INTEGRATED LAND AND WATER RESOURCE MANAGEMENT IN A WATERSHED CONTEXT[1]

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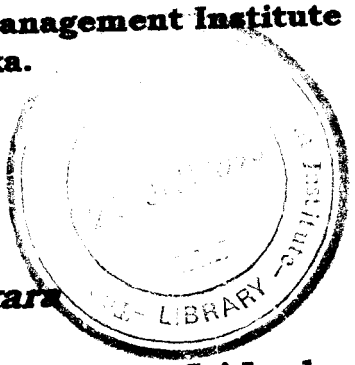

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ABSTRACT:

The Shared Control of Natural Resources (SCOR) project aims at developing and testing a strategy to increase the sustainable productivity of land and water resources base in Sri Lanka. The focus on "watershed" as a basic planning, co-ordinating and implementation unit is a unique feature of SCOR project. In order to develop and maintain a balance between production and protection as a point of departure, the SCOR efforts focus on : changes in the incentive structure, changes in the institutional context and changes in the use of technologies.

At the outset, a participatory assessment of supply and demand characteristics of land and water resources as well as management practices has been conducted in selected watersheds. In this exercise, the strengths and weaknesses of existing user organizations and the potential for group action have been identified. It was evident that ways in which the land and water are used in the upper parts of the watershed affect the ways in which these resources can be used in the downstream. The hydrological, socio-economic management factors and various other factors influence the form of this interdependency.

Next, the project examined the "gap" between existing and "ideal" land and water management patterns within sample contiguous areas or sub watersheds. Participatory mapping of land use patterns and associated practices formed an integral component of this initial assessment. Existing land use pattern was then compared with an ideal pattern and, through a participatory planning process, a package of activities and management practices are selected to achieve production and protection goals.

The "protection" strategy of SCOR is different from traditional approaches. SCOR project believes that a package of measures (type of vegetation, a land and water management practices and related user rights) should be selected in consultation with (or jointly with) the users and both production and protection should be incorporated into the package. This means that the package provides adequate incentives - such as profits, desired cash flow and desired non-monetary benefits - to the user in order to motivate her/him to protect natural resources.

Organizing users in to groups and linking users with institutions such as markets (eg. through forward contracting) credit and information/extension and providing users/groups with appropriate legal rights (such as usufructuary) will form an effective mechanism for overcoming such difficulties as scale constraints. The SCOR strategy is based on past experience in group economic and natural resources management efforts - notably of the water user groups associated with irrigation.

1. INTRODUCTION

The focus on watersheds as basic planning, co-ordinating and implementation units is a unique feature of SCOR Project. The term watershed is defined as the area of land surface that drains water in to a common point along a stream or river. A typical dry zone watershed would comprise of catchment, reservoir command and drainage areas. The project promotes integrated planning for land and water resources utilization in these areas, gradually transforming the strategy of development from a "project" to a "program" mode. This paper will briefly examine the strategy being adopted by the Shared Control of Natural Resources Project, SCOR, for integrated management of land and water resources in a watershed context.

The prime goal of this action-research project is to develop and test a strategy to increase the sustainable productivity of the natural resources base in Sri Lanka in ways that will improve peoples' livelihoods beneficially and equitably now and in the future with due regard to **environment**. In order to achieve this goal SCOR will increase the share of user's control over land and water resources, firstly in two pilot watersheds (Huruluwewa & Nilwala), through **state- user partnerships based on formal agreements** that contribute to intensified and sustainable agricultural production while conserving physical, biological and social environments. Thus the project is designed to strike a **balance between production and protection** in relation to the utilization of land and water resources. To develop and maintain such a balance, the project aims at a proper mix of **Technology, Organizations and Resources ("TOR")**. For example, appropriate production and conservation techniques and technologies are being used to augment and sustain the resource base and its productivity through participatory processes and novel modes of state-suer partnerships.

2. RAPID ASSESSMENT OF WATERSHED RESOURCES AND RESOURCE USE PATTERNS

SCOR project launched its field activities in October 1993 with a participatory assessment of : supply and demand characteristics of land and water resources base in the two watersheds; user characteristics including group formation if any; strengths and weaknesses of users, related government agencies, NGOs, etc.; and basic socio-economic features including incomes tenurial forms, labour etc. At the inception, the identification of "watersheds" and marking of the "boundaries" were done by the Land Use Policy Planning Division (LUPPD) of the Ministry of Lands, using 1:50,000 and 1:63,360 maps. Next a complete land-use map, using accepted land-use categories, has been prepared for each watershed. The LUPPD then identified a few sub-watersheds for **interventions** in phase I (1993-95) of SCOR implementation. The participatory assessment was initially limited to these sub watersheds.

Participatory Appraisal

In any given location of a selected sub-watershed, participatory appraisal of the characteristics of resource uses and users as well as resource use mapping were done by a 'group' comprising of : IIMI-SCOR professionals/catalysts, relevant local officials *(such as Grama Niladhari, Colonization Officers, Agric. Instructor)* and farmer/user representatives. The catalysts took the lead role for preparing the "map" and recording of information. Other group members as well as the users helped the catalysts in the identification of land holdings, consultations with users and providing information. The groups were guided and supported by senior IIMI-SCOR professionals, Divisional Secretaries, Irrigation Engineers and technical officers,

Divisional Officers of Agrarian Services, Senior Officials of Forest and Agriculture Departments, etc. General objectives of a typical participatory appraisals were:

a. prepare a map of the sub watershed indicating individual **land holdings**, land use patterns, type and quality of vegetation, water use, drainage lines and irrigation methods etc.;

b. gather some basic data such as : type and membership of user organizations, ownership and tenurial patterns, cropping patterns and intensities, apparent degree of soil erosion, conservation practices, production and productivity, and constraints to production and protection;

c. help establish a baseline for the resource use pattern using (a) and (b); and

d. sensitize the officials of relevant government agencies/NGOs, and resource users on the importance and need for this exercise and to obtain their active participation in future work.

3. SUPPLY AND DEMAND CHARACTERISTICS OF WATER RESOURCES IN THE HURULUWEWA WATERSHED

Analysis of water resources, its uses and users, however, was not limited to participatory appraisal or to the sub watersheds. The rationale for using the watershed as the basic unit for integrated planning of resources utilization is mainly based on the **supply characteristics of water: the watershed is a physical entity geographically defined by an important natural resources, i.e. water**. The ways in which the land and water are used in the upper parts of the watershed will affect (both qualitatively and quantitatively) the ways in which these resources can be used downstream, and they **affect the associated land resource**. Thus, the various parts of the watershed are physically and operationally linked in important ways, and the potential benefits from integrated use can be large. This can be better illustrated by an analysis of supply and demand characteristics of water resources in a watershed.

For example, sources of water (supply) in the Huruluwewa watershed can be classified into four categories:

Rainfall
Major (Huruluwewa) and minor tanks,
Ground water, and
Mahaweli Feeder canal.

Obviously, the ground water resources have no bearing on the watershed boundary as aquifers underneath can extend beyond.

Huruluwewa is a "water deficit" system. Huruluwewa tank is (supposed to be) supplemented by the diversions from Mahaweli System via a feeder canal. However, a high degree of illicit water tapping is reported along the feeder canal from Mahaweli system to Huruluwewa tank. Out of the 22 mile-long feeder canal the first five miles fall within the jurisdiction of the Mahaweli authority. The balance part comes under the control of the Irrigation Department.

The watershed is spotted with many tanks of which Huruluwewa reservoir (55,000 ac.ft.) is dominant. (Fig. 1). There are about 220 small tanks which frequently constitute different **"cascade systems"** within the watershed. In general, the hydrological (as well as socio-economic) interactions between tanks/people within cascades have not been considered in tank rehabilitation or related development efforts. Moreover, there exist strong inter-dependencies between minor tank systems and between minor tanks and the Huruluwewa major reservoir. The minor tanks in the Huruluwewa Watershed are classified into several categories. These include:

I. tanks located above the command where drainage return flow enters the Huruluwewa major reservoir system, both the reservoir and the irrigation distribution system;

II. tanks located below the main reservoir and within the command which are directly augmented by the canal system;

III. tanks located within the command which are not augmented directly by the canals but are augmented by the return flows of the command;

IV. tanks with own catchments augmenting the supply to lands in the Huruluwewa command area.

Some of these hydrological "interactions" are illustrated in Fig. 2. **It is evident that "supply exchanges" among minor tanks and between minor tank and the major tank take place without much planning and co-ordination.**

The minor tanks are managed by the farmers. Most of these systems have farmer organizations established under the Agrarian Services act (Amendment) of 1991. The farmer organizations of Huruluwewa have been established by the Irrigation Management Division. As discussed elsewhere in this paper, the drainage return flows of Huruluwewa and associated tank systems are being tapped by Agro-wells for lift irrigation. On the whole, there is an urgent need to strengthen co-ordination between Mahaweli Authority, Department of Agrarian Services, Provincial and National Departments of Irrigation and various forms of users. The SCOR project is "catalyzing" such a process to achieve its objective of integrated management of land and water resources in the watershed.

