	7 VSILsodic	88 V High	5.86 Mg sli deficient	12.33 K deficient
Aceh Besar Blang Luas	s BLD0	O 3B	D	30 -		71 13	16	SL	0.20	6.9	5.7	1.20	0.02	0.18	75.7	14			2.49	4 LOW	INIOU	8.73	1.7 0.1 0.86 13.16 11.39	13	1	1	7	87	5.14 Mg sli deficient	17.00 K deficient
Aceh Besar Geunteut La	Lamsuien GL O	25	D	Rating 50 -	_	18 11	71	SiCL	Non Sal 0.29	Neutral 8.0	ND 7.4	ND 0.60		V Low 0.18	High 4.7	V Defic			Mod 2.8	Mod 0.15	Good 19	Mod 10.83		ND V I	.0W	V Low	VSIi-sodic 19	V High 96	6.30 Mg sli deficient	4.78 OK
Aceh Besar Krueng Kala			D	Rating ND		91 1	9	c	Non Sal 0.30	Sli Alk	ND 6.4	ND 1.10		V Low 1	Mod / OK 23.6	ND 74.2			Mod 0.60	Low	Mod	High 7.76	Mod Mod V High Mod High	ND VI	.OW	V Low	Sodic	V High	5.07 Mg cli deficient	6.84 OK
				Rating				3	Non Sal	Neutral	ND	ND	V Low	V Low 1	Mod / OK	Low			Low	V Low	Mod	Mod	Low Low High Low Mod	ND VI	.OW	V Low	VSIi-sodic	V High	3.97 mg sii delicieli	
Aceh Besar Krueng Kala			D	0 Rating	12	84 12		LS	0.32 Non Sal	7.5 Neutral	6.4 ND	1.10 ND	V Low	0.16 V Low 1	23 Mod / OK	74 Low			1.34 Mod	V Low	Good	Mod	1.3 0.39 0.91 12.49 10.36 Low Mod High Low Mod	ND VI	.OW	V Low	7 VSII-sodic	83 V High	5.97 Mg sli deficient	3.33 OK
Aceh Besar Geunteut La	Lamsujen GL O	05	0	0 Rating	15	11 40	49	SiC	0.34 Non Sal	7.8 Sli Alk	7.0 ND	0.80 ND		0.18 V Low 1	11 Mod / OK	32.1 Defic			1.38 Mod	0.16 Low	9 Mod	9.36 Mod	1.08 0.62 1.63 12.70 12.69 Low High High Low Mod	V Low V L	.ow	1 V Low	13 Sli-sodic	100 V High	8.67 Mg deficient with P inhibition	1.74 Mg deficient
Aceh Besar Blang Luas	is BLA	8	D	0 Rating	20	97 1	3	S	0.35 Non Sal	7.6 Sli Alk	6.7 ND	0.90		0.20 Low 1	14.6 Mod / OK	234.1 Mod			0.42 V Low		4	6.23		7 Vlow VI	1	2 V Low	10 VSII-sodic	79 High	8.65 Mg deficient with P inhibition	5.54 OK
Aceh Besar Krueng Geu	eupeu KG I.	2B		ND		62 20	18	SL	0.35	6.4	5.2	1.20	0.22	0.18		23.3			3.57				2.55 0.26 1.10 11.60 8.96	22	2	2	9	77	1.98 Ca sli deficient	9.81 OK
Aceh Besar Krueng Kala	ala KKE	10	D	Rating ND		87 4	9	LS	0.35	Sli Acid 7.7	6.5	ND 1.20	0.23	V Low 0.16	V High 11.8	V Defic 160.1			0.41	0.14	Mod 3	7.09	Mod Low High Low Mod 1.06 0.57 1.34 11.90 10.06	9 VI	.ow	V Low	VSIi-sodic	High 85	6.69 Mg sli deficient	1.86 Mg deficient
Aceh Resar Riann Luas		2	D	Rating	40	82 4	14	15	Non Sal 0.36	Sli Alk 8.0	ND 8.0	ND 0.00		V Low 1	Mod / OK	Mod 128.5			V Low	Low 0.13	V Poor	Mod	Low Mod High Low Mod  1.43 0.34 2.2 14.61 13.63	V Low V L	.0W	V Low	Sli-sodic 15	V High	6.76 Ma sli deficient	4.21 OK
Figure 5000			5	Rating	Ŭ	-		10	Non Sal	Sli Alk	ND 6.9	ND	Low	V Low 1	Mod / OK	Mod			Mod	Low	Good	Mod	Low Mod V High Low Mod	V Low V L	.OW	V Low	Mod-sodic	V High	2.02	
Aceh Besar Blang Luas			D	Rating	10		13	LS	0.39 Non Sal	7.7 Sli Alk	ND	ND ND	V Low	0.22 Low	Defic	270.7 Mod				Low	Mod	Mod		ND VI	.OW	V Low	Sli-sodic	V High	3.82 JUK	11.47 K sli deficient
Aceh Besar Geunteut La	Lamsujen GLK1	1	D	0 Rating	10	90 1	10	S	0.40 Non Sal	7.9 Sli Alk	6.7 ND	1.20 ND	0.04 V Low	0.16 V Low 1	5.1 Mod / OK	234.7 Mod			0.50 V Low	0.08 V Low	6 Mod	9.93 Mod	1.06 0.28 1.6 13.62 12.87 Low Low High Low Mod	V Low V L	.ow	1 V Low	12 Sli-sodic	94 V High	9.37 Mg deficient with P inhibition	3.79 OK
Aceh Besar Blang Luas	IS BLA	2	0	40 - Rating		63 3	34	SCL	0.47 Non Sal	7.5 Neutral	5.6 ND	1.90 ND	0.20	0.19 V Low	4.7 Mod / OK	83.8 Low			1.8 Mod	0.22 Mod	8 Mod	8.85 Mod		7 VIow VI	OW.	2 V Low	13 Sli-sodic	99 V High	11.06 Mg deficient with P inhibition	2.35 Mg sli deficient
Aceh Besar Blang Luas	s BLD0	O 3A	D	0 Rating	30	90 1	10	S	0.47 Non Sal	7.8	6.9 ND	0.90	0.23			239.3			0.26		3		1.26 0.19 1.19 12.72 11.13	10 V I ow V I	1	1 V Low	9 VSII-sodic	88 V High	6.74 Mg sli deficient	6.63 OK
Aceh Besar Blang Luas	is BLA	8	0	20 -		62 1	38	SCL	0.52	7.1	6.5	0.60	0.23	0.17	107.8	97.2			1.70	0.12	14	6.04	1.03 0.29 1.39 9.69 8.75	11	3	2	14	90	5.86 Mg sli deficient	3.55 OK
Aceh Besar Geunteut La	Lamsuien GLK1	1	0	Rating 10 -		48 23	29	SCI	Non Sal 0.58	Neutral 7 4	ND 6.1	ND 1.30	0.03		V High 22.4	Low 58.9			Mod 0.81	0.15	Good	Mod 9.4	Low Low High Low Mod 2.74 0.26 1.12 14.67 13.52	ND VI	.0W	V Low	Sli-sodic 8	V High	3.43 OK	10.54 K sli deficient
			0	Rating				CI	Non Sal 0.59	Neutral	ND 6.8	ND 0.70	V Low	V Low 1 0.39	Mod / OK	318.6				Low	Mod	Mod		ND VI	.OW	V Low	VSIi-sodic	V High	7.15 Ma deficient with D inhibition	
		25		Rating		74 17	9	3L	Non Sal	Neutral	ND	ND	V Low	Low	Defic	Mod			Mod	Mod	Good	Mod	Low High V High Mod Mod	V Low V L	.OW	V Low	Sodic	V High	7.15 mg delicient wai P initiation	2.18 Mg sli deficient
Aceh Besar Blang Luas	IS BLH	20	0	10 - Rating		11 45	45	SiC	0.61 Non Sal	7.1 Neutral	6.2 ND	0.90 ND		0.17 V Low 1	19.6 Mod / OK	45.1 V Low			4.64 High				2.69 0.2 2.36 15.85 13.30 Mod Low V High Mod Mod	ND VI	.OW	1 V Low	15 Sli-sodic	V High	2.99 Ca sli deficient	13.45 K deficient
Aceh Besar Geunteut La	Lamsujen GL H	12	D	0 Rating	17	90 6	3	S	0.66 Non Sal	7.3 Neutral	6.5 ND	0.80 ND	0.00	0.17 V Low N	25 Mod High	88 Low			0.78 Low	0.08 V Low	10 Mod	7.72 Mod	1.09 0.29 1.37 12.23 10.47 Low Low High Low Mod	9 V V Low V L	2 .ow	1 V Low	11 Sli-sodic	86 V High	7.08 Mq deficient	3.76 OK
Aceh Besar Geunteut La	Lamsujen GLA6	6	D	0 Pating	25	91 2	7	S	0.66 Non Sal	7.6	6.5 ND	1.10 ND	0.03		5.1 Mod / OV	266.3 Mod			0.31 V Low	0.08 VLow	4 V Poor		1.09 0.29 1.37 12.23 10.67 Low Low High Low Mod	9 :	2	1 V Low	11 Sli-sodic	87 V High	7.27 Mg deficient with P inhibition	3.76 OK
Aceh Besar Krueng Kala	ala KKE	10	0	ND		18 48	34	SiC	0.84	7.3	6.6	0.70	0.02	0.17	75.9	166.2			0.80	0.15	5	6.04	0.97 0.29 2.1 11.54 9.40	8	3	1	18	81	6.23 Mg sli deficient	3.34 OK
Aceh Besar Krueng Geu	eupeu KG C	23	0	Rating 22 -		23 32	45	С	Non Sal 0.90	Neutral 7.2	ND 6.1	ND 1.10		V Low 0.17	High 22	Mod 59			0.13			Mod 8.4	Low Low VHigh Low Mod 1.74 0.26 1.12 13.67 11.52	V Low V L	.0W	V Low	Sodic 8	V High 84	4.83 OK	6.69 OK
Aceh Besar Krueng Kala	ala KKD	4		Rating ND		33 27	40	CI	Non Sal 0.90	Neutral 7.3	ND 6.5	ND 0.80	0.02	V Low 1 0.19	Mod / OK 118.8	Low 165.9			V Low 2.56	Mod 0.22	Ext Poor	Mod 6.54	Mod Low High Low Mod 1.37 0.44 0.84 13.67 9.19	ND VI	.0W	V Low	VSII-sodic	V High	4.77 OK	3.11 OK
			ů	Rating				OL.	Non Sal	Neutral	ND	ND	V Low	V Low	V High	Mod 53.1			Mod	Mod	Good	Mod 8.89	Low Mod High Low Mod	ND VI	.OW	V Low	VSII-sodic	High	4.77 OK	
Aceh Besar Geunteut La	Lamsujen GL O	)5	0	Rating Rating		53 18	29	SCL	0.95 Non Sal	Sli Alk	6.9 ND	0.80 ND	0.17 V Low	0.21 Low 1	Mod / OK	53.1 Low			V Low	0.18 Low	V Poor	Mod	Low High High Low Mod	V Low V I	.OW	V Low	VSII-sodic	V High	8.23 Mg deficient with P inhibition	1.71 Mg deficient
Aceh Besar Krueng Kala	ala KK F.	2	0	ND Rating		14 35	51	С	0.95 Non Sal	7.3 Neutral	6.4 ND	0.90 ND	0.02 V Low	0.19 V Low	78 High	165 Mod			2.61 Mod	0.22 Mod	12 Good	6.64 Mod	1.37 0.54 0.84 11.96 9.39 Low Mod High Low Mod	ND VI	.ow	V Low	7 VSIi-sodic	79 High	4.85 OK	2.54 Mg sli deficient
Aceh Besar Krueng Geu	eupeu KGC	4	D	0 Rating	28	93 7	1	S	1.02 Non Sal	7.5 Neutral	6.3 ND	1.20 ND		0.17 V Low 1	12.3 Mod / OK	400.4 Mod			0.96	0.12 Low	8 Mod	7.63 Mod	1.70 0.36 1.71 13.64 11.40 Mod Mod High Low Mod	12 ND VI	OW.	1 V Low	13 Sli-sodic	84 V High	4.49 OK	4.72 OK
Aceh Besar Krueng Geu	eupeu KGC	4		28 Pating		27 16	56	CL	1.09	7.1	6.2 ND	0.90	0.05	0.16	12.1 Mod / OK	97.3			3.22	0.38	8	6.19	1.81 0.21 0.92 12.66 9.13	14 ND VI	2	1 Vlow	7 VSII codio	72 High	3.42 OK	8.62 OK
Aceh Besar Geunteut La	Lamsujen GL H	12		Rating ND		14 35	51	С	Non Sal 1.19	Neutral 7.1	6.4	0.70	0.05	V Low 1 0.17	101	103			High 2.93	0.22	13	7.01	Mod         Low         High         Low         Mod           1.78         0.47         1.07         11.80         10.33	15	4	1	v 311-SUGIC	88	3.94 OK	3.79 OK
Aceh Besar Krueng Geu	eupeu KG C	23	D	Rating 0	22	86 10	4	LS	Non Sal 1.20	Neutral 7.5	ND 6.7	ND 0.80		V Low 0.16	V High 15	Mod 27			Mod 0.89	Mod	Good 11	Mod 7.62	Mod         Mod         High         Low         Mod           0.6         0.28         1.6         12.62         10.10	ND VI	.OW	V Low	VSII-sodic 13	V High 80	12.70 Mg deficient with P inhibition	2.14 Mg sli deficient
Aceh Besar Blang Luas	is BLE	7	0	Rating 9 -		59 19	22	SCI.	Non Sal 1.54	Neutral 6.8	ND 5.6	ND 1.20	V Low	V Low 1	Mod / OK 8.1	Defic 149.4			Low 1.31	V Low	Good	Mod	Low Low High Low Mod 1.19 0.38 1.45 11.07 9.85	V Low V L	.OW	V Low	Sli-sodic	V High 89	5.74 Ma cli deficient	3.13 OK
			Ů	Rating				JUL	Non Sal	Neutral	ND	ND	V Low	V Low 1	Mod / OK	Mod			Mod	Low			Low Mod High Low Mod	ND VI	.OW	V Low	Sli-sodic	V High	53.4 arg an denicient	
Aceh Besar Geunteut La			0	Rating			18	L	1.75 Non Sal	7.5 Neutral	6.9 ND	0.60 ND	V Low	Low	228.4 Ext High	279 Mod			1.62 Mod	Mod	6 Mod	V Low	8.07   0.9   1.9   14.20   12.00     V High   High   High   Low   Mod	ND VI	.OW	V Low	13 Sli-sodic	85 V High	U.14 Ca deficient	8.97 OK
Aceh Besar Geunteut La	Lamsujen GL R	22	D	0 Rating	30	91 6	3	S	1.90 Non Sal	8.0 Sli Alk	7.5 ND	0.50 ND			18.1 Mod / OK	149.9 Mod			1.01 Low	0.30 Mod	V Poor	2.13 Low	9.06         92         1.05         13.90         104.24           V High         V High         High         Low         V High	65 6 ND V F	62 ligh	V Low	VSIi-sodic	750 V High	0.24 Ca deficient	0.10 Mg deficient
Aceh Besar Blang Luas	is BLE7	7	D	0 Rating	9	82 1	17	LS	2.00 Non Sal	7.5 Neutral	6.3 ND	1.20 ND		0.17 V Low	5.2 Mod / OK	309.0 Mod			0.91 Low	0.15 Low		7.78	0.35 0.5 1.02 10.39 9.65 V Low Mod High Low Mod	3 VIow VI	5 OW	2 V Low	VSII-sodic	93 V High	22.23 Mg deficient with P inhibition	0.70 Mg deficient
Aceh Besar Geunteut La	Lamsujen GLA6	6	D	25		81 1	18	SL	2.20	7.1	6.4	0.70	0.04	0.17	101.8	111.6			2.38	0.22	11 Good	7.21	1.78 0.47 1.07 11.80 10.53	15	4	1	9	89 V High	4.05 OK	3.79 OK
Aceh Besar Krueng Geu	eupeu KG I	2A	D	Rating 15		94 5	2	S	Non Sal 2.60	Neutral 7.6	ND 6.7	ND 0.90	0.42	0.16	V High 10.1	Mod 221.1			Mod 0.41		5	5.04	1.28 0.57 1.98 10.04 8.87	ND VI	6	2	VSII-sodic 20	88	3.94 OK	2.25 Mg sli deficient
Aceh Besar Krueng Geu	eupeu KG D	01	0	Rating 36		46 39	15		Non Sal 3.00	Sli Alk 7.5	ND 7.5	ND 0.00		V Low 1 0.19	Mod / OK 8.6	Mod 274.6			V Low 2.06	V Low		Mod 9.28	Low         Mod         High         Low         Mod           1.18         0.54         1.15         12.31         12.15	ND VI	.ow	V Low	Sodic	V High	7.86 Ma deficient with P inhibition	2.19 Mg sli deficient
		)1	Č	Rating	2/	77 12	10	CI	Non Sal	Neutral	ND 7.4	ND		V Low 1	Mod / OK	Mod 1004.2			Mod	Mod	Mod	Mod	Low Mod High Low Mod	V Low V L	.OW	V Low	VSII-sodic	99 V High	6.17 Ma oli deficient	2.00
Aceh Besar Krueng Geu	Lupcu ING D	/1	U	Rating	JU	77 13	10	JL	Sli Sal	Neutral	ND ND	ND	Low	Low 1	Mod / OK	High			Mod	Mod	Mod	Mod Mod	1.48 0.48 1.13 13.67 12.67 Low Mod High Low Mod	ND VI	.OW	V Low	VSIi-sodic	V High	U.17 Ing all delicies	5.55 OK

