SALT IN THE SOIL

By

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Due to the recent tsunami disaster, the croplands in the coastal areas of Sri Lanka were inundated by sea water leading to development of salinity. These lands need to be rehabilitated for the agricultural community to start their farming activities again. This article summarizes a case study carried out by the Soil Science Society of Sri Lanka on the salinity effected areas of Ampara district and proposes ways and means of rehabilitating these lands. A detailed report of these findings and the recommendations were handed over to the Minister of Agriculture by the Society on 18th January 2005 at the ministry office at Battaramulla. Today, after one month of the disaster, medium and long-term relief operations should be in place to resettle the affected people.

Due to the Tsunami disaster which took place on 26th December 2004 large extents of crop lands were affected by sea water intrusion. With the action of sea waves, the lands were physically damaged by removal of soil by erosion and deposition of large amounts of sand and other debris. The irrigation and drainage channels were damaged. The loss to agricultural machinery, implements and livestock was extensive. In addition, the sea water intrusion led to development of soil salinity, damaging the present crop as well as making these lands unsuitable for cultivation in the near future. Salinity develops in soil due to accumulation of soluble salts. As sea water contains considerable quantities of sodium bearing salts, its intrusion creates soil salinity. In addition Sodium ion create dispersion of soil particles destroying it's the aggregates or the structure. These factors prompted the immediate need of rehabilitating the lands affected by tsunami disaster. The Soil Science Society of Sri Lanka made an effort to assess the damages to agricultural lands in tsunami affected areas and to propose a methodology for rehabilitating these for future use. This article is an account of the preliminary investigations conducted by the society.

For the first lag of the study, Ampara district was selected, where the damage to the cropland was extensive. The average yield of Rice (paddy) in the Eastern region of Ampara was high as 5 t/ha (105 bushels/ac) in the last year. In addition to paddy, many highland crops are grown successfully in this district. As most of the damaged paddy tracts were uniform, Nindavur area, where the paddy yields are in the range of 120 to 140 bushels/ac was selected to assess the damage to lowlands. Vinaygapurum in Thrukkovil where tomato, chillies, cowpea and brinjals are grown extensively was selected to assess the damage to the highlands. As all the crops and boundaries of farmland is no more, it was difficult to identify allotments of each farmer. The farmers are still in the rehabilitation camps and are not in a position to start their farming activities. Therefore, the lands were considered as large farm tracts for this study. Soil salinity was assessed at different distances from the sea to the inland towards the tsunami affected areas. Due to high rainfall and flooding immediately after the tsunami activity, there was a possibility of leaching these salts to greater depths. Soil salinity was assessed within the first 30 cm depth at 5, 15 and 30 cm on 14th January 2005, 18 days after the disaster. The rooting depth of most of the annual crops is also within the range of 30 cm. Standing water in the paddy fields, surface water remaining in the depressions in poorly drained spots in highlands as well as water in wells was examined to obtain additional information.

Salinity in Rice (Paddy) Fields

The pictures show affected paddy fields in Nindavur area. About 575 acres of paddy fields were affected in this area where the soil type is Alluvial (Entisols). The rice variety cultivated in most fields was variety BG 94-1 and the crop was totally damaged due to salinity in affected areas. As the crop was near maturity age, grains have become empty. The limit where the crop was visually affected is the limit of sea water intrusion due to tsunami. The electrical conductivity values (EC) of the saturated soil paste indicating the salinity levels in unaffected lands were around 0.04 decisemens per meter (dS/m). In the affected lands, the EC increased to a range of about 20 to 200 times. Highest EC values as 6.2 dS/m were recorded in fields nearest to the sea. The pH of non-affected fields showed a value of 6.4 while in effected fields it increased to only 7.1 showing that the effected lands are saline.

Rice plants affected due to salinity

According to the literature, if the EC value is higher than 4 ds/m the crop will be damaged permanently. Some traditional rice verities tolerant to salinity can be grown up to EC values of 6 to 8 dS/m., but most of the modern verities except At 354 and At 401 cannot be grown beyond a salinity level of 3 to 3 dS/m. Even at EC levels of 2 dS/m in the saturated paste, the EC near the roots may be higher and the susceptible crops will be effected in numerous ways. The standing water in paddy fields showed EC values of 5.8 to 11.5 dS/m. These results indicated that even after 2 weeks of the tsunami disaster, and after heavy rains, salinity still remains at higher values. As the seepage of water from paddy fields are poor due to the hard pan below the plough depth and as the drainage channels are blocked there is no way for the salts to be washed away. With continuing Evaporation there is a tendency for the salinity levels to become more damaging.