Ground Water and Re-Cycling of Drainage Water

It has been generally believed that the dry zone, with the exception of Jaffna peninsula and immediate surroundings, do not offer a great potential for ground water explorations on large scale. However, ground water extraction from the weathered rock up to a depth of about 10m in the dry and intermediate zones is taking place at an increasing rate. No regulations or accepted norms have been adopted with regard to well density, spacing between wells, pumping durations, etc. In certain locations, it is reported that pumping operations of one or more wells interfere with adjoining wells. This is evident from the sudden draw-down of water in the well, while pumping of adjoining wells are in progress. In such occasions farmers are compelled to adhere to pre-agreed "rotational schedules". This situation has limited the "on-demand" nature of some of the wells. Moreover, in certain locations farmers, after excavating to depths exceeding 6-7m and spending about Rs.40,000 - 50,000 per well, have found that the water yields are not satisfactory. Some of them continued their efforts by driving tube wells from that point up to underlying deep rock. In addition, the negative consequences of the proliferation of Agro-wells include: lowering water table and associated problems such

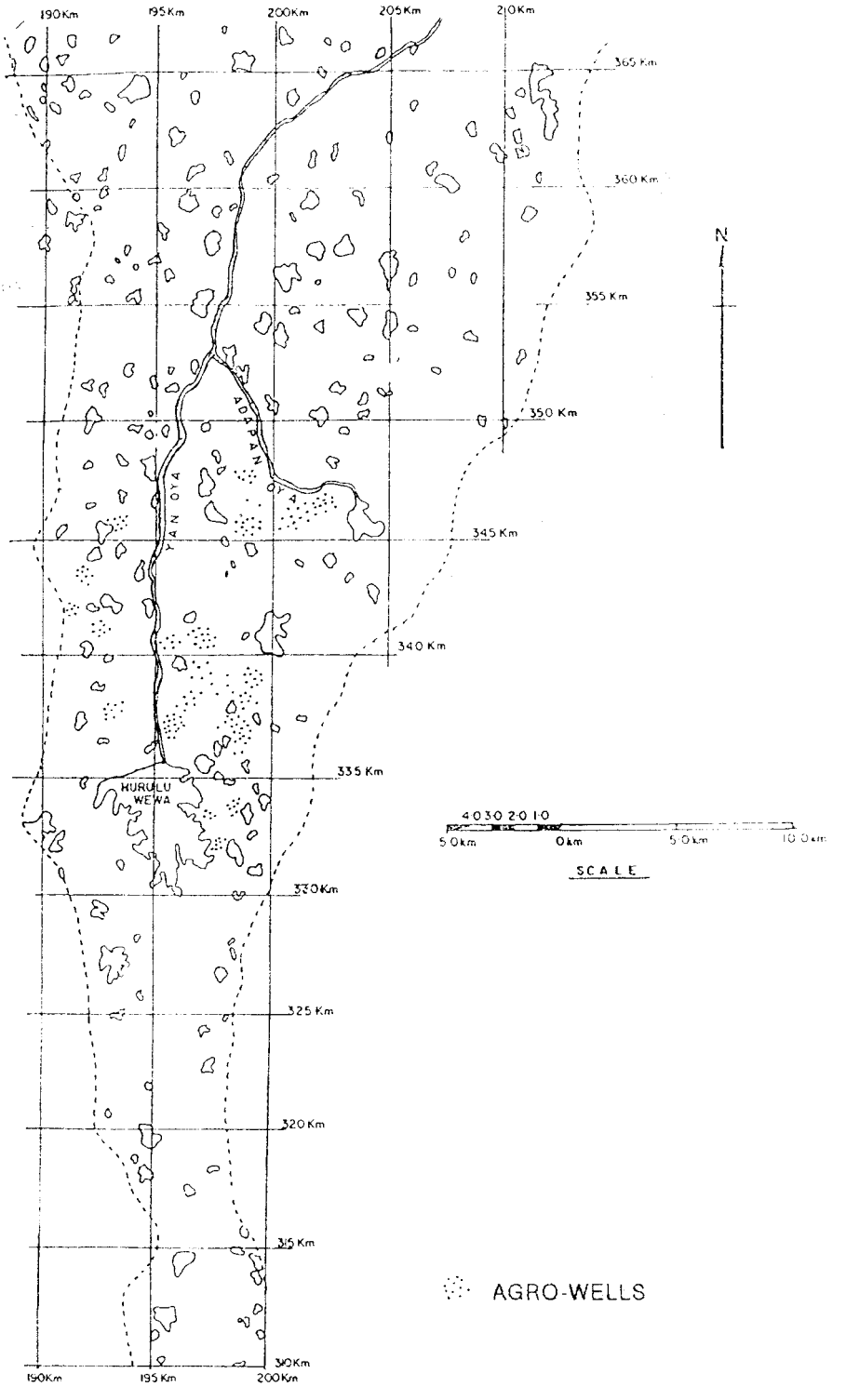


Figure 1. **Distribution of water reservoirs and Agro-wells in Huruluwewa Watershed.**

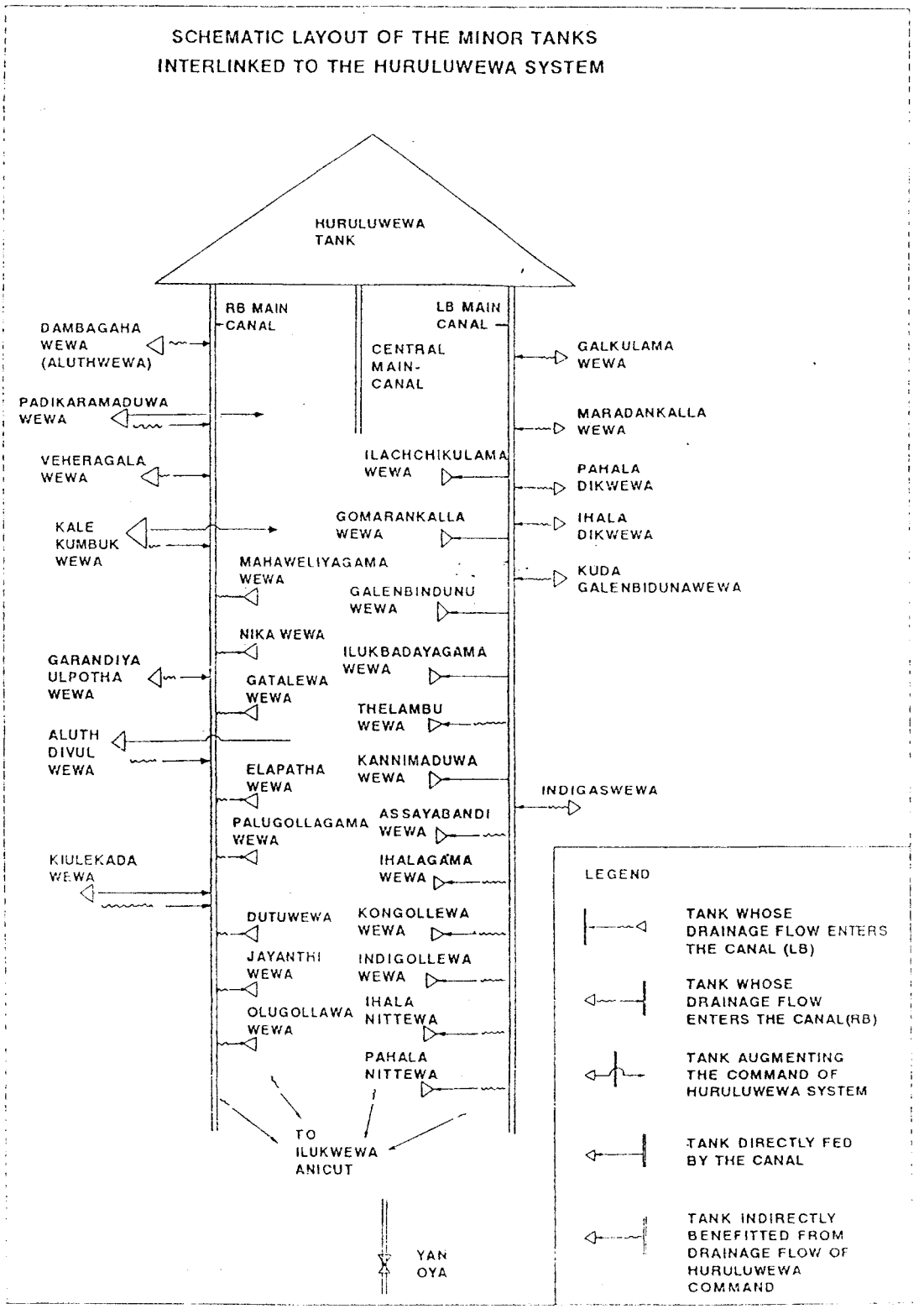


Figure 2. Schematic layout of the minor tanks interlinked to the Huruluwewa system.

as moisture deficits in rain-fed farming areas, threats domestic wells and income disparities (i.e. due to inefficiencies in the subsidy scheme of the government, usually the Agro-wells are owned by well-do-do farmers. This however, need to be studied further.)

Water level fluctuation at three sample sites are illustrated in Figs. AF_1, AF_2 & AF_3 in Annex I. These samples represent the following:

(a) Water level fluctuations in irrigation wells located in the command area of the major reservoir (AF_1);
(b) Water level fluctuations in irrigation wells located highlands (AF_2);
(c) Water level fluctuations in the domestic wells (AF_3).

From these figures it is evident that the fluctuation variation over time is more in wells used for irrigation and the variation is influenced by rainfall, canal water levels and pumping. A comprehensive research/monitoring activity is being conducted and the analysis will be extended to several other areas including : economics of ground water usage, potential for using ground water in conjunction with tank water, feasibility of group wells, effects on water quality, potential for legal and regulatory mechanisms etc. However, SCOR project investigations show some important benefits deriving from agro-wells - increased incomes and profits, better re-use patterns of water, diversification of agriculture, improvements in nutrition standards, etc.

According to SCOR project studies there are 721 agro-wells within the Huruluwewa watershed. Most of these have been constructed over the past 2-4 years. The number of agro-wells within different sectors of the watershed is shown in Table I.