Table B.2 ETESP LabData Collation – Aceh Jaya (1)

		J			٠٠																						1						i	
			Location:	Sumatra		Add Date in V	WHITE bo	oxes by Samp	ile or Horizon														Exchange	ahlos					s	ASP	ESP	Base	Cation Ratios	Cation Ratios
Kabupaten	Scheme	Site	Soil (O)	Depth		S Si	С	Lab	EC	pH	pH	pH	Exchangeal	ble	Fe	SO <sub>4</sub>	Avail P	Avail K	Org C	Total N	C:N			meg / 100g				Mg	K	AI Sat%	Na	BS	Outon Ruino	Cultilitatios
Aceh Java	/ Desa Alue Monmata	MD 2	Deposit (D)	From ND		% % 16 23	61	Texture C	dS/m 0.50	H2O 5.5	5.0	0.50	н 0.12	0.88	ppm 75	24	ppm	ppm	2.77	0.12	23		Mg 0.7	0.55	Na 0.86		TEB 4.84	Sat%	Sat%	Sat%	Sat%	44	Ca/Mg Rating 3.90 OK	Mg/K Rating 1.27 Mg deficient
Aceh Java	Alue Monmata	MME	0	Rating 40		20 31	40	C	Non Sal 2.00	Str Acid 6.6	ND 5.5	ND 1.10		Mod 0.18					Mod 2.61					Mod 1.18			Low	V Low	Low	Low	VSIi-sodic	Low	0.70 Ma deficient with D inhibition	0.01 Ma deficient
		IVIIVO	0	Rating				·	Non Sal	Neutral	ND	ND	V Low	V Low	High	Mod			Mod	Mod		Mod	Low	High	High	Low	Mod	V Low	/ Low	V Low	VSIi-sodic	V High	8.79 Ing delicient with P milibilion	0.81 Mig delitierit
Aceh Jaya	Alue Monmata	MN5	D	0 Rating	40	90 1	9	S	0.95 Non Sal	7.8 Sli Alk	6.9 ND	0.90 ND	0.02 V Low	0.18 V Low	11.9 Mod / OK	230.4 Mod			1.74 Mod	0.31 Mod	6 Mod	10.06 High	1.13 Low	1.49 V High	1.72 High	15.00 Mod	14.40 Mod	V Low	10 Low	V Low	11 Sli-sodic	96 V High	8.90 Mg deficient with P inhibition	0.76 Mg deficient
Aceh Jaya	Alue Monmata	MO2 (PAM2)	D	Dalina	30	Hemist			0.30 Non Sal	5.1 Str Acid	4.3 ND	0.80 ND	0.13 V Low	0.26 Low	23 Mod / OK	74 Low			12.34 V High	0.22 Mod	56 Boor	4.76	1.3 Low	0.39 Mod	0.19		6.64 Low	6 V Low	2 / Low	1 V Low	1 Non-sodic	30 V Low	3.66 OK	3.33 OK
Aceh Jaya	Alue Monmata	PM 14	0	15		51 22	27	SCL	1.72		5.9	0.60		0.20					3.06		15	7.11	1.22	0.59	1.09	12.26	10.01	10	5	2	9	82	5.83 Mg sli deficient	2.07 Mg sli deficient
Aceh Java	Alue Monmata	PM 14	D	Rating 0	15	90 1	9	S	Non Sal 0.94	Sli Acid 7.4	ND 6.5	ND 0.90	0.45	0.19	High 3.9	Mod 129			High 2.85	0.17	Mod 17		1.62	Mod 0.60		Low 15.97	Mod 14.13	V Low 1	/ Low	V Low	VSIi-sodic 9	V High 88	6.43 Mg sli deficient	2.70 Mg sli deficient
Acob Jours	Alue Monmata	PM4	0	Rating		32 31	27	CI	Non Sal 0.77	Neutral	ND 4.6	ND 1.20	Low	V Low 0.19	Defic 220 E	Mod 169			Mod 2 29		Mod			High 0.48		Mod 10.52	Mod	ND 1	Low	V Low	VSIi-sodic	V High	0.71 May deficient with Dishibition	2.44 Mandoficioni
нсси зауа			0	Rating				CE	Non Sal	Mod Acid	ND	ND	Low	V Low	Ext High	Mod			Mod	Low	Good	Mod	Low	Mod	High		Mod	V Low	/ Low	V Low	Sli-sodic	V High	8.71 Mg dendent with P illinolitori	1.44 Mid dentilent
Aceh Jaya	Alue Monmata	PM4	D	0 Rating	25	89 2	9	L	2.30 Non Sal	7.0 Neutral	6.5 ND	0.50 ND	0.15 V Low	0.19 V Low	45.5 High	521.2 M High			2.21 Mod		7 Mod	9.62 Mod	1.52 Mod	1.01 High	1.68 High	14.93 Low	13.83 Mod	ND 1	7 / Low	V Low	Sli-sodic	93 V High	6.33 Mg sli deficient	1.50 Mg deficient
Aceh Jaya	Baba Awe	CB A1	0	30 Rating		50 31	19	L	0.88 Non Sal	7.5 Neutral	6.3 ND	1.20 ND	0.02 V Low	0.22 Low	11.6 Mod / OK	184 Mod			2.71 Mod		8 Mod			0.49 Mod		17.90 Mod	14.60 Mod	9 Vlaw	3 / Low	1 V Low	12 Sli-sodic	82 V High	6.64 Mg sli deficient	3.20 OK
Aceh Jaya	Baba Awe	CB A1	D	0	30	88 8	4	LS	0.70	7.4	6.6	0.80		0.18		312.2			1.37		9	8.6		0.45	1.86	14.60	12.40	10	3	1	13	85	5.77 Mg sli deficient	3.31 OK
Aceh Jaya	Baba Awe	CBA B3	D	Rating 12		58 26	16	SL	0.60	Neutral 7.5	ND 6.8	0.70	0.23	0.18	Mod / OK 5.3	Mod 399.9			Mod 1.51	0.15	Mod 10	Mod 9,99	1.85	Mod 0.24		Low 16.28	Mod 14.21	ND \	/ Low	V Low	Sli-sodic 13	V High 87	5.40 Mg sli deficient	7.71 OK
Aceh Jaya	Baba Awe	CBA B3	n	Rating	12	62 22	14	¢)	Non Sal 1.50	Neutral 7.0	ND 6.6	ND 0.40	Low	V Low 0.18	Mod / OK	Mod			Mod 1.38	Low	Good	Mod	Mod	Low 1.09	V High	Mod	Mod 14.49	ND \	/ Low	V Low	Sli-sodic	V High	7 07 May deficient with D inhibition	1.12 Mardoficient
		CDM D3	U	Rating				JL	Non Sal	Neutral	ND	ND	Low	V Low	High	Low			Mod	Low	Mod	Mod	Low	High	V High	Mod	Mod	V Low	/ Low	V Low	Mod-sodic	V High	my dendent with I mindredit	my delicent
Aceh Jaya	Baba le	BI 3	D	40 Rating		87 10	3	LS	2.00 Non Sal	6.8 Neutral	5.2 ND	1.60 ND	0.38 Low	0.22 Low	13.9 Mod / OK	140.8 Mod			1.41 Mod	0.16 Low	9 Mod	5.25 Mod	2.25 Mod	0.72 High	1.09 High	10.19 Low	9.31 Mod	ND N	7 / Low	V Low	Sli-sodic	91 V High	2.33 Ca sli deficient	3.13 OK
Aceh Jaya	Baba le	BLES	0	35 Rating		37 16	47	С	3.50 Non Sal	6.7 Neutral	6.1 ND	0.60 ND	0.40	0.23	69 High	107.1			1.89 Mod		9 Mod	8.58	0.64	0.36 Mod	0.83	11.84	10.41 Mod	5 Vlow	3 / Low	2 V Low	7 VSIi-sodic	88 V High	13.41 Mg deficient with P inhibition	1.78 Mg deficient
Aceh Jaya	Baba le	BI ES	D	0	35	94 5	1	S	0.81	7.8	7.1	0.70	0.12	0.19	15	87.7			3.04	0.17	18	10.44	1.25	0.52	1.37	14.36	13.58	9	4	1	10	95	8.35 Mg deficient with P inhibition	2.40 Mg sli deficient
Aceh Java	Blang Alue Gaiah	BUG 12	ND	Rating ND		66 11	24		Non Sal 2.15	Sli Alk 7.25	ND 6.6	ND 0.65	V Low 0.26	V Low 0.21	Mod / OK 42	97.4			High 2.465		Mod 13	9.51		Mod 0.44		Low 13.1	Mod 12.00	V Low 1	/ Low	V Low 2	VSIi-sodic 8	V High 92	10.06 Mg deficient with P inhibition	2.15 Mg sli deficient
Aceh Jaya	Blang Alue Gajah	BUG C3	D	Rating 8		85 7		IS	Non Sal 0.92	Neutral 7.3	ND 6.5	ND n.en	Low	0.24	High	Low			Mod 2 77		Good			Mod 0.38	rag.	Low	Mod	V Low	Low	V Low 2	VSII-sodic 12	V High	5.42 Ma eli deficient	4.32 OK
нсси зауа			D	Rating		63 /	0	LJ	Non Sal	Neutral	ND	ND	Low	Low	Mod / OK	M High			Mod	Mod	Mod	Mod	Mod	Mod	High	Low	Mod	ND 1	/ Low	V Low	Sli-sodic	V High	Mg Sit delicities	4.32 OR
Aceh Jaya	Blang Alue Gajah	BUG C3	D	0 Rating	8	76 9	15	LS	0.47 Non Sal	7.2 Neutral	6.6 ND	0.60 ND	0.02 V Low	0.20 Low	39.7 Mod High	45.1 V Low			2.81 Mod	0.23 Mod	Good	8.87 Mod		0.27 Low		13.85 Low	12.35 Mod	ND V	2 / Low	V Low	10 Sli-sodic	V High	4.87 OK	6.74 OK
Aceh Jaya	Blang Alue Gajah	BUG D8	D	20 Rating		83 14	3	LS	1.88 Non Sal	7.4 Neutral	6.6 ND	0.80 ND	0.21 Low	0.17 V Low		44.4 V Low			1.33 Mod		9 Mod	8.84 Mod		0.12 Low		10.84 Low	9.95 Mod	6 V Low	1 /Low	2 V Law	4 Non-sodic	92 V High	14.73 Mg deficient with P inhibition	5.00 OK
Aceh Jaya	Blang Alue Gajah	BUG D8	D	0	20	82 13	5	LS	0.26	7.1	6.3 ND	0.80	0.01	0.38	300.1	58.8			1.66 Mod	0.19	9	8 94	1 49	0.12 Low	0.62	12.36	11.17 Mod	12	1	3 V Low	5	90 V High	6.00 Mg sli deficient	12.42 K deficient
Aceh Jaya	Blang Alue Gajah	BUG F6	0	Rating 35		52 16	32	SCI	Non Sal 1.38	Neutral 7.0	6.2	0.80		0.21		13.8			0.4	0.10	4	8.52	0.88	0.67	1.29	12.31	11.36	7	Low 5	2	VSIi-sodic 10	92	9.68 Mg deficient with P inhibition	1.31 Mg deficient
Aceh Java	Blang Alue Gaiah	BUG F6	0	Rating	35	90 5	5	SCI	Non Sal 2.50	Neutral 7.2	ND 6.3	ND 0.90	0.38	Low 0.38	· · · · ·	V Defic 483.1			V Low 0.21		Mod 1			High 0.61		Low 16.53			/ Low	V Low 2	Sli-sodic 11	V High 87	5.19 Mn sli deficient	3.15 OK
				Rating				61	Non Sal 0.95	Neutral 7.4	ND 6.6	ND	Low	Low	Mod / OK	Mod			V Low	Mod	Ext Poor	Mod	Mod	High	High	Mod	Mod	ND \	/ Low	V Low	Sli-sodic	V High		
Aceh Jaya	Blang Alue Gajah	BUG G1	D	23 Rating		65 2		SL	Non Sal	Neutral	ND	ND	Low	0.18 V Low	High	Low			1.35 Mod	Mod	Mod	High	Low	0.45 Mod	High	Low	13.04 Mod	V Low	/ Low	V Low	VSIi-sodic	V High	12.64 Mg deficient with P inhibition	1.84 Mg delicient
Aceh Jaya	Blang Alue Gajah	BUG G1	D	0 Rating	23	95 15	20	S	2.10 Non Sal	7.3 Neutral	6.6 ND	0.70 ND	0.35 Low	0.23 Low	10.2 Mod / OK	524.5 M High			1.33 Mod	V.L./	5 Mod			0.64 High		15.49 Mod	13.58 Mod	V Low	4 / Low	1 V Low	7 VSIi-sodic	88 V High	11.65 Mg deficient with P inhibition	1.47 Mg deficient
Aceh Jaya	Blang Alue Gajah	BUG I2	0	30		40 30	30	CL	0.84 Non Sal	7.2	6.3	0.90	0.23	0.43	47.4 High	71.5			3.93	0.17 Low	23 Poor	7.8	1.69	0.67 High	1.29	12.10	11.45 Mod	14 ND 3	6	4 V Low	11 CE codo	95 V High	4.62 OK	2.52 Mg sli deficient
Aceh Jaya	Blang Alue Gajah	BUG I2	D	0	8	91 1	8	SL	3.00	6.6	5.9	0.70	0.37	0.22	33.5	180.7			1.14	0.14	8	6.17	1.82	0.55	2.21	13.03	10.75	14	4	2	17	83	3.39 OK	3.31 OK
Aceh Java	Blang Alue Gaiah	BUG I2	D	Rating 8	30	69 21	10	SI	Non Sal 3.10	Neutral 7.1	ND 6.4	ND 0.70	0.41	0.18	Mod High 30	Mod 1594			Low 3.1		Mod 15	7.14	1.08	Mod 0.62		Low 13.08	Mod 10.68	ND \	Low 5	V Low	Sodic 14	V High 82	6.61 Ma sli deficient	1.74 Mg deficient
Aceh Java	Blang Alue Gaiah	BUG K4		Rating 25		16 33			Non Sal 0.76	Neutral	ND 6.4	ND 0.40	Low	V Low 0.18	Mod High	High				Mod	Good	Mod	Low	High 0.24	High	Low	Mod 11.06	V Low	Low	V Low	Sli-sodic	V High	12.10 May deficient with Dishibition	2.12 OV
			U	Rating				·	Non Sal	Neutral	ND	ND	Low	V Low	Ext High	Mod			High	Mod	Mod	Mod	Low	Low	High	Low	Mod	V Low	/ Low	V Low	VSII-sodic	V High	12.17 Mg denovati with P titilioniON	3.13 UK
Aceh Java	Blang Alue Gajah	BUG K4	D	0 Rating	25	89 1	10	S	0.55 Non Sal	7.2 Neutral	6.7 ND	0.50 ND	0.23 Low	0.18 V Low	9.5 Mod / OK	189 Mod			1.53 Mod	0.31 Mod	5 Mod	10.66 High	1.38 Low	0.14 Low	2 V High	15.75 Mod	14.18 Mod	V Low	1 / Low	V Low	13 Sli-sodic	90 V High	7.72 Mg deficient with P inhibition	9.86 OK
Aceh Jaya	Blang Jempeuk	BJ B3	0	30 Pating		18 19	63	С	2.90 Non Sal	5.0 VStr Acid	4.2 ND	0.80 ND	0.78 Mod	0.24	405.2 Toxic	81.2			2.51 Mod	0.31 Mod	8 Mod	5.30 Mod	0.29 V Low	0.38 Mod	0.51 Mod	9.60 Low	6.48 Low	V I ow	4 /Low	3 V Low	5 VSIi-sodic	68 High	18.28 Mg deficient with P inhibition	0.76 Mg deficient
Aceh Jaya	Blang Jempeuk	BJ B3	D	0	15	78 11	11	SL	5.50	7.4	6.7	0.70		0.23	19	180			1.89		9	9.74	1.29	0.35	2.51	15.80	13.89	8	2	1	16	88	7.55 Mg deficient with P inhibition	3.69 OK
Aceh Jaya	Blang Jempeuk	BJ B3	0	Rating 15	30	8 51	41	SiC	Sli Sal 8.40	Neutral 7.2	ND 6.4	ND 0.85	V Low 0.23	0.18	Mod / OK 83.2	Mod 859.5			Mod 2.16	0.21	Mod 10	8.33	1.14	Mod 0.52	1.50	Mod 14.30	1/1.49	V Low 1	/ Low	V Low	Sodic 10	V High 80	7.31 Mg deficient with P inhibition	2.19 Mg sli deficient
Aceh Java	Blang Jempeuk	BJ D3	0	Rating 25		32 27		Ć	Mod Sal	Neutral 6.8	ND 5.1	ND 1.70	Low 0.44	V Low 0.18	High	M High				Mod	Good	Mod	Low	Mod 0.31	High	Low 16.95	Mod 14.79	V Low 1	/ Low	V Low	Sli-sodic 10	V High	6.28 Min sli deficient	5.48 OK
			U	Rating				·	Non Sal	Neutral	ND	ND	Low	V Low	High	Mod			High	Mod	Good	High	Mod	Mod	High	Mod	Mod Mod	ND \	/ Low	V Low	Sli-sodic	V High	0.20 My Sit Delicient	5.40 UK
Aceh Jaya	Blang Jempeuk	BJ D3	0	0 Rating	25	64 2	34	SCL	0.56 Non Sal	6.6 Neutral	5.5 ND	1.10 ND	0.20 Low	0.24 Low	101.2 V High	289.2 Mod			3.20 High	0.27 Mod	12 Good	High	Low	0.29 Low	High	16.69 Mod	13.36 Mod	V Low	2 / Low	V Low	9 VSIi-sodic	80 V High	6.86 Mg sli deficient	5.10 OK
Aceh Jaya	Blang Jempeuk	BJB3 Mean	0	ND Rating		48 15	38		0.41 Non Sal	6.70 Neutral	5.30 ND	1.40 ND	0.32	0.21 Low	99.15 High	354.45 Mod			3.19 High	0.28 Mod	12 Good	10.42 High	1.59 Mod	0.30 Mod	1.57 High	16.82 Mod	13.87 Mod	9 VIaw	2 / Low	1 VI ov	9 VSIi-sodic	82 V High	6.55 Mg sli deficient	5.30 OK
Aceh Jaya	Blang Jempeuk	KJ 2	0	25		45 17	38	CL	1.50	6.0	5.2	0.80	0.22	0.18	108.4	11100			2.24		5	5.93	0.61	0.29	0.81	9.80	7.64	6	3	2	8	78	9.72 Mg deficient with P inhibition	2.10 Mg sli deficient
Aceh Jaya	Blang Jempeuk	KJ 2	D	Rating 0	25	84 5	11	LS	Non Sal 1.54	Mod Acid 6.5	ND 5.9	0.60	0.23	V Low 0.18	V High 16.8	Mod 149.3			Mod 1.40	0.15	Mod 9	6.59	1.09	0.38	,	10.23	Mod 9.76	V Low 1	LOW 4	V Low 2	VSIi-sodic 17	High 95	6.05 Mg sli deficient	2.87 Mg sli deficient
Acah Java	Runhun	BL N1	0	Rating 12		80 2	18	SI	Non Sal 0.53	Sli Acid 5.0	ND 4.2	ND 0.80	Low 0.62	V Low 0.18	Mod / OK	Mod 593.2			Mod 2.54	Low	Mod 7	Mod	Low	Mod 0.36	High	Low 10.01	Mod 9.16	ND 1	/ Low	V Low	Sodic 15	V High	12.11 Min deficient with Prinhibition	1.56 Ma deficient
ALCII Jaya	Duniulii	DE NI		Rating			10	JL.	Non Sal	VStr Acid	ND	ND	Mod	V Low	High	M High			Mod	Mod	Mod	Mod	Low	Mod	High	Low	Mod			V Low	Sli-sodic	V High	my delical milit linional	ing unident
Aceh Jaya	Bunbun	BL N7	0	ND Rating		63 2	36	SCL	0.67 Non Sal	5.5 Str Acid	4.7 ND	0.80 ND	0.43 Low	0.18 V Low	15.8 Mod / OK	430.2 Mod			1.89 Mod	0.28 Mod	7 Mod	6.38 Mod	2.14 Mod	0.35 Mod	1.76 High	12.27 Low	10.63 Mod	ND V	2 / Low	1 V Low	14 Sli-sodic	87 V High	2.98 Ca sli deficient	6.11 OK

