Status, priorities and needs for sustainable soil management in Madagascar

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Some facts about Madagascar

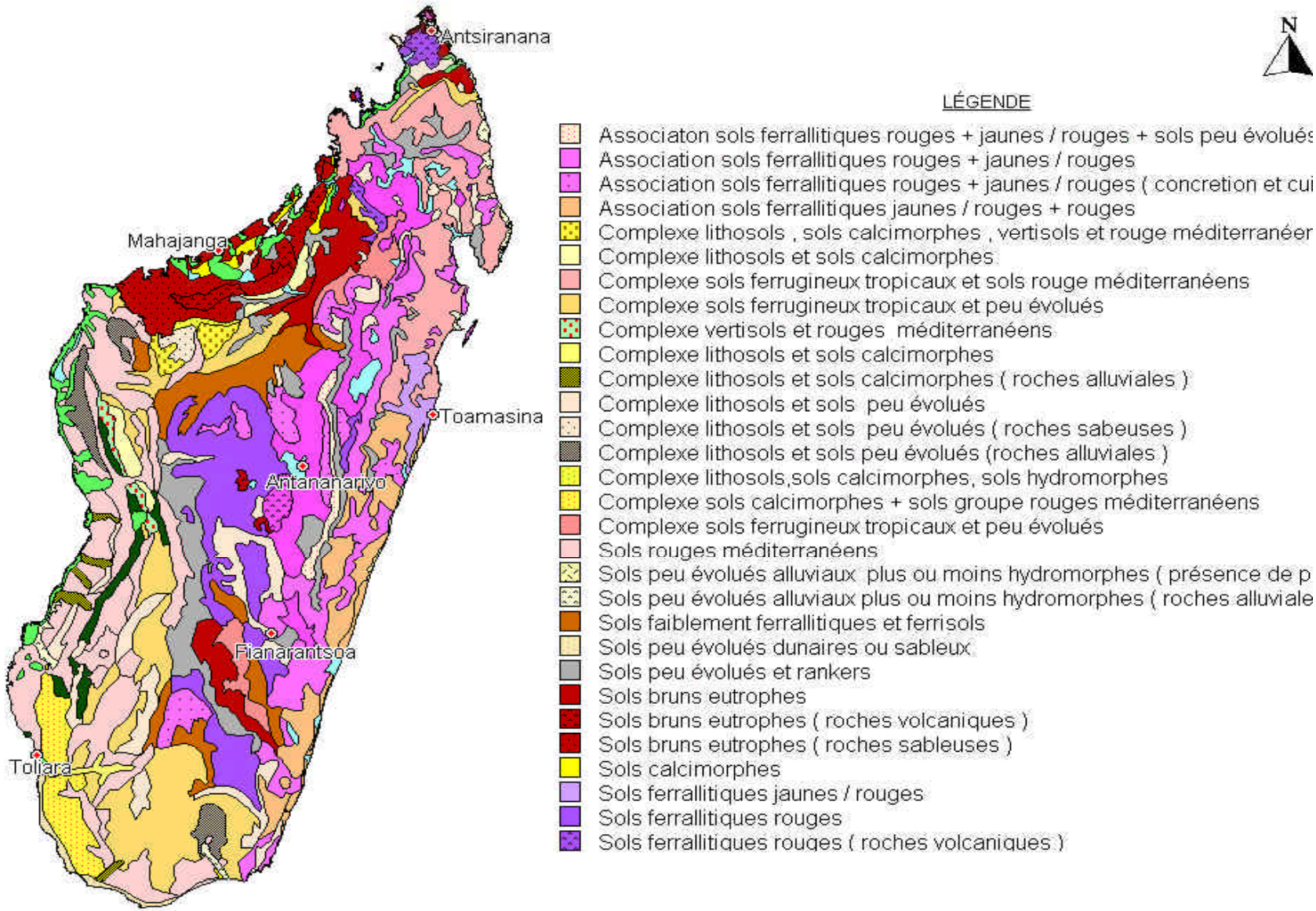
- Location: Island situated 400 km East of Mozambique
- Latitude :20°00’ S, Longitude : 47°00’ E
- Total area: 587,040 km²
  water: 5,500 km² (1%)
  lands: 581,540 km² (99%)
- Shoreline: 5,000 km
- Fourth biggest island in the World
- Climate : tropical climate along the Littorals, temperate in the Central High Plateaus, and aridic in the South.

