# MONITORING LAND USE CHANGE IN RURAL SRI LANKA FROM SEQUENTIAL AERIAL PHOTOGRAPHY

C.D. Gangodawila

Land & Water Use Division Sri Lanka
Department of Agriculture

Peradeniya
Sri Lanka

Commission No. VII

ABSTRACT

Sequential airphoto interpretations proved to be useful for the monitoring and acquisition of data on land use change in a typical agrarian environment of the Nachchaduwa Tank (Reservoir) Catchment in rural Sri Lanka. The land use and land use change maps (1956-1982/83) of the sample areas produced, permitted detailed qualitative and quantitative analyses which revealed basic structure, the spatial and temporal characteristics of land use change as well as the factors affecting them. These changes over a period of two decades tend to show a significant increase in all catergories of use. Man-induced land clearing activities appeared as a major causal factor responsible for the environmental degradative trends and impacts obsetved, notably, increased siltation of small tanks and the twin problems of salinity and water-logging in low-land rice lands. The latter, was common to both large & small-scale irrigated agricultural systems in the area.

## 1. INTRODUCTION

Aerial photography has been used for a variety of natural resource studies during the past few decades in Sri Lanka and is infact quite fortunate to have considerable natural resource data that have been periodically mapped-out under the scope of numerous development projects that have been implemented in the Island.

However, resource survey information available thus, does not include adequate details for planning and management decisions, at local level,being at general reconnaissance to semi-detailed levels of survey. Further, the land cover/land uses that have been mapped-out and classified are often on the basis of topography and soils. The classifications themselves have been intended to determine the feasibilities of development programs and projects and not for monitoring the status of the resource/ or managerial purposes. In spite of these limitations, it is realised that the applications of remote sensing, specially large-scale aerial photography, are most useful and pertinent for Sri Lanka's natural resource development and planning programs for optimum use and results (1).

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Eventhough, accurate land use maps as well as large -scale aerial photos could serve as useful information base for sound land resource management decisions, yet, one of the well-known major drawbacks for their wider use has been a lack of adequate information about the accuracy of measurements made from them. However, in recent times, the latter have provided useful data for quantitative estimates of change in surface vegetative cover and density (2).

The use of large-scale sequential aerial photos plays a central role in these studies and presently available standard procedures have been followed during mapping for land use/land use change, in order to improve the accuracy of thematic mapping. Further, the accuracy of spatial and temporal dimensions of the mapped information has been increased by comprehensive field studies and the resulting empirical data has been used for interpretation of the final results.

In this paper, the author presents some preliminary results from environmental impact studies initiated in a rural agricultural environment in Sri Lanka that has been in flux during the past few decades, due to influence of increased population & modern irrigation technologies introduced to the area where predominenatly rainfed or small-scale tank (reservoir) irrigated agricultural systems have been in operation.