Table B.3 ETESP LabData Collation – Aceh Jaya (2)

			Location: Sumatra	Add Date in WHITE boxes by Samp.	e or Horizon			ΙΓ	Saturations	
		T al.						Exchangeables	ASP ESP Base	Cation Ratios Cation Ratios
Kabupaten	Scheme / Desa	Site No	Soil (O)   Depth   Range	S Si C Lab % % % Texture	dS/m H2O KCI	dif H Al ppm ppm ppm	Avail K Org C Total N C:N	Ca Mg K Na CEC TEB	Sat% Sat% Sat% Sat% %	Ca/Mg Rating Mg/K Rating
Aceh Jaya	Jabie	JB 4	D 8	55 29 16 SL	0.46 7.5 6.8  Non Sal Neutral ND	0.70 0.01 0.22 4 63 ND V Low Defic Low	3.22 0.29 11 High Mod Go	1 10.85 1.19 0.3 1.51 15.15 13.85 od High Low Mod High Mod Mod	8 2 1 10 91  VLow VLow VLow VSII-sodic VHigh	9.12 Mg deficient with P inhibition 3.97 OK
Aceh Jaya	Jabie	JB 4	D 0 8	84 6 10 LS	0.46 7.6 7.0 Non Sal Sii Alk ND	0.60 0.02 0.18 3.1 63 ND VLow VLow Defic Low	1.72 0.21 8 Mod Mod Mod	3 10.66 1.66 0.87 1.46 15.18 14.65 od High Mod High High Mod Mod	11   6   1   10   97   ND   V Low   V Low   V Sil-sodic   V High	6.42 Mg sli deficient 1.91 Mg deficient
Aceh Jaya	Jabie	JG 2	0 12	4 27 69 C	0.76 6.0 5.5	0.50 0.01 0.38 364 122.8	1.72 0.30 6	8.23 0.87 0.2 1.31 11.14 10.61	8 2 3 12 95	9.46 Mg deficient with P inhibition 4.35 OK
Aceh Jaya	Jabie	JG 2	Rating D 0 5	30 28 42 C	Non Sal         Mod Acid         ND           0.61         7.3         6.5	ND V Low Ext High Mod 0.80 0.40 0.23 7 370.4	Mod Mod Mod 2.96 0.44 7	od         Mod         Low         Low         High         Low         Mod           7         10.62         1.44         1.21         2.05         16.54         15.32	V Low         V Low         V Low         Sli-sodic         V High           9         7         1         12         93	7.38 Mg deficient with P inhibition 1.19 Mg deficient
Aceh Java	Jabie	IG 2	Rating	56 16 18 SCI	Non Sal Neutral ND 0.70 7.5 6.9	ND Low Low Mod / OK Mod 0.60 0.23 0.19 4.2 281.6	Mod Mod Mod 1,54 0.22 7	od High Low VHigh VHigh Mod High 7 9.28 1.49 1.21 1.83 13.80 13.81	V Low         V Low         V Low         Sli-sodic         V High           11         9         1         13         100	6.23 Mg sli deficient 1.23 Mg deficient
	Jable	JG Z	Rating	30 10 16 SCI	Non Sal Neutral ND	ND Low V Low Defic Mod	Mod Mod Mo	od Mod Low V High High Low Mod	ND V Low V Low Sli-sodic V High	0.25 Initi sil deliderit 1.25 Initi deliderit
Aceh Jaya	Jabie	JG2 Mean	O ND Rating	43 22 30	0.66 7.4 6.7 Non Sal Neutral ND	0.70	2.25 0.33 7 Mod Mod Mod Mo	7 9.95 1.465 1.21 1.94 15.17 14.57 od Mod Low V High High Mod Mod	10   8   1   13   96	6.79 Mg Sil deficient 1.21 Mg deficient
Aceh Jaya	Karang Tunong	KT A1	O 40	10 45 45 SiC	0.70 7.1 6.2 Non Sal Neutral ND	0.90 0.24 0.17 19 120 ND Low V Low Mod / OK Mod	5.53 0.32 13 V High Mod Mod	7 8.05 2.69 0.2 2.36 15.85 13.30 od Mod Mod Low V High Mod Mod	17	2.99 Ca sli deficient 13.45   K deficient
Aceh Jaya	Karang Tunong	KT H1	O 12	47 18 35 SCL	3.10 7.1 6.5 Non Sal Neutral ND	0.60 0.12 0.18 218.1 247.7 ND VLow VLow Ext High Mod	2.64 0.24 11 Mod Mod Go	1 8.26 1.29 0.68 1.6 12.66 11.83 ood Mod Low High High Low Mod	10 5 1 13 93 ND V Low V Low Sli-sodic V High	6.40 Mg sli deficient 1.90 Mg deficient
Aceh Jaya	Karang Tunong	KT H1	D 0 12	94 1 5 S	0.97 7.3 6.3	1.00 0.41 0.17 14.8 127	1.43 0.22 7	9.14 1.55 1.08 2.86 15.95 14.63	10 7 1 18 92	5,90 Mg sli deficient 1.44 Mg deficient
Aceh Jaya	Karang Tunong	KTG1	O 38	73 16 11 SL	Non Sal   Neutral   ND	ND Low VLow Mod/OK Mod 0.60 0.18 0.22 20.5 217.2	1.39 0.19 7	od Mod Mod High V High Mod Mod 7 8.21 1.97 0.8 2.49 15.18 13.47	VLow         VLow         VLow         Sodic         VHigh           13         5         1         16         89	4.17 OK 2.46 Mg sli deficient
Aceh lava	Karang Tunong	KTG1	Rating	95 1 1 S	Sli Sal   Neutral   ND	0.60 0.18 0.22 20.5 217.2 ND VLow Low Mod/OK Mod 0.70 0.02 0.18 14.5 209.9	Mod Low Mo	7 8.21 1.97 0.8 2.49 15.18 13.47 od Mod Mod High V High Mod Mod 9 9.02 1.52 1.23 2.94 36.13 14.71	13 5 1 16 89 ND V Low V Low Sodic V High 4 3 0 8 41	E 02 Marcil deficient 124 Marciledes
7 tooli Juju		KTOT	Rating		Non Sal Neutral ND	ND V Low V Low Mod / OK Mod	Mod Low Mo	od Mod Mod V High V High High Mod	V Low V Low V Sli-sodic Low	5.75 mg sil delitidelit. 1.24 mg delitidelit
Aceh Jaya	Kr. Ateu	KA 1	O 18 Rating	42 45 13 L	1.41 7.5 6.6 Non Sal Neutral ND	0.90 0.01 0.38 11.2 375.6 ND V Low Low Mod / OK Mod	2.6 0.18 14 Mod Low Go	4 9.14 0.71 0.62 0.80 12.82 11.27 od Mod Low High High Low Mod	6 5 3 6 88 VLow VLow VSII-sodic VHigh	12.87 Mg deficient with P inhibition 1.15 Mg deficient
Aceh Jaya	Kr. Ateu	KA 1	D 0 18	40 14 46 C	0.25 7.9 7.2 Non Sal Sii Alk ND	0.70 0.41 0.18 15.3 242	1.91 0.15 13 Mod Jow Go	3 10.12 1.53 0.64 1.00 14.53 13.29	11   4   1   7   91     ND   V Low   V Low   V Sli-sodic   V High	6.61 Mg sli deficient 2.39 Mg sli deficient
Aceh Jaya	Kr. Ateu	KA 14	D 14	25 45 30 CL	0.90 7.5 6.3	1.20 1.23 0.07 12.3 40.4 ND Mod Vlow Mod/OK Vlow	3.24 0.12 2	7 6.63 1.71 0.39 1.71 13.60 10.44	13 3 1 13 77  ND V Low V Low Sli-sodic High	3.88 OK 4.38 OK
Aceh Jaya	Kr. Ateu	KA 14		85 10 5 SL	0.90 7.3 6.5	0.80 1.02 0.09 99 65.9	6.6 0.20 33	3 6.54 1.34 0.49 1.84 11.30 10.21	12 4 1 16 90	4.88 OK 2.73 Mg sti deficient
Aceh Jaya	Kr. Ateu	KA 30	Rating D 43	54 33 14 SL	Non Sal   Neutral   ND	ND Mod VLow High Low 0.00 0.37 0.22 77.8 292.4	V High Mod Po	Mod         Low         Mod         High         Low         Mod           7         8.08         0.97         0.3         0.65         10.54         10.00	ND VLow VLow Sodic VHigh 9 3 2 6 95	8.33 Mg deficient with P inhibition 3.23 OK
Aceh Jaya	Kr Ateu	KA 30	Rating		Non Sal   Neutral   ND	ND Low Low High Mod 0.00 0.13 0.24 37.3 557.6	Mod Mod Mod 1.46 0.17 9	od Mod Low Mod Mod Low Mod 9 9.61 1.1 0.41 0.96 12.36 12.08	9 3 2 6 95 VLow VLow VLow VSII-sodic VHigh	8.74 Mg deficient with P Inhibition 2.68 Mg sli deficient
	14.7404	10100	Rating		Non Sal Sli Alk ND	ND V Low Low Mod High M High	Mod Low Mo	od Mod Low Mod High Low Mod	VLow VLow VLow VSII-sodic VHigh	
Aceh Jaya	Kr. Ateu	KA 30	D 0 20 Rating	84 0 18 LS	5.60 7.8 7.8 Sli Sal Sli Alk ND	0.00 0.19 0.23 80.4 801.9 ND V Low Low High M High	2.17 0.31 7 Mod Mod Mod Mod	7 9.66 1.14 0.4 1.13 13.27 12.33 od Mod Low Mod High Low Mod	9 3 2 9 93 VLow VLow VSII-sodic VHigh	8.47 Mg deficient with P inhibition 2.85 Mg sli deficient
Aceh Jaya	Kr. Ateu	KA 8	O 8 20	10 48 42 SiC	2.20 7.4 5.5 Non Sal Neutral ND	190 0.23 0.19 18.4 428.4 ND Low VLow Mod/OK Mod	1.56 0.16 10 Mod Low Mo	0 8.18 2.46 0.52 2.31 14.28 13.47 od Mod Mod Mod V High Low Mod	17   4   1   16   94     ND   V Low   V Low   Sodic   V High	3.33 OK 4.73 OK
Aceh Jaya	Kr. Ateu	KA 8	D 0 8	87 5 8 SL	8.10 6.0 5.1 Mod Sal Mod Acid ND	0.90 0.23 0.19 94.9 2930.7	1.45 0.20 7 Mod Mod Mod Mod	7 6.24 1.63 0.24 1.74 10.73 9.85 od Mod Mod Low High Low Mod	15 2 2 16 92 ND V Low V Low Sodic V High	3.83 OK 6.79 OK
Aceh Jaya	Kr. Ateu	KA 8	O 20	17 43 25 SiCI	1.60 6.9 5.4	1.50 0.20 0.22 80.8 87.4	2.52 0.27 9	7.57 1.67 0.42 1.78 12.04 11.44	14 3 2 15 95	4.53 OK 3.98 OK
Aceh Java	Kr. Ateu	KA 8 Mean	Rating MIX 8 20	52 24 17	Non Sal Neutral ND 4.85 6.45 5.25	ND Low Low High Low 1.20 0.215 0.205 87.85 1509.05	Mod Mod Mod 1.985 0.235 8	od Mod Mod Mod High Low Mod 8 6,905 1.65 0.33 1.76 11.385 10.65	14 3 2 15 94	4.18 OK 5.00 OK
Aceh Java	Kr. Ateu	KA A5	Rating	34 34 32 L	Sli Sal Sli Acid ND	ND Low Low High High	Mod Mod Mod 1,35 0.08 17	od         Mod         Mod         High         Low         Mod           7         0.35         1.52         0.23         0.77         10.81         2.87	ND V Low V Low Sodic V High	
			Rating		Non Sal Neutral ND	0.80         0.02         0.18         28         22           ND         VLow         VLow         Mod High         V Defic	Mod V Low Mo	od V.Low Mod Low High Low V.Low	14 2 2 7 27 ND V Low V Low VSI-sodic V Low 10 3 2 7 81	0.23   Ca delicient 6.61   OK
Aceh Jaya	Kr. Ateu	KA A5	D 0 25  Rating	83 7 15 SL	2.00 7.1 6.3 Non Sal Neutral ND	0.80	0.89 0.09 10 Low V Low Mo		ND V Low V Low VSII-sodic V High	5.86 Mg Sil deficient 3.83 (OK
Aceh Jaya	Kr. Ateu	KA B	O 10 Rating	22 43 35 CL	0.33 6.3 6.5 Non Sal Sli Acid ND	-0.20 0.12 0.17 33 92.1 #N/A V Low V Low Mod High Low	2.3 0.15 15 Mod Low Mo	5 6.04 0.9 0.29 2.1 11.55 9.33 od Mod Low Low V High Low Mod	8 3 1 18 81 VLow VLow VLow Sodic VHigh	6.71 Mg sli deficient 3.10 OK
Aceh Jaya	Kr. Ateu	KA B3	D 0 10	92 48 4 S	0.56 6.8 6.0 Non Sal Neutral ND	0.80 0.23 0.16 15 105.5 ND Low V Low Mod/OK Mod	2.06 0.14 15 Mod Jow Go	5 3.09 1.16 0.52 1.34 10.91 6.11	11   5   1   12   56     ND	2.66 Ca sli deficient 2.23 Mg sli deficient
Aceh Jaya	Kr. Ateu	KAC	0 9	13 61 26 SIL	0.86 7.5 7.5	0.00 0.23 0.18 4.4 96.3	1.89 0.24 8	8.81 0.99 0.34 0.95 12.24 11.09	8 3 1 8 91	8.90 Mg deficient with P inhibition 2.91 Mg sli deficient
Aceh Jaya	Kr. Ateu	KAC		60 0 40 SC	0.27 7.9 7.9	ND Low V Low Defic Low 0.00 0.41 0.18 11.3 51	1.37 0.18 8	od Mod Low Mod High Low Mod 8 10.28 1.91 0.39 1.54 14.94 14.12	V Low         V Low         V SII-sodic         V High           13         3         1         10         95	5.38 Mg sli deficient 4.90 OK
Aceh Java	Kr. Ateu	KAC4	D 30	60 29 10 SL	Non Sal SII Alk ND 0.24 7.0 7.0	ND Low V Low Mod / OK Low 0.00 0.22 0.18 99 30.9	1.72 0.16 11	od High Mod Mod High Low Mod 1 9.15 1.39 0.50 1.31 12.63 12.35	ND V Low V Low SII-sodic V High 11 4 1 10 98	6.58 Mg sli deficient 2.78 Mg sli deficient
Aceh Java	Kr Ateu	KACA	Rating	86 0 14 IS	Non Sal   Neutral   ND	ND Low VLow High Defic 0.00 0.01 0.40 20.5 153.3	Mod Low Go	Mod         Low         Mod         High         Low         Mod           2         10.39         2.87         0.74         2.10         16.33         16.10	ND V Low V Low SII-sodic V High	362 TOK 200 TOV
nucii Jaya	14.7404	IGNOT	Rating	00 0 11 23	Non Sal Mod Alk ND	ND V Low Low Mod / OK Mod	Mod Low Go	od High Mod High V High Mod High	ND VLow VLow SII-sodic VHigh	5.00 JUN
Aceh Jaya	Kr. Ateu	KAI 4	O 50 Rating	49 46 4 L	0.40 7.6 7.6 Non Sal Sli Alk ND	0.00 0.21 0.39 63.0 73.1 ND Low Low High Low	1.84 0.32 6 Mod Mod Mod	6 9.20 1.43 0.20 1.69 12.94 12.52 od Mod Low Low High Low Mod	11	6.43 Mg sli deficient 7.15 OK
Aceh Jaya	Kr. Ateu	KAI 4	D 0 50	39 23 38 CL	0.51 7.5 7.5	0.00 0.31 0.10 10.5 197.2 ND Low VLow Mod/OK Mod	1.66 0.35 5 Mod Mod Mod	8.26 1.18 0.20 1.82 12.75 11.46 od Mod Low Low High Low Mod	9 2 1 14 90 VLow VLow VLow Sli-sodic VHigh	7.00 Mg deficient 5.90 OK
Aceh Jaya	Kr. Ateu	KD 10	O 23	56 26 17 CL	1.13 7.4 7.4	0.00 0.02 0.18 3.3 209.9 ND VLow VLow Defic Mod	1.63 0.16 10 Mod Low Go	0 9.14 1.61 0.53 1.76 14.00 13.04 lood Mod Mod Mod High Low Mod	12 4 1 13 93 ND V Low V Low Sli-sodic V High	5.68 Mg sli deficient 3.04 OK
Aceh Jaya	Kr. Ateu	KD 10	D 0 23	67 11 22 SL	0.61 8.3 8.3	0.00 0.19 0.21 15.7 316	1.4 0.30 5	10.14 2.3 0.68 2.04 15.62 15.16	15 4 1 13 97	4.41 OK 3.38 OK
Aceh Jaya	Krueng Tunong	KT A1	Rating	84 3 13 SL	0.40 7.7 6.9	0.80 0.01 0.22 12 55	Mod Mod Mod 0.87 0.09 10	0 6.44 0.95 0.27 1.29 12.25 8.95	ND         V Low         V Low         SII-sodic         V High           8         2         2         11         73	6.78 Mg sli deficient 3.52 OK
Acob Jours	Vruona Tunona	KT D1	Rating	89 2 9 LS	Non Sal Sli Alk ND 0.45 7.5 6.5	ND V Low Low Mod / OK Low	Low V Low Mo	od Mod Low Low High Low Mod 8 5.04 1.03 0.69 1.39 10.69 8.15	V Low V Low SII-sodic High	
Aceh Jaya	Krueng Tunong		Rating		Non Sal Neutral ND	ND Low V Low Mod High Low	Mod Low Mo	od Mod Low High High Low Mod	10   6   2   13   76	4.89 CK 1.49 Mg delicient
Aceh Jaya	Krueng Tunong	KT D1	O 36 50  Rating	12 50 38 SiCL	0.67 7.5 6.5 Non Sal Neutral ND	1.00         0.40         0.18         5.2         101.2           ND         Low         V Low         Mod / OK         Mod	2.68 0.15 18 Mod Low Mo	8 5.78 0.35 0.5 1.02 10.39 7.65 od Mod V Low Mod High Low Mod	3 5 2 10 74 V Low V Low V Low V Sil-sodic High	16.51 Mg deficient with P inhibition 0.70 Mg deficient
Aceh Jaya	Krueng Tunong	KTC	D 0 60	93 1 6 S	0.47 6.5 5.8 Non Sal Sli Acid ND	0.70 0.13 0.23 22.2 177.7 ND VLow Low Mod/OK Mod	1.54 0.15 10 Mod Low Go	0 5.92 0.72 0.61 0.46 8.75 7.71 od Mod Low High Mod Low Mod	8 7 3 5 88 VLow VLow VSII-sodic VHigh	8.22 Mg deficient with P inhibition 1.18 Mg deficient
Aceh Jaya	Kuala Meurisi	ML	D 0 20	85 10 5 LS	0.66 7.0 6.2 Non Sal Neutral ND	0.80	1.4 0.12 13 Mod Low Go	2 7.92 0.78 0.3 1.37 11.40 10.37 and Mod Low Mod High Low Mod	7 3 1 12 91 VLow VLow VLow Sli-sodic VHigh	10.15 Mg deficient with P inhibition 2.60 Mg sli deficient
Aceh Jaya	Kuala Meurisi	ML	O 20 50	12 40 48 SiC	0.78 6.5 6.0	0.50 0.04 0.17 30 109		3 5.21 0.95 0.47 1.07 12.25 7.70	8 4 1 9 63	5.48 Mg sli deficient 2.02 Mg sli deficient