Saline water still remaining in paddy fields

Salinity in Highlands

The Vinayagapurm village, where the highlands were examined consisted of about 460 acres of tomato, brinjals, chillies, maize and cow pea. These annuals as well as perennials as banana and even Palmyra palms were damaged due to the sea waves and salinity. The soils of this area belong to sandy Regosols (*****) and the water has already drained away. Due to the heavy rains after the tsunami disaster and the well drained conditions, the salts have got washed off in these highlands. Therefore, the EC of soils in well drained areas were in the range of 0.13 to 0.60 dS/m. In areas where soil was eroded due to the force of the waves, pools of stagnant water could be observed. The EC of this stagnant water was high as 3 dS/m which is highly damaging to many crops. In some of these areas where water had evaporated, patches of salt crust could be seen on the land surface.

Due to the high amount of Sodium, the soil structure is broken down (get dispersed) and these lands will be very susceptible to erosion. The well water in highlands showed high EC values of 3 dS/m and water table was near to the soil surface. This well water cannot be used for any domestic or agricultural purpose. The shallow ground water table will contribute to increase in salinity with time. The evaporation rates are high as 6 to 8 mm/day in the *yala* season which will worsen this situation.

Tomato crop affected by tsunami

Rehabilitating the Paddy Lands

Short term, medium term and long term strategies are proposed for rehabilitating these lands effected by salinity.. The best short term strategies for paddy lands are to immediately drain them before the salts get more concentrated due to evaporation. For this purpose the drainage channels

should be cleaned. The sand and other debris should be removed from the paddy fields and seed paddy of salt tolerant varieties as At 353, AT 354 and At 401 must be collected immediately, even by offering high prices to farmers already growing these, to be distributed in the next season. Where ever clean water can be used to leach the salts, soil amendments as Gypsum could be used with the supervision of Soil Scientists to make the reclamation faster. Therefore, orders must be placed soon for the Gypsum requirement so it will be available when needed.

Areas as these need to be drained as soon as possible

As medium term measures (which may last to about 3 months), farmers should be trained in special cultural methods that lead to reduction of salinity, and monitoring the salinity levels of the fields are required. Efforts should be made to produce more salt tolerant varieties sufficient for few seasons until the soil salinity decreases periodically.

As long term measures (longer than 6 months), farmers must be advised to clean and maintain drainage channels in the long run. Part of the water from *maha* rains must be used to wash off salts in soil by adding gypsum, flooding the fields and ploughing them and draining few times to displace the sodium ions. This must be done under proper supervision.

Rehabilitating the Highlands

The short term measures for rehabilitating highlands include removing sand and other debris from he lands and improving the drainage by construction of drains to lower the water table. The wells have to be emptied, cleaned and rehabilitated so that the no more salt water will enter the subsoil. Once the wells are cleaned they could be used for domestic purposes and irrigation. Removing the excess water from eroded depressions must be done as soon as possible. Programs have to be initiated to distribute planting material of salt tolerant crops for home gardens. The medium term

measures should be to educate the farmers about special agricultural practices to reduce salinity, providing agricultural implements and salt tolerant varieties and monitor the salinity levels by field officers. Conductivity meters for measuring salinity should be provided for the extension officers of these areas and training provided in time.

As long term strategies, farmers must be encouraged to maintain drainage channels effectively and to use the water from maha rains to leach salts as much as possible. For this purpose the soil structure has to be developed by applying organic matter for better drainage. A program has to be initiated to make panting material available for perennial plants especially for the home gardens.

General Recommendations

In addition to these, some general recommendations are made for policy makers for their attention.

- The problem of soil salinity should be viewed as a holistic problem affecting the whole tract of land than considering as an individual isolated problem of farmers.

- As the paddy fields already show high salinity levels and are poorly drained, those will be more difficult to reclaim. Therefore priority should be given to paddy lands in this exercise.

- There is a need to map the affected areas for agricultural and for many other purposes which should be undertaken by a relevant authority.

- The damage to lands due to salinity must be assessed and rehabilitation must be undertaken at national level, where all the stake holders including farmers, soil scientists, extension officers, irrigation and drainage engineers should contribute.

- Where the individual allotments cannot be identified and damage is extensive, the state must rehabilitate the land as a national priority and resettle farmers.

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