This note is the first of a serie of 5 that will cover the following topics:

1. *Framework for Reclamation Action Plan (FRAP) for Affected Soils*
2. *Salt measurements simple devices: how to monitor salt status in water bodies and soils.*
3. *Set of agro-bioclimatic data for the main affected agro-ecozones in the region*
4. *Specific farming recovery strategies for crop and animal production*
5. *Costing estimation for remediation and rehabilitation works.*

A Framework for Reclamation Action Plan for Affected Soils

[Version L1]

Summary:

Agricultural affected lands need to be quickly rehabilitated to restore the production capacity of farmers and ensure food security in rural areas. A framework of intervention is proposed to ensure that the next cropping season can start in fairly good conditions for medium to low damaged areas and that for badly affected areas rehabilitation works or plans for reorientation of production are carried out soon.

Reclaiming field/soils affected by the tsunami will depend on the severity of the damage and the resilience of the system. FAO proposes to confront this crisis with an approach developed in three steps:

1. **Classifying and zoning the damages and the resilience of the system.**
2. **Identifying the capacity of farmers and local communities in restoring progressively their production capability.**
3. **Designing and scheduling a consistent set of targeted interventions for the short and long term, for each zone, considering the above as well as the agro-climatic constraints (rainfall, agricultural calendar and usual practices)**

Given the extreme dispersion of sites to be investigated and rehabilitated, it is critical that local expertise is engaged and strengthened to deal with the diagnosis and remediation.

Therefore FAO aims to help governments and regional authorities in increasing the local capacity through:

- **a massive consistent training program of local staff;**
- **by making available cheap salinometers (at least 100 per country for a start); and**
- **assist farmers in reaching their pre-disaster agricultural production capacity or reorient them towards diversified production activities.**

1. Assessing the needs

Damages differ **by nature**:

- Direct crop destruction by uprooting, salt poisoning, flood, etc...
- Erosion and scouring that modifies the topography, land levelling and the elimination of bunds (for paddy fields)
- Soil fertility losses when upper layer is washed away
- Deposition of salted sediment
- Salt infiltration
- Trash and debris accumulation.

or by **intensity** which depends on three main characteristics of the particular location:

- the energy of the flood,
- the type of soil coverage and vegetation, and
- the soil hydraulic properties including drainage capacity*.

FAO proposes a simple classification for assessing the damages based on 3 main subsets:

- **Field level**
- **Infrastructure**
- **Farming capacity**

Methodology

Rationale: The level of support and the specific set of interventions required to return to normal situation in affected areas depend on damages intensity, capacity of main infrastructure to allow remediation, the farming capacity both human and material to reengage in agricultural activities and reclamation works when required.

It is proposed to quantify the damages through ranked indicators for each subset using the following tables.

FIELD DAMAGES characterises the gravity of damages at field level (see table 1)

INFRASTRUCTURE CAPACITY indicates the constraints faced at system levels that may impede carried out civil works and field works (land levelling and watering) and returning to a normal situation (see Table 2).

Physical damages preventing from recovering the field production capacity are related to irrigation and drainage infrastructures, but also to transportation infrastructure. Drainage networks can be destroyed, silted or plugged, while irrigation structures may have been damaged or destroyed. Irrigation networks may be silted up; no longer able to feed by gravity; or fields may be un serviceable due to a significant increase of their elevation as a result of sedimentation.

Table 1.

* The presence of high, and/or saline, ground water tables will negatively affect the hydraulic and drainage properties.

FIELD DAMAGES	Low	Medium	High	Suggested ranking
Trash and debris	1	2	3	*1 low or nil* *2 medium scattered* *3 massive impeding restart of field works*
Erosion	1	4	6	*1 small erosion here and there* *2 medium erosion that needs some resurfacing light works* *3 major erosion problems such as erased bunds, land levelling disturbances and/or soil top layer washed out that requires major intervention for restoring capacity/fertility*
Sedimentation	1	4	6	*1 several centimetres* *4 more than 10 centimetres* *6 more than 20 centimetres*
Flood duration	1	4	6	*1 limited to several hours,* *4 flood lasted more than one day* *6 flood lasted more than one week*
Infiltration**(*)**	1	2	3	***(**)*** *1 Clay soil* *2 medium* *3 high vertical hydraulic characteristic (well drained soil)*
Total	Between 5 and 24			***below 8 = Low damaged area*** ***between 8 and 16 =Medium damaged area*** ***above 16 = High damaged area***

(*) Infiltration rate of upper soil layer influences the quantity of salt that contaminates the soil profile. Of course this aspect also influences the ability for remediation, highly infiltrating soil such as the sandy soils in Maldives are likely to be quickly leached and cleaned with fresh water.