The major soil types

- Morpho-pedologically, Malagasy soils are subdivided to:
- 1) Cristalline terrains: Red Ferralitic soil
- 2) Sedimentary terrains: Yellow Ferralitic soil, Red Ferrugenous soil, Calcareous soil
- 3) Volcanic terrains: Andosols, Ferralitic soil
- 4) Alluvial and colluvial terrains: Fluvisol, Hydromorphic soil, Podzol, Ferralitic soil

Main soil characteristics/properties

- Acidic to very acidic (4.5<pH<5.5) except for calcareous soils
- High Fe content (Iron toxicity in rice cultivation)
- High Al content (Al toxicity in upland crops, like maize)
- Very low available P (high P-fixation due to high amount of Al and Fe oxides)
- N deficient
- Poor SOM
- Pockets of K and S deficient soil emerging
- Probably some micronutrients deficiency
- Compact, low infiltrability, high erodibility


Antsiranana
Mahajanga
Toamasina
Antananarivo
Fianarantsoa
Toliara
N
LÉGENDE
Associaton sols ferrallitiques rouges + jaunes / rouges + sols peu évolués
Association sols ferrallitiques rouges + jaunes / rouges
Association sols ferrallitiques rouges + jaunes / rouges (concretion et cui
Association sols ferrallitiques jaunes / rouges + rouges
Complexe lithosols , sols calcimorphes , vertisols et rouge méditerranéer
Complexe lithosols et sols calcimorphes
Complexe sols ferrugineux tropicaux et sols rouge méditerranéens
Complexe sols ferrugineux tropicaux et peu évolués
Complexe vertisols et rouges méditerranéens
Complexe lithosols et sols calcimorphes
Complexe lithosols et sols calcimorphes (roches alluviales)
Complexe lithosols et sols peu évolués
Complexe lithosols et sols peu évolués (roches sabeuses)
Complexe lithosols et sols peu évolués (roches alluviales)
Complexe lithosols,sols calcimorphes, sols hydromorphes
Complexe sols calcimorphes + sols groupe rouges méditerranéens
Complexe sols ferrugineux tropicaux et peu évolués
Sols rouges méditerranéens
Sols peu évolués alluviaux plus ou moins hydromorphes (présence de p
Sols peu évolués alluviaux plus ou moins hydromorphes (roches alluviale
Sols faiblement ferrallitiques et ferrisols
Sols peu évolués dunaires ou sableux
Sols peu évolués et rankers
Sols bruns eutrophes
Sols bruns eutrophes (roches volcaniques)
Sols bruns eutrophes (roches sableuses)
Sols calcimorphes
Sols ferrallitiques jaunes / rouges
Sols ferrallitiques rouges
Sols ferrallitiques rouges (roches volcaniques)

Major issues: degradation of watersheds

Causes:

- Over use of soils (population pressure) and inappropriate agricultural practices, over grazing…
- Erosion (lavaka) very frequent in the Central High Plateaus (Ferralitic soils)
- Wild fire, tavy (slash and burn agriculture practiced on steep slope, very humid environment)
- Deforestation
- Absence of vegetal cover
- Heavy rains
- Steep slopes

Degradation of watersheds (cont'd)

Consequences:

- Loss of top soil (5-20 $Mg.ha^{-1}.yr^{-1}$)
- Loss of nutrients and of soil fertility
- Siltation (paddy fields, lakes, rivers, irrigation networks…)
- Economic impacts

Degradation of watersheds(cont'd)

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Two case studies

- In the Alaotra Basin, there are 4,735 lavakas, of which 13% are stable (*Source : Situation de l' érosion en lavaka et ses impacts, ONE - Rabarimanana Mamy, 2002)*
- *In the Region of Itasy, out of the* 400 lavakas inventoried, only 2% are stabilized.
- The mean size of the lavaka ranges from 3 to 15.5 ha.
- NB: Methodology: Landsat Imagery