Table B.4 ETESP LabData Collation – Aceh Jaya (3)

			Location:	Sumatra	Ad	ld Date ii	in WHITE b	oxes by Samp	ale or Horizon														Satura					
Kabupaten	Scheme	Site	Soil (O)	Depth	Range	S Si	i C	Lab	EC	pH	pH	pH	Exchange	able	Fe	SO <sub>4</sub>	Avail P	Avail K	Org C Total N	C:N	Exchangeables	Mg			SP Bas		Cation Ratios	Cation Ratios
h Jaya	/ Desa Kulam Asan	LB B3	Deposit (D)	From 30	To	% % 47 31	6 % 1 22	Texture L	dS/m 1.13	H2O 7.4	6.6	0.80	0.32	0.18	ppm 244.3	ppm 65.1	ppm	ppm	% % 2.75 0.21	13	Ca         Mg         K         Na         CEC         TEB           9.15         1.51         0.53         1.1         13.42         12.29	Sat% 11	Sat% Sa 4	% S	at% % 8 92	Ca/l	Mg Rating  06 Mg sli deficient	Mg/K Rating 2.85 Mg sli deficient
lava	Kulam Asan	LB B3	D	Rating	20	00 0	2	c	Non Sal 1.25	Neutral 7.7	ND 7.1	ND 0.60	Low 0.57	V Low	Ext High	Low			Mod Mod 1.57 0.15	Good	Mod Mod Mod High Low Mod	ND 12	V Low V L	ow VSI	-sodic V Hi	gh	DE IOV	2 NE - 10 V
i Jaya		LD D3	D	Rating	30	70 0	) 2		Non Sal	Sli Alk	ND	ND	Mod	Low	Mod High	322 Mod			Mod Low	Good	Mod Mod High V High Mod Mod	ND	V Low V L	ow Sli-	sodic V Hi	gh	UK.	3.03 OK
n Jaya	Kulam Asan	LBG1	ND	ND Rating				Saprist (pea	0.34 Non Sal	4.0 Ext Acid	3.6 ND	0.40 ND	4.04 High	0.56 Mod	Mod / OK	140 Mod			4.9 0.15 High Low	33 Poor	2.12 0.67 0.57 0.77 24.21 4.13 Low Low Mod High Mod Low	V Low	V Low V L	ow Non	sodic V Lo	3.1	16 OK	1.18 Mg deficient
n Jaya	Lambaro	LB9	0	ND Rating		62 12	2 26	SCL	1.18 Non Sal	7.3 Neutral	6.4 ND	0.90 ND	0.01 V Low	0.39	26.5 Mod High	350.3 Mod			1.97 0.41 Mod Mod	5 Mod	5.25 1.34 0.42 1.28 9.87 8.29	14 ND	4 4 Vlow VI	nw Sli.	13 84 sodic V Hi	3.9	92 OK	3.19 OK
h Jaya	Lambaro	LD1	D	20		51 22	2 27	SCL	2.60	6.6	6.0	0.60	0.15	0.26	68	182.2			1.99 1.00	2	5.85 0.96 0.87 1.19 10.54 8.87	9	8 2		11 84	6.0	09 Mg sli deficient	1.10 Mg deficient
eh Jaya	Lambaro	LD1	D	Rating	20	85 3	12	LS	3.20	Neutral 7.2	6.5	0.70	0.18	0.22	High 21.4	328			1.42 0.13 Mod Low	Ext Poor 11	8.94 1.38 1.17 1.87 13.43 13.36	V Low	9 Z	ow SII-	sodic V Hi 14 99	gh 6.4	48 Mg sli deficient	1.18 Mg deficient
nh lava	Lambaro	IDI	0	Rating		31 21	1 //0		Non Sal	Neutral 6.6	ND 6.0	ND 0.60	V Low	Low 0.26	Mod / OK	Mod 182.2			Mod Low 1.99 0.21	Good	Mod Low High High Low Mod	ND Q	V Low V L	ow Sli-	sodic V Hi	gh 6.0	Mn sli deficient	1.13 Ma deficient
l l		LDI	0	Rating	00	20 0		CI	Non Sal	Neutral	ND	ND	V Low	Low	High	Mod			Mod Mod	Mod	Mod Low High High Low Mod	V Low	V Low V L	ow Sli-	sodic V Hi	gh		
h Jaya	Lambaro	LDI	D	Rating	20	83 9	8	SL	3.20 Non Sal	7.2 Neutral	6.5 ND	0.70 ND	0.18 V Low	0.22 Low	21.4 Mod / OK	328 Mod			1.42 0.13 Mod Low	Good Good	8.94 1.39 1.17 1.37 13.43 12.87  Mod Low High High Low Mod	ND ND	V Low V L	ow Sli-	sodic V Hi	gh 6.4	Mg sli deficient	1.19 Mg deticient
h Jaya	Lambesoi	LS 10	0	20 Rating		28 61	1 11	SiL	1.70 Non Sal	6.5 Sli Acid	5.9 ND	0.60 ND	0.16 V Low	0.28 Low	187.4 V High	126 Mod			2.14 0.25 Mod Mod	9 Mod	7.42 0.86 0.11 1.30 10.73 9.69 Mod Low Low High Low Mod	8 V Low	1 3 V Low V L	ow Sli-	12 90 sodic V Hi	8.6 ah	Mg deficient with P inhibition	7.82 OK
h Jaya	Lambesoi	LS 10	D	0 Detine	6 (	94 2	2 4	S	2.70	7.7 Sli Alk	7.0 ND	0.70	0.23 Low	0.19	107.8	1035.9			1.56 0.15 Mod Low	10	9.24 1.41 0.44 1.83 13.68 12.92 Mod Low Mod High Low Mod	10 ND	3 1	ow Sli-	13 94 sodic V Hi	6.5	Mg sli deficient	3.20 OK
n Jaya	Lambesoi	LS 10	D	6	20 2	22 44	4 34	CL	1.64	8.0	7.3	0.70	0.42	0.18	182	123.7			1.71 0.21	8	10.01 2.43 0.64 2.24 16.25 15.32	ND 15	4 1	UW SII-	14 94	4.1	12 OK	3.80 OK
n Java	Lambesoi	LS 13	0	Rating 10	50	40 51	1 0		Non Sal 0.47	Sli Alk 7.2	ND 6.6	ND 0.60	0.23	V Low 0.26	V High	Mod 66			Mod Mod 1.34 0.12	Mod 11	High         Mod         High         V High         Mod         High           6.49         1.26         0.59         1.19         12.75         9.53	ND 10	V Low V L	ow Sli-	sodic V Hi	gh 5.1	15 Mn sli deficient	2.14 Mn sli deficient
			Ů	Rating				Ė	Non Sal	Neutral	ND	ND	Low	Low	Mod / OK	Low			Mod Low	Good	Mod Low Mod High Low Mod	V Low	V Low V L	ow VSI	-sodic Hig	h	ing sir denotes.	z. II Ing sir dendent
n Jaya	Lambesoi	LS 13 CLAY	U	ND Rating		14 30	U 56	C	1.09 Non Sal	6.5 Sli Acid	6.0 ND	0.50 ND	0.55 Mod	U.26 Low	V High	97 Low			5.77 0.38 V High Mod	15 Mod	6.63         0.81         0.41         0.92         12.60         8.77           Mod         Low         Mod         High         Low         Mod	V Low	V Low V L	ow VSI	sodic Hig	8.1 h	Mg delicient with P inhibition	1.96 Mg deficient
n Jaya	Lambesoi	LS 26	0	15 Rating		13 33	3 54	С	4.50 Sli Sal	7.0 Neutral	6.2 ND	0.80 ND	0.01 V I ow	0.21	224.4 Ext High	502.4 M High			2.32 0.26 Mod Mod	9 Mod	9.12 1.2 0.44 1.09 15.91 11.85 Mod Low Mod High Mod Mod	VI ow	3 1	ow VSI	7 74 -sodic Hig	7.6	Mg deficient with P inhibition	2.73 Mg sli deficient
n Jaya	Lambesoi	LS 26	D	0	4 4	45 33	3 22	L	4.50	7.6	6.9 ND	0.70	0.20	0.41	96.5	1084.2			1.79 0.19	9	10.06 2.82 0.74 2.53 17.02 16.15	17	4 2		15 95	3.5	57 OK	3.81 OK
n Jaya	Lambesoi	LS 26	D	4	15	16 74	4 11	SiL	3.25	Sli Alk 7.7	7.0	0.70	0.23	0.19	17.5	483.1			1.99 0.16 Mod Low	M00 12	9.73 1.43 0.21 1.89 15.73 13.26	ND 9	1 1	-	12 84	6.8	Mg sli deficient	6.81 OK
h Java	Lambesoi	LS N17	0	Rating 30		29 50	0 21		Non Sal 1.46	Sli Alk 6.0	ND 5.2	IND	0.43	V Low 0.18	Mod / OK	Mod 157.4			2.11 0.28	Good 8	Mod Low Low High Mod Mod 653 0.97 0.70 1.46 10.84 9.66	V Low	V Low V L	ow Sli-	sodic V Hi	gh 67	73 Mn sli deficient	1 39 Ma deficient
			Ŭ	Rating		27 30	0 21	-	Non Sal	Mod Acid	ND	ND	Low	V Low	Mod / OK	Mod			Mod Mod	Mod	Mod Low High High Low Mod	V Low	V Low V L	ow Sli-	sodic V Hi	gh	ing an derivers	1.07 mg denotes
Jaya	Lambesoi	LS N4	D	Rating	50	3/ 30	0 33	CL	1.02 Non Sal	5.9 Mod Acid	5.1 ND	0.80 ND	U.22 Low	0.18 V Low	267.7 Ext High	86 Low			1.82 0.31 Mod Mod	6 Mod	7.01 2.23 0.35 2.25 14.41 11.84 Mod Mod Mod V High Low Mod	ND ND	V Low V L	ow Si	odic V Hi	gh 3.1	14 OK	6.37 JOK
Jaya	Meudheun	M3	0	7 Rating	4	44 23	3 34	CL	2.70 Non Sal	6.5 Sli Acid	6.0 ND	0.50 ND	0.46 Low	0.20 Low	68.7 High	187.6 Mod			2.63 0.30 Mod Mod	9 Mod	6.34 1.22 0.3 0.91 9.71 8.77 Mod Low Mod High Low Mod	13 ND	3 2 V Low V L	ow VSI	9 90 -sodic V Hi	5.2 ah	20 Mg sli deficient	4.07 OK
Jaya	Meudheun	M3	D	0 Detine	7 9	92 7	1 1	S	1.75 Non Sal	7.7 Sli Alk	7.1 ND	0.60 ND	0.01 V I ow	0.38	18	279 Mod			1.67 0.22 Mod Mod	8 Mod	8.83 1.92 0.75 1.93 14.49 13.43	13 ND	5 3	CII	13 93 sodic V Hi	4.6	60 OK	2.56 Mg sli deficient
Jaya	Meulha	MA9	0	25		20 63	3 17	SiCL	3.40	5.9	5.9	IID	0.19	LOW	338.7	mou			2.61 0.32	8	5.83 0.92 0.58 1.08 9.04 8.41	10	6 2		12 93	6.3	34 Mg sli deficient	1.59 Mg deficient
Java	Meulha	MA9	D	Rating 0	25	54 3	3 43	SC	Non Sal 6.00	Mod Acid 7.2	ND 7.2	ND 0.00	V Low 0.13	0.23	Ext High 46.8	Mod 151.3			2.37 0.31	Mod 8	Mod Low Mod High Low Mod 10.65 1.46 0.72 1.70 15.64 14.53	ND 9	V Low V L	ow Sli-	sodic V Hi	gh 7.2	29 Ma deficient with P inhibition	2.03 Mg sli deficient
n Jaya	Donahulus Hasalist	PH A3	0	Rating 24		59 30	0 11	CCI	Sli Sal 1.09	Neutral 7.4	ND 6.8	ND 0.00	V Low 0.46	Low	High 10.4	Mod 122.F			Mod Mod 3.06 0.27	Mod	High Low High High Mod Mod 8.7 1.16 0.4 1.41 12.20 1167	V Low	V Low V L	ow Sli-	sodic V Hi	gh	DO Mandadada and Districtor	200 March deficient
	Panghuleu Harakat		U	Rating		39 30	0 11	301	Non Sal	Neutral	ND	ND	Low	Low	Mod / OK	Mod			High Mod	Good	Mod Low Mod High Low Mod	V Low	V Low V L	ow Sli-	sodic V Hi		ang denicient wat P trinibilion	2.90 mig sil delicient
Jaya	Panghuleu Harakat	PH A3	D	0 Rating	24	93 2	2 5	S	0.35 Non Sal	7.8 Sli Alk	7.0 ND	0.80 ND	0.18 V Low	0.20 Low	14.1 Mod / OK	129.7 Mod			2.72 0.19 Mod Low	14 Good	9.81 1.75 0.27 1.71 14.19 13.54 Mod Mod Low High Low Mod	12 ND	2 1 V Low V L	ow Sli-	12 95 sodic V Hi	5.6 gh	Mg sli deficient	6.48 OK
ı Jaya	Panghuleu Harakat	PH D1	0	18 Rating		60 15	5 25	SCI	8.10 Mod Sal	6.0 Mod Acid	5.1 ND	0.90 ND	0.22	0.40	94.9 High	2930.7 V High			2.13 0.31 Mod Mod	7 Mod	7.95 0.88 0.62 0.58 12.73 10.03	7 VIow	5 3	ow Non	5 79 -sodic Hia	9.0 h	Mg deficient with P inhibition	1.42 Mg deficient
Jaya	Panghuleu Harakat	PH D1	D	0	18	59 30	0 11	SL	1.45	5.0	4.1	0.90	0.58	0.22	97.9	925			2.67 0.33	8	7.50 0.74 0.46 0.56 11.00 9.26	7	4 2		5 84	10.	.14 Mg deficient with P inhibition	1.61 Mg deficient
Java	Rawa Krueng Itam	Gambut KH12	0	Rating 70		_	+	peat	0.47	VStr Acid	3.7	0.60	Mod 0.70	0.93	High 681	M High 3533.6			Mod Mod 9.78 0.63	Mod 16	6.22 0.85 0.30 1.26 18.21 8.63	V Low	V Low V L	ow VSI	-sodic V Hi 7 47	gh 7.3	32 Mg deficient with P inhibition	2.83 Mg sli deficient
Java	Rawa Krueng Itam	Gambut KH7	0	Rating		_		nost	Non Sal 1.72	Ext Acid	ND 2.0	ND 0.60	Mod	Mod	Toxic	V High			V High High	Mod 17	Mod Low Mod High Mod Mod	V Low	V Low Lo	w VSI	-sodic Lov	77	Ma deficient	250 Macli deficient
		Ganibul KIT/	U	Rating	30			peat	Non Sal	Ext Acid	3.9 ND	NU	0.65 Mod	0.75 Mod	Toxic	Mod			10.93 0.65 V High High	Mod	7.06 1.00 0.40 0.91 18.85 9.37 Mod Low Mod High Mod Mod	V Low	V Low V L	ow Non	-sodic Lov	V	and the same of th	and an acrossit
Jaya	Rawa Krueng Itam	KH12	0	ND Rating				Febric	0.30 Non Sal	4.0 Ext Acid	3.5 ND	0.50 ND	5.19 V High	0.30 Low	55 High	200.1 Mod			9.22 0.14 V High Low	66 Poor	2.23 0.72 0.73 0.67 30.22 4.35 Low Low High Mod High Low	V Low	V Low V L	ow Non	2 14 -sodic V Lo	3.1	IU UK	u.99 Mg deficient
Jaya	Seneubok Padang	Gambut RK 1	0	ND Rating				Hemist	1.44 Non Sal	4.0 Ext Acid	3.1 ND	0.90 ND	0.37 Low	0.86 Mod	271.7 Ext High	1465.6 High			11.26 0.66 V High High	17 Mod	6.56 2.24 0.78 1.13 13.64 10.71 Mod Mod High High Low Mod	16 ND	6 6	w VSI	8 79 -sodic Hig	2.9 h	Ca sli deficient	2.87 Mg sli deficient
Jaya	Seneubok Padang	Gambut SP C1	0	90				Hemist	3.00	3.0	2.3	0.70	0.49	0.93	780.1	7198.1			10.22 0.63	16	4.82 2.43 0.23 1.55 10.84 9.03	22 ND	2 9		14 83	1.9	Ca sli deficient	10.57 K sli deficient
n Jaya	Seneubok Padang	SP 0 - 70 peat	0	Kating 0	70			Hemist	1.18	Ext Acid 4.1	3.5	0.60	0.80 Mod	Mod 0.24	232.4	829.1			V High High 10.41 0.64 V High High	Mod 16	6.29 2.45 0.28 1.35 13.08 10.37	ND 19	V LOW Lo	w Sli-	10 79	2.5	57 Ca sli deficient	8.75 OK
Java	Seneubok Padang	SPC2 peat	0	Rating ND				Homist	Non Sal 0.40	Ext Acid	ND 3.5	ND 0.60	Mod 5.42	0.22	Ext High	M High			V High High 6.12 0.12	Mod 51	Mod         Mod         Low         High         Low         Mod           2.04         0.78         0.57         0.58         24.35         3.97	ND 3	V Low V L	ow SII-	sodic Hig	h 2,6	62   Ca sli deficient	1.37 Min deficient
Jaya		or oz pedl	Ů	Rating				Hollist	Non Sal	Ext Acid	ND ND	ND	V High	Low	Mod / OK	Mod			V High Low	Poor	Low Low Mod Mod Mod Low	VLow	V Low V L	ow Non	sodic V Lo	OW 2.0		11.5 20.00
Jaya	Seneubok Padang	SPJ2	0	ND Rating				Saprist	0.35 Non Sal	4.1 Ext Acid	3.4 ND	ND	6.22 V High	0.32 Low	76 High	125.6 Mod			5.14 0.18 V High Low	Poor	2.05	V Low	V Low VL	ow Non	sodic V Lo	3.7	/S  UK	U.96 Mg deficient
Jaya	Treng Lipeh	KM B2	0	10 Rating		3 24	4 73	С	1.45 Non Sal	6.1 Sli Acid	5.4 ND	0.70 ND	0.18 V Low	0.18 V Low	2.1 V Defic	3.1 ND			2.34 0.21 Mod Mod	11 Good	8.84 1.49 0.12 0.62 12.36 11.07 Mod Low Low Mod Low Mod	12 ND	1 1 V Low V L	ow VSI	5 90 -sodic V Hi	5.9 gh	Mg sli deficient	12.42 K deficient
Jaya	Treng Lipeh	KM B2	D	0 Rating	10	91 2	2 7	S	1.05 Non Sal	7.4 Neutral	6.5 ND	0.90	0.36	0.36	15.5 Med / C*	127.8 Mod			1.54 0.29 Mod Mod	5	7.08 1.72 0.46 0.68 11.79 9.94 Mod Mod Mod Mod Low Mod	15	4 3 V Low V L		6 84 -sodic V Hi	4.1	12 OK	3.74 OK
Jaya	Treng Lipeh	KM C2	0	20		2 36	6 62	С	1.26	5.6	4.7		0.44	0.18	224.8	61.9			2.54 0.19	13	6.35 0.95 0.17 1.89 11.63 9.36	8	1 Z	ow vSI	16 80	6.6	68 Mg sli deficient	5.59 OK
lava	Treng Lipeh	KM C2	D	Rating 0	20	A 00		(	Non Sal 0.36	Mod Acid	ND 6.4	0.90	0.24	V Low 0.20	Ext High 7.2	Low			Mod Low	Good	Mod Low Low High Low Mod 954 193 0.39 2.02 14.55 13.88	V Low	V Low V L	OW S	odic V Hi	gh	94 TOK	4.95 10K
. suyu	rrong Elpon	Num OE	U	Rating	20	,,,		,	Non Sal	7.3 Neutral	ND	ND	Low	Low	Mod / OK	Mod			1.98 0.23 Mod Mod	Mod	9.54   1.93   0.39   2.02   14.55   13.88     Mod   Mod   Whigh   Low   Mod	ND	V Low VL		sodic V Hi	3.		
						-															A Page 31 of 40	ustin	Hutch	eon l	BSc M	Sc	www.geocities.co	m/Austin-su