(**) The ranking given here is considering the damages resulting from a small duration flood which makes sandy soils more damaged than clay soils and more impacting the shallow fresh water aquifers. For long duration floods, the damage intensity on soil is the reverse and so should be the ranking: clay soil will store much more salted water and fix much more salt than sandy soils which can be easily leached out by fresh water. [Reverse ranking for long duration floods: 1 sandy (high drainage); 2 medium (medium drainage); 3 clay-silt (low drainage)].

Table 2.

INFRASTRUCTURE CAPACITY	Low	Medium	High	Suggested ranking
Irrigation network	1	4	6	*1 supply from irrigation network is operational* *2 supply is interrupted but can be restore with minor interventions* *3 supply is stopped and needs major interventions*
Drainage network	1	4	6	*1 surface drainage capacity is operational* *2 surface drainage is not functional but can be restore with minor interventions* *3 surface drainage is stopped and needs major interventions*
Transport and access to fields	1	2	3	*Access to fields and irrigation and drainage infrastructures for farming equipment and machinery is:* *1 operational* *2 non operational and requires short term rehabilitation works to be re-established* *3 non operational and requires major long term rehabilitation works to be re-established*

FARMING CAPACITY indicates the ability of farmers to re-engage in cultivation (see Table 3).

Farmers, extension workers, staff of agricultural services may have suffered a lot from the tsunami. Some are among the many that lost their lives, while many of survivors are in a state of chock and trauma. In the worse stricken areas it might take some time for farmers to go back to normal life and affected fields.

Furthermore draught animals, equipments and tools may be lost or damaged by the tsunami as well and need to be quickly replaced.

The program of reclamation should give full consideration to this aspect and favour as much as possible guidance to farmers with a set of practical actions on the fields, aiming at restoring the full capacity wherever it is possible. The time horizon for attaining full capacity will differ from one category to the other.

Table 3.

FARMING CAPACITY ***Production means***	Low	Medium	High	Suggested ranking
Household labour capacity (as fraction of pre-disaster capacity)	1	2	3	*1 Capacity unchanged or slightly decreased (greater than 90 % of pre-disaster)* *2 Capacity is significantly reduced to 75-90 %* *3 Capacity is highly reduced to below 75%*
Drought animals, equipment and tools for farming	1	2	3	*1 Capacity unchanged or slightly decreased* *2 Capacity is significantly reduced constraining the cropping calendar* *3 Capacity is highly reduced impeding cultivation*
Agricultural inputs availability	1	2	3	*1 Availability is unchanged* *2 Availability is decreased* *3 Availability is significantly decreased or nil*
Local/regional labour and equipment capacity for rehabilitation	1	2	3	*1 Capacity is sufficient* *2 Capacity is insufficient but rehabilitation works can be carried out with minor external inputs* *3** Capacity is nil and requires strong external inputs to complete rehabilitation works.*

**** or the capacity is already over-deployed in other reconstruction activities and not available for agriculture.**

2. Zoning the field damages

2.1 The zoning is made firstly with consideration on the Field Damages indicators.

Important: *there is no a priori methodology to give the right weighting factors of the criteria used in previous tables. The ranking of indicators and the weighting should be revised after preliminary tests on the ground.*

This note provides a preliminary guesstimate about the ranking and the weights each aspect should be given. Officers in the field should revise them and report to AGLW for further refinement and possibly homogenisation, if needed.

Class A "Low damaged area = below 8 ". In this category there is no major obstacle to a rapid reclamation and salt leaching either through rainfall or through some special allocation of surface water. The restoration of capacity in this category should be monitored carefully but obtained without major intervention before the beginning of the next cropping season in April and May 2005.

