Enhancing the potable water potential of Tsunami-hit areas of NE Sumatra using high resolution airborne and ground geophysics

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Co-operation Partners:

Directorate General of Geology and Mineral Resources (DGGMR)

Executive Agency for the Rehabilitation and Reconstruction in Nanggroe Aceh Darussalam Province and Nias Islands
• Introduction
• Results of the airborne electromagnetic survey
• Results of ground electromagnetic and direct current soundings
• Achievements and recommendations
Spacings:
Flight lines 500 m
Tie lines 3000 m

Mileage flown:
Flight lines 1100 km
Tie lines 230 km

Nominal flight height
EM Bird 30-40 m a.g.
Helicopter 70-80 m a.g.
Electric conductivity of water as taken from wells

- < $10^3$ µS/cm
- $10^3$ – $2\times10^3$ µS/cm
- > $2\times10^3$ µS/cm
Airborne Geophysics

- Maps depicting resistivity at selected depths below ground (5, 10, 15, 30, 45, 60 m below ground)
- Example vertical resistivity sections along flight path
Resistivity at 5 m below ground level
Resistivity at 10 m below ground level
Resistivity at 15 m below ground level
Resistivity at 30 m below ground level
Resistivity at 45 m below ground level
Resistivity at 60 m below ground level

Potential inland aquifers

Vertical resistivity sections to be discussed
VRS (along flight line 36.1) with minimum salinisation at shore due to fresh water flow from inland
VRS (along flight line 51.1) with major salinisation at shore and SW dipping layers
VRS (along flight line 60.1) with major salinisation at shore and SW dipping layers
Ground Geophysics

- Time Domain Electromagnetic (TDEM) and
- Direct Current (DC) Resistivity Soundings
Sites of TEM and DC Soundings conducted in Batee Area, Sigli - Pidie
VRS running parallel to shore line (flight line 8.9)
Principle of the Transient Electromagnetic Technique
Sample TEM sounding close to shore
TEM sounding about 500 m inland
Principle of the Direct Current (DC) Four-Point Schlumberger Depth Sounding

Current Density

Equipotential Lines

$\rho_1, \rho_2$ Electric resistivity of layers 1 and 2 ($\rho_1 > \rho_2$)

$k_1, k_2$ Electric resistivity of layers 1 and 2 ($k_1 > k_2$)
Comparison of DC (left) and TEM (right) soundings at site sig_19
Comparison of DC (left) and TEM (right) soundings at site sig_16
<table>
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<th>Aid Organisation</th>
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<td>German Agro Action (Welthungerhilfe)</td>
<td>Rehabilitation of existing wells, drilling program covering Bireuen – Sigli region</td>
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<td>German Development Cooperation (GTZ)</td>
<td>Running refugee camps and providing these with fresh water</td>
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<td>French Red Cross - Sigli</td>
<td>River water treatment and logistics of fresh water for settlements and refugee camps with no nearby fresh water</td>
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<td>Oxfam – Sigli (UK)</td>
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<td>International Professionals (US Aid)</td>
<td>Reconstruction of heavily hit settlements</td>
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Area: "Sigli/Indonesia" – Survey 2005
Helicopter Electromagnetics: Multi-layer inversion results

Flight number: 12304
Profile number: 12.1
Hor. scale: 1 : 50 000
Ver. scale: 1 : 2000

f1 = 387 Hz, s = 7.94 m
f2 = 1820 Hz, s = 7.93 m
f3 = 8225 Hz, s = 7.93 m
f4 = 41550 Hz, s = 7.91 m
f5 = 133200 Hz, s = 7.92 m
s = coil spacing

- corrected data
- smoothed data

Sdg Sig_27
TEM sounding 27 reveals a 6 Ohm*m resistive substrate with top at 45 m below ground.
Electric borehole log (right hand side track) reveals resistive intercalation with 5 Ohm*m at 45 m below ground.
Achievements and Recommendations

- Potential inland aquifers outlined by airborne electromagnetics
- Salinisation along the Sigli coastal zone is hardly a product of the Tsunami flooding
- Artesian fresh water resources are confirmed in major parts of the Sigli coastal zone
- Ground electromagnetic surveys achieved greater depth of investigation in the coastal zone
- Ground electromagnetic surveys required to guide drilling programs, maximising the chance to hit potable water in the coastal zone
- Drilling would support back-evaluation of geophysical survey data
Mission Completed