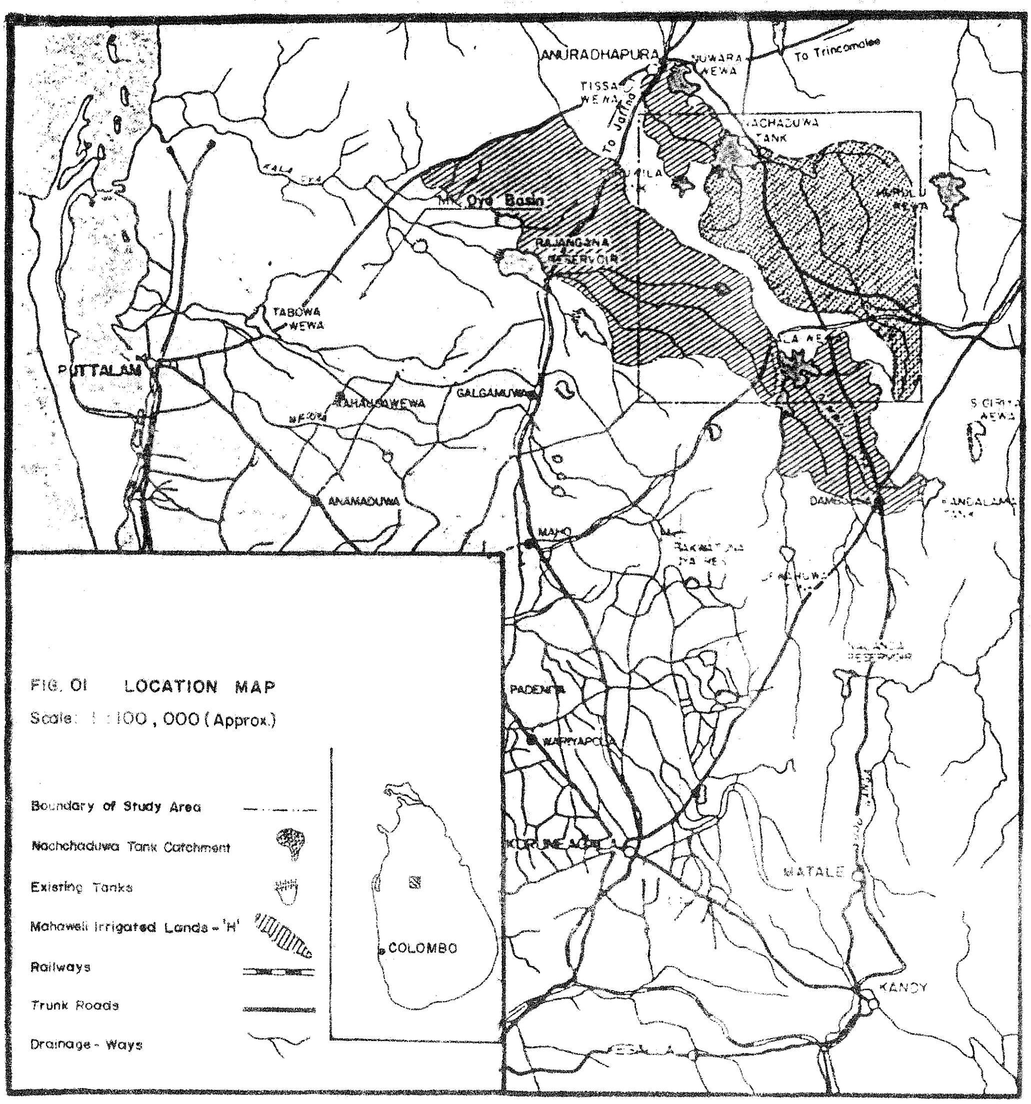


FIG. 01 LOCATION MAP
Scale: 1 : 100,000 (Approx.)

# 2. MATERIALS & METHODS

## 2.1 GENERAL

In these studies, investigations were concentrated on the following;

a) Measurement of areal extents of change in land use and tank bed surface area during the time frame, 1956 to 1982, in ten micro-catchments within the Nachchaduwa Tank Catchment. It was considered a good representation of the traditional small-scale irrigation system of the North Central Dry Zone of Sri Lanka (Fig. 01).

b) Recording of types of land degradation indicators and their relation to land use in the catchments and surrounding areas.

c) Surveys of soil salinity in the 'H' irrigated area of the Mahaweli Development Project, considering it as a good representation of a modern large-scale irrigation system introduced to the Dry Zone in recent times, and its relation to the natural landscape of the area.

In the assessment of environmental degradative trends, the entire Nachchaduwa Tank Catchment was used as the primary study unit. The selected microcatchments ($MC_1$ - $MC_{10}$) were suited for investigations of this kind for a number of reasons:

- They were situated near Maradankadawela town and were easily accessible all the year round.
- All the micro-catchments had at least one traditional tank cascade, which acted as sediment traps making it possible to conduct studies on sediments and sedimentation patterns.
- More background data were available than for most other catchments in the North Central Dry Zone.
- Good quality air photographs of this area were available.

Further, in order to obtain an overall view of the present situation concerning degradation of the physical environment, regular field reconnaissance trips were undertaken throughout the study period. Also, to relate the present situation to conditions in the recent past, a thorough survey of older literature was made, so that trends of change in the environment and in the intensity of land use could be determined.