Class B "Medium damaged area = between 8 and 16". This category requires specific and significant interventions to reclaim soil, to restore land surface properties (land levelling, trash, sediment). Salt leaching would require high quantities of water either through rainfall or through some special allocation of surface water. Farmers can do most if not all the rehabilitation works themselves possibly on a "work for food program" provided that the farming capacity has not been too much reduced.

Class C "Highly damaged area = above 16". For this category there are major obstacles to a rapid reclamation and probably the next cropping season is out of reach. In some cases, the return to cultivation might even be discussed and alternative production activities from natural resources use and management (eco-systems) may be sought for these coastal lands, while compensating current landowners and helping them reorienting/diversifying their activities on other land or other productive activities.

3. Remediation work plans

3.1. Water leaching

Leaching of salt in the upper soil profile is obtained from excess water on surface that provoke percolation below the top soil layers, flushing out of the profile salt water. This excess water results from a positive balance of [Rainfall+ irrigation- Evaporation].

In monsoon areas the rainfall is regularly greater than evaporation and the excess is thus positive. But this is not true everywhere and all the time. For instance, in the East part of Sri Lanka the Yala season from April till September is mostly dry and the balance is negative.

Heavy rainfall has occurred immediately after the tsunami in at least two countries; Sri Lanka and Indonesia. This has to be considered when it comes to discuss remediation. Thus as a

special attenuation factor of damages, rainfall between the 26th December and the day of assessment should be monitored.

The **net water balance [Rainfall+ irrigation- Evaporation]** should be roughly assessed for affected areas in order to estimate the leaching occurred.

A significant positive net water balance decreases the FIELD damages and for instance can pull field from Class B to Class A (but not from C to B).

3.2. Determining a set of actions

3.2.1. Class A fields

It is expected that for this situation recovery is likely to be obtained without major intervention. More likely net water balance between January and April, will be enough to flush out the salt and cultivation with normal crops can resume for the next cropping season in March and April. The existing farming system and production are able to recover quickly and no specific precaution for crops are required.

It will still be required to monitor upper soil salinity, to ensure that good conditions are met for the next cropping season and convince farmers to return to normal cultivation.

3.2. Class B fields.

For this type of situation recovery will take some more time and more specific interventions, at least one full cropping season and/or a full monsoon season will be required to recover. We cannot expect to restore full capacity before the start of the next cropping season, but farmers should be able, and encouraged, to crop at least partly their lands.

In this situation we may have to consider:

- Salt tolerant varieties of usual crops to allow cropping in not fully cleaned soils
- Delayed start of the season with varieties having shorter period of growth
- Temporary changes in the production system to compensate for the expected losses of food production and incomes in the coming seasons.

For the coming campaign and possibly the following one, farmers should receive support for seeds, inputs and advice. Their food security should also be assured by compensating them for expected reduced yields, and by providing them easier access to credit.

3.3. Class C fields

To reclaim these fields major works of rehabilitation/reclamation are required either within the field or in the near-by infrastructures.

For some of these fields, mostly very close to the sea shore, alternatives land use and production services might be sought within the context of a comprehensive agro-eco-systems rehabilitation. Abandoning land cultivation can then be a viable option if affected farmers and landowners are well compensated with alternatives productions means.

For the major part of these fields return to cultivation cannot be reached immediately and solutions must be found to allow farmers to temporary cultivate in other un/less affected lands; and to diversify land and natural resources management in order to provide them with alternative means of production and food security.

In the coming weeks specific prototypes for cropping pattern plans and production diversification will be suggested for the last two categories by FAO-AG department.

It is likely that this C class will be further subdivided into two classes:

- **C1 Agriculture vocation is maintained**
- **C2 Ecosystem services are preferable.**

Table 4. Summary of rehabilitation plans.

	Situation	CROPS/farming	Agronomic support required
Class A "Low damaged area".	Return to normal expected for the next season starting in APRIL 2005	Usual crops	Monitoring salinity Seeds and inputs supply, equipment supply if needed
Class B "Medium damaged area".	Delayed return to normal to allow enough time for specific interventions	Cultivation of salt tolerant rice varieties recommended.	Support for seeds and inputs Compensation for reduced yields Support for diversification.
Class C "Highly damaged area".	No return to normal this year. Major rehabilitation works needed Possible reorientation of land uses	Major temporary or permanent diversification of farming system	Compensation for land abandon [C2] Support to diversification

4. Guesstimate Needs Assessment

For the moment estimation of the classification of the damages suffered are made for the 3 badly hit countries for which preliminary information is available.

