ETESP

Earthquake & Tsunami Emergency Support Project

Technical Paper

Soil Conditions for Wetland Rice

and

ETESP Tools for Monitoring Land Conditions

ETESP Site Monotoring Form for Wetland Rice

District (Kabupaten): Pidie | Sub-District (Kecamatan): Meureudu | **Desa:** Meuraksa | **Farmer / Owner:** Pak Lima

Geographic Coordinates from Map or GPS								Surface Soil Texture		SALINITY OF SITE or VILLAGE			Reaction		In-field Drains		Irrigation Water		Actual	Actions and
Date of Visit		Northings			Eastings			1 = Heavy 2 = medium	3 = light 4 = sand	Soil	Predicted	Action	Soil	pH	Depth	Action	H_2O	H_2O	Yield	Conclusion
Day	Month Year	Deg	Min	Sec	Deg	Min	Sec	Class	Rating	dS/m	% Yield		pH	Class	(cm)		(dS/m)	Class	%	Based on Yield
13	Mar-05	5	15	33.1	96	15	0.9	2	OK	7.7	65	Leach & plant	7.0	Mod	25	Deepen	0.19	Very good	50	Land recovering
30	Nov-05	5	15	33.1	96	15	0.9	2	OK	1.0	100	Plant	6.5	Good	50	Clear	0.10	Very good	75	Land recovered

(March 2006)

CONTENTS

1. INTRODUCTION

This short technical or background paper was compiled after visiting various sites within the Project Study Area and updating the ETESP Scenarios report. The need for this paper was seen since virtually all the sites visited in the course of the field studies were land where the preferred use was for padi – wetland rice. At most of these sites the main problems were invariably soil salinity and poor soil drainage.

Routines were compiled and described as to how to overcome the salinity and drainage problems and in theory, all of the sites visited (scenarios) would technically be able to be reclaimed. However, irrigated sites would be easier and quicker to reclaim than sites where the water supply relied solely on rainfall simply due to the amount of fresh water that could be applied to the soil to leach out the salts. Then, if the land still did not produce crop yields that were up to pre-tsunami levels, or preferably better than pre-tsunami levels, further questions would be asked and answers would be required.

Accordingly, this paper attempts to summarise what has happened to tsunami-damaged soils and the basic soil requirements and conditions for the growth of wetland rice. To make full use of the data presented in this paper further field testing may be required with the following being checked, this is on the assumption the recommended amelioration interventions have been carried out of installed:

- Salinity level of the soil
- Salinity level of the irrigation water – if irrigation water is supplied
- Basic levels of the various soil nutrients and chemical features present in the reclaimed land

In addition an ETESP tool, in the form of an Excel spreadsheet, has been compiled to assist field staff assess and monitor the status of wetland rice soils. This tool is called "Site Monitoring Tool.XLS" and it is briefly introduced in this paper and copies of the tool can be supplied on request. A further, much larger tool has also been compiled and this tool, "Soil Conditions Database.XLS" uses the same data but the data are entered into a pro-forma with all villages listed that qualify for inputs under the ETESP programme.

2. THE DAMAGE THE TSUNAMI INFLICTED

This section is limited to the "technical" damage to the soil properties through the effects of sedimentation and inundation by sea-water - that is if "damage" is the correct word since, in some cases or locations, soil has been improved. In the Meulaboh area the Dinas Pertanian staff reported that some lands had been improved by the deposition of sediments basically deepening the amount of soil on the site – often also improving the texture.

2.1 Background

When it struck the shore the tsunami-wave did various things, including:

- Wreaked devastating physical damage – not the subject of this document
- Rapidly started to drop the sand-load along with any other marine sediments or debris it carried
- Picked-up and redistribute anything that lay in its path – including surface soil from exposed areas such as farms
- Redistributed the new material it had picked as the material settled out via sedimentation and continued to pick more material as it progressed inland
- Flooded the land and slowly doing less physical damage at is progressed inland – often up to 5km or so
- Flood water then infiltrated the soils and the longer the land was flooded then the greater the amount of infiltration
- Sandy and coarse textured soils infiltrated much more water much more quickly than heavier soils – this is a standard feature of soils and is determined by the particle size class (texture) of the upper or surface horizons
- Where floodwater became trapped, for example in low-lying places and in padi fields, the salinity of the flood water increased. The longer that water remained on a site the more saline it became – this was due to the salt solution concentrating as the water evaporated