## 2.1A THEMATIC MAPPING

A number of methods have been applied to identify the spatial variation, the extent of land use change within the area under study.

Mapping of land use and land degradative features was carried out by means of black/white Panchromatic photography supplemented by field checks. The aerial survey remote sensing techniques has proved to be well suited for studies of the rural environment of Sri Lanka (3). Sequential aerial photography of 1956 (scale 1:40,000) and 1982 (1:20,000) and their photographic enlargements were used for the present studies.

### 2.1A$_1$ PRELIMINARY INTERPRETATIONS

After choosing the study area, a preliminary air photo interpretations were systematically carried out by carefully viewing stereoscopic pairs of photographs to improve the accuracy of interpretations and assessments of agricultural land and water resources. The photographic materials used for this purpose were Panchromatic black and white 1956 airphotos (scale 1:40,000) and 1982 airphotos (scale 1:20,000). Landsat digital flase colour composite imagery (approximate scale 1:150,000) and multi-temporal Landsat diazo prints were also employed, in order to improve the basic airphoto-interpretation maps.

A well-structured map legend was prepared and resulting mapping units were described by their image characteristics (interpretation key).

### 2.1A$_2$ CHECKING FOR "GROUND TRUTH"

Several exploratory trips to the study area, each of three to 5 day field work periods were used to check the interpretation key and the mapped units. These field work also included prepared interviews with farmers, especially on matters of agricultural land and water use and agricultural practices.

Observations were made to understand the physiographic relationships of various photo-interpretation units. Across the drainage pattern, selected traverses were studied. Because of the large-scale changes in land use and some changes in physical infrastructure, sighting of observations (ground truth) on the proper locations were rather difficult. Compass and pocket stereoscope were a great help in such cases.

Most of the land use mapping units were found correctly interpreted. However, it was clearly evident that the vegetative cover could greatly mislead in attributing some of the main land use types, especially those involving cleared land. Under tropical climatic conditions, the rate of regeneration of surface cover is rapid. Thus, even in areas where large extents of forest cover had been already cleared only a few years back (evident in the 1982 aerial photography), the regenerated carpet of scrub had become so dense and homogeneous, that it was difficult to distinguish between the cleared areas, mostly for Chena activity ('slash and burn' cultivation).

The importance of the use of recent photography in this case was evident and in order to compensate for this limitation , systematic and careful checking for "ground truth" was carried out during field work.

## 2.1$A_3$ USE OF VEGETATION TO MAP SALINIZED LANDS

Vegetation is frequently considered a clear indicator of the hydro-geological environment. Those plants which are in direct and most intimate contact with ground water are termed Phreatophytes (4). From the composition and distribution of plant species, it is possible to determine the depth of occurence of ground water, degree of mineralization, place of charging and re-charge of water-bearing horizons and the direction of their movement. As an indicator of hydro-geological environment, it is best not to use individual plants but plant assemblages which occupy considerable area. Plant assemblages are more reliable indicators and can be interpreted from aerial photographs (4).

In the study area, a number of vegetation types that are popularly associated with salinity locally were recognised on the large scale (blown-up) aerial photographs and were mapped, based on their image characteristics.

Detailed study of selected traverses along soil catenas was done with a view to understand salinization of the landscape. In all about 400 observations were made and sampled for laboratory analyses using standard sampling techniques.

## 2.1$A_4$ ESTIMATION OF SEDIMENTATION FROM MAPPING OF TANK AREAL EXTENT

Under natural conditions, all water-bodies are subject to sedimentation. The total amount of sediment contained in a tank will represent the sediment input since the construction of the tank, that is, the sediment supply of its catchment. It will be an index of the degree of degradation of the catchment environment with respect to soil erosion. The latter is the outcome of natural geochemical degradation of soil leading to sediment production and also by man's action making the soil vulnerable to erosive forces of nature (5). Under the present study, the latter causal factor namely, man's intensified use of the available physical agricultural resource base resulting in destruction of the natural cover a exposing more of the soil to erosive action of water etc., is assumed the major factor responsible for siltation of tanks in the study area.