Just for illustration

Assuming

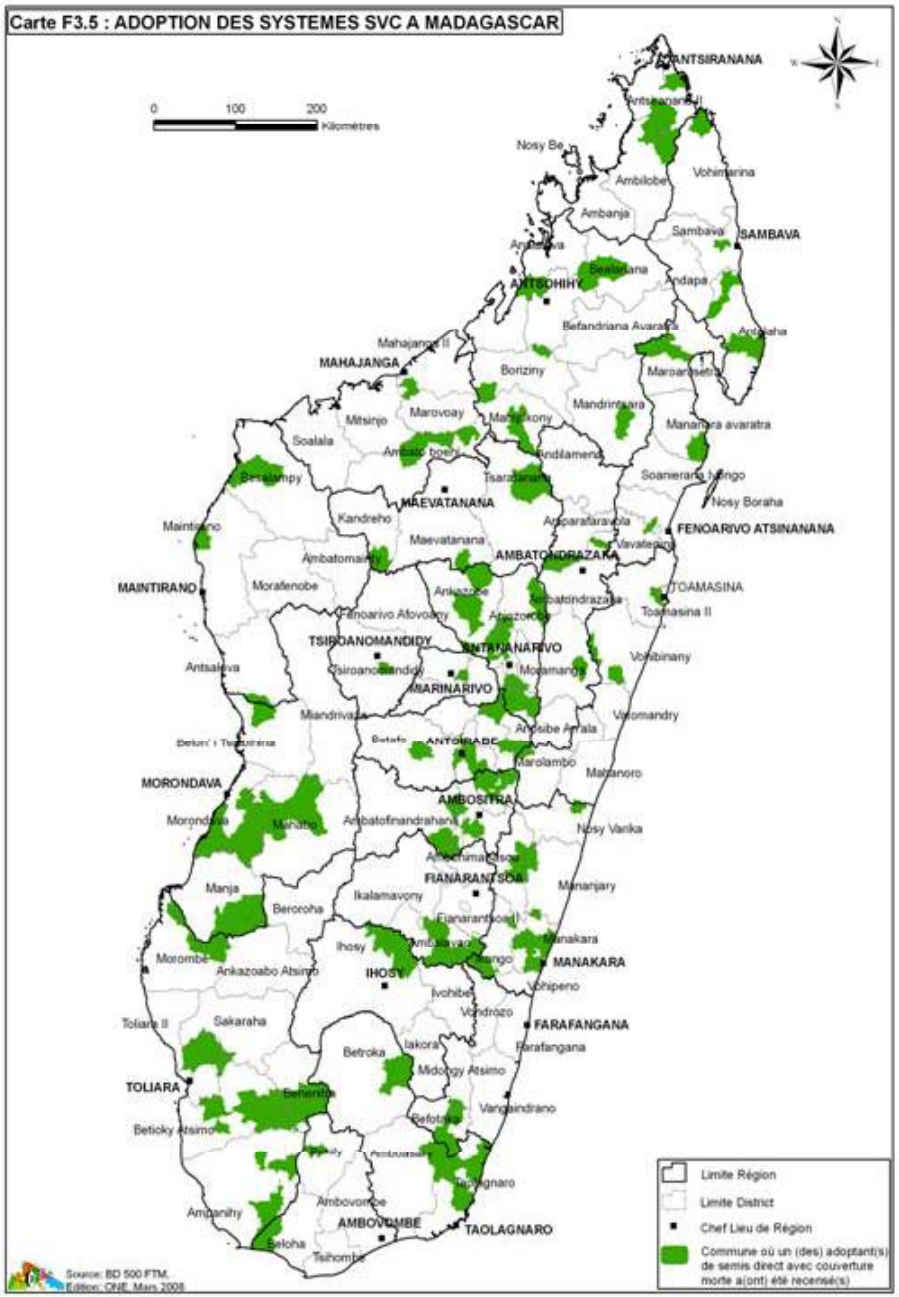
- a) Lavaka (40%)
- Blanket erosion (60%)
- Average area of one lavaka : 10 ha
- Average depth of one lavaka : 15 m
- Number of lavaka : 5,000
- Then
- volume of soil lost : 7.5×10^9 m^3
- B) Blanket erosion (60%) = 11.25 m^3
- Total soil loss = 20 Billions m^3

Evolution of the « lavaka »