2.2 Soil Damage

As the sea-water infiltrated the soil the salts dissolved in the sea-water entered the soil and there were a few processes that happened:

- The salt (NaCl) was deposited and became loosely attached to the structural soil units or surfaces, that is it coated the soil peds and sand grains
- The sodium (Na^+) part of the salt (sea-water is dominantly sodium chloride or common salt NaCl) started to replace the nutrient cations attached to the soil exchange complex. That is the calcium (Ca^{++}), magnesium (Mg^+) and potassium (K^+) ions were replaced by sodium. This is all natural soil chemistry processes and well recognised by soil scientists as it is a natural phenomenon
- Other nutrients, often previously added as fertilisers and composts, were dissolved and flushed out of the soil by the water – such nutrients as nitrogen and phosphorus plus any soluble potassium and calcium etc

The result being that the soil fertility was vastly reduced by losing all the nutrients and it became saline due to the presence of the sodium. Soil salinity is measured and reported as electrical conductivity (EC) and the currently accepted unit used for reporting is dS/m (deci-Siemens / metre) which is equivalent to the older mmhos/cm (milli-mhos/cm). The terminology and salinity classes are fully reported in the Soil Desalinisation and Improvement "Mobilisation Report" of October 2005.

The various classes with definitions of the salinity classes are given in Table 2.1

Table 2.1 Soil Salinity Classes

Description	Salinity class	Range in ECe (dS/m)
Non saline	SC1	0.1 – 3.9
Slightly saline	SC2	4.0 – 7.9
Moderately saline	SC3	8.0 – 15.9
Highly saline	SC4	16.0 – 31.9
Extremely saline	SC5	32.0 – 63.9
Ultra saline	SC6	64.0 – 127.9

NB Some versions of the classification system include "strongly saline" between "moderately" and "highly"

2.3 Reclamation of Salinised Soils

This subject is not addressed in this document, apart from stating the basic requirements to achieve soil de-salinisation which are:

- Fresh water has to be applied and pass through the salinised soil to leach-out the salt
- The area being reclaimed must have an operational drainage system
- The full depth of the soil, that is the depth to which the roots of the crops to be grown will penetrate in their search for nutrients and water, has to be reclaimed

- If salinisation is bad then vast amounts of water – several metres – have to pass through the soil. A common misconception is that the quoted amount of water has to be applied to the soil, this is incorrect and the volume or depth of water is the amount that has to pass through and discharge into the drainage system
- An adequate water supply has to be available and this usually means irrigation. Unless there is very high rainfall, complemented by an efficient operating drainage system, rainfall alone will not, or will take a very long time, to reclaim land – and even then the soil may still be saline at depth
- The drainage system must remove the saline leachate from the location and discharge it into a river or drain that will efficiently take it back to the sea

3. THE TARGETS and REQUIREMNTS FOR WETLAND RICE

3.1 Introduction

The main requirements for wetland rice cultivation can be basically covered under four headings:

- tolerance to salinity
- rooting depth
- nutrients, and
- soil reaction

Soil texture is not discussed here as the lands under question have been used for rice in the past and farmer knowledge means that texturally unsuitable soils are not put under padi. The following data have been compiled following a basic literature search.

3.2 Tolerance to Salinity

Wetland rice is classified as being moderately tolerant to soil salinity. Although "highly tolerant" varieties do exist the seed is not normally readily available in Aceh. Various levels of yield depression can be directly related to salinity levels, these are:

Table 3.1 Yield Reduction versus Salinity

Soil salinity level dS/m	Yield Reduction %
5	10%
6	25%
8	50%
>15	Possible failure

Bookers: Bookers Tropical Soil Manual, 1991

Hence, if the soil salinity level is know it is possible to roughly calculate whether it is worthwhile trying to grow a crop or if the land should be rehabilitated first. Generally it is worthwhile starting to consider growing a first crop when the surface salinity has been reduced to about 4dS/m – this assumes that by the time crop roots reach deeper layers the reclamation leaching will have progressed and reduced the salinity in the lower horizons.

This ties-in with the general principal that the surface EC should be below 4 – 5dS/m before seedlings are planted.