Aerial photograph of large scale (blown-up) have been used to map the areal extent of tank surface area, both in 1956 and 1982 for selected tanks in the study area and to locate the major sites of sediment supply in the micro-catchments under study.

Detailed study of selected traverses along tanks beds were also done with a view to understand the type of sediments and also their sorting out pattern along the length of the tank beds. Here too, a total of about 300 observations were made and sampled for laboratory analyses using standard sampling methods.

### 2.1$A_5$ FINAL INTERPRETATION

By the end of field studies, most of the photographic enlargements (1956 and 1982) of the study area became available at 1:10,000 scale. It was advantageous to make the final interpretation on the larger scale photographs. Comparison was made between the two sets of photography of larger scale, taken at an interval of a more than two and a half decades. The most striking aspect was the drastic changes in land use and improvements in the physical infrastructure in the study area.

After completion of the final interpretations, the respective maps were accurately compiled and the accuracy of mapping was checked, using a statistical sampling method (6).

### 2.1B EMPIRICAL STUDIES

In order to obtain detailed views of land use/ land cover and degradatory trends in the catchments, a thorough field investigations were made on the micro-catchments, (with detailed studies on micro - catchments $MC_1$ & $MC_4$) . Transects were measured from linear ridges forming the watershed boundary to the valley bottom lands. Along the transects reading of slope gradient were made every 25 or 50 m. section. Notes were taken on bedrock, soils, vegetation, and indicators of land degradation.

Soil samples of the representative soil catenary sequences were collected and for studies of the characteristics of the sediment, samples were collected from different part of the tank beds. In each tank, 15 sampling points were randomly selected along a transect within the tank bed. From each sampling point, 2 samples were taken at 2 depth levels.
The latter served as useful information on sedimentation process which is related to soil erosion in the catchment.

### 2.1$B_1$ SALINITY SURVEYS

These were done with a view to understand the nature and intensity of salinity and alkalinity build up in the newly irrigated lands in the 'H' irrigated area of the Mahaweli Development Programme. As a preliminary guide to these surveys, land units/ blocks already abandoned by settlers without cultivation during the past few cultivation seasons and also identified by them were investigated.

Soils were sampled from the surface and sub soil along measured transacts from the valley bottom lands of the newly created irrigated landscape of Blocks 409, 403 and 302.

### 2.1B$_2$ LABORATORY STUDIES

During laboratory analyses, preliminary statistical tests were done to select the more suitable of the commonly available methods, namely Hydrometer method and the Pipette Method, for the samples collected. Since these two techniques were not significantly different in the preliminary checks and results, therefore , the Hydrometer Method was selected for analyses of silt.

Further, during the laboratory analyses, the soil samples were investigated for electrical conductivity (EC), pH, Ca, Mg, Na, and K, concentrations and the Cation Exchange Capacity (CEC) values, using the standard laboratory procedure, viz., the determination of electrical conductivity (EC) of the soil saturation extract using S.C.T. Meter - YSI MODEL 33 and 33 M, the pH (1; 2.5) using "Orion Research" ion analyser/MODEL 407A, the concentrations of Ca, Mg, Na, and K using IN Ammonium acetate, and Atomic Absorption Spectro-photometer (Perkin and Elmer MODEL 2380) and the CEC was determined using IN Sodium acetate, Iso-propyl alcohol, IN Ammonium acetate and Atomic Absorption Spectro-photometer (Perkin and Elmer MODEL 2380). Exchangable Na Percentage (ESP) for the soil samples were calculated according to the definition of the US Salinity Laboratory Staff (7).

## 3. RESULTS, ANALYSES AND DISCUSSION

The results and analyses of data generated from these studies are summarised in the tables 1,2,3,4,5,6,and 7 which are self explanatory.

Apart from the well known problems generally inherent in spatial data as above there were other limitations specific to these studies. Firstly, since only two time points have been considered, that of 1956 & 1982, the studies ignore the pattern of change or trend over the years. Secondly, all tanks within the cascades as well as all micro-catchments mapped out from the study area are considered together. No attempt has been made to classify them by their physical or any other characteristics. This means, it is only an absolute relationship for a difference of two time points have been examined and therefore, definite conclusions as to the cause and effect cannot be reached.