Table B.5 ETESP LabData Collation – Aceh Timur, Aceh Utara & Bireuen

			Location: Sumatra	Add	Date in WHITE L	boxes by Samp	ale or Horizon																		Saturati				
	Scheme	Site	Soil (0) Donth I	Panne S	SI C	Lab	EC	nH	nH	nH F	xchangeable		Fe	SO. Avail I	Avail K	Org C	Total N	C·N		Exchangeable:	/ 100a			Ma k	ASP		Base	Cation Ratios	Cation Ratios
Kabupaten	/ Desa	No	Soil (0) Depth I Deposit (D) From		% %	Texture	dS/m	H2O	KCI	diff	Н	Al	ppm	SO <sub>4</sub> Avail I ppm ppm	ppm	%	%	C.IV	Ca		K Na			Mg F Sat% Sa	Al % Sat%	Dutio	BS %	Ca/Mg Rating	Mg/K Rating
Aceh Timur	Julok Tunong	JT B7		25 25	33 42	CL	1.06	5.7 Med Add	5.2				50.99				0.14		2			12.12		5 S			34	3.39 OK	0.91 Mg deficient
Arch Times	Lifeli Tonana	IT DO	Rating	25 10	44 27	CIOI	Non Sal	Mod Acid	ND	ND 0.40	V Low	Mod 0.E/	High	Mod 5(7.10		High	LOW	Poor 18	LOW		ligh High	Low	Low	V Low V L			V Low	2 70 IN	0.02 Ma deficient
Aceh Timur	Julok Tunong	JT B2	O 0 Rating	25 19	44 37	SiCL	1.55 Non Sal	5.9 Mod Acid	5.5 ND	0.40 ND	0.18 V Low	0.56 Mod	40.24 High	567.12 M Hinh	+	2.76 Mod	0.15 Low	Mod	1.93 V Low	0.51 0	.55 0.95 Mod High	Low	LOW	V Low V L			Low	3.78 OK	0.93 Mg deficient
Aceh Utara	Pase Kanan	PKNI	0 0	25 23	29 48	C	0.10	6.0	5.5	0.50	0.23	0.56	15	32	_	2.78	0.18	15	2.99	0.4 0	.55 0.67	10.21	4.61	4 !	5	7	45	7.48 Mg deficient with P inhibition	0.73 Mg deficient
7 ISON CILITA	T doo realidii	144	Rating	EU EU	27 10		Non Sal	Mod Acid	ND	ND			Mod / OK	Defic		Mod	Low	Mod			Mod Mod	Low			w Low			•	
Aceh Utara	Pase Kiri	PKR B5	0 0	25 19	24 57	С	0.42	6.0	5.4		0.33	0.67	67	45		3.23	0.22	15	2.64	0.61 0	.57 0.59	9.52		6 6			46	4.33 OK	1.07 Mg deficient
			Rating				Non Sal	Mod Acid	ND	ND	Low	Mod	High	V Low		High	Mod	Good	Low	Low N	Mod Mod	Low	Low	V Low V L	_		_		
Aceh Utara	Pase Kiri	PKR A3		25 20	25 54	С	0.76	5.7 Med Arid	5.3				100.5		1		0.17	23	2.3			11.34		4 4				4.60 OK	1.00 Mg deficient
Annh I Itara	Doos Viri	DVD D4	Rating 0	20 20	4F 24	CI	Non Sal	Mod Acid	ND	ND 0.30		Low	V High	LOW 11F 2F	+	High	Low	Poor 17	Low		Mod Mod		Low 4.00			Non-sodic 5	35	4.24 OK	0.00 Ma deficient
Aceh Utara	Pase Kiri	PKR B4	0 0 Rating	25 30	45 24	CL	0.90 Non Sal	5.6 Mod Acid	5.3 ND	ND ND			189.9 V High	Mod Mod	_	2.87 Mod	0.17 Low	Mod	2.33 Low		.56 0.56 Mod Mod	11.34 LOW	LOW	V Low V L	w V Lov			4.24 UK	0.98 Mg deficient
Aceh Utara	Krueng Tuan	BK7	0 0	25 19	42 39	SiCL	0.93	5.6	5.0	0.60			116.91	89 25	+	3.78	0.25	15	2.18	0.5 0	.88 0.82			4	_		33	4.36 OK	0.57 Mg deficient
			Rating			-	Non Sal	Mod Acid	ND	ND		Mod	V High	Low		High		Mod	Low		ligh High			V Low V L	w V Lov	VSIi-sodic	V Low	-	" "
Aceh Utara	Krueng Tuan	BKB7	0 0	25 33	27 40	CL	0.97	5.5	5.0				130.31				0.19	16	2.08	0.5 0		11.25		4	4	8	39	4.16 OK	0.62 Mg deficient
			Rating				Non Sal	Str Acid	ND	ND		Low	V High	Mod		High	Low	Mod	Low		ligh High	Low	Low		w V Lov				
Aceh Utara	Pase Kiri	PKR 28		25 80	14 6	SL	1.02	7.4	6.7				60.63	303.68			0.15		3.7		.93 0.95				2		68 High	1.95 Ca sti deficient	2.04 Mg sli deficient
Annie I Itara	Valona Tuon	BK6	Rating	25 24	45 24	CI	Non Sal 1.05	Neutral 5.5	ND 5.0	ND 0.50	V Low	0.76	High 137.9	1000		Mod			Low 1.9		0.56 High	LOW	Low 3.76	ND VL	N V Lov			2.17 OV	0.96 Mg deficient
Aceh Utara	Krueng Tuan	RKO	O 0 Rating	25 21	45 34	CL	Non Sal	Str Acid	ND ND	ND ND	0.40 Low	Mod Mod	V High	V Defic	_	3.4 High	0.21 Mod		V Low		ligh Mod	12.05 Low	Low		w Low			3.17 OK	0.86 Mg deficient
Aceh Utara	Pase Kanan	PKM B5	3	25 23	57 20	Sil	1.95	5.9	5.6				135.12		1	,	0.19		0.59		.56 0.59			27			43	0.20 Ca deficient	5.36 OK
/iccii olala	i doc Karlan	i idii bo	Rating	20 20	37 20	JIL	Non Sal	Mod Acid	ND	ND	Low		V High			High			V Low		And Mod				w V Lov				
Aceh Utara	Pase Kanan	PKM B1	0 0	25 32	36 32	CL	2.05	5.9	5.5	0.40	0.19	0.54	95.55	160.59	1	3.23	0.16	20	2.56	2.56 (	0.6	11.20	6.32	23 5	5	5	56	1.00 Ca sli deficient	4.27 OK
			Rating				Non Sal	Mod Acid	ND	ND	V Low	Mod	High	Mod		High	Low	Poor	Low	Mod H	ligh Mod	Low	Low	ND VL		VSII-sodic			
Aceh Utara	Pase Kiri	PASE KIRI MIX	D 0	10		LS	2.60	7.4	6.7				60.63	303.69		2.57	0.15	17			.91 0.9			17 8			63	1.68 Ca sli deficient	2.10 Mg sli deficient
A 1 10	D 1011	DVD 00	Rating	F0 44	05 04		Non Sal	Neutral	ND	ND	V Low	Low	High	W00		MOO	Low	MOD	Low		ligh High	Low	Low	ND VL				( 17 Mary Ed Colors	051
Aceh Utara	Pase Kiri	PKR 28	O 10 Rating	50 41	35 24	L	3.29 Non Sal	6.3 Sli Acid	5.8 ND	ND	0.18 V Low	0.24 Low	45.87 High	657.47 M High	+	3.92 High	0.17 Low	23 Poor	3.7 Low		.17 0.88 ligh High	11.14 Low	Low	5 1 V Low N	2 V Lov		57 Mod	6.17 Mg sli deficient	0.51 Mg deficient
Aceh Utara	Pase Kiri	Pase Kiri III	3	10	+	IS	13.64	7.0	6.6		_		45.87	J	+	_	0.17	23			.15 0.81		_		2		52	5.30 Mg sli deficient	0.53 Mg deficient
Accii olara	I doc Kill	I dat Kill III	Rating	10		LJ	Mod Sal	Neutral	ND	ND		Low	High	M High		High	Low	Poor	Low		ligh High	Low	Low		V Lov			1111	,
			,		_								,	,		,					, ,								
Bireuen	Paya Nie	PYN 2	0 10	22	25 52	С	0.64	5.6	5.0	0.60	0.19	0.61	91.33	100.33	+	3 1/1	0.16	20	2	0.56 0	.59 0.51	12.13	2.66	5 5	5	4	30	3.57 OK	0.95 Mg deficient
Dircucii	r aya Nic	FINZ	Rating	22	23 32	C	Non Sal	Mod Acid	ND ND	ND ND	V Low	Mod	High	Mod	_	High	Low	Mod	Low		Mod Mod	Low	Low	V Low V L				3.3/ OK	0.93 My delicient
Bireuen	Pava Nie	PYN 2	D 0	10 43	25 32	CL	0.79	5.3	4.7	0.60		0.53	119.07	122.44	+	3.47	0.16	22	2.08		.66 0.53		3.79	4 (			32	4.00 OK	0.79 Mg deficient
Dirodon	i aja mo	1112	Rating	10 10	20 02	- OL	Non Sal	Str Acid	ND	ND	Low	Mod	V High	Mod		High	Low	Poor	Low	_	ligh Mod	Low	Low	V Low V L	w V Lov	Non-sodic	V Low		
Bireuen	Peudada	PAD 25	0 0	25 30	29 41	С	0.89	5.4	4.6			0.62	169.77	132.27			0.19	21	2	0.01	.76 0.63	12.24			5			3.70 OK	0.71 Mg deficient
			Rating				Non Sal	Str Acid	ND	ND	Low	Mod	V High	Mod		High	Low	Poor	Low	Low H	ligh Mod	Low	Low	V Low V L	w Low	VSII-sodic	V Low		
Bireuen	Pate Lhong	PL1		25 33	25 42	С	0.90	5.9	5.5		0.23	0.55	90.5		1		0.16		2.08		.71 0.52			4 (			33	4.16 OK	0.70 Mg deficient
Dirouon	Date I hong	PL2	O 10	20 20	20 57	C	Non Sal 0.90	Mod Acid 5.9	ND 5.5	ND 0.40	0.23	Mod 0.55	High 289.9			High 4.01	L0W	Poor 24	Low		.51 0.55	Low 12.04	Low 3.82	V Low V L	w V Lou	Non-sodic	V Low	2 02 OV	1.10 Ma deficient
Bireuen	Pate Lhong	rl/	O 10 Rating	25 25	29 56	L	Non Sal	5.9 Mod Acid	5.5 ND	ND ND	Low	V.00 Mod	Ext High	15Z.30 Mod	+	4.01 High	0.17 Low	Poor Poor	2.2 Low	_	.51 U.55 Mod Mod	12.04 Low	Low		w V Lov	Non-sodic		3.93 OK	1.10 Mg deficient
Bireuen	Pandrah	PD1		25 22	45 33	CL	1.62	5.6	5.2			0.56	156.66	132.55			0.22			_		12.33		5 3			44	6.58 Mg sli deficient	1.90 Mg deficient
			Rating		10 00	, J.	Non Sal	Mod Acid	ND	ND	Low	Mod	V High	Mod		High	Mod	Poor	Low	Low N	And Mod	Low	Low	V Low V L					
Bireuen	Paya Nie	PN 1		25 30	31 39	C	2.05	5.5	5.0	0.50	0.01	0.49		197.25		3.78		21	3		.46 0.53			4			37	5.36 Mg sli deficient	1.22 Mg deficient
			Rating				Non Sal	Str Acid	ND	ND	Low	Low	V High	Mod		High	Low	Poor	Low		Nod Mod	Low	Low	V Low V L			_		
Bireuen	Peudada	PAD D3		25 30	32 38	CL	2.05	5.9	5.4		VILL	0.82	149.22		1		0.26	17 Mod	3		.46 0.53				7			5.36 Mg sli deficient	1.22 Mg deficient
Director	Data I hong	DI 12	Rating	10 40	20 40		Non Sal	Mod Acid	ND	ND 0.50	Low	MUU	V High	Mod		High	0.17	20	Low	Low N	Mod Mod	Low	Low	V Low V L	_			E 71 Ma cli deficient	0.00 Ma deficient
Bireuen	Pate Lhong	PL13	0 0 Rating	10 40	20 40		2.18 Non Sal	6.0 Mod Acid	5.5 ND	ND	0.21 Low	0.55 Mod	209.45 Ext High	213./1 Mod		3.47 High	0.17 Low	20 Poor	2.8 Low		.56 0.63	10.14 Low	4.48 Low	V Low V L	w Low	_	Low	5.71 Mg sli deficient	0.88 Mg deficient
Bireuen	Pate Lhong	PI 13	,	50 19	45 36	SiCI	2.19	5.6	5.3		0.33	0.78	289.9	132.56		2.99		15	2.2	_	.51 0.55	12.01	3.82	5 4	_		32	3.93 OK	1.10 Mg deficient
DIICUCII	I are Eliving	I L IJ	Rating	50 17	10 30	JIOL	Non Sal	Mod Acid	ND ND	ND	Low	Mod	Ext High	Mod		Mod	Mod	Good	Low		Mod Mod	Low	Low		w Low				, , , , , , , , , , , , , , , , , , ,
Bireuen	Samalanga	S6	0 0	25 15	20 65	С	2.20	5.9	5.5	0.40	0.13	0.54	56.17	442.12		3.32	0.19		2.5	0.61 0	.45 0.55	11.55		5 4				4.10 OK	1.36 Mg deficient
			Rating				Non Sal	Mod Acid	ND	ND	V Low	Mod	High	Mod		High	Low	Mod	Low	Low N	Mod Mod	Low	Low		w V Lov			•	
Bireuen	Samalanga	S7		25 25	27 48	C	3.36	5.8	5.2				66.66				0.20		2.93		.75 0.51			3 6				7.71 Mg deficient with P inhibition	0.51 Mg deficient
D)		04.0	Rating	OF TOTAL	04	_	Non Sal	Mod Acid	ND		V Low	Low	High	Mod		High	Mod	Mod	Low		ligh Mod	Low	Low	V Low V L	_	_		214 00	1.00 UMa deSajort