Table I. Distribution of Agro-Wells within Huruluwewa Watershed

Sector of watershed	- Number of Wells - Lined	Unlined	Total
Catchment	10	46	56
Irrigation Command	65	434	499
Highlands (RB)	20	106	126
Highlands (LB)	12	28	40
Total	107	614	721

Source : SCOR Agro-wells Survey (1994)
Notes : RB = Right Bank, LB = Left Bank

The SCOR project conducted a participatory mapping exercise to gain more knowledge (for SCOR staff, government officials and the users) on the spatial distribution of agro-wells (Fig. 1). The area cultivated per well is in the range of 0.1 - 0.2 ha. The major crops irrigated by wells are chillies, onion and vegetables. In addition to this form of "re-use", some farmers have resorted to recycling of drainage water through other methods. For example, farmers practice lift irrigation especially near two pick-up anicuts which have been

constructed across Yan Oya at Nikawewa and Illukwewa, reusing drainage return flows of command area of Huruluwewa tank system. Several others have started pumping from Yan Oya in the Huruluwewa catchment area. It has become increasingly evident from the analysis of current trends in ground water and drainage re-use patterns that the interactions (namely hydrological, user and institutional) between different sources of water for irrigation should be considered in any development effort focused on land and water resources.

Rain fall

In regard to climatic factors such as rainfall, temperature, solar radiation, and wind patterns, Huruluwewa watershed represents the characteristics of a typical dry zone regime. Seasonal distribution of rainfall than the total amount plays a major role in influencing agricultural activities in the watershed. The watershed receives an average rainfall about 1,000 mm per annum. On the average, more than 75 percent of precipitation is received during the period from November to January from the North-east monsoon. Periods from May to September is virtually "dry".

Moreover, recent monitoring of rainfall at several points within the watershed shows a significant "micro-scale variation" (Fig. 3). **The real challenge to SCOR is to study the spatial and temporal variations in rainfall and try to combine various sources of water available to this agricultural production system (both spatially and temporally), equitably among various users and rationally between different uses.**

The present major problem in both major and minor tank commands (within the watershed) is the inadequacy of water for agricultural production, especially in the dry season. However, it was clear from the above discussion that different combinations of various sources of water can be used. An in depth analysis of supply (eg: water balance) and demand options (eg: conjunctive use, diversified cropping, water conservation measures) is required for this purpose. Temporal and spatial dimensions should also be considered in such an analysis. The SCOR project has already initiated a research program towards this end.

4. INTERVENTIONS TO IMPROVE LAND USE PATTERN
- Balancing Production and Protection -

Participatory land use mapping provided SCOR participants with a more clearer picture about land use patterns - farm by farm - and associated technologies including **quality** of land cover, conservation practices if any, and potential productivity etc. As the next logical step, the SCOR team analyzed there information, more specifically to address the following issues:

I examine the "gap" between present land use pattern (with associated management practices) and the ideal pattern.

- recognize land class and appropriate land use pattern
- compare it with present use pattern

II Set ideal as the "target" and plan interventions to approach this situation.

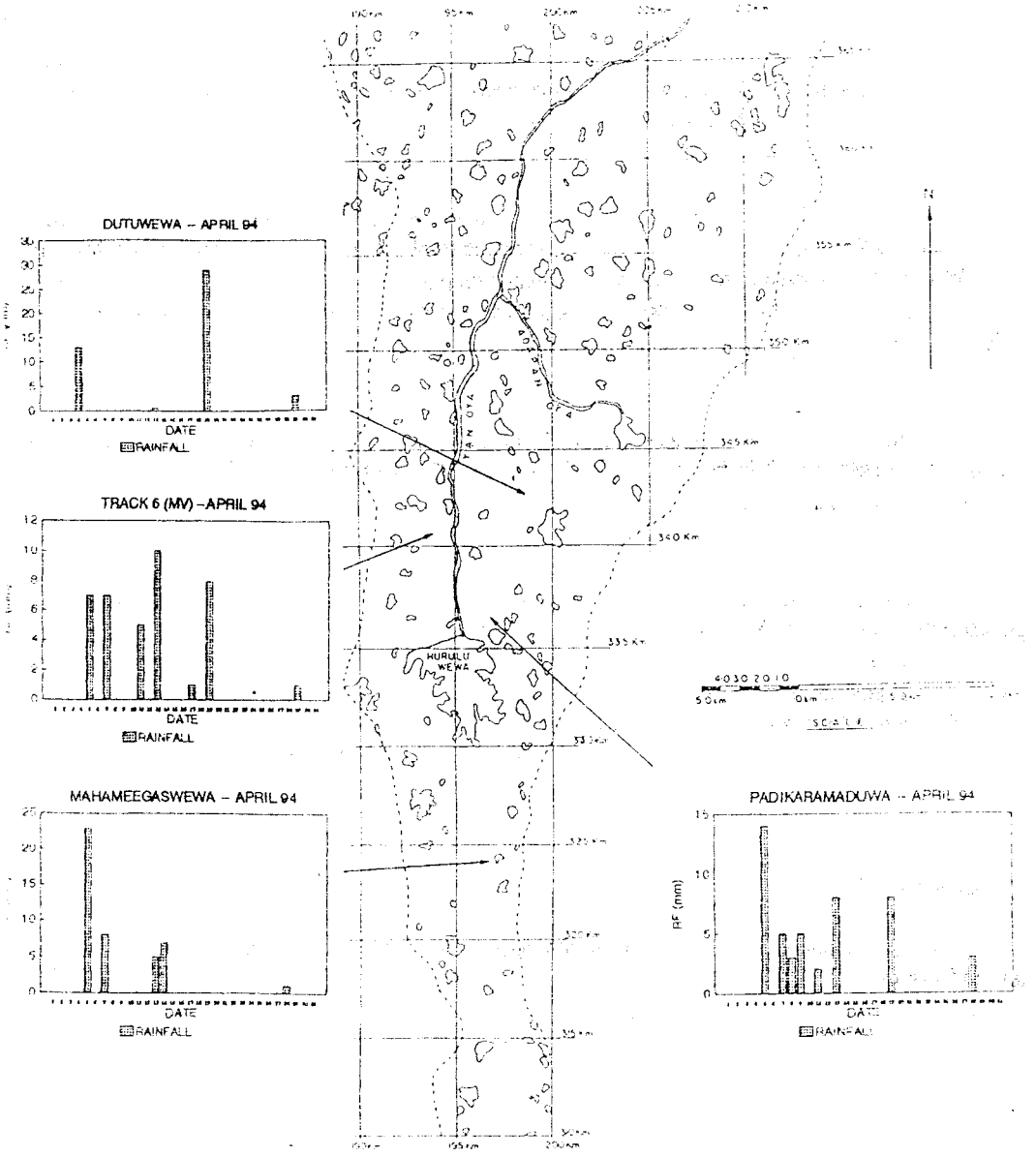


Figure 3. **Micro-scale rainfall variation in the Huruluwewa watershed.**

The Gap Between Present Land Use Pattern and the "Ideal" Pattern

For some selected **pilot contiguous areas**, land class or slope/terrain characteristics have been identified. Classification of land area in one of the contiguous areas in the Nilwala watershed is illustrated in Fig. 4. The total area of this pilot site is 296 ha.

The selected contiguous areas are sub watersheds of manageable size within main watershed, having characteristic profiles of ecological, socio-economic and environmental features similar to that of the respective main watersheds. Size of selected sub watersheds ranges from 200 ha to 1000 ha. Action will be taken to demonstrate an "ideal" land use pattern with due emphasis of production and protection. This "contiguous area" or "model watershed" approach of implementation would illustrate the various production - protection elements along with their intimate relationships, that will have to be incorporated in watershed management in order to produce a sustainable land and water resources base.

At present, land use information collected through participatory mapping exercise are being incorporated into SCOR spatial data base using Geographic Information System (GIS) software. As this is not yet completed, 1989 land use pattern will be used for illustration purposes. This is the latest version available for country-wide land use patterns. In order to strike a balance between production and protection the users should be motivated to select the correct types of vegetation and management practices to match with the different land classes.

According to Fig. 5, area under forest in 1989 was only 8.9ha or 3% of the pilot area. However, over one third of the pilot site falls within the land class of slopes over 60%. This is not a healthy trend and is mainly due to illegal acts of clearing jungle by various users. There are vulnerable areas and classified as **reserved** land.

Inappropriate hill side cultivation is evident from Figure 6 which compares the land use pattern with slope categories. Land use patterns in slopes over 45% are given in this figure. It is evident that 39% of such sloping lands are under tea and 31% are classified as "gardens". The participatory mapping exercise in the same area has generated more detailed information on land use patterns. According to this source, a substantial portion of "gardens" are also cultivated to tea. Hence, the area under tea within this category of sloping land is well over 50%. The situation is further aggravated by the fact that part of tea lands are poorly managed.

Planning Interventions

It has been observed that deforestation and inappropriate hillside cultivation in the upper Nilwala watershed has resulted in reduced water availability in the dry season (as reported by people) erosion, sedimentation, distorted runoff patterns and decline in water quality. In this particular sub watershed, namely **Aninkanda**, users - especially those who live in the downstream - have begun to realize the ill effects of deforestation and hillside cultivation. Consequently, it was reported that there were few ad-hoc yet organized efforts by villagers to 're-plant" at hillside. The SCOR project helps strengthen such efforts so that the users would direct them in a planned manner. To facilitate such efforts it is important to reach a consensus on anticipated or targeted changes in land use. For respective pilot contiguous areas, this is being done through a participatory planning process. A hypothetical situation based on land (class) suitability considerations is illustrated in Fig. 7.