3.3 Rooting Depth

Wetland rice roots can and do go to about 100cm maximum depth in their search for nutrients and moisture for growth. However, the main nutrient uptake zone is less than 50cm. The ETESP recommendation for drainage ditch installation to enable reclamation leaching is that field drains should be excavated to 100cm depth as this will enable reclamation of the full possible root zone of the crop.

Similarly, the ETESP recommendation is that the crop could be planted when the surface layers (0-25cm), the easiest and first layer that will desalinise under leaching, falls to less than 4 – 5dS/m. Normal irrigated rice cultivation with intermittent irrigations of approximately 100mm depth at 4 - 5 day intervals will then achieve two purposes:

- the crop will be supplied with sufficient moisture, and
- the excess water will infiltrate to depth and slowly leach the sub-soil

By the time the crop roots reach their maximum depth the soil should have de-salinised enough to allow growth to continue within the yield expectations given in Table 3.1.

3.4 Nutrient Requirement

Wetland rice has, overall, a low demand for nutrients however only calcium is specifically mentioned in the literature as far as exchangeable cations are concerned, but it is implied that potassium and magnesium are also required in low amounts. The most common deficiencies reported are with nitrogen (Total-N) and phosphorus (Available-P), though in some circumstances (not detailed) potassium (K) can also be deficient. Also, in peaty soils there can be a deficiency of silica (Si).

The normal uptake by a wet-land rice crop is in the order of:

Table 3.2 Major Nutrient Uptake

Major Nutrient	Norma l Uptake in Kg / ha
N	100 – 150
P	20 – 40
K	80 - 120

Bookers: Bookers Tropical Soil Manual, 1991

As noted previously the presence of sodium (Na+) in the soil has adverse effects on exchangeable Ca, Mg and K plus phosphorus (P) and zinc (Zn).

As and when a soil is desalinsed and yields are still poor a programme of soil sampling and laboratory analyses should be carried out to determine which, if any, of the nutrients appear to be very low or deficient. Suggestions on necessary analyses and procedures are given in the ETESP site visit report to Oxfam Sites in Aceh Jaya, March 2006.

3.5 Soil Reaction

3.5.1 Normal Ranges

Soil reaction or acidity must also be considered but, generally, this does not present too much of a problem for wetland rice. The critical soil pH values are given in Table 3.3.

Table 3.3 Critical pH Values for Wetland Rice

pH Range	Suitability
5.0 – 6.5	Optimum range for rice growth
4.0 – 8.0	Range over which an acceptable crop should be obtained
3.4 - 2.0	Rice will not grow but this soil acidity level is only found in recovered mangrove soils – Acid Sulphates

Bookers: Bookers Tropical Soil Manual, 1991

3.5.2 Effects of Puddling Rice Soils

The chemical processes are quite complicated but are summarised below, the information being extracted from ETESP Soil Acidity and Aluminium, 2005.

When acidic soils are flooded or puddled, such as for wetland rice cultivation, the pH will rise, in time, to near neutral – around 6.5. The reactions are very complicated but, in general, there are reactions in flooded soils which consume protons (hydrogen ions - H^+) and so the pH rises.

The most common chemical reaction is reduction and the most normally quoted reaction is the one involving the reduction of ferric iron to ferrous forms:

$Fe(OH)_3 + H^+ = Fe(OH)_2 + H_2O$

Hence, in this case, some of the hydrogen ions (H+), or protons, are used up and the soil pH rises. In addition, with increasing hydrolysis the aluminium hydroxy compounds formed are not exchangeable and hence the aluminium falls out of play as far as acidity is concerned

However, as soon as wetland soils start to dry out, such as when left un-irrigated for fallow, they rapidly re-acidify. Sulphur is very involved in this acidification and the presence of sulphur compounds in soils in Aceh is known and this could be an additional problem that may need to be addressed. But, to date, acid sulphate does not seem to be a problem. Also, the pH of top-soils can be influenced by the quality of the irrigation water applied. Most data seen on water quality suggest that there is unlikely to be a problem from this source in Aceh.

4 EFFECTS of WATER QUALITY

The quality, salinity, of irrigation water has an effect on the soil it irrigates. In time the soil will develop the same EC as the irrigation water. Various grades of water have been defined internationally and the definitions are given below.

Most water samples tested in the Project Area to date have had nil or very low salinity levels.