Bireuen	Samalanga	210	0 0 Rating	25 23	21 56	C	6.33	6.0 Mod Acid	5.6 ND			0.34 Low	70.33 High	302.22 Mod		2.92 Mod	0.17 Low		2.23 Low		.65 1.55 ligh High	10.14 Low		V Low V L			51 Mod	3.14 OK	1.09 Mg deficient
			roully				Oll Out	mou road	ND	HD	· LUII	LUII	riigii			IIIOU	LUII	mou	LUII	COII II	-y- myn	LOH	LUIT	· con V c	··· ¥ LUI	Joult	mou	<u> </u>	

Table B.6 ETESP LabData Collation – Pidie & Aceh Singkil

Iabic	D.U LIL	OI Lan									Jii 19	, IXII																					ai		
			Location:	Sumatra	1	Add Date i	in WHITE b	oxes by Sam	ole or Horizon			ı											Exchangea	hlas						Saturation		Base	Cation Ratios		Cation Ratios
Kabupaten	Scheme / Desa	Site	Soil (O) Deposit (D)	Depth	Range	S S	i C	Lab	EC dS/m	pH	pH	pH E	xchangeable H	le	Fe	SO <sub>4</sub>	Avail P	Avail K	Org C	Total N	C:N			neq / 100q				Mg	K	Al Cattle	Na Sarac	BS	Caudi Railos		Cation Railos
Didio		Reuracan I	Deposit (D)	From 10	20	% 9	6 %	S	0.62	5.9	5.0	0.00	0.30	0.48	116.90	97.55	ppm	ppm	3.78	0.12	32	2.88		071	0.62	10.99	4.76	Sat%	Sat%	Sat%	Sat%	43	5.24 Mg sli deficient	0.7	77 Mg deficient
Pidie	Beuracan	penacani	M		20			2F		017	0.U ND	U.9U		_		91.00 Low	ш		••		-			011 1	0102		_		177				3.24 My Sil Deliciell	0.11	/ Ingualization
				Rating					Non Sal	Mod Acid	NU	INU	LOW	LOW	V High				High	LOW	Poor	Low	LOW	High	Mod	Low	Low	V LOW	V LOW	V Low	VSIi-sodic	Low			
Pidie	Beuracan	BE F3 (mix)	М	ND		31 3	0 39	CL	0.67	6.1	5.4	0.70	0.17	0.44	45.00	45.00			2.12	0.12	18		0.17	0.61	0.99	10.23	4.64	2	6	4	10	45	16.88 Mg deficient with P inhibition	0.28	28 Mg deficient
				Rating					Non Sal	Sli Acid	ND	ND	V Low	Low	High	V Low			Mod	Low	Mod	Low	V Low	High	High	Low	Low	V Low	V Low	V Low	VSIi-sodic	Low			
Pidie	Cubo Trienggading	CT 11 mixed	М	0	30	21 3	7 42	C	0.83	5.9	5.3	0.60	0.40	0.58	106.92	99.75			2.78	0.25	- 11	2.18	0.55	0.81	0.92	11.33	4.46	5	7	5	8	39	3.96 OK	0.6	68 Mg deficient
				Rating					Non Sal	Mod Acid	ND	ND	LON	Mod	V High	Low			Mod	Mod	Good	LOW	LOW	High	High	LOW	Low	V Low	V Low	Low	VSIi-sodic	Low			
Pidie	Beuracan	Be C2 mix	М	n	25	22 /	1 26	ĊΙ	0.85	5.5	5.1	0.40	0.21	0.82	87.95	122.93	-	_	3.07	0.16	10	1.80	0.44	0.36	0.43	9.55	3.03	5	4	9	5	32	4.09 OK	12	22 Mg deficient
TIUIC	DCUIdCall	DC OZ IIIN	m	Rating	ZJ	ZJ 4	1 JU	UL	Non Sal	Str Acid	ND	ND	LOW	Mod	High	Mod	$\vdash \vdash$		High	Low	Mod	V Low	V Low	Mod	Mod	LOW	Low	V Low	V Low	Low	Non-sodic	V Low	1.07 OIL		2 Ing delicion
D' l'	D	D F0	^	J	0.5	00 0	1 00	ΔΙ				0.00	_		J						01								_				2/5 10/	- 0.0	7 Madelia
Pidie	Beuracan	Be E2	U	Defree	25	30 3	1 39	CL	1.05	5.6	5.1	U.5U	0.22	0.72	127.95	105.27	<u> </u>	<u> </u>	3.4		ZI		0.52	10.1	0.46	10.22		5	6		5 Non-auto	34	3.65 OK	0.8	87 Mg deficient
				Kating					Non Sal	Mod Acid	NU	NU	LON	Mod	V High	Mod			High	LOW	Poor	V LOW	LOW	High	MOO	Low	Low	V LOW	V LOW	Low	Non-sodic	V LOW			
Pidie	Cubo Trienggading	CT C1 mix	М	0	30	34 3	5 31	CL	1.05	5.4	5.0	0.40	0.42	0.75	127.95	105.27			2.4	0.11	22	1.9	0.62	0.6	0.66	10.01	3.78	6	6	1	7	38	3.06 OK	1.03	03 Mg deficient
				Rating					Non Sal	Str Acid	ND	ND	LON	Mod	V High	Mod			Mod	LOW	Poor	V Low	LOW	High	Mod	Low	Low	V Low	V Low	Low	VSIi-sodic	Low			
Pidie	Cubo Trienggading	CTA3 mixed	M	0	30	19 2	5 56	C	1.25	6.0	5.4	0.60	0.27	0.33	109	122			2.45	0.15	16	2.12	0.19	0.59	0.76	10.01	3.66	2	6	3	8	37	11.16 Mg deficient with P inhibition	0.3	32 Mg deficient
	3,53			Rating			-		Non Sal	Mod Acid	ND	ND	LON	Low	V High	Mod			Mod	LOW	Mod	LOW	V Low	Mod	High	Low	Low	V Low	V Low	V Low	VSIi-sodic	Low			
Didio	Dournean	Beuracan Iron mix	М	0	25			ςI	2.18	5.0	45	050	0.22	0.52	109.87	112.27	-	_	6.47	0.14	40	2.0	6.25		-	11.04	9.34	57	5	5	5	85	0.32 Ca deficient	117	.16   K sli deficient
riule	Beuracan	Dourdournonnin		Rating	20			JL	Non Sal	VStr Acid	ND ND	ND	LOW	Mod	V Hinh	Mod	$\vdash \vdash$		V High	LOW	Poor	LOW	0.20 High	Mod	Mod	11.04 LOW	Mod	ND	V Low	V Low	Non-sodic	V High	U. U		o it ai delicion
				rung		_			Non Ju	You Note	ND	ND	LVII	mou	Tillgii	mou		_	villgii	LUII	1 001	LVII	High	mou	mou	LUII	IIIUu	ND	V EUII	V LUII	Non Souls	Tilligii			
				··3																															
Singkil	Sidorejo	SD B1	0	15	50	24 3	1 45	C	0.56	5.0	4.5	0.50	0.24	3.55	67.8	89			3.55	0.17	21	2.74	0.52	0.6	0.5	12.90	4.36	4	5	28		34	5.27 Mg sli deficient	0.87	87 Mg deficient
				Rating					Non Sal	VStr Acid	ND	ND	LON	High	High	Low			High	Low	Poor	Low	Low	High	Mod	Low	Low	V Low	V Low	High	Non-sodic	V Low			
Sinakil	Ujung Bawang	UB1	0	0	40	20 4	0 40	CL	0.62	5.9	5.3	0.60	0.42	0.90	200.9	90.5			4	0.19	21	2.88	0.57	0.71	0.62	10.29	4.78	6	7	9	6	46	5.05 Mg sli deficient	0.80	BO Mg deficient
				Rating					Non Sal	Mod Acid	ND	ND	LON	Mod	Ext High	Low			High	LOW	Poor	LOW	LOW	High	Mod	Low	Low	V Low	V Low	Low	VSIi-sodic	Low	1		
Sinakil	Sidoreio	SD A1	Λ	0	10	50 2	1 20	SCL	0.65	5.2	47	0.50	0.24	3.00	153.58	190.34			3.5	0.18	19	1.65	0.56	0.76	0.55	22.15	3.52	3	3	- 14	2	16	2.95 Ca sli deficient	07	74 Mg deficient
Jiliqkii	Judico	JUNI		Rating	10	00 2	1 2/	JUL	Non Sal	Str Acid	ND	ND	LON	High	V High	Mod	$\vdash$		High	Low	Mod	V Low	LOW	High	Mod	Mod	Low	V Low	V Low	Mod	Non-sodic	V Low			
Cinald	Darokan Culamni	PS1	۸	ND		17 3	1 [1		0.67	5.0	4.6	0.40	0.16	1.90	76.77	135.22		_	3.12	0.17	10	2.47	0.48	0.61	0.5	12.12	4.06	4	5		4	33	5.15 Mg sli deficient	0.7	79 Mg deficient
Singkil	Parakan Sulampi	rai	U	Rating		1/ 3	2 31			VStr Acid	4.0 ND	MD.	V Low	Mod Mod	Hiah	130.22 Mod	lacksquare	<b>—</b>		U.17	Mod	LOW	0110	U.01 High	U.D Mod	LOW	Low	V Low	V Low	Mod	Non-sodic	V Low	3.13 My Sil Uchicicili.	0.11	7 Ingualuan
A		10.141		J					Non Sal			IND	V LUW		High				High	LUW	MUU			IllyII	WUU	LUW	LUW						00/		7. 14. 16.
Singkil	Ujung Bawang	UB A4Mean	M	0	50				0.66	5.1	4.65	0.45	0.2	2.45	115.175	162.78	<u></u>	<u></u> '	3.31	0.1/5	19	2.06	0.52	0.685	0.525	17.135	3.19	3	4	14	3	22	3.96 OK	0.16	76 Mg deficient
				Rating					Non Sal	Str Acid	ND	ND	LON	High	V High	Mod			High	Low	Mod	Low	LOW	High	Mod	Mod	Low	V Low	V Low	Mod	Non-sodic	V Low			
Singkil	Ujung Bawang	UB A4	0	30	50			Peat	0.76	4.0	3.4	0.60	0.23	2.55	143.56	288.56			9.12	0.17	54	1.89	0.51	0.44	0.5	24.66	3.34	2	2	10	2	14	3.71 OK	1.1/	16 Mg deficient
				Rating					Non Sal	Ext Acid	ND	ND	Low	High	V High	Mod			V High	Low	Poor	V Low	Low	Mod	Mod	Mod	Low	V Low	V Low	Mod	Non-sodic	V Low			
Sinakil	Sidoreio	SD A1	0	10	50	23 2	1 56	C	0.78	5.0	4.5	0.50	0.19	4.22	175.34	201.34			3.57	0.16	22	2.14	0.56	0.56	0.42	20.33	3.68	3	3	21	2	18	3.82 OK	1.0	00 Mg deficient
			<u> </u>	Rating				Ť	Non Sal	VStr Acid	ND	_	V Low	High	V High	Mod			High	Low	Poor	Low	Low	Mod	Mod	Mod	Low	V Low	V Low	High	Non-sodic	V Low			
Singkil	Sidorejo	SD B1	Λ	0	20	33 2	5 42	ſ	0.90	5.0	47		0.24	3.22	122.12	189.34			3.77	0.19	20	)		0.66	0.54	18.90	_	3	3	·	3	20	3.51 OK	n s	86 Mg deficient
JIIIYNI	Sidulicia	ועטו	V	Rating	۷V	JJ Z	J 4Z	L.	Non Sal	VStr Acid	4.7 ND	ND.	U.Z4 LOW	3.22 High	133.12 V High	109.34 Mod			3.77 High	LOW	Mod	Low	LOW	U.00 High	Mod Mod	Mod Mod	Low	V Low	V Low	Mod	Non-sodic	V Low	VOI ON	0.00	o any ucatorist
01 13	T D	TD 4	^	J	00	01 0	1 10	_		_		0.40	LUII	_	,				v	LUII	11100	LUII	LUII	ů	_		2.00						2 F2 OV		(I III difficult
Singkil	Tana Bara	TB1	U	Defree	20	24 3	4 42	Ü	0.98	4.6	4.2	U.4U	0.20	2.22	125.7	209.88	<u> </u>		5.06	0.1/	3U	2.01	0.5/	0.89	0.43	20.23	3.90	3	4	11	2	19	3.53 OK	0.64	64 Mg deficient
				Kating					Non Sal	VStr Acid	ND	NU	LOW	High	V High	Mod			V High	Low	Poor	Low	LOW	High	Mod	Mod	Low	V Low	V LOW	Mod	Non-sodic	V Low		ــــ	
Singkil	Tana Bara	TB 2	0	0	25	24 4	2 34	CL	1.01	4.5	4.0	0.50	0.40	2.17	110.9	199.23			4.44	0.17	26	2.22	0.57	0.66	0.4	24.23	3.85	2	3	9	2	16	3.89 OK	0.8/	B6 Mg deficient
				Rating					Non Sal	Ext Acid	ND	ND	LON	High	V High	Mod			High	Low	Poor	Low	Low	High	Mod	Mod	Low	V Low	V Low	Low	Non-sodic	V Low			
Sinakil	Ujung Bawang	UB A4	0	0	30			Peat	1.05	4.3	4.0	0.30	0.35	1.55	320.45	359.57			10.01	0.18	56	2	0.59	0.89	0.43	30.33	3.91	2	3	5	1	13	3.39 OK	0.6	66 Mg deficient
	33			Rating					Non Sal	Ext Acid	ND	ND	LON	Mod	Ext High	Mod			V High	Low	Poor	LOW	LOW	High	Mod	High	Low	V Low	V Low	Low	Non-sodic	V Low			
Singkil	Uiung Bawang	UB B5	۸	U	50			Dogt	1.05	1/3	4.0	0.30	0.35	212	250.0	367.89			8.12	0.10	43	1,99	0.50	0.67	0.34	42.76	3.59	1	2	5	1	8	3.37 OK	n R	88 Mg deficient
JIIIJNI	Ujuliy Dawaliy	OD DO	U	Rating	JU			real	Non Sal	4.5 Ext Acid	4.0 ND	ND.	LOW	L.1Z Hinh	Eyt High	307.09 Mod			V High	LOW	Poor	V Low	LOW				Low	VIon	V Low	V Low	Non-sodic	V Low	UN UN	0.00	o my uchoroni
				rulling					INUII JOI	EXC MUIU	HU	IND	LUII	High	LALTIIGH	mou			vingii	LUW	1 001	V LUW	LUII	High	MUU	V High	LUW	V LUW	V LUIT	V LUW	noirsoult	T LUW	I		