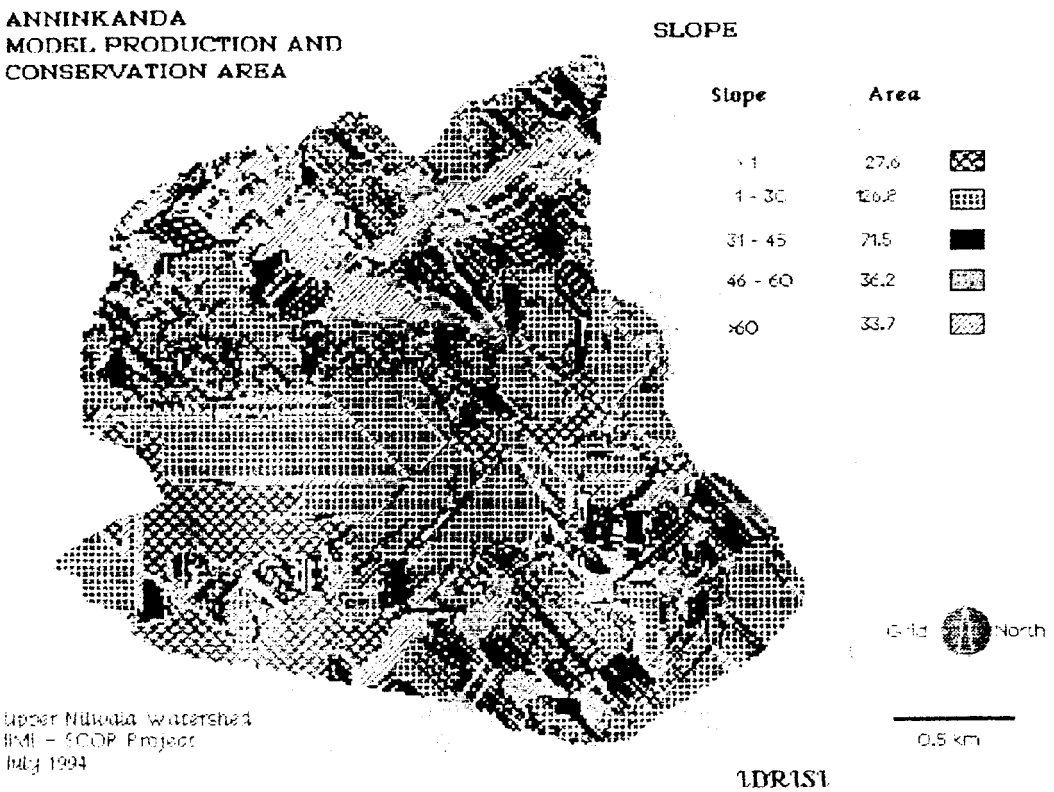

ANNINKANDA
MODEL PRODUCTION AND
CONSERVATION AREA
SLOPE
Slope
Area
< 1
27.6
1 - 30
126.8
31 - 45
71.5
46 - 60
36.2
>60
33.7
Grid
North
Upper Nilwala Watershed
IIMI - SCOP Project
July 1994
0.5 km
IDRISI

Figure 4

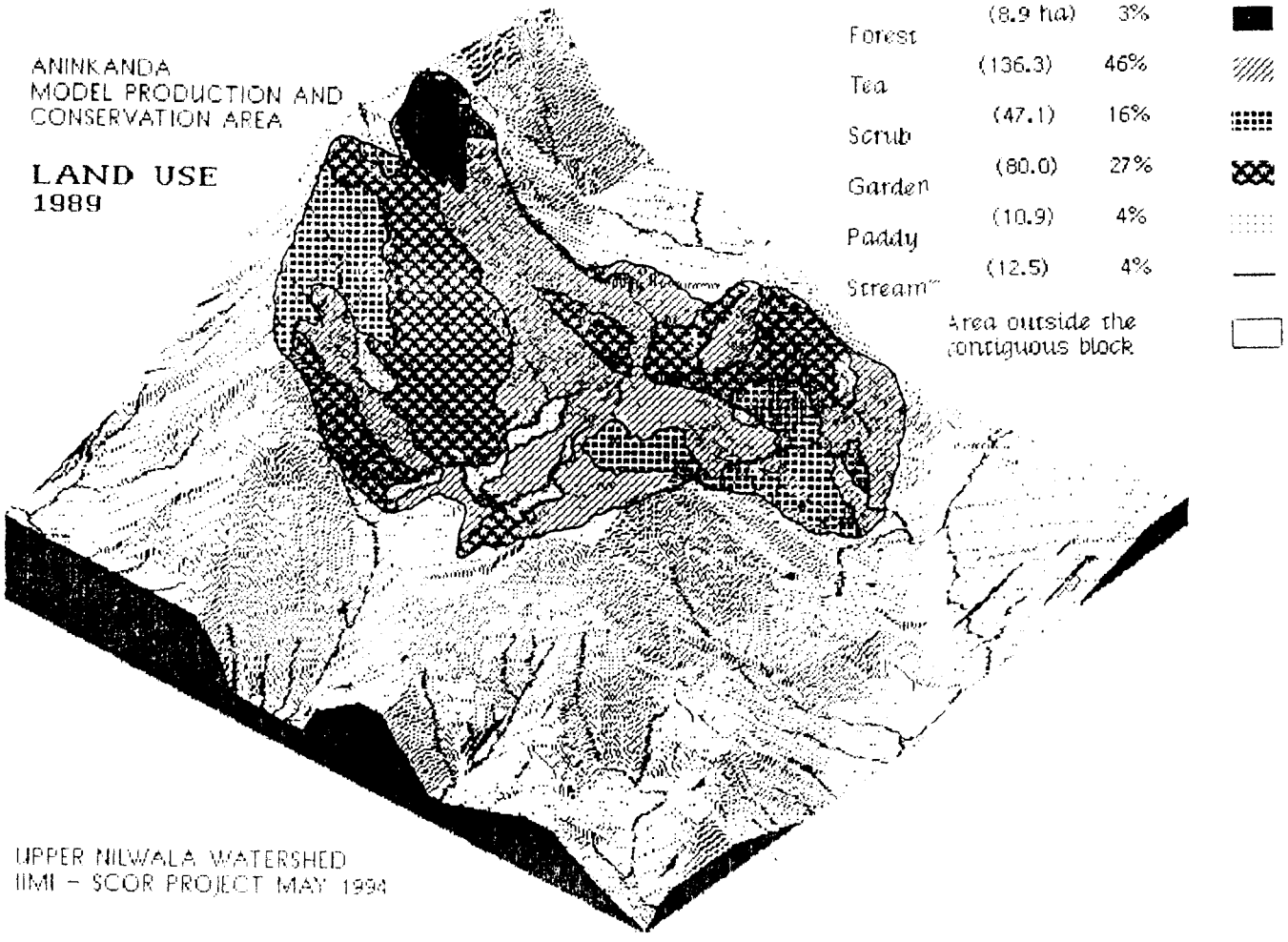

ANINKANDA
MODEL PRODUCTION AND
CONSERVATION AREA
LAND USE
1989
Forest (8.9 ha) 3%
Tea (136.3) 46%
Scrub (47.1) 16%
Garden (80.0) 27%
Paddy (10.9) 4%
Stream (12.5) 4%
Area outside the contiguous block
UPPER NILWALA WATERSHED
IIMI - SCOR PROJECT MAY 1994

Figure 5

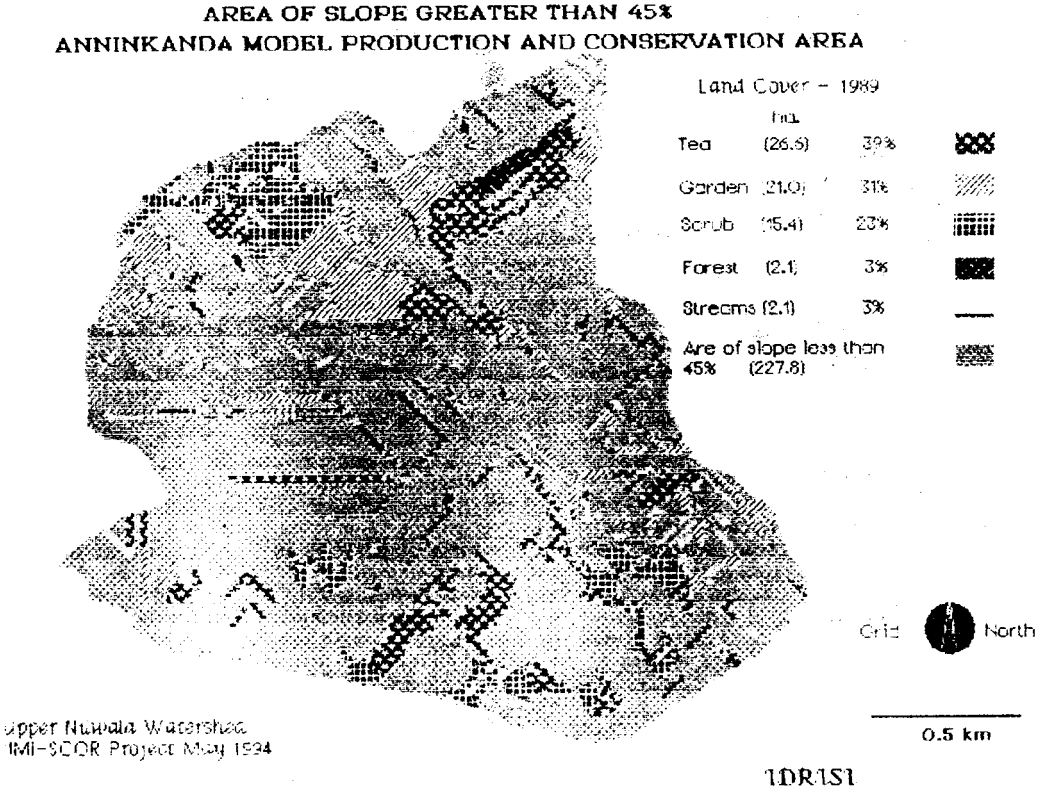
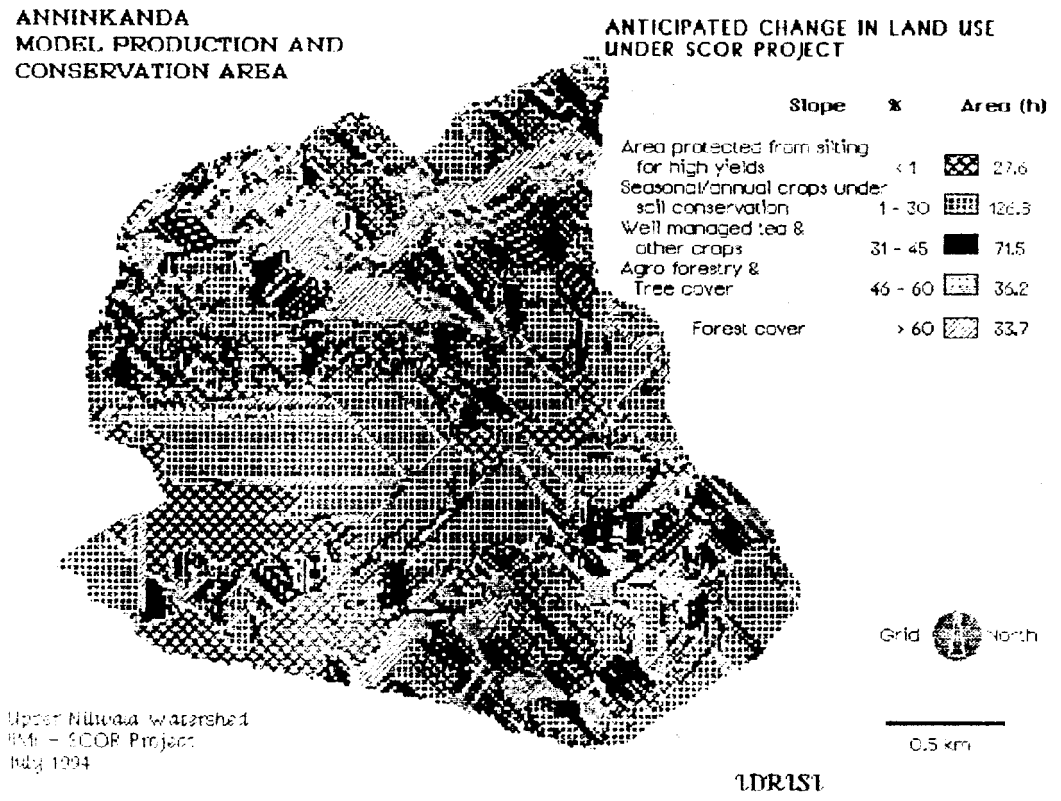