Table 4.1 Classification and Definition of Irrigation Waters

Irrigation water Salinity Hazard Class	ECw (dS/m)	Description & Notes
C1 Low salinity water	<0.25	Can be used for most crops on most soils with low chance of developing a salinity problem. Some leaching required but this would happen under normal, well managed irrigated agriculture
C2 Medium salinity class	0.25 – 0.75	Can be used if a moderate amount of leaching occurs. Crops with moderate tolerance to salinity can be cultivated without special measures for control of salinity
C3 High salinity class	0.75 – 2.25	Cannot be used on soils with restricted drainage. Even with adequate drainage special management for salinity control will be required and crops with high tolerance to salinity used.
C4 Very high salinity class	>2.25	Not suitable for irrigated agriculture under normal circumstances. Soils must be very permeable (sandy), drainage must be good, irrigation water must be supplied in excess to provide excessive leaching and only very salt tolerant crops can be grown

Source: Bookers, 1991

5. ETESP Tools for Monitoring Conditions for Rice

5.1 Introduction

Two tools have been compiled as MS Excel spreadsheets:

- The Site Monitoring tool, and
- Soil Conditions Database tool

5.2 The Tools and Use of the Tools

5.2.1 Site Tool

The basic tool is an MS Excel spreadsheet but, in the field, the monitoring agent (Extension staff) requires only a paper print out of the "Data Sheet" which is shown as Figure 5.1. The relevant data are then appended to the shaded or coloured boxes on the sheet. If the coordinates can be collected then they are entered into the columns labeled Nothings and Eastings.

The "Site" monitoring tool is very simple to use and all that the field operator has to do is collect some basic soil and water information along with relevant site location details. The location details include:

- Kabupaten
- Kecamatan
- Desa
- Farmer or Land-owners name plus, if maps or a GPS unit are available
- The geographic coordinates of the site(s)

The latter data are an essential part of the first steps in compiling a geospatial database / geographic information (GIS) system. With the coordinates the results collected can be mapped directly from the system and updated easily by an experienced operator. The soil and land data that have to be collected comprise:

- Textural class of the surface soil, that is if it is heavy / fine (clay etc), medium (clay loams), light (sandy loams) or just sand (sands and loamy sands)
- Soil salinity measured by hand held salinity meter
- Soil pH measured with pH papers, or hand held pH meter if available
- Depth of in-field or on-farm drains, measuring tape, ruler or guestimate
- Salinity of irrigation water by hand held salinity meter
- Actual crop yield as a percentage (%) of the pre-tsunami yield

Figure 5.1 Data Sheet of Site Tool

ETESP Site Monotoring Form for Wetland Rice

District (Kabupaten): Pidie | Sub-District (Kecamatan): Meureudu | Desa: Meuraksa | Farmer / Owner: Pak Lima

Geographic Coordinates from Map or GPS								Surface Soil Texture		SALINITY OF SITE or VILLAGE			Reaction		In-field Drains		Irrigation Water		Actual	Actions and
Date of Visit		Northings			Eastings			1 = Heavy 2 = medium	3 = light 4 = sand	Soil	Predicted	Action	Soil	pH	Depth	Action	H_2O	H_2O	Yield	Conclusion
Day	Month Year	Deg	Min	Sec	Deg	Min	Sec	Class	Rating	dS/m	% Yield		pH	Class	(cm)		(dS/m)	Class	%	Based on Yield
13	Mar-05	5	15	33.1	96	15	0.9	2	OK	7.7	65	Leach & plant	7.0	Mod	25	Deepen	0.19	Very good	50	Land recovering
30	Nov-05	5	15	33.1	96	15	0.9	2	OK	1.0	100	Plant	6.5	Good	50	Clear	0.10	Very good	75	Land recovered

Back in the office the data are then entered into a digital copy of the form and the messages or information boxes will fill. The introduction page which contains some simple instructions is shown as Figure 5.2

Figure 5.2 Introduction Page of the Site Tool

ETESP

TOOL FOR MONITORING SITE CONDITIONS FOR WETLAND RICE

ETESP Site Monotoring Form for Wetland Rice

District (Kabupaten): Pidie | Sub-District (Kecamatan): Meureudu | Desa: Meuraksa | Farmer / Owner: Pak Lima