## **APPENDIX C Nutrient Cation Ratios and Deficiencies**

**Table C.1 Calcium Deficiencies** 

Kabupaten	Scheme	Site No	Soil O		Ratio		Ratio	
Kabupaten			Deposit D	TEB	Ca/Mg	Rating	Mg/K	Rating
Aceh Besar	Geunteut Lamsujen	GL R2	D	104.24	0.24	Ca deficient	0.10	Mg deficient
Aceh Besar	Geunteut Lamsujen	GL R2	0	12.00	0.14	Ca deficient	8.97	OK
Aceh Jaya	Kr. Ateu	KA A5	0	2.87	0.23	Ca deficient	6.61	OK
Aceh Utara	Pase Kanan	PKM B5	0	4.74	0.20	Ca deficient	5.36	OK
Pidie	Beuracan	Beuracan mix	M	9.34	0.32	Ca deficient	11.16	K sli deficient

NB Main deficiency seems to be Calcium with some possible deficiency of magnesium and Potassium

**Table C.2 Slight Calcium Deficiencies** 

Kahunatan	Scheme	Site No	Soil O		Ratio		Ratio	
Kabupaten			Deposit D	TEB	Ca/Mg	Rating	Mg/K	Rating
Aceh Besar	Blang Luas	BLH 20	0	13.30	2.99	Ca sli deficient	13.45	K deficient
Aceh Besar	Krueng Geupeu	KG I 2B	D	8.96	1.98	Ca sli deficient	9.81	OK
Aceh Jaya	Baba le	BI 3	D	9.31	2.33	Ca sli deficient	3.13	OK
Aceh Jaya	Bunbun	BL N7	0	10.63	2.98	Ca sli deficient	6.11	OK
Aceh Jaya	Karang Tunong	KT A1	0	13.30	2.99	Ca sli deficient	13.45	K deficient
Aceh Jaya	Kr. Ateu	KA B3	D	6.11	2.66	Ca sli deficient	2.23	Mg sli deficient
Aceh Utara	Pase Kanan	PKM B1	0	6.32	1.00	Ca sli deficient	4.27	OK
Aceh Utara	Pase Kiri	PASE KIRI MIX	D	6.92	1.68	Ca sli deficient	2.10	Mg sli deficient
Aceh Utara	Pase Kiri	PKR 28	0	7.48	1.95	Ca sli deficient	2.04	Mg sli deficient
Singkil	Sidorejo	SD A1	0	3.52	2.95	Ca sli deficient	0.74	Mg deficient

NB Calcium slightly deficient with Magnesium often slightly deficient to deficient and Potassium also sometimes deficient

**Table C.3 Magnesium Deficiencies** 

W.L.	Scheme	Site No	Soil O		Ratio		Ratio	
Kabupaten			Deposit D	TEB	Ca/Mg	Rating	Mg/K	Rating
Aceh Jaya	Alue Monmata	MD 2	0	4.84	3.90	OK	1.27	Mg deficient
Aceh Jaya	Krueng Tunong	KT D1	D	8.15	4.89	OK	1.49	Mg deficient
Aceh Timur	Julok Tunong	JT B2	0	3.94	3.78	OK	0.93	Mg deficient
Aceh Timur	Julok Tunong	JT B7	0	4.09	3.39	OK	0.91	Mg deficient
Aceh Utara	Krueng Tuan	BK6	0	3.76	3.17	OK	0.86	Mg deficient
Aceh Utara	Krueng Tuan	BK7	0	4.38	4.36	OK	0.57	Mg deficient
Aceh Utara	Krueng Tuan	BKB7	0	4.34	4.16	OK	0.62	Mg deficient
Aceh Utara	Pase Kiri	PKR A3	0	3.80	4.60	OK	1.00	Mg deficient
Aceh Utara	Pase Kiri	PKR B4	0	4.00	4.24	OK	0.98	Mg deficient
Aceh Utara	Pase Kiri	PKR B5	0	4.41	4.33	OK	1.07	Mg deficient
Bireuen	Pate Lhong	PL1	0	3.81	4.16	OK	0.70	Mg deficient
Bireuen	Pate Lhong	PL 13	0	3.82	3.93	OK	1.10	Mg deficient
Bireuen	Pate Lhong	PL2	0	3.82	3.93	OK	1.10	Mg deficient
Bireuen	Paya Nie	PYN 2	D	3.79	4.00	OK	0.79	Mg deficient
Bireuen	Paya Nie	PYN 2	0	3.66	3.57	OK	0.95	Mg deficient
Bireuen	Peudada	PAD 25	0	3.93	3.70	OK	0.71	Mg deficient
Bireuen	Samalanga	S1 0	0	5.14	3.14	OK	1.09	Mg deficient
Bireuen	Samalanga	S6	0	4.11	4.10	OK	1.36	Mg deficient
Pidie	Beuracan	Be C2 mix	M	3.03	4.09	OK	1.22	Mg deficient
Pidie	Beuracan	Be E2	0	3.48	3.65	OK	0.87	Mg deficient
Pidie	Cubo Trienggading	CT C1 mix	M	3.78	3.06	OK	1.03	Mg deficient
Pidie	Cubo Trienggading	CT I1 mix	M	4.46	3.96	OK	0.68	Mg deficient
Singkil	Sidorejo	SD A1	0	3.68	3.82	OK	1.00	Mg deficient
Singkil	Sidorejo	SD B1	0	3.77	3.51	OK	0.86	Mg deficient
Singkil	Tana Bara	TB 1	0	3.90	3.53	OK	0.64	Mg deficient
Singkil	Tana Bara	TB 2	0	3.85	3.89	OK	0.86	Mg deficient
Aceh Besar	Geunteut Lamsujen	GL H2	D	10.47	7.08	Mg deficient	3.76	OK
Aceh Jaya	Kr. Ateu	KAI 4	D	11.46	7.00	Mg deficient	5.90	OK

NB Magnesium deficient but both calcium and potassium appear  $\mathsf{O}\mathsf{K}$ 

**Table C.4 Magnesium Deficiencies with Possible Phosphorus Inhibition** 

Vahunatan	Scheme	Site No	Soil O		Ratio		Ratio	
Kabupaten			Deposit D	TEB	Ca/Mg	Rating	Mg/K	Rating
Aceh Besar	Blang Luas	BL A2	0	11.48	11.06	Mg deficient with P inhibition	2.35	Mg sli deficient
Aceh Besar	Blang Luas	BLA 8	D	8.05	8.65	Mg deficient with P inhibition	5.54	OK
Aceh Besar	Blang Luas	BLE7	D	9.65	22.23	Mg deficient with P inhibition	0.70	Mg deficient
Aceh Besar	Geunteut Lamsujen	GL 05	0	12.69	8.67	Mg deficient with P inhibition	1.74	Mg deficient
Aceh Besar	Geunteut Lamsujen	GL 05	0	11.81	8.23	Mg deficient with P inhibition	1.71	Mg deficient
Aceh Besar	Geunteut Lamsujen	GL Q5	D	14.21	7.15	Mg deficient with P inhibition	2.18	Mg sli deficient
Aceh Besar	Geunteut Lamsujen	GLA6	D	10.67	7.27	Mg deficient with P inhibition	3.76	OK
Aceh Besar	Geunteut Lamsujen	GLK1	D	12.87	9.37	Mg deficient with P inhibition	3.79	OK
Aceh Besar	Krueng Geupeu	KG C3	D	10.10	12.70	Mg deficient with P inhibition	2.14	Mg sli deficient
Aceh Besar	Krueng Geupeu	KG D1	0	12.15	7.86	Mg deficient with P inhibition	2.19	Mg sli deficient
Aceh Jaya	Alue Monmata	MN5	D	14.40	8.90	Mg deficient with P inhibition	0.76	Mg deficient
Aceh Jaya	Alue Monmata	MN5	0	11.44	8.79	Mg deficient with P inhibition	0.81	Mg deficient
Aceh Jaya	Alue Monmata	PM4	0	8.65	8.71	Mg deficient with P inhibition	1.44	Mg deficient
Aceh Jaya	Baba Awe	CBA B3	D	14.48	7.97	Mg deficient with P inhibition	1.12	Mg deficient
Aceh Jaya	Baba le	BI ES	0	10.41	13.41	Mg deficient with P inhibition	1.78	Mg deficient
Aceh Jaya	Baba le	BI ES	D	13.58	8.35	Mg deficient with P inhibition	2.40	Mg sli deficient
Aceh Jaya	Blang Alue Gajah	BUG 12	ND	12.00	10.06	Mg deficient with P inhibition	2.15	Mg sli deficient
Aceh Jaya	Blang Alue Gajah	BUG D8	D	9.95	14.73	Mg deficient with P inhibition	5.00	OK
Aceh Jaya	Blang Alue Gajah	BUG F6	0	11.36	9.68	Mg deficient with P inhibition	1.31	Mg deficient
Aceh Jaya	Blang Alue Gajah	BUG G1	D	13.58	11.65	Mg deficient with P inhibition	1.47	Mg deficient
Aceh Jaya	Blang Alue Gajah	BUG G1	D	13.04	12.64	Mg deficient with P inhibition	1.84	Mg deficient
Aceh Jaya	Blang Alue Gajah	BUG K4	0	11.06	12.19	Mg deficient with P inhibition	3.13	OK
Aceh Jaya	Blang Alue Gajah	BUG K4	D	14.18	7.72	Mg deficient with P inhibition	9.86	OK
Aceh Jaya	Blang Jempeuk	BJ B3	0	6.48	18.28	Mg deficient with P inhibition	0.76	Mg deficient
Aceh Jaya	Blang Jempeuk	BJ B3	D	13.89	7.55	Mg deficient with P inhibition	3.69	OK
Aceh Jaya	Blang Jempeuk	BJ B3	0	11.49	7.31	Mg deficient with P inhibition	2.19	Mg sli deficient
Aceh Jaya	Blang Jempeuk	KJ 2	0	7.64	9.72	Mg deficient with P inhibition	2.10	Mg sli deficient
Aceh Jaya	Bunbun	BL N1	0	9.16	12.11	Mg deficient with P inhibition	1.56	Mg deficient
Aceh Jaya	Jabie	JB 4	D	13.85	9.12	Mg deficient with P inhibition	3.97	OK
Aceh Jaya	Jabie	JG 2	D	15.32	7.38	Mg deficient with P inhibition	1.19	Mg deficient
Aceh Jaya	Jabie	JG 2	0	10.61	9.46	Mg deficient with P inhibition	4.35	OK
Aceh Jaya	Kr. Ateu	KA 1	0	11.27	12.87	Mg deficient with P inhibition	1.15	Mg deficient
Aceh Jaya	Kr. Ateu	KA 30	D	12.08	8.74	Mg deficient with P inhibition	2.68	Mg sli deficient
Aceh Jaya	Kr. Ateu	KA 30	D	12.33	8.47	Mg deficient with P inhibition	2.85	Mg sli deficient
Aceh Jaya	Kr. Ateu	KA 30	D	10.00	8.33	Mg deficient with P inhibition	3.23	OK
Aceh Jaya	Kr. Ateu	KAC	0	11.09	8.90	Mg deficient with P inhibition	2.91	Mg sli deficient
Aceh Jaya	Krueng Tunong	KT D1	0	7.65	16.51	Mg deficient with P inhibition	0.70	Mg deficient
Aceh Jaya	Krueng Tunong	KTC	D	7.71	8.22	Mg deficient with P inhibition	1.18	Mg deficient
Aceh Jaya	Kuala Meurisi	ML	D	10.37	10.15	Mg deficient with P inhibition	2.60	Mg sli deficient
Aceh Jaya	Kuala Meurisi	TL 7	D	12.92	7.69	Mg deficient with P inhibition	3.90	OK
Aceh Jaya	Lambesoi	LS 10	0	9.69	8.63	Mg deficient with P inhibition	7.82	OK
Aceh Jaya	Lambesoi	LS 13 CLAY	0	8.77	8.19	Mg deficient with P inhibition	1.98	Mg deficient
Aceh Jaya	Lambesoi	LS 26	0	11.85	7.60	Mg deficient with P inhibition	2.73	Mg sli deficient
Aceh Jaya	Meulha	MA9	D	14.53	7.29	Mg deficient with P inhibition	2.03	Mg sli deficient
Aceh Jaya	Panghuleu Harakat	PH A3	0	11.67	7.50	Mg deficient with P inhibition	2.90	Mg sli deficient
Aceh Jaya	Panghuleu Harakat	PH D1	0	10.03	9.03	Mg deficient with P inhibition	1.42	Mg deficient
Aceh Jaya	Panghuleu Harakat	PH D1	D	9.26	10.14	Mg deficient with P inhibition	1.61	Mg deficient
Aceh Utara	Pase Kanan	PKNI	0	4.61	7.48	Mg deficient with P inhibition	0.73	Mg deficient
Bireuen	Samalanga	S7	0	4.57	7.71	Mg deficient with P inhibition	0.51	Mg deficient
Pidie	Beuracan	BE F3 (mix)	M	4.64	16.88	Mg deficient with P inhibition	0.28	Mg deficient
Pidie	Cubo Trienggading	CTA3 mixed	M	3.66	11.16	Mg deficient with P inhibition	0.32	Mg deficient