Indonesia: out of the 30,000 ha affected, FAO guesstimates that 30 % belongs to Class A (9,000 ha), 30 % to Class B (9,000 ha) and 40 % to lass C (12,000ha).

Sri Lanka: out of the 5,500 ha affected, FAO guesstimates that 30 % belongs to Class A (1,650 ha), 70 % to Class B (3,850 ha) and no area belongs to class C.

Maldives: 60 % of the affected area belongs to Class A, 40 % to Class B (where top soil has been washed away).

5. Work plan for rehabilitation of agricultural lands in affected areas

The affected areas are stretching along several thousands km of coast or disseminated among numerous islands. This will not be therefore a massive project with large compact areas under rehabilitation but numerous microsurgeries.

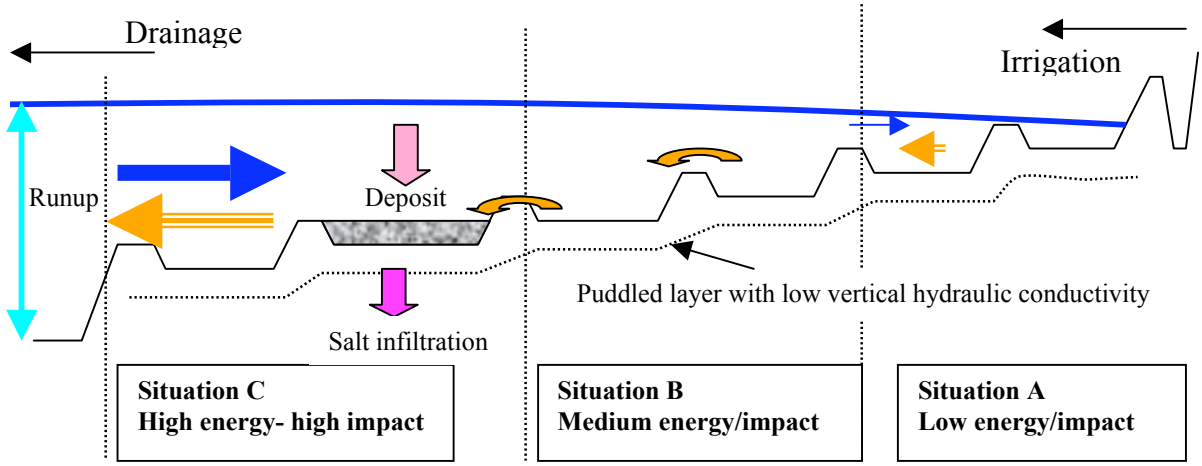
To achieve success in this endeavour we should rely on decentralized technical staff from Government of from Civil Society. These staff should be properly trained to allow them carrying out diagnosis and reclamation interventions with farmers when needed.

Monitoring of salinity will be crucial at local level to better control the efficiency of reclamation measures and allow return to cropping whenever measurements shows that the soil has been cleaned.

Therefore the FAO proposed work plan is based on several tracks:

- **Training of local staff**
- **Monitoring of salinity**
- **Development of main rehabilitation projects**
- **Development and support to temporary farming/production scenario for medium to high affected areas.**

6. Example of classification, limited to field impacts, on a typical transect of paddyfield



	Situation C	Situation B	Situation A
Stream Velocity	High velocity of the front wave and recession front provoking erosion and scouring. Possible destruction of bunds	Medium velocity	Low velocity
Duration of flood	Several hours for well drained lands to several days and weeks for poorly drained fields.	Intermediate	Minimum drainage to nearby field
Salinization due to infiltration	Limited to only few millimetres of salted water for well drained areas.		
	High for long duration of inundation (A value of 5 to 10 mm of infiltration per day might be consider for paddyfield considering the usual values of deep percolation below the puddled layer)		
Sediment deposit	Salted deposit thickness can reach up to 30 cm. Part of the initial deposit can also be eroded during rapid recession flows if the area is well drained.	Salted deposit thickness can reach up to 30 cm.	Low deposit due to low water depth.
	High deposit where inundation lasts.		