According to the Bench-mark salinity surveys, salinity development appeared to be relatively high on surface soil than in the sub soil.

TABLE 1 : LAND USE PATTERNS OF NACHCHADUWA TANK CATCHMENT

| Micro-Catchments | Land Use Category (1956) | | | | | | Land Use Category (1982) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Chena (4S) | Homestead (2H) | Open forest (OF) | Dense forest (DF) | Tank area (T) | Rice land (P) | Chena (4S) | Homestead (2H) | Open forest (OF) | Dense forest (DF) | Tank area (T) | Rice land (P) |
| $MC_1$ | 53.49% | 2.81% | 5.62% | 18.52% | 9.31% | 10.25% | 16.20% | 17.40% | 33.80% | 5.00% | 9.40%, | 18.20% |
| $MC_2$ | 28.00% | 1.83% | 15.32% | 44.15% | 7.60% | 3.10% | 17.42% | 12.38% | 29.04% | 21.70% | 10.15% | 9.31% |
| $MC_3$ | 44.17% | 3.46% | 9.87% | 29.96% | 4.42% | 8.12% | 18.35% | 18.42% | 17.00% | 19.65% | 11.66% | 15.10% |
| $MC_4$ | 61.46% | 10.18% | 8.30% | - | 9.05% | 11.01% | 16.67% | 4.33% | 39.30% | - | 15.20% | 24.50% |
| $MC_5$ | 26.60% | 5.26% | 23.25% | 27.34% | 6.44% | 11.11% | 7.58% | 16.73% | 25.16% | 10.28% | 9.65% | 30.60% |
| $MC_6$ | 40.81% | 2.15% | 26.69% | 17.05% | 5.25% | 8.10% | 19.31% | 1.70% | 25.57% | 21.88% | 9.00% | 27.81% |
| $MC_7$ | 69.21% | 1.99% | 14.52% | - | 9.97% | 4.31% | 18.92% | 10.86% | 28.61% | 22.26% | 10.40% | 9.21% |
| $MC_8$ | 58.35% | 1.68% | 16.82% | 4.20% | 8.74% | 10.21% | 5.85% | 6.70% | 12.40% | 45.50% | 13.35% | 16.20% |
| $MC_9$ | 74.76% | 2.63% | 4.33% | 5.46% | 6.59% | 6.23% | 18.12% | 12.05% | 41.08% | 13.87% | 4.67% | 10.21% |
| $MC_{10}$ | 67.87% | 1.44% | 16.38% | 5.36% | 5.93% | 3.02% | 23.05% | 1.74% | 31.90% | 9.79% | 13.00% | 20.52% |
| Total Tank Catchment | 48.67% | 3.34% | 14.11% | 19% | 7.33% | 7.55% | 14% | 10.60% | 27.88% | 18.8% | 10.64% | 18.13% |

Table 2 : LAND CLEARING & TANK SILTATION INTER-RELATIONSHIPS FROM LAND USE MAPPING OF THE NACHADUWA TANK CATCHMENT

| Micro-Catchment | Total Extent Land cleared (Acres) | | Total Extent of Tanks (Acres) | | Change of Areal Extent of Tanks (Acres) |
|---|---|---|---|---|---|
| | 1956 | 1982 | 1956 | 1982 | 1956-1982 |
| $MC_1$ | 2583.31 | 4507.47 | 793.6 | 805.156 | 11.556 |
| $MC_2$ | 84.61 | 66.16 | 365.945 | 487.72 | 121.775 |
| $MC_3$ | 7697.367 | 5171.54 | 423 | 1115.12 | 692.12 |
| $MC_4$ | 1176.93 | 978.09 | 165.2 | 277.54 | 112.34 |
| $MC_5$ | 1389.58 | 732.133 | 116.96 | 182.634 | 65.674 |
| $MC_6$ | 2780.92 | 2039.33 | 177.51 | 304.284 | 126.774 |
| $MC_7$ | 2280 | 1958.66 | 280 | 333.05 | 53.05 |
| $MC_8$ | 1202.73 | 1078.69 | 148.03 | 225.79 | 77.76 |
| $MC_9$ | 2723 | 3207.656 | 224 | 214.368 | -09.632 |
| $MC_{10}$ | 2464 | 1050.486 | 168 | 214.368 | 46.36 |