Geographic Coordinates from Map or GPS								Surface Soil Texture		SALINITY OF SITE or VILLAGE			Reaction		In-field Drains		Irrigation Water		Actual	Actions and
Date of Visit		Northings			Eastings			1 = Heavy 2 = medium	3 = light 4 = sand	Soil	Predicted	Action	Soil	pH	Depth	Action	H_2O	H_2O	Yield	Conclusion
Day	Month Year	Deg	Min	Sec	Deg	Min	Sec	Class	Rating	dS/m	% Yield		pH	Class	(cm)		(dS/m)	Class	%	Based on Yield
13	Mar-05	5	15	33.1	96	15	0.9	2	OK	7.7	65	Leach & plant	7.0	Mod	25	Deepen	0.19	Very good	50	Land recovering
30	Nov-05	5	15	33.1	96	15	0.9	2	OK	1.0	100	Plant	6.5	Good	50	Clear	0.10	Very good	75	Land recovered

The above are actual data

Data Required: Coordinates of the site to allow registration into a geo-referenced Database / GIS system once such a system is set-up

Textural "class" where 1 = heavy soils (clays etc), 2 = medium soils (clay loams, sandy clay loams etc), 3 = light soils (loams, sandy loams etc) and 4 = sands (all sands and loamy sands)

Soil salinity measured by hand held salinity meter

Soil pH measured with pH papers or field pH meter if available

Depth of in-field or on-farm drains, measuring tape, ruler or guestimate

Salinity of irrigation water by hand held salinity meter

Actual yield as a percentage (%) of the pre-tsunami yield

Kabupaten, Kecamatan and Desa names plus numbers are detailed in the NAD sheet

Other Points to Consider:

If the SOIL SALINITY is 4dS/m or less AND the SOIL pH is Moderate to Good plus in-field drains are installed and flowing and YIELD is still poor then consider SOIL FERTILITY

* take soil samples and have them analysed in the laboratory - take samples from 0 - 25, 25 - 50, 50 - 75 and 75 - 100cm depth
* enter the laboratory data into the ETESP LabData Summary form to assess the data and get information on soil fertility problems

5.2.2 The Soil Condition Database Tool

The actual tool comprises a relatively large MS Excel spreadsheet with several pages or worksheets. The first page or worksheet, presented as Figure 5.3, is an introduction with basic instructions on how to proceed and use the tool. The difference with this tool is that all the villages that qualify for ETESP inputs are listed by kecamatan and kabupaten. Each, kabupaten is on a separate sheet to simplify handling and data entry.

Once, data are collated and compiled from the field sheet and mean, or average data, for a village have be calculated then the resultant average values can be entered against each village and an overall picture if the effected villages and kecamatan etc built up.

Data from this sheet can then easily be copied over into a full database compiled in MS Access or the data from the Excel sheets can be used directly in GIS system.

Figure 5.3 ETESP Tool "Soil Conditions for Rice"

ETESP

TOOL FOR MONITORING CONDITIONS FOR WETLAND RICE

District		Sub-District				Surface Soil Texture		SALINITY OF SITE or VILLAGE			Reaction		In-field Drains		Irrigation Water		Actual	Actions and
Kabupaten		Kecamatan		Qualifying DESA		1 = Heavy 2 = medium	3 = light 4 = sand	Soil	Predicted	Action	Soil	pH	Depth	Action	H_2O	H_2O	Yield	Conclusion
No	Name	No	Name	No	Name	Class	Rating	dS/m	% Yield		pH	Class	(cm)		(dS/m)	Class	%	Based on Yield
1	Simeuleu	10	Teupah Selatan	2	Labuhan Bajau	1	Good	3.0	94	Plant	9.0	Very poor	100	Maintain	0.10	Very good	85	Land recovered
				5	Lataling	3	OK	7.0	65	Leach & plant	5.0	Good	75	Clear	0.20	Good	55	Land recovering
				6	Pulau Bengkalak	4	No good	17.0	0	Abandon	3.0	Fail	45	Deepen	0.30	Mod	5	Land not reclaimed

Before trying to use this sheet or tool save it to your DOCUMENTS with a name that means something to you

On this spreadsheet there is on page for each of the Kabupaten's / Districts of the ETESP Area, use the relevant sheet for your area

If you really screw up there is a sheet (NAD) for the whole area - this sheet could be used to start compiling a database