7. Preliminary analysis and recommendations based on Aceh-Indonesia

Type 1. Soils of coastal areas with natural drainage

Annual rainfall concentrated in the monsoon season from May to December (Banda Aceh 1600 mm).
Soils: probably, light textured soils with good infiltration and percolation rate.
Damaged crops: ?
Priority: to open the outlets of the natural main drainage system to the sea to facilitate the discharge by gravity of the stagnated water.
Shallow wells: care with pumping to prevent sea water intrusion (dynamic water level must be always above the mean sea level).
Leaching with fresh irrigation water if available before the soil dries (in light textured soils approximately 200-300 mm of water to reclaim 40 cm top layer; 2-3 water applications are better that continuous leaching).

Accordingly to soil salinity levels crops can be grown: the threshold soil salinity (EC_e) for salt tolerant crops (80% of relative crop yield) is approximately 10 dS/m)[1]. For moderately sensitive crops is approximately 6 dS/m.

If soil sodification occurs by the effect of soil salinity (pH>8.5); dispersion of surface soil particles), gypsum applications will be required to promote water infiltration and leaching (about 5t/ha mixed with the top 5 cm).

If not irrigation water is available, land smoothing, rehabilitation of field bunds and to wait for natural leaching with rainfall when the monsoon season starts.

Type 2. Soils of backswamps with stagnating water

Annual rainfall concentrated in the monsoon season from May to December (Banda Aceh 1600 mm).
Soils: probably, agricultural lands with loamy and fine textured (clay) soils (levees with light textured soils covered by slightly affected natural vegetation).
Priority: to open the outlets of the main drainage system to the river to facilitate the discharge by gravity of the stagnated water. If this is not feasible, pumping.
Second step: rehabilitation of the field drainage system if available. If not, opening of a basic system of parallel ditches (first approach: ditch depth 1 m and 50-100 m spaced according to the soil permeability[2]).
Leaching with fresh irrigation water if available before the soil dries (in fine textured soils approximately 500 mm of water to reclaim the 40 cm top layer; 5-6 water applications are better that continuous leaching).

Accordingly to soil salinity levels crops can be grown: the threshold soil salinity (EC_e) for salt tolerant crops (80% of relative crop yield) is approximately 10 dS/m)[3]. For moderately sensitive crops is approximately 6 dS/m.

[1] $EC_e \approx 12\ EC_{1:5}$ for loamy soils (see synthesized information).
[2] This soil characteristic can be estimated from the soil texture (see table in synthesized information).
[3] $EC_e \approx 8 EC_{1:5}$ for clay soils (see synthesized information).

If soil sodification occurs by the effect of soil salinity (*pH*>8); dispersion of surface soil particles), gypsum applications will be required to promote water infiltration and leaching (about 5t/ha mixed with the top 5 cm). Better put gypsum on the soil surface and avoid disturbing the soil as much as possible, at least for non-rice crops.

If not irrigation water is available, land smoothing, rehabilitation of field bunds and to wait for natural leaching with rainfall when the monsoon season starts.

Type 3. Soils of paddy fields

Annual rainfall concentrated in the monsoon season from May to December (Banda Aceh 1600 mm).
Priority: to open the outlets of the main drainage system to the river systems to facilitate the discharge by gravity of the stagnated water.
Second step: rehabilitation of the main drainage systems starting from downstream.
Third step: rehabilitation of surface drainage systems, starting by the relatively high-lying fields. If not, opening of a basic system of shallow ditches (depth 30-40 cm).

Flushing of saline water with fresh irrigation water if available before the soil dries. The purpose is to replace the saline water layer by a fresh water layer to permit planting of salt tolerant rice varieties ($EC_i \approx 1 dS/m$). A thin salt-free layer is enough for paddy rice to give reasonable yields, but it is needed to refresh the water, because if stagnant it becomes brackish by diffusion.

Sodification may not be a great problem in rice fields, which are kept under water and are often "puddled" to become watertight.

If not fresh water is available, land smoothing, rehabilitation of field bunds and wait for replenishment of paddy fields with rainfall when the monsoon season starts.