Active lavaka

Pseudo-stable lavaka

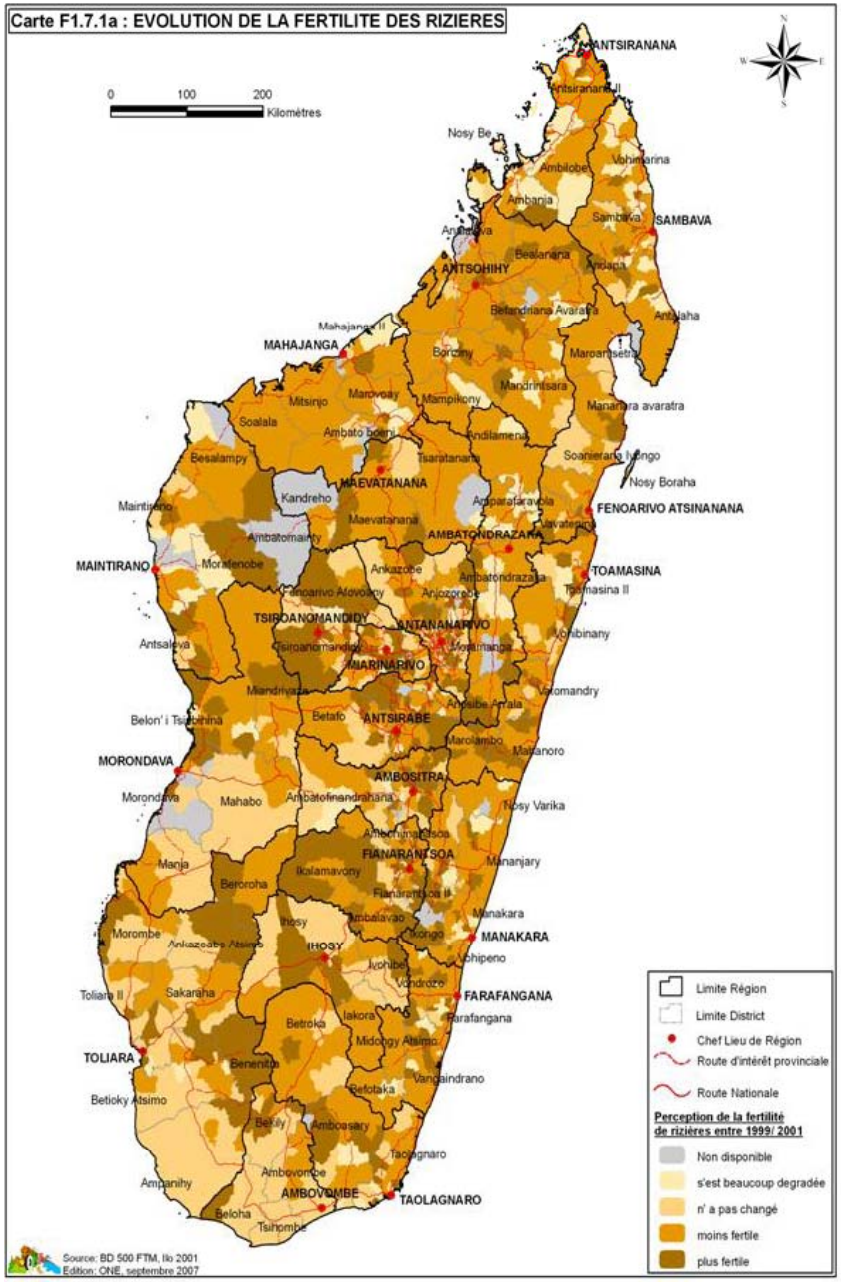
Stabilized lavaka

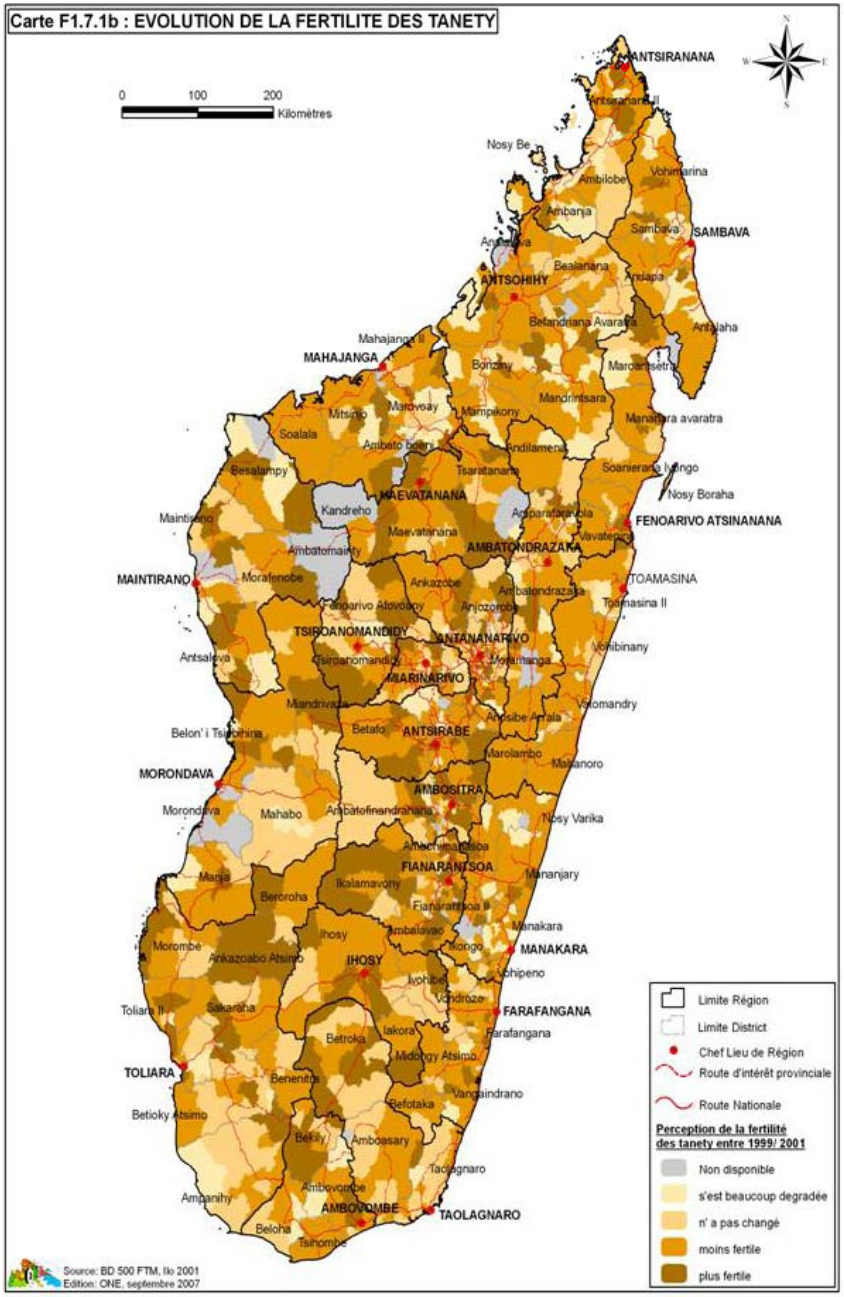

Carte F3.5 : ADOPTION DES SYSTEMES SVC A MADAGASCAR
0
100
200
Kilomètres
ANTSIRANANA
Nosy Be
Ambilobe
Vohemarina
Ambanja
Sambava
SAMBAVA
ANTSOHIHY
Andapa
Befandriana Avaratra
Antalaha
Mahajanga II
MAHAJANGA
Boriziny
Maroantsetra
Mandritsara
Marovoay
Mitsinjo
Manakony
Manantsa avaratra
Soalala
Andilamena
Soanierana Ivongo
Nosy Boraha
Tsaratanana
MAEVATANANA
Kandreho
Antsohihy
FENOARIVO ATSINANANA
Maintirano
Maevatanana
Vavatenina
AMBATONDRAZAKA
Ambatomainty
MAINTIRANO
Morafenobe
Ankazobe
Antananarivo
TOAMASINA
Fenoarivo Atsinanana
Toamasina II
TSIROANOMANDIDY
ANTANANARIVO
Vohibinany
Antsalova
Tsiroanomandidy
Moramanga
MARINARIVO
Miandrivazo
Vavomandry
Antsirabe Afara
Belon' i Tsiribihina
ANTSIRABE
Marolambo
Mahanoro
MORONDAVA
AMBOSITRA
Morondava
Mahabo
Ambatofinandrahana
Nosy Varika
Antsirabe Atsimo
FIANARANTSOA
Manjakandriana
Manja
Ikalamavony
Mananjary
Beroroha
Fianarantsoa I
Manakara
Ihosy
Morombe
Ankazoabo Atsimo
IHOSY
MANAKARA
Ivohibe
Vohipeno
Vondrozo
Toliara II
Sakaraha
FARAFANGANA
Farafangana
Betroka
Iakora
Midongy Atsimo
TOLIARA
Behenjy
Vangaindrano
Befotaka
Betioky Atsimo
Taolagnaro
Ambovombe
Amboasary
Ambanihy
AMBOVOMBE
TAOLAGNARO
Beloha
Tsihombe
Limite Région
Limite District
Chef Lieu de Région
Commune où un (des) adoptant(s) de semis direct avec couverture morte a(ont) été recensé(s)
Source: BD 500 FTM,
Edition: ONE, Mars 2008

Evolution of soil fertility

- Farmer perception between 1990 and 2001, at Commune level
  - For paddy soil (lowland rice soil)
  - For upland soil