AREA OF SLOPE GREATER THAN 45%
ANNINKANDA MODEL PRODUCTION AND CONSERVATION AREA
Land Cover - 1989
Tea (26.6) 39%
Garden (21.0) 31%
Scrub (15.4) 23%
Forest (2.1) 3%
Streams (2.1) 3%
Are of slope less than 45% (227.8)
Grid
North
0.5 km
Upper Nuwara Watershed
IMI-SCOR Project May 1994
IDRISI

Figure 6



Upper Nilwala watershed
RMP - SCOR Project
July 1994

Figure 7

It is proposed that hill tops and high slopes should be under the land cover category of dense forests. Most of such areas come under the control of the Forest Department. The department officials, SCOR project catalysts and other relevant agencies have already joined the user groups to plan re-forestation patterns at hillside, helped raise nurseries and facilitated re-planting.

In areas within the range of 46-60% slopes a production oriented interventions will be launched. Agro-forestry practices with woody perennial and agricultural crops, tapping of available resources through **proper user-state partnerships and acceptable usufructuary rights** will be adopted for this region. The emphasis will be on **conservation farming** aimed at balancing production and protection. A brief description of intervention areas is given in Annex 2.

It is evident that the protection strategy of SCOR is different from conventional approaches. For example, when physical works such as terraces and protected water ways or tree planting are required, the time necessary to recover the costs usually is too long for the resource user to bear. The customary way to reduce this economic dis-incentive is to pay some or all of the cost incurred. On the contrary, SCOR efforts are focused on:

a) changes in the incentive structure by combining production and protection activities in one package,
b) changes in the institutional context, and
c) changes in the information base and in the use of technologies

For example, users are motivated to adopt protection measures because this package of measures will also enhance their profits, maintain cash flow at desired levels and provide security for future. Moreover, organizing users into groups and linking users with institutions such as markets (eg. through forward contracting) credit and extension, and providing users/groups with appropriate legal rights (such as usufructuary) will provide an effective mechanism for overcoming such difficulties as scale constraints. The SCOR strategy is built on past experience of group economic activities - notably of the water user groups in major irrigation schemes.

Organized Group Action for Production and Protection

The SCOR group formation and anticipated organizational structure is illustrated in Fig. 8. Figure 9 shows the locations of some of those groups already in place. In order to maximize environmental impact, efforts/activities aimed at balancing production and protection must cover the entire area of the selected contiguous block and should not be limited to sample plots or selected farms/home gardens. As most of the holdings are small (ranging from about 0.2ha to about 1ha.)[1], most productive conservation practices such as contour bunding, biological measures (such as planting) along contours, integrated pest management and reducing water pollution demand group action. For instance, contour bunds will cut across individual holdings.

Moreover, group action will enhance individual profits through various means: benefits accrued to pooled resources and scale economies, increased bargaining, exchange expertise in a

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[1] Privately owned large holdings as well as company estates can be found in the Upper Nilwala watershed. However, a vast majority of farmers are small holders.

complementary way etc. Users are being grouped and united for various purposes - ranging from groups for multiplication of anthurium/cut flower through groups for sub hydropower plants (coupled with conservation of the corresponding "catchment") to production companies or NGOs.

Group formation in a given contiguous area may be guided by certain principles:

I. Groups (10-20 users)

Groups may be formed for the realization of various service functions, production purposes, protection purposes or for combined action of production and protection. Most common mode is the latter, that is most groups are aimed at balancing production and protection. Single purpose group formation (either production or protection or even for specific service such as marketing/input supply etc) **will not be** discouraged because the composition of different activities in the contiguous area will ensure that when they put together the objective of balancing production and protection will be achieved. And, the total area will be covered by the interventions.

II. Organization (5-20 groups)

Usually, various groups in a particular contiguous area may get together and form an organization.[2] When all the activities in a contiguous area are assembled together, it will take the form of an integrated production and protection plan for that sub-watershed/contiguous area. In most cases, the SCOR professionals/catalysts have consulted existing organizations and/or users as well as the relevant officials etc at the beginning, analyzed the existing situation in a collaborative way and identified the potential for various interventions. In other words, an indicative plan for the entire area and activities for various groups/locations have been developed.

In most cases, the integrated plans (of respective contiguous areas) are being developed into **PROJECTS**. A typical budget of such a project will comprised of collection of mini budgets for individual activities. There will be three sources of inputs/funding:

a. Users inputs including labour, materials, money,
b. Seed money/grant from SCOR project. (in most cases this will be used as a revolving fund, and will not exceed 20% of total budget)
c. a bank loan (according to present arrangements this will be 4-5 times more than the SCOR project contribution.)

III. Councils/Sub Councils

It is expected that the users will like to federate up small groups into area councils or sub-councils (through organizations). For example, all the organizations in the Huruluwewa watershed may decide to federate up to one single body for production and protection purposes. Such a trend can be seen in certain irrigation districts eg: Polonnaruwa and Anuradhapura

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Even though a typical process of formation of organizations may follow this pattern, there may be exceptions as desired by the users. For example, several groups in different contiguous areas/micro watersheds may decide to get together as an registered organization if they share a common goal. (eg: Kithul products).

A SCHEMATIC PRESENTATION TO ILLUSTRATE GROUP, ORGANIZATIONS AND (SUB) COUNCIL FORMATION IN A MICRO WATERSHED/CONTIGUOUS PILOT AREA