NB Magnesium generally deemed deficient via both ratios with the a possibility that due to imbalance of nutrients phosphorus could be inhibited. No Available-P or Total-P values determined so no comment can be made on this topic

## **Table C.5 Slight Magnesium Deficiencies**

Kabupaten	Scheme	Site No	Soil O		Ratio		Ratio	
'			Deposit D	TEB	Ca/Mg	Rating	Mg/K	Rating
Aceh Besar	Blang Luas	BL A2	D	13.63	6.76	Mg sli deficient	4.21	OK
Aceh Besar	Blang Luas	BLA 8	0	8.75	5.86	Mg sli deficient	3.55	OK
Aceh Besar	Blang Luas	BLDO 3A	D	11.13	6.74	Mg sli deficient	6.63	OK
Aceh Besar	Blang Luas	BLDO 3B	D	11.39	5.14	Mg sli deficient	17.00	K deficient
Aceh Besar	Blang Luas	BLE 7	0	9.85	5.74	Mg sli deficient	3.13	OK
Aceh Besar	Blang Luas	BLG 13	D	8.40	5.86	Mg sli deficient	12.33	K deficient
Aceh Besar	Geunteut Lamsujen	GL Q5	D	15.98	6.30	Mg sli deficient	4.78	OK
Aceh Besar	Krueng Geupeu	KG D1	D	12.67	6.47	Mg sli deficient	3.08	OK
Aceh Besar	Krueng Kala	KK F2	D	10.36	5.97	Mg sli deficient	3.33	OK
Aceh Besar	Krueng Kala	KKD 4	D	10.16	5.97	Mg sli deficient	6.84	OK
Aceh Besar	Krueng Kala	KKE 10	0	9.40	6.23	Mg sli deficient	3.34	OK
Aceh Besar	Krueng Kala	KKE 10	D	10.06	6.69	Mg sli deficient	1.86	Mg deficient
Aceh Jaya	Alue Monmata	PM 14	D	14.13	6.43	Mg sli deficient	2.70	Mg sli deficient
Aceh Jaya	Alue Monmata	PM 14	0	10.01	5.83	Mg sli deficient	2.07	Mg sli deficient
Aceh Jaya	Alue Monmata	PM4	D	13.83	6.33	Mg sli deficient	1.50	Mg deficient
Aceh Jaya	Baba Awe	CB A1	0	14.60	6.64	Mg sli deficient	3.20	OK
Aceh Jaya	Baba Awe	CB A1	D	12.40	5.77	Mg sli deficient	3.31	OK
Aceh Jaya	Baba Awe	CBA B3	D	14.21	5.40	Mg sli deficient	7.71	OK
Aceh Jaya	Blang Alue Gajah	BUG C3	D	12.44	5.43	Mg sli deficient	4.32	OK
Aceh Jaya	Blang Alue Gajah	BUG D8	D	11.17	6.00	Mg sli deficient	12.42	K deficient
Aceh Jaya	Blang Alue Gajah	BUG F6	0	14.39	5.19	Mg sli deficient	3.15	OK
Aceh Jaya	Blang Alue Gajah	BUG I2	D	10.68	6.61	Mg sli deficient	1.74	Mg deficient
Aceh Jaya	Blang Jempeuk	BJ D3	0	13.36	6.86	Mg sli deficient	5.10	OK
Aceh Jaya	Blang Jempeuk	BJ D3	0	14.38	6.28	Mg sli deficient	5.48	OK
Aceh Jaya	Blang Jempeuk	BJB3 Mean	0	13.87	6.55	Mg sli deficient	5.30	OK
Aceh Jaya	Blang Jempeuk	KJ 2	D	9.76	6.05	Mg sli deficient	2.87	Mg sli deficient
Aceh Jaya	Jabie	JB 4	D	14.65	6.42	Mg sli deficient	1.91	Mg deficient
Aceh Jaya	Jabie	JG 2	0	13.81	6.23	Mg sli deficient	1.23	Mg deficient
Aceh Jaya	Jabie	JG2 Mean	0	14.57	6.79	Mg sli deficient	1.21	Mg deficient
Aceh Jaya	Karang Tunong	KT H1	0	11.83	6.40	Mg sli deficient	1.90	Mg deficient
Aceh Jaya	Karang Tunong	KT H1	D	14.63	5.90	Mg sli deficient	1.44	Mg deficient
Aceh Jaya	Karang Tunong	KTG1	D	14.71	5.93	Mg sli deficient	1.24	Mg deficient
Aceh Jaya	Kr. Ateu	KA 1	D	13.29	6.61	Mg sli deficient	2.39	Mg sli deficient
Aceh Jaya	Kr. Ateu	KA A5	D	8.60	5.86	Mg sli deficient	3.83	OK
Aceh Jaya	Kr. Ateu	KA B	0	9.33	6.71	Mg sli deficient	3.10	OK
Aceh Jaya	Kr. Ateu	KAC	D	14.12	5.38	Mg sli deficient	4.90	OK
Aceh Jaya	Kr. Ateu	KAC4	D	12.35	6.58	Mg sli deficient	2.78	Mg sli deficient
Aceh Jaya	Kr. Ateu	KAI 4	0	12.52	6.43	Mg sli deficient	7.15	OK
Aceh Jaya	Kr. Ateu	KD 10	0	13.04	5.68	Mg sli deficient	3.04	OK
Aceh Jaya	Krueng Tunong	KT A1	D	8.95	6.78	Mg sli deficient	3.52	OK
Aceh Jaya	Kuala Meurisi	ML	0	7.70	5.48	Mg sli deficient	2.02	Mg sli deficient
Aceh Jaya	Kuala Meurisi	TL 7	D	11.83	6.85	Mg sli deficient	1.92	Mg deficient
Aceh Jaya	Kuala Meurisi	TL B3	0	9.20	5.41	Mg sli deficient	2.73	Mg sli deficient
Aceh Jaya	Kulam Asan	LB B3	D	12.29	6.06	Mg sli deficient	2.85	Mg sli deficient
Aceh Jaya	Lambaro	LD1	D	13.36	6.48	Mg sli deficient	1.18	Mg deficient
Aceh Jaya	Lambaro	LD1	D	8.87	6.09	Mg sli deficient	1.10	Mg deficient
Aceh Jaya	Lambaro	LDI	0	9.89	6.99	Mg sli deficient	1.13	Mg deficient
Aceh Jaya	Lambaro	LDI	D	12.87	6.43	Mg sli deficient	1.19	Mg deficient
Aceh Jaya	Lambesoi	LS 10	D	12.92	6.55	Mg sli deficient	3.20	OK
Aceh Jaya	Lambesoi	LS 13	0	9.53	5.15	Mg sli deficient	2.14	Mg sli deficient
Aceh Jaya	Lambesoi	LS 26	D	13.26	6.80	Mg sli deficient	6.81	OK
Aceh Jaya	Lambesoi	LS N17	0	9.66	6.73	Mg sli deficient	1.39	Mg deficient
Aceh Jaya	Meudheun	M3	0	8.77	5.20	Mg sli deficient	4.07	OK
Aceh Jaya	Meulha	MA9	0	8.41	6.34	Mg sli deficient	1.59	Mg deficient
Aceh Jaya	Panghuleu Harakat	PH A3	D	13.54	5.61	Mg sli deficient	6.48	OK
Aceh Jaya	Treng Lipeh	KM B2	0	11.07	5.93	Mg sli deficient	12.42	K deficient
Aceh Jaya	Treng Lipeh	KM C2	0	9.36	6.68	Mg sli deficient	5.59	OK
Aceh Utara	Pase Kiri	Pase Kiri III	D	5.80	5.30	Mg sli deficient	0.53	Mg deficient
Aceh Utara	Pase Kiri	PKR 28	0	6.35	6.17	Mg sli deficient	0.51	Mg deficient
Bireuen	Pandrah	PD 1	0	5.40	6.58	Mg sli deficient	1.90	Mg deficient
Bireuen	Pate Lhong	PL13	0	4.48	5.71	Mg sli deficient	0.88	Mg deficient
	, , ,	PN 1	0	4.55	5.36	Mg sli deficient	1.22	Mg deficient
Bireuen	Paya Nie	FINI		7.00	0.00			
Bireuen Bireuen	Peudada	PAD D3	0	4.55	5.36	Mg sli deficient	1.22	Mg deficient

Table C.5 Slight Magnesium Deficiencies (Continued)

Kabupaten	Scheme	Site No	Soil O		Ratio		Ratio	
			Deposit D	TEB	Ca/Mg	Rating	Mg/K	Rating
Singkil	Parakan Sulampi	PS 1	0	4.06	5.15	Mg sli deficient	0.79	Mg deficient
Singkil	Sidorejo	SD B1	0	4.36	5.27	Mg sli deficient	0.87	Mg deficient
Singkil	Ujung Bawang	IUB 1	0	4.78	5.05	Mg sli deficient	0.80	Mg deficient
Aceh Besar	Krueng Geupeu	KG I 2A	D	8.87	3.94	OK	2.25	Mg sli deficient
Aceh Besar	Krueng Kala	KK F2	0	9.39	4.85	OK	2.54	Mg sli deficient
Aceh Jaya	Blang Alue Gajah	BUG I2	0	11.45	4.62	OK	2.52	Mg sli deficient
Aceh Jaya	Karang Tunong	KTG1	0	13.47	4.17	OK	2.46	Mg sli deficient
Aceh Jaya	Kr. Ateu	KA 14	D	10.21	4.88	OK	2.73	Mg sli deficient
Aceh Jaya	Meudheun	M3	D	13.43	4.60	OK	2.56	Mg sli deficient

NB In the above group magnesium deemed deficient via the Ca:Mg ratio but in at least 50% of the samples also deemed slightly deficient to deficient via the Mg:K ratio

**Table C.6 Potassium Deficiencies** 

Kabupaten	Scheme	Site No	Soil O		Ratio		Ratio	
Kabupaten			Deposit D	TEB	Ca/Mg	Rating	Mg/K	Rating
Aceh Besar	Blang Luas	BLG 13	0	9.77	4.84	OK	11.69	K sli deficient
Aceh Besar	Blang Luas	BLH 20	D	10.85	3.82	OK	11.47	K sli deficient
Aceh Besar	Geunteut Lamsujen	GLK1	0	13.52	3.43	OK	10.54	K sli deficient

NB Potassium deemed only slightly deficient whilst other nutrients would appear to be OK

## **Appendix D ETESP Reports and Tools plus References**

## **D.1 ETESP Soil Desalinisation and Improvement Reports**

## **D.1.1 Technical Data Reports**

ETESP Agricultural Component, Desalinisation & Soil Improvement, Mobilisation Report, OCTOBER 2005, Updated FEBRUARY 2006

ETESP, Banda Aceh Kota, Kuta Alam, Data Assessment and Soil Reclamation, NOVEMBER 2005

ETESP, Aceh Besar Kabupaten, *Lhoknga, Darussalam and Baitissalam*, Data Assessment and Soil Reclamation, DECEMBER 2005

ETESP, Pidie Kabupaten, Meureudu, Triang Gadeng, Panteraja and Simpang Tiga, Data Assessment and Soil Reclamation, DECEMBER 2005

ETESP, Bireuen Kabupaten, Samalanga, Jeunieb, Jeumpa, Jangka and Ganda Pura, Data Assessment and Soil Reclamation, DECEMBER 2005

ETESP, Executive Summary, Soil and Land Reclamation, DECEMBER 2005

ETESP, Soil and Land Reclamation Scenarios, DECEMBER 2005, Updated March 2006

ETESP, Interpretation of Laboratory Data for ETESP Irrigation Component, FEBRUARY 2006

ETESP, Detailed Study of Laboratory Data, APRIL 2006

## **D.1.2 Background Technical Papers**

ETESP, Background Paper, Annual & Monthly Rainfall, OCTOBER 2005

ETESP, Background Paper, Soil Acidity and Aluminium, DECEMBER 2005

ETESP, Digital Maps, FEBRUARY 2006, Update MARCH 2006

ETESP, Sandy Sediments, FEBRUARY 2006, Updated March 2006

ETESP, Soil Conditions for Wetland Rice, MARCH 2006

#### **D.1.3 Site Visit and Tour Reports**

ETESP, Site Visit Report - BRR Area at Lhoong: Kemukiman Cot Jeumpa, DECEMBER 2005

ETESP, Site Visit report, BLANG KREUNG SITE, DECEMBER 2005

ETESP, Tour Report, Field Tour Report NAD Areas, Feb 20th - Feb 24th 2006, FEBRUARY 2006

ETESP, Site Visit Report, Visit to Oxfam Sites Calang, MARCH 2006

ETESP, Site Visit Report, Visit to Red Cross Site, Aceh Besar, MARCH 2006

ETESP, Site Visit Report, Lhamno Irrigation Sites, Aceh Jaya, MARCH 2006

## D.2 ETESP Soil Desalinisation and Improvement Tools

File name and date

Purpose

**ETESP** 

ECe from EM38 data.XLS OCTOBER 2005

Calculate soil salinity (ECe) values from raw data collected by EM38 salinity device when no calibration information provided

**ETESP** 

**ETESP** 

Leaching Water Requirements.XLS **NOVEMBER 2005** 

Irrigation Leaching Progress.XLS

Calculate the depths and volumes of water that have to be applied and pass through a selected depth of soil to achieve desalinisation. Information required includes:

- Textural class of soil
- Initial salinity of the soil (dS/m)
- Target salinity wished to be achieved (dS/m)

Determine how many irrigation gifts have to be applied to achieve de-salinisation of various depths of variously textured soil. Information required includes:

- Soil textural group, or
- AWHC (Available Water Holding Capacity)
- Estimate of water application efficiency, or use default values
- Size of irrigation gift as mm of water
- Correlate the scale at which to map surveys of various types from reconnaissance 1. to very detailed level
- Determine observation density (Sites / hectare)
- Calculate the total number of sites for surveys at various reliability levels

**ETESP** 

Survey Density.XLS DECEMBER 2005

**NOVEMBER 2005** 

## Requirements:

Survey area extent in hectares (ha)

Also presents various map and mapping information

Enter standard laboratory data and obtain ratings as to the level of all the various nutrients and chemical properties.

**ETESP** Labdata summary.XLS Version 4 FEBRUARY 2006

Also calculate weighted mean vales for topsoil and subsoil plus obtain automatic simple summary of:

- Inherent fertility
- Fertility potential
- Possible nutrient deficiencies
- Salinity status, and
- Reaction

Also experimental estimate of possible perceived risks Enter field data for specific sites or villages making note of :

- Site Monitoring tool.XLS
- March 2006

**ETESP** 

- Locational information
  - Kabupaten Kecamatan
  - Desa
  - Farmer or Land-owner, and
  - Geographic coordinates
- 2. Soil, land and crop features
  - surface soil textural group
  - soil salinity
  - soil acidity
  - irrigation water quality (salinity)
  - status of drains, plus
  - estimate (%) of the actual pre-tsunami crop yield

to monitor land reclamation progress and get information on further interventions possibly required

Austin Hutcheon BSc MSc www.geocities.com/Austin-supermi

#### **ETESP**

Soil Conditions Database tool.XLS March 2006

Enter field collected on the site form, or data collated and analysed from the data on the site form into a format that will be the first stages of a dbms / GIS compilation:

- surface soil textural group
- soil salinity
- soil acidity
- irrigation water quality (salinity)
- status of drains, plus
- estimate (%) of the actual pre-tsunami crop yield

The data are stored against the official Dinas selected villages that qualify for ETESP inputs. This collation will allow monitoring land reclamation progress within kecamatan and kabupaten and get information on further interventions possibly required Simple pro-forma for recording data collected during soil investigations to establish depths and distribution of sandy sediments

**ETESP** 

Auger Description Form

ETESP

Labdata Collation.XLS APRIL 2006 Enter standard laboratory data and obtain ratings as to the level of all the various nutrients and chemical properties

pH ECe

Exch H and Al Exch-cations Total-N Organic-C CEC TEB BS ASP ESP Ca:Mg ratios Mg:K ratios

#### **D.3 References**

Booker Tropical Soil manual, Editor J R Landon, "A handbook for soil survey and agricultural land evaluation in the tropics and subtropics, Longman Scientific and Technical 1991. ISBN 0-582-00557-4

C J Hatten, Soil Scientist, UK, Chris@wrensfield.freeserve.co.uk

FAO, Soil Survey investigations for Irrigation, FAO Soils Bulletin No 42, Rome 1979