All the operator has to do to monitor conditions and get some practical advice from this tool is fill in the requred data in the yellow boxes

Data Required: Textural "class" where 1 = heavy soils (clays etc), 2 = medium soils (clay loams, sandy clay loams etc), 3 = light soils (loams, sandy loams etc) and 4 = sands (all sands and loamy sands)

Soil salinity measured by hand held salinity meter

Soil pH measured with pH papers

Depth of in-field or on-farm drains, measuring tape, ruler or guestimate

Salinity of irrigation water by hand held salinity meter

Actual yield as a percentage (%) of the pre-tsunami yield

Other Points to Consider: If the SOIL SALINITY is 4dS/m or less AND the SOIL pH is Moderate to Good plus in-field drains are installed and flowing then consider SOIL FERTILITY

* take soil samples and have them analysed in the laboratory - take samples from 0 - 25, 25 - 50, 50 - 75 and 75 - 100cm depth
* enter the laboratory data into the ETESP LabData Summary form to assess the data and get information on soil fertility problems

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The tool (file) normally has its properties set to be a "Read Only" file. This means that the file can be used and tested by entering data but the changes made cannot be saved. Accordingly, the first step is to save the file, using the "Save As" routine with some name that is meaningful to the user. This means that the original file will always be available for use or re-use at a later date. Also, boxes which will automatically fill are protected and the operator cannot alter or add data to them.

The data that have to be entered are entered into the "yellow" boxes on one of the pages or worksheets – there are pages (worksheets) for the various kabupaten in which ETESP is expected to operate. There is also a page where data from all the qualifying villages in within NAD can be entered – this page might be used in time to form the start of a database or for back-up purposes. The final page contains formulae and data to generate the various "messages". Villages that qualify for inclusion in the ETESP programme are included under the respective kecamatan on the page for the kabupaten. Refer Figure 5.4 which contains the qualifying villages from the first included kecamatan in Aceh Barat.

Figure 5.4 Extract of Aceh Barat Page

Aceh Barat							SALINITY OF SITE or VILLAGE			Reaction		In-field Drains		Irrigation Water		Actual	Actions and
AREA	District (Kabupaten)		Sub-District (Kecamatan)		Qualifying DESA		Soil	Predicted	Action	Soil	pH	Depth	Action	H_2O	H_2O	Yield	Conclusion
	No	Name	No	Name	No	Name	dS/m	% Yield		pH	Class	(cm)		(dS/m)	Class	%	Based on Yield
NAD	7	Aceh Barat	50	Johan Pahlawan	3	Padang Seurahet											
					12	Kampung Darat											
					15	Suak Ribee											
					16	Suak Raya											
					17	Suak Nie											

NB Coordinates have not been included in this tool since, if a GIS is compiled, the geo-referencing should be possible from the maps f the villages contained within the system.

As data are added to the yellow boxes data messages or information automatically fills in the white boxes. If no data are added then, in theory that section is not used. Hence, if there are no data then leave the appropriate yellow box empty. Data can be spot data from a single site on a farm or, what would be better, the average data for a village or block of fields. It all depends exactly what the operator is monitoring or studying.

If all the necessary interventions have been installed or carried out and:

- the salinity suggest the yield should be normal
- the soil pH claims to be favourable for rice cultivation
- in-field drains have been installed and are functioning
- the irrigation water is of good quality, and
- the actual yield obtained is well below what would be expected then the problem is most likely with the soil fertility and soil samples will have to be collected and laboratory analyses carried out

Refer to Section 3.4 above for more information on nutrients and nutrient requirements for rice and follow the instructions given on page 1 of the tool.

5.3 Soil Analyses

If the yield is depressed to any great extent then soil sampling should be considered and the samples subjected to normal laboratory analyses for:

- Soil Reaction with pH (water) plus
- Exchangeable H (hydrogen) and Al (aluminium) *in me/100g soil*
- Soil salinity as EC – *in dS/m*
- Exchangeable-Ca (calcium) *in me/100g soil*
- Exchangeable-Mg (magnesium) *in me/100g soil*
- Exchangeable-K (potassium) *in me/100g soil*
- Exchangeable-Na (sodium) *in me/100g soil*
- Total-N%
- Organic carbon%
- Available-P in ppm, and
- CEC – Cation Exchange Capacity *in me/100g soil*

As this is to establish fertility over the entire site take the soil samples as mixed bulk samples (taken in a scattered random manner) and have them analysed in the laboratory - take samples from:

- 0 – 25
- 25 – 50
- 50 - 75 and
- 75 - 100cm depth

These routine soil analyses could be carried out by ISRI, Bogor. Once obtained the data should be entered into the ETESP tool (Excel spreadsheet) "ETESP Lab Data Summary *Version 4*". This tool applies ratings to the level of the various nutrients and also presents a summary indicating fertility level, any possible deficiencies and obvious risk factors presented by the chemical status of the soil.