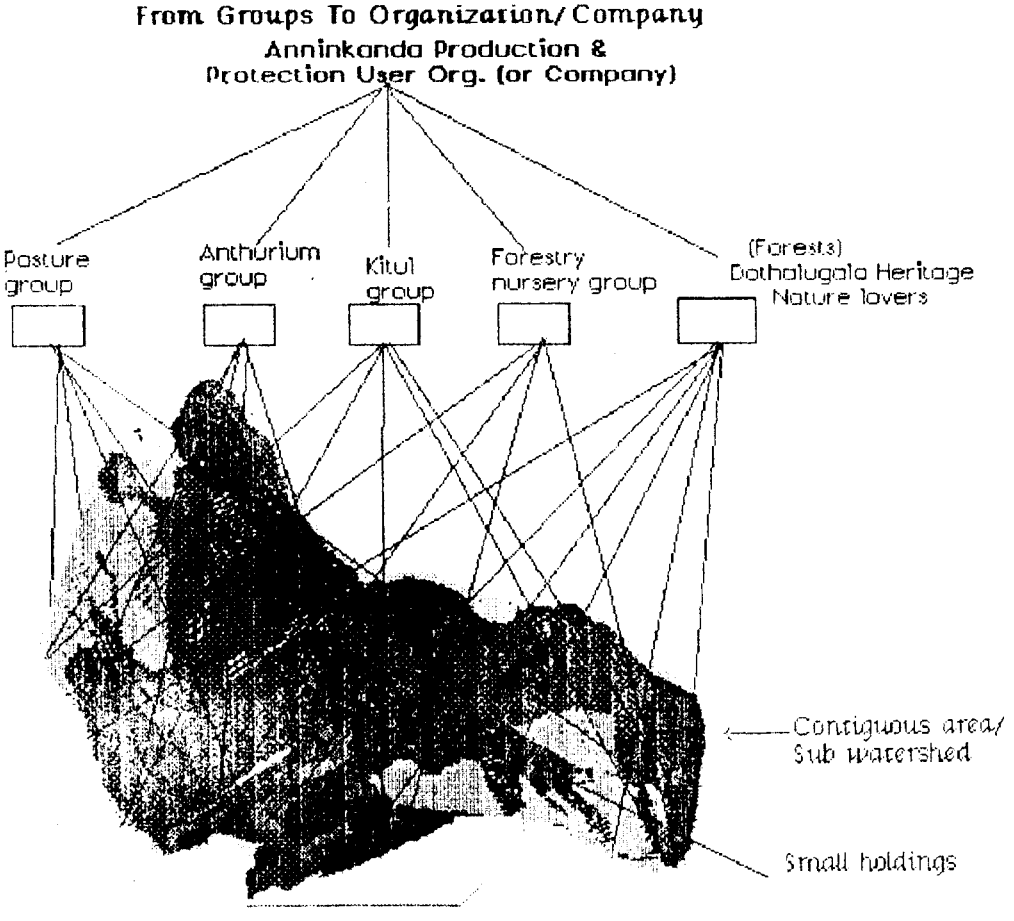

Figure 8

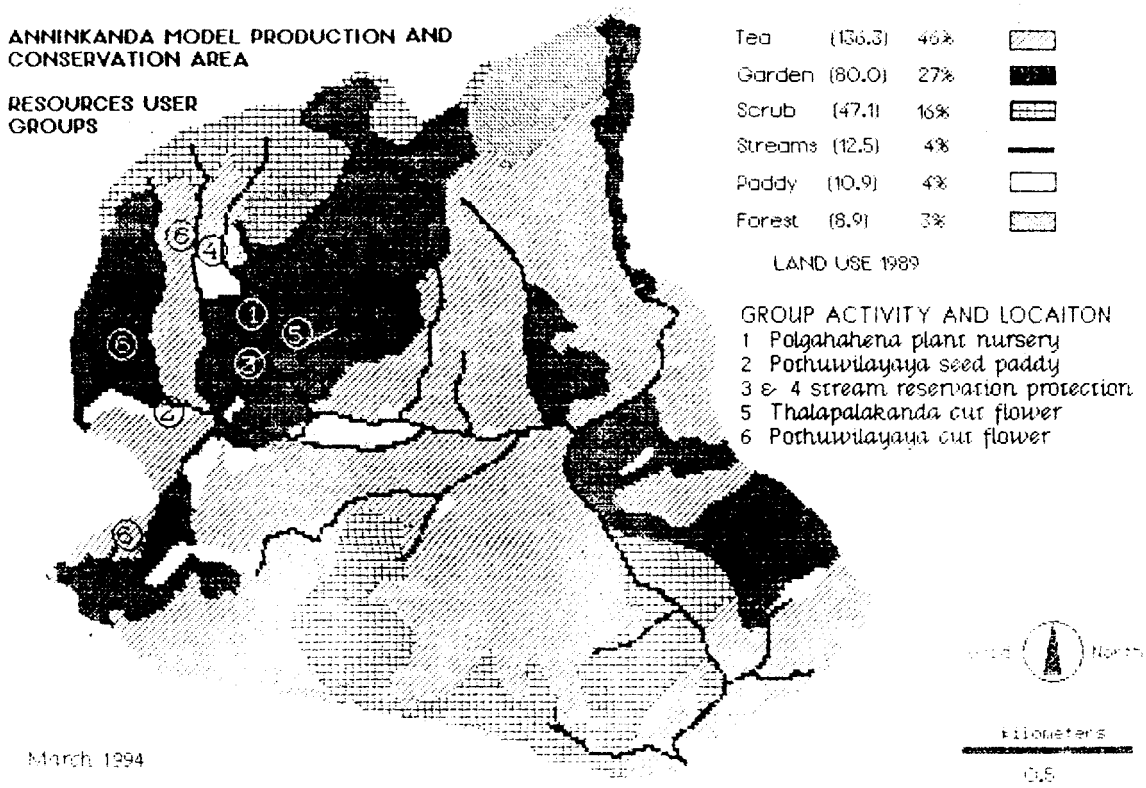
ANNINKANDA MODEL PRODUCTION AND CONSERVATION AREA
RESOURCES USER GROUPS
Tea (136.3) 46%
Garden (80.0) 27%
Scrub (47.1) 16%
Streams (12.5) 4%
Paddy (10.9) 4%
Forest (8.9) 3%
LAND USE 1989
GROUP ACTIVITY AND LOCAITON
1 Polgahahena plant nursery
2 Pothuwilayaya seed paddy
3 & 4 stream reservation protection
5 Thalapalakanda cut flower
6 Pothuwilayaya cut flower
North
kilometers
0.5
March 1994

Figure 9

IV. Legal Arrangements

Even though the smaller groups may remain at "informal status" the organizations, more often than not, would like legal recognition. Farmer Organizations may register under the Agrarian Services Act. In the future, certain organizations may wish to have more independence. They may not like that a government department is vested with the powers of dissolving user organizations. Moreover, certain complex organizations such as small farmer production companies may seek recognition under (modified?) company act. In addition to such legal recognition, the groups, organizations and councils may need to enter into contracts with their partners. These may include, state/user contracts for usufructuary rights, producer-buyer contracts such as forward contracting, user group-bank contracts, service contracts, etc.

Monitoring and Evaluation[3]

The monitoring and evaluation system (M&ES) of the SCOR project has been designed to reflect the project performance in respect of its use of inputs, generation of planned output, expected effects and anticipated impact. Such reflection is expected to help steer the project towards its declared goals. The M&ES is a part of the broad Management Information System (MIS) of the SCOR project. The four major functions viz. data capture and entry, store and retrieve, processing and analysis and display and report of SCOR MIS will facilitate the planning and implementation process of SCOR activities supported by a Geographic Information System (GIS).

The SCOR M&ES is structured to collect information that would reflect and highlight any difference between

(a) the targets, and the actual use of planned financial and physical resources inputs utilized to create the planned output,
(b) the targets, and the actual direct outputs produced from those inputs,
(c) the targets, and the expected effects that are observable in the short run as the outcome of the increased utilization of the produced output.
(d) Change of certain processes and physical properties that are directly relevant to the generation of promised outputs, permitting monitoring with such a frequency to extract useful information for SCOR project interventions.

Some selected areas covered by M&ES are listed below. For each of these areas objectively verifiable indicators have been identified and measurement as well as analytical methods/procedures have been developed. Some selected points of measurement in one sample contiguous area are illustrated in Figs. 10 and 11.

(a) awareness, changes in attitude, acceptance of strategies and concepts on balancing production and protection by : users, agency personnel, private sector & NGOs.

(b) quality and quantity indicators related to information base and MIS.

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[3] Adopted from SCOR Work plan for Phase I, 1993-95 (1993)

(c) investment on production by users (change)

(d) investment on protection by users (change)

(e) economically and environmentally sound production modes (change)

- business turnover
- profits (individual & group, economic & financial)
- cash flow
- sustainability of income/profit levels
- environmentally sound production modes as measured by a package of indicators including (f) below.
- percentage area under improved land and water management (production and protection)

(f) Rainfall : runoff, run-off, infiltration, in-situ water-induced erosion loss, sediment concentration, vegetation cover, soil moisture retention capacity, water quality, nutrient loss.

(g) Groups/Organizations : number, membership, quantity and extent of new production/protection activities, interactions with partners (legal contracts), legal recognition, group cohesiveness, conflicts and conflict resolution,

(h) Benefit : cost analyses of activities and total project.