TABLE 3 : RESULTS OF ANALYSES OF LAND CLEARING ASSOCIATED MAPPED LAND USE UNITS AND TANK AREA FOR THE MICRO-CATCHMENTS ($MC_1$ - $MC_{10}$) IN THE NACHCHADUWA TANK CATCHMENT FOR TWO TIME POINTS (1956 & 1982)

| Year | 1956 | | | | 1982 | | | | 1956 & 1982 Differences | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | Tank area TA | Land Clearing | | | Tank area TA | Land Clearing | | | TA | OF | DF | CH |
| | | OF | DF | CH | | OF | DF | CH | | | | |
| Mean | 286.2 | 495.4 | 808.6 | 1913.2 | 413 | 1128.7 | 650 | 612.2 | -126.8 | -633.2 | 158.5 | 1300.9 |
| Std. Dev. | 204 | 283.2 | 1019.8 | 1287.1 | 309.4 | 824.7 | 540.3 | 500.0 | 204.1 | 842.5 | 708.2 | 874.1 |
| Minimum | 116.9 | 147.2 | 0 | 438.6 | 182.6 | 209.8 | 0 | 66.5 | -692.1 | -2405 | -698.7 | 372.1 |
| Maximum | 793.6 | 944 | 2864.5 | 432.0 | 1115.1 | 288.5 | 188.3 | 1661.7 | 9.6 | 206.9 | 117.5 | 3103.3 |
| Coeff. of Var. % | 71.3 | 57.2 | 126.1 | 67.3 | 74.9 | 73.1 | 83.1 | 81.7 | | | | |

TABLE 4 : CORRELATION TEST RESULTS

| | TA | OF | DF | CH |
|---|---|---|---|---|
| TA | 1 | | | |
| OF | -0.1244 | 1 | | |
| DF | -0.4304 | -0.4114 | 1 | |
| CH | -0.2023 | -0.7698 | 0.3655 | 1 |

TA ________ Y

$X_{25}$ ________ DF ________ 18% 47%

$X_{24}$ ________ OF ________ 29%

$X_{26}$ ________ CH ________ 47.4

TABLE 5 : GENERAL SOIL SALINITY STATUS* OF RICE LANDS (LOCATED IN SITES OF FORMER TANK BEDS) IN THE MAHAWELI 'H' IRRIGATED AREA IN THE NORTH CENTRAL DRY ZONE