  NB: In the legend
  - Not available (blue)
  - Dramatically degraded (light pink)
  - No change (pink)
  - Less fertile (light brown)
  - More fertile (dark brown)


Carte F1.7.1a : EVOLUTION DE LA FERTILITE DES RIZIERES
0
100
200
Kilomètres
ANTSIRANANA
Nosy Be
SAMBAVA
ANTSOHIHY
MAHAJANGA
MAEVATANANA
FENOARIVO ATSINANANA
AMBATONDRAZAKA
MAINTIRANO
TOAMASINA
TSIROANOMANDIDY
ANTANANARIVO
MARINARIVO
ANTSIRABE
MORONDAVA
AMBOSITRA
FIANARANTSOA
MANAKARA
FARAFANGANA
TOLIARA
AMBOVOMBE
TAOLAGNARO
Limite Région
Limite District
Chef Lieu de Région
Route d'intérêt provinciale
Route Nationale
Perception de la fertilité de rizières entre 1999/ 2001
Non disponible
s'est beaucoup degradée
n' a pas changé
moins fertile
plus fertile
Source: BD 500 FTM, Ilo 2001
Edition: ONE, septembre 2007


Carte F1.7.1b : EVOLUTION DE LA FERTILITE DES TANETY
0
100
200
Kilomètres
ANTSIRANANA
Antsiranana II
Nosy Be
Ambilobe
Vohimarina
Ambanja
Sambava
SAMBAVA
Andapa
Bealanana
ANTSOHIHY
Antalaha
Betandriana Avaratra
Mahajanga II
MAHAJANGA
Boriziny
Maroantsetra
Mandritsara
Mitsinjo
Marovoay
Mampikony
Soalala
Ambato boeny
Andilamena
Besalampy
Tsaratanana
Soanierana Ivongo
MAEVATANANA
Nosy Boraha
Kandreho
Maintirano
Maevatanana
FENOARIVO ATSINANANA
Ambatomainty
AMBATONDRAZAKA
MAINTIRANO
Morafenobe
Ankazobe
TOAMASINA
Fenoarivo Atsinanana
Toamasina II
TSIROANOMANDIDY
ANTANANARIVO
Antsalova
Tsiroanomandidy
Miarinarivo
Vohibinany
Miandrivazo
Antsirabe Afara
Betafo
ANTSIRABE
Belon' i Tsiribihina
Marolambo
MORONDAVA
AMBOSITRA
Morondava
Mahabo
Nosy Varika
FIANARANTSOA
Mananjary
Ikalamavony
Manakara
Ihosy
MANAKARA
Morombe
Ankazoabo Atsimo
IHOSY
Vohipeno
Toliara II
Sakaraha
FARAFANGANA
Farafangana
Betroka
Midongy Atsimo
TOLIARA
Benenitra
Vangaindrano
Betioky Atsimo
Befotaka
Beloha
Amboasary
Taolagnaro
Ambovombe
Amboasary
AMBOVOMBE
TAOLAGNARO
Beloha
Tsihombe
Limite Région
Limite District
Chef Lieu de Région
Route d'intérêt provinciale
Route Nationale
Perception de la fertilité des tanety entre 1999/ 2001
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s'est beaucoup degradée
n' a pas changé
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Source: BD 500 FTM, Ilo 2001
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Current efforts to address soil management challenges

- National program for watershed and irrigated areas protection (WB, FAD, GEF, Government…)
- Promoting integrated use of mineral and organic fertilizers in any fertilizers recommendations
- Promoting agro ecological techniques and conservation agriculture (mulching, Legumes cover crop, zero or minimum tillage…)
- National Strategy for Ferilizers Use
- Promote use of locally available materials (guano, liming materials, ammonium sulfate from Ambatovy Plant Co-Ni after identifying areas where it could be used,…)

Some challenges towards sustainable soil management

- Soil degradation and erosion
- Declining soil fertility
- Inappropriate farming practices
- Low adoption of techniques by farmers
- Bridge the gap in terms of policies (land use)

The needs

- Update soil inventories and mapping using state of the art digital /geospatial tools
- Training of young Soil Scientists
- Make accurate and sound fertilizers recommendations
- Capacity building and strengthening (soil, plant and fertilizers testings and analytical labs) (research and public service)
- Set up fertilizer blending plant (in collaboration with PS)

ASANTI SANA

THANK YOU

GRACIAS

MERCI

MISAOTRA