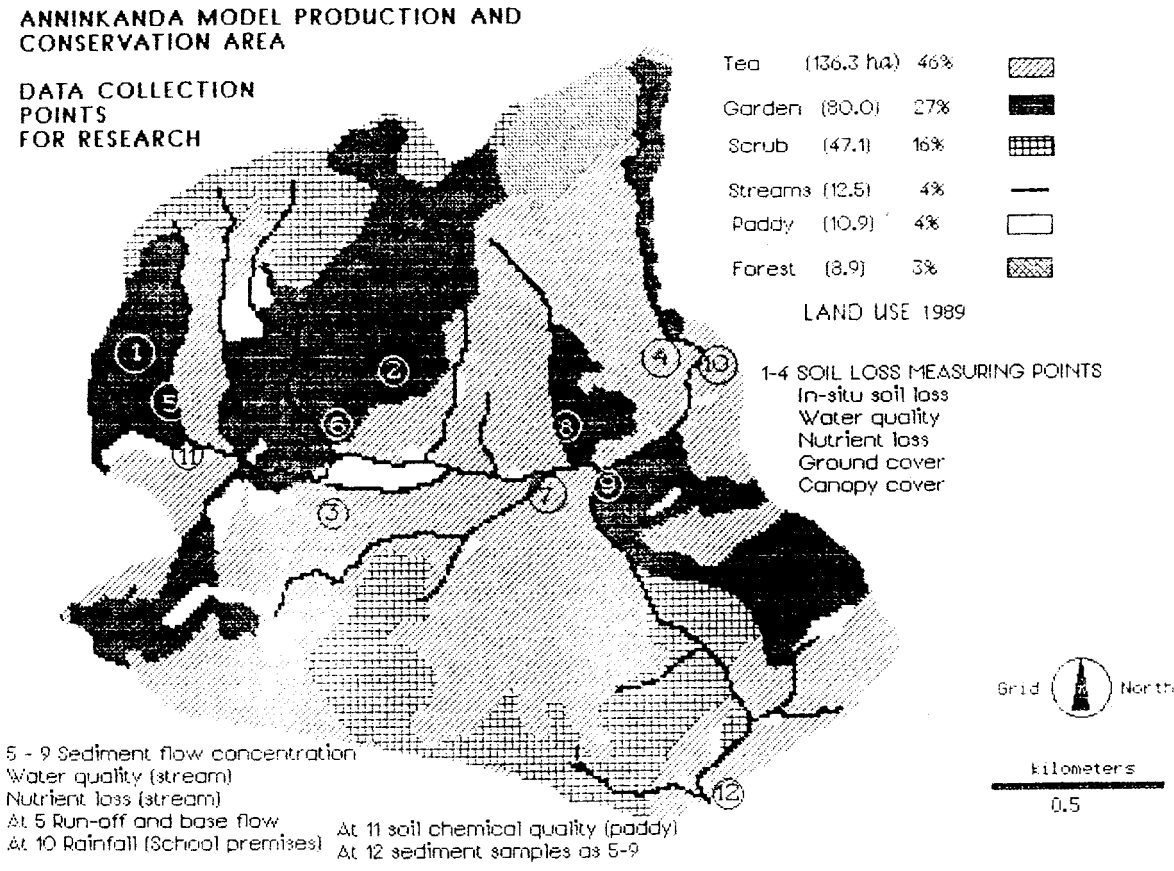

ANNINKANDA MODEL PRODUCTION AND CONSERVATION AREA
DATA COLLECTION POINTS FOR RESEARCH
Tea (136.3 ha) 46%
Garden (80.0) 27%
Scrub (47.1) 16%
Streams (12.5) 4%
Paddy (10.9) 4%
Forest (8.9) 3%
LAND USE 1989
1-4 SOIL LOSS MEASURING POINTS
In-situ soil loss
Water quality
Nutrient loss
Ground cover
Canopy cover
Grid North
Kilometers
0.5
5 - 9 Sediment flow concentration
Water quality (stream)
Nutrient loss (stream)
At 5 Run-off and base flow
At 10 Rainfall (School premises)
At 11 soil chemical quality (paddy)
At 12 sediment samples as 5-9

Figure 10

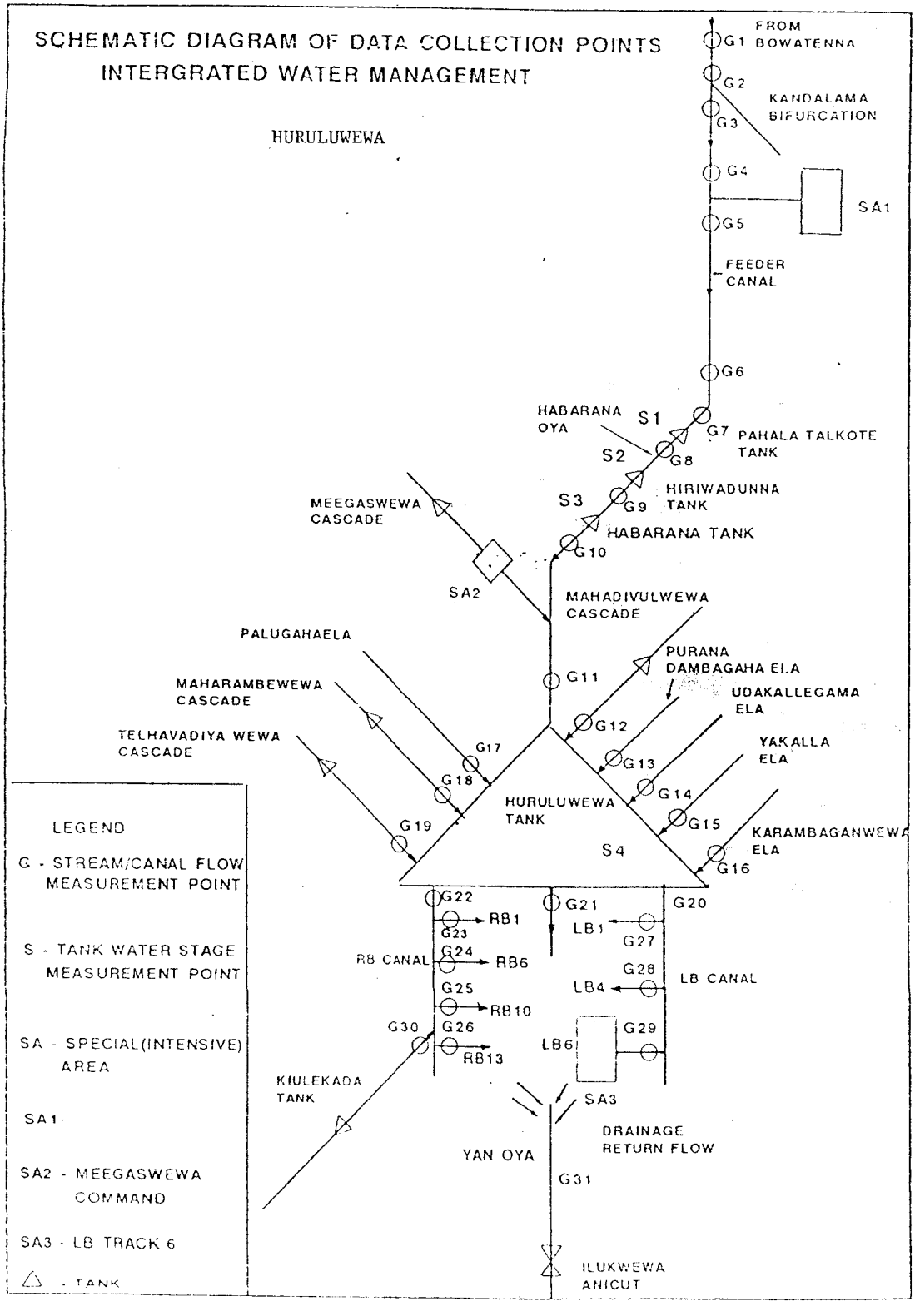

SCHEMATIC DIAGRAM OF DATA COLLECTION POINTS
INTERGRATED WATER MANAGEMENT
HURULUWEWA
FROM BOWATENNA
G1
G2
KANDALAMA BIFURCATION
G3
G4
SA1
G5
FEEDER CANAL
G6
HABARANA OYA
S1
G7
PAHALA TALKOTE TANK
S2
G8
S3
G9
HIRIWADUNNA TANK
HABARANA TANK
G10
MEEGASWEWA CASCADE
SA2
MAHADIVULWEWA CASCADE
PALUGAHAELA
PURANA DAMBAGAHA EI.A
G11
MAHARAMBEWEWA CASCADE
UDAKALLEGAMA ELA
G12
TELHAVADIYA WEWA CASCADE
G17
YAKALLA ELA
G13
G18
G14
HURULUWEWA TANK
G19
G15
KARAMBAGANWEWA ELA
S4
G16
G22
G21
G20
RB1
G23
LB1
G27
RB CANAL
G24
RB6
G28
LB CANAL
LB4
G25
RB10
G30
G26
G29
LB6
RB13
KIULEKADA TANK
SA3
DRAINAGE RETURN FLOW
YAN OYA
G31
ILUKWEWA ANICUT
LEGEND
G - STREAM/CANAL FLOW MEASUREMENT POINT
S - TANK WATER STAGE MEASUREMENT POINT
SA - SPECIAL(INTENSIVE) AREA
SA1 -
SA2 - MEEGASWEWA COMMAND
SA3 - LB TRACK 6
- TANK