| Sample Transect location/Nr. from Block 403 | Depth (cm) | pH (1:2.5) | EC mmohs / cm at 25°C | Cationic Composition | | | | CEC | ESP |
|---|---|---|---|---|---|---|---|---|---|
| | | | | $Ca^{2*}$ meg/ 100g | $Mg^{2*}$ meg/ 100g | $Na^{*}$ meg/ 100g | $K^{*}$ meg/ 100g | meg/ 100g | |
| T034 Ac No.8 Unit 5 ($R_1$) | 15 | 9.0 | 2800 | 9.57 | 6.06 | 4.79 | 0.07 | 20.0 | 31.4 |
| | 30 | 7.8 | 1700 | 5.2 | 4.2 | 3.1 | 0.10 | 11.0 | 39.2 |
| T034 Ac No.8 Unit 5 ($R_2$) | 15 | 8.6 | 4000 | 9.2 | 5.2 | 2.2 | 0.81 | 20.5 | 26.5 |
| | 30 | 7.4 | 2200 | 8.2 | 2.0 | 2.12 | 1.1 | 11.0 | 23.8 |
| T034 Ac No.8 Unit 5 ($R_3$) | 15 | 7.5 | 5000 | 10.21 | 4.8 | 4.1 | 0.09 | 15.0 | 27.0 |
| | 30 | 7.8 | 3000 | 12.85 | 4.16 | 4.34 | 0.08 | 21.0 | 26.0 |
| T034 Ac No.5 Unit 5 ($R_1$) | 15 | 7.7 | 2500 | 8.21 | 3.26 | 4.98 | 0.08 | 16.0 | 45.2 |
| | 30 | 7.2 | 2000 | 8.2 | 2.1 | 2.2 | 0.12 | 13.0 | 20.3 |
| T034 Ac No.5 Unit 5 ($R_2$) | 15 | 7.2 | 1700 | 7.91 | 2.91 | 2.18 | 0.09 | 12.89 | 30.7 |
| | 30 | 7.3 | 2500 | 9.72 | 3.1 | 2.0 | 0.12 | 15.0 | 15.3 |
| T034 Ac No.5 Unit 5 ($R_3$) | 15 | 7.5 | 2600 | 8.92 | 3.51 | 5.01 | 0.07 | 16.2 | 40.3 |
| | 30 | 7.4 | 2400 | 8.51 | 2.98 | 2.32 | 0.08 | 15.1 | 26.6 |
| Ac No. 630 $D_2$ FC 57 ($R_1$) | 15 | 8.8 | 1600 | 6.2 | 0.725 | 8.3 | 1.2 | 25.2 | 49.1 |
| | 30 | 8.3 | 1100 | 5.12 | 0.69 | 8.1 | 1.10 | 23.9 | 75.7 |
| Ac No. 630 $D_2$ FC 57 ($R_2$) | 15 | 8.9 | 1550 | 5.35 | 1.33 | 10.39 | 1.03 | 24.5 | 73.6 |
| | 30 | 9.0 | 3100 | 8.8 | 1.5 | 14.13 | 0.085 | 25.3 | 126 |
| Ac No. 630 $D_4$ FC 57 ($R_3$) | 15 | 7.3 | 1700 | 7.13 | 1.016 | 12.86 | 1.17 | 25.21 | 107 |
| | 30 | 8.5 | 1550 | 5.82 | 1.30 | 11.10 | 1.08 | 24.9 | 93.0 |
| Ac No. 563 $D_3$ FC 52 ($R_1$) | 15 | 7.5 | 4300 | 10.1 | 8.3 | 5.2 | - | - | 24.1 |
| | 30 | 8.2 | 3900 | 12.5 | 3.61 | 4.82 | - | - | - |
| Ac No. 563 $D_3$ FC 52 ($R_2$) | 15 | 8.0 | 3800 | 30.0 | 5.59 | 13.04 | - | 50.0 | 35.0 |
| | 30 | 7.3 | 2000 | 15.0 | 2.25 | 4.34 | - | 35.5 | 13.9 |
| Ac No. 563 $D_3$ FC 52 ($R_3$) | 15 | 7.9 | 2600 | 8.4 | 2.25 | 6.217 | - | 25.5 | 32.2 |
| | 30 | 7.5 | 2200 | 15.0 | 4.0 | 5.21 | - | 25.0 | 25.8 |

* Based on Bench mark salinity surveys conducted in 1985/86 by the author in specific locations in the 'H' irrigated area of the Mahaweli Project that has the twin problems of salinity/water-logging and identified for investigations by the settlers themselves.

TABLE 6 : GENERAL SOIL SALINITY STATUS* FOR DIFFERENT LANDSCAPE POSITIONS (VALLEY BOTTOM LANDS) IN A TRADITIONAL TANK CASCADE/SMALL - IRRIGATION SYSTEM : (TORUWEWA - $MC_4$)