6. ABBREVIATIONS and GLOSSARY

(Simple metric units and chemical element symbols not included)

asl	Above sea level
ASP	Aluminium Saturation Percentage
Avail-P	Available phosphorus (in ppm)
AWC / AWHC	Available water capacity (amount of water held in soil at suctions low enough for root uptake, and = MC% FC – MC% WP)
BS%	Base saturation percentage
C	Clay (finest mineral particles in soils, < 2um in diameter, important store for some nutrients and water, make soils sticky & heavy to work)
Ca++	Exchangeable calcium (in me/100g)
CEC	Cation exchange capacity
CL	Clay loam
cm	Centimetre
EC	Electrical conductivity
Exch	Exchangeable (for cations)
FYM	Farmyard manure
GIS	Geographical information system
GPS	Global positioning system
ha	Hectare
Horizon	Soil layer
ID	Imperfectly drained (soil)
Imperfectly drained	Soils in which most large pores drain their water soon after rain or irrigation for much of the year, but remain filled for long spells in summer Identified by moist or wet feel, and grey or brown colours and many grey, rust or orange mottles.
In situ	In original position or place (Latin)
K+	Exchangeable potassium (in me/100g)
L	Loam (Mixed soil with substantial quantities of all three particle size classes, i.e. clay, silt and sand)
LS	Loamy sand
Mg+	Exchangeable magnesium (in me/100g)
MD / MWD	Moderately well drained (soil)
Munsell	System of standard soil colour notation, operated by matching soil against standard charts. Colour described by ‘hue’ (Spectral composition, red, yellow, blue, green); ‘value’ (dilution with white), & ‘chroma’ (darkness)
NA	Not applicable / Not applied
ND	No data / Not Determined
NS	Not sampled (in soil profile descriptions)
OC	Organic carbon
OM	Organic matter
P	Phosphate
PD	Poorly drained (soil)
PM	(Soil) Parent Material
Pptn	Precipitation, rainfall
pH	Measure of acidity - alkalinity
Si	Silt (intermediate sized mineral particles in soils, 2 - 50 um in diameter, important store for plant available water, make soils slippery & vulnerable to surface erosion and capping, aka Z, Zi)
Total-N	Total soil nitrogen (in %)
Zn	Zinc, plant micro-nutrient

7. REFERENCES and ETESP SOIL DESALINISATION and IMPROVEMENT REPORTS

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Booker Tropical Soil manual, Longmans, London 1991

7.2 ETESP 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, updated March 2006

7.3 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

ETESP, Sandy Sediments, FEBRUARY 2005

ETESP, Soil Conditions for Wetland Rice, MARCH 2005

7.4 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

7.5 ETESP Soil Desalinisation and Improvement Tools

File name and date	Purpose
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
Leaching Water Requirements.XLS NOVEMBER 2005	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)

Irrigation Leaching Progress.XLS NOVEMBER 2005	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 •
Survey Density.XLS DECEMBER 2005	1. Correlate the scale at which to map surveys of various types from reconnaissance to very detailed level 2. Determine observation density (Sites / hectare) 3. Calculate the total number of sites for surveys at various reliability levels Requirements: • Survey area extent in hectares (ha) Also presents various map and mapping information
ETESP Labdata summary.XLS Version 4 FEBRUARY 2006	Enter standard laboratory data and obtain ratings as to the level of all the various nutrients and chemical properties. 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
ETESP Site Monitoring tool.XLS March 2006	Enter field data for specific sites or villages making note of : 1. <u>Locational information</u> • Kabupaten • Kecamatan • Desa • Farmer or Land-owner, and • Geographic coordinates 2. <u>Soil, land and crop features</u> • 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
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