Tea Bull, **12** (1/2), 03-07, 1992

EUTROPHICATION OF THE KOTMALE RESERVOIR

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INTRODUCTION

From time to time in the past few years, the Kotmale reservoir has had dense growth of algae - algal blooms. Such dense growth of algae is caused by `eutrophication' -- accumulation of nutrients in water bodies above normally required levels. When these nutrients exceed certain critical balance (more specifically in respect of the ratio of nitrogen to phosphates), specific organisms such as algae gain disproportionate advantage and multiply rapidly and cover large areas of the water body and consume available oxygen and poison the water with toxic materials, thus making the water body unsuitable for other life and become harmful to humans. These algal blooms can also interfere with the hydro-power turbines and the general water supply system.

A similar phenomenon is observed from time to time in the Beira Lake in Colombo, but never seen in other large water bodies such as the Nuwara wewa or Parakrama samudra! The answer to this lies in phosphate enrichment of certain water bodies in which nitrogen is in any case available. How do specific water bodies become enriched with phosphates?

Movement of nutrients into the Kotmale Reservoir

The Kotmale reservoir is fed by the Kotmale river and the associated streams and rivulets that meander through the sensitive land areas planted to tea, a major plantation crop that has been grown in these areas for several decades. A significant proportion of tea in these sensitive lands are on steep areas subject to much soil erosion, with the consequent loss in soil fertility. In order to help sustain economic yields, these plantations have been on regular dressings of compounded fertilizers, including nitrogen, phosphorus and potassium (NPK). The continuing soil erosion from these sensitive land areas carry along with it appreciable amounts of phosphate fertilizer, which eroding soils enriched with phosphates find their way into the streams and rivulets feeding the Kotmale river.

Causes for phosphate-enrichment of eroding soils

The continued use of large doses of nitrogen (in the form of sulphate of ammonia) has led to severe soil acidification, to levels even below pH 4.0 (the optimum pH range for tea being between pH 4.8 to 5.0). Soil acidification has led to the release of large amounts of the oxides of iron and aluminium and silicic acid, all of which act as cementing substances to form a surface soil crust that impedes moisture infiltration. Soils in this condition cause a significant amount of surface run-off of rain water, with the consequent eroding of the phosphate-enriched top-soil.

The aluminium that increases with soil acidification gets readily bound to available phosphates, thus causing "soil fixation" of phosphates. As a consequence of such fixation, the tea plants too are denied of sufficiency levels of phosphates, despite adequate annual applications. In view of the acidified status and the lack of sufficient organic matter (humus), the microbial activity in these soils has declined drastically to a level of being almost a "non-living soil"! As a consequence of such poor soil fertility, and the associated lack of adequate amounts of microbial (humic) acids, which acids play a significant role in the liberation of bound phosphates (through competitive displacement), the phosphates continue to remain firmly fixed and unavailable to the tea plants.

The continuing soil erosion from the large numbers of tea plantations occupying the sensitive lands in the Kotmale valley has thus been continuously bringing along with it large quantities of fixed phosphates, with the consequent gradual enrichment of phosphate levels in the water bodies feeding the Kotmale reservoir.

Soil erosion accelerated by manual weeding practices

The system of weeding adopted on these plantations and other cultivated areas had been dominantly manual, using weed-scrapers, a practice that has caused much soil disturbance and the eroding away of valuable top-soil. This has been particularly bad in the poorly managed tea fields that had many vacancies and thus opening themselves to heavy weed growth. Large quantities of such eroded soil have

found their way into the streams and rivulets feeding the Kotmale river, a situation that is already leading to the gradual siltation of the reservoir.

Release of fixed phosphates in water bodies

Under specific conditions in the water-body, the phosphates bound to aluminium can get hydrolysed to release the phosphates in soluble form, along with the hydroxides of aluminium. In view of the already evident algal blooms, conditions suitable for such hydrolysis seem to prevail in water bodies such as the Beira Lake and the Kotmale reservoir. As a consequence of such chemical changes,besides phosphate enrichment, the water will accumulate aluminium as well, which by itself could pose a threat to water quality and human health.

The action needed to arrest this imminent danger

The one way of arresting the trend towards such dangerous situations is to enforce a strict curb on soil erosion in the plantation areas and in the other "cultivated areas", especially that of tobacco and potatoes, the two other crops that cause much erosion. One other important aspect in minimizing soil erosion in tea plantations is to cover all existing exposed vacant areas, either by consolidating the tea fields that have sparse and low plant density, through an active programme of infilling with young tea, or by planting suitable cover crops,including grasses in all exposed vacant areas, as is recommended by the Tea Research Institute.

The implementation of the "Sloping Agricultural Land Technology" (SALT) in these sensitive land areas (as recommended by the Tea Research Institute (TRI) and the Upper Mahaweli Watershed Management Project (UMWP), by planting hedge-rows of various mulch-generating fast growing crops at regular spacing between specified numbers of tea rows, is a very useful and important strategy to prevent erosion and enhance soil fertility.

A greater concerted effort needs to go towards **soil quality improvement** by enhancing soil fertility, which in turn would minimize soil fixation of phosphates. In view of the availability of adequate levels of fixed phosphates in the rhizosphere (feeder root-zone), it is more sensible to stop using phosphate fertilizers for at least a year or two (as already recommended by the TRI), and make a greater concerted effort at improving soil fertility to help release the fixed phosphates for plant availability, ensuring a better supply of available phosphates to the tea plants, which would not only help economize on fertilizer use, but will also curb the unwanted movement of the fixed phosphates to cause off-site problems.

The several land areas that continue to remain abandoned for want of implementation of proper land-use programmes, should be harnessed for the commissioning of the appropriate action plans, without further delay.