| Sample (Location/Nr.) | Depth (cm) | pH (1:2.5) | E.C. mmohs/cm at 25°C | Cationic Composition | | | | CEC | ESP |
|---|---|---|---|---|---|---|---|---|---|
| | | | | $Ca^{2*}$ meq/ 100g | $Mg^{2*}$ meq/ 100g | $Na^{*}$ meq/ 100g | $K^{*}$ meq/ 100g | meq/ 100g | |
| Attawirawewa | 0-15 | 8.6 | 2200 | 13.1 | 5.55 | 11.13 | 1.02 | 57.39 | 24 |
| - Puranawela | 15-30 | 8.7 | 2000 | 9.02 | 1.95 | 14.47 | 2.01 | 57.4 | 33.7 |
| Attawirawewa | 0-15 | 8.6 | 3000 | 2.55 | 2.31 | 19.17 | 0.055 | 21.96 | 68.45 |
| - Akkarawela | 15-30 | 9.2 | 1750 | 5.76 | 0.054 | 17.10 | 0.955 | 25.66 | 20.6 |
| (upper part) | | | | | | | | | |
| Attawirawewa | 0-15 | 8.6 | 3550 | 7.025 | 0.52 | 11.26 | 0.066 | 17.83 | 17.6 |
| - Akkarawela | 15-30 | 8.7 | 2100 | 4.03 | 4.73 | 3.74 | 1.75 | 18.40 | 22.77 |
| (lower part) | | | | | | | | | |
| Ihala Nochchikulama | 0-15 | 8.3 | 4500 | 11.70 | 6.9 | 17.84 | 2.07 | 53.4 | 50.46 |
| (upper part) | 15-30 | 8.4 | 4300 | 7.97 | 10.3 | 18.0 | 2.01 | 54.0 | 50.0 |
| Ihala Nochchikulama | 0-15 | 8.2 | 3300 | 13.40 | 9.39 | 15.47 | 1.89 | 53.65 | 41.85 |
| (lower part) | 15-30 | 8.2 | 2400 | 10.3 | 13.29 | 11.52 | 2.31 | 54.7 | 26.6 |
| Pahala Nochchikulama | 0-15 | 9.6 | 1600 | 11.21 | 3.266 | 4.98 | 0.83 | 19.2 | 35 |
| (lower part) | 15-30 | 9.7 | 1500 | 3.345 | 3.45 | 12.34 | 0.078 | 19.5 | 23.1 |
| Kahatagaswewa | 0-15 | 9.1 | 3600 | 5.85 | 1.90 | 16.79 | 0.05 | 25 | 110.9 |
| | 15-30 | 9.6 | 2300 | 7.77 | 3.88 | 12.75 | 0.037 | 25 | 105 |

* Based on Bench mark salinity surveys conducted in 1985/86 by the author in specific locations in the North Central Dry Zone, Eg. Toruwewa tank cascade that had previous history of the problem and also identified by the farmers as to their locations.

Table 7 : SALINITY DEVELOPMENT FROM IRRIGATED AGRICULTURAL SYSTEMS

| Irrigated agricultural system/location | Total Extent Irrigable area (bottom land) Ha. (Ac.) | Extent of area salinized Ha. (Ac.) | Salinized Extent as a % |
|---|---|---|---|
| Small-scale traditional irrigation system Eg. Toruwewa Cascade ($MC_4$) | 94.56 (233.4) | 1.77 (4.37) | 1.86 |
| Large-scale modern irrigation system eg. Mahaweli ('H' area) | | | |
| Bl. 403 | 563.33 (1391.4) | 267.84(661.5) | 47.54 |
| Bl. 302 | 38.46 (95) | 11.94 (29.5) | 31.04 |

## CONCLUSIONS

Comparisons of mapped agricultural land use patterns in the Nachchaduwa Tank catchment for two time points, 1956 and 1982 using black and white sequential aerial photos shows that approximately half the variation of tank surface area for the 10 micro-catchments considered, can be explained by the change in the land clearing associated land use mapping units, namely, OF, DF and CH. Adding further to the credibility of this relationship isthe fact that both the years 1955/56 and 1981/82 qualify as normal rainfall years thereby significantly having no influence on the areal extents of tanks mapped from the aerial photos.

The environmental degradative trends and impacts recorded in the field notably, increased siltation of small tanks in the Nachchaduwa tank catchment and the twin problems of salinity and water-logging in the lowland rice paddies in both small and large-scale irrigated agricultural systems considered namely, the micro-catchments of Nachchaduwa Tank catchment and the Mahaweli 'H' irrigated area respectively, suggests that man-induced land clearing activities have played a major role in effecting these changes in these agricultural environments.

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