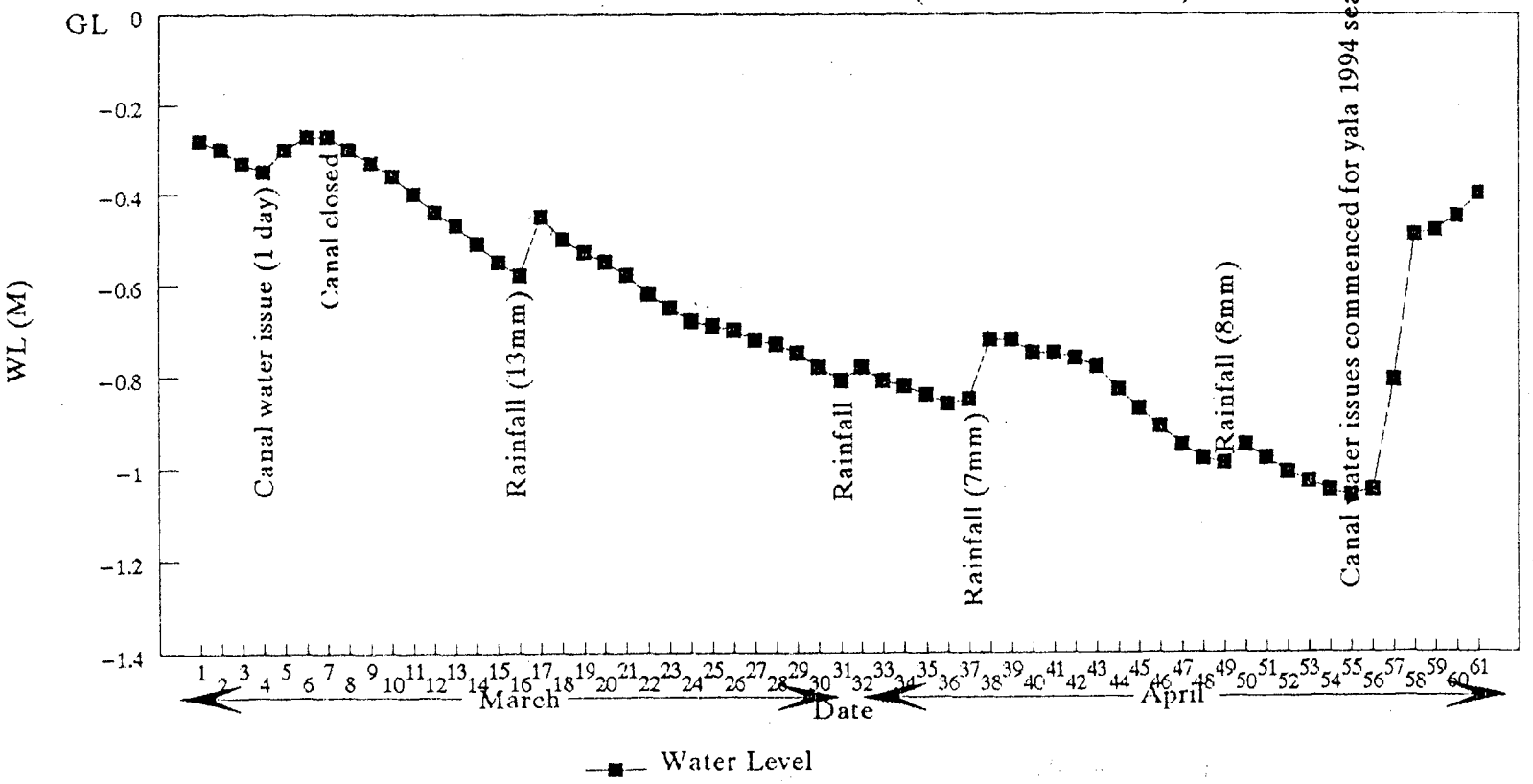
Figure 11

Annex 1

AF1

WATER LEVEL FLUCTUATION (Well – 02)

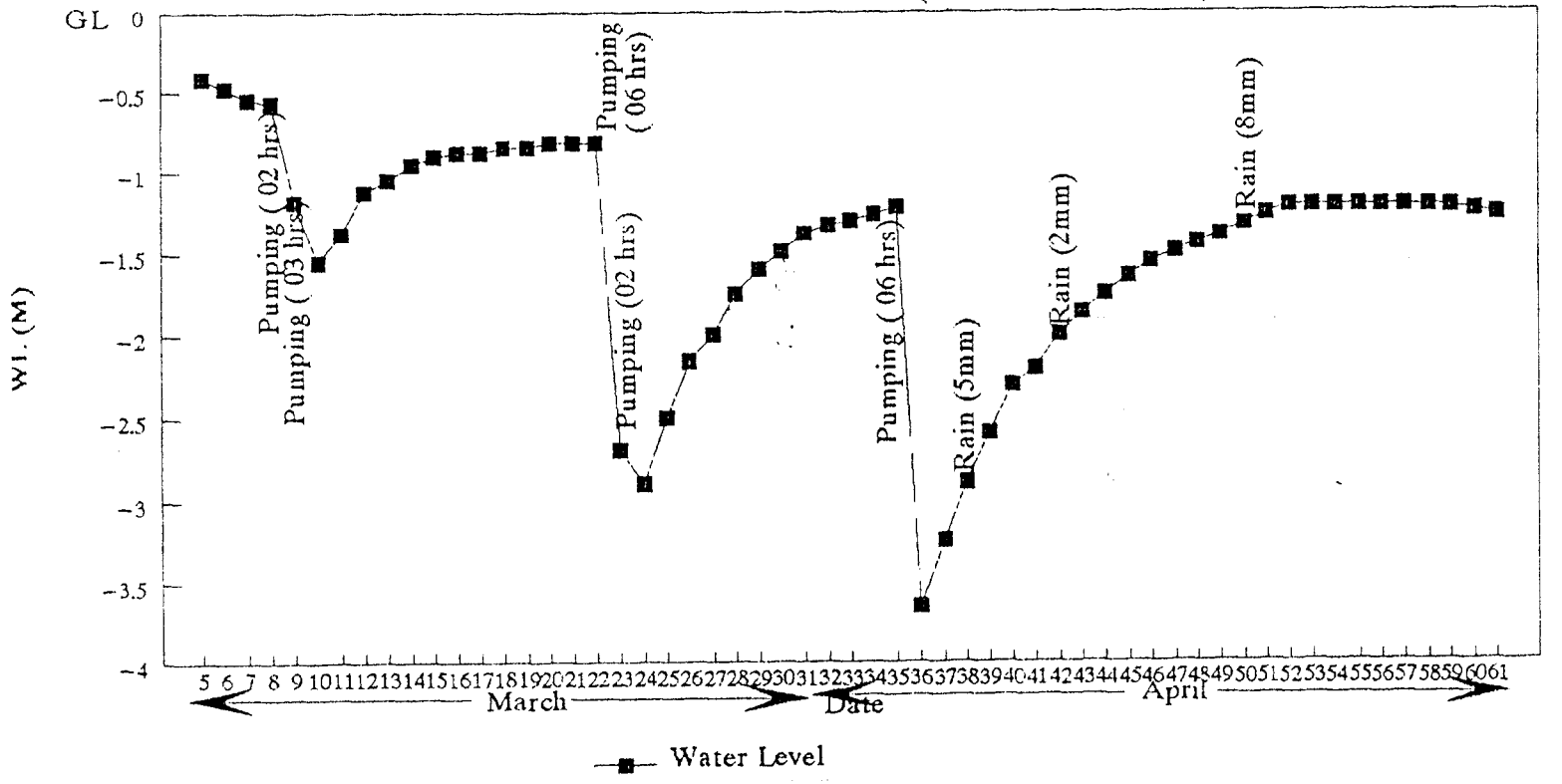
HURULUWEWA COMMAND (IRRIGATION USE)



AF2

WATER LEVEL FLUCTUATION (Well – 16A)

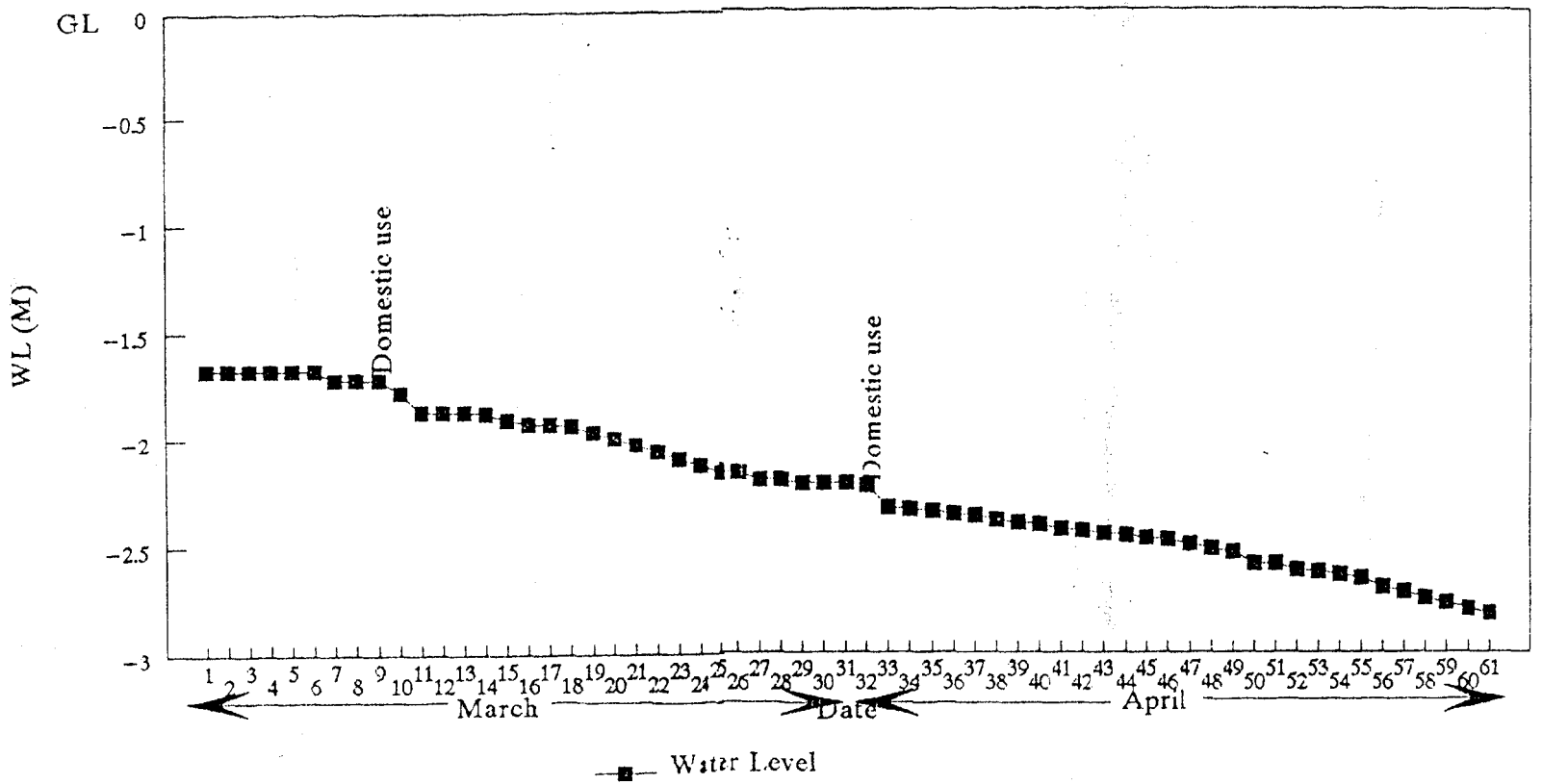
HURULUWEWA HIGHLAND (IRRIGATION USE)



AF3

WATER LEVEL FLUCTUATION (Well – 17B)

HURULUWEWA HIGHLAND (DOMESTIC USE)



Annex 2

SELECTED INTERVENTIONS OF SCOR PROJECT

1. INTRODUCTION

SCOR activities are facilitated by IIMI through a multidisciplinary team of professionals placed in the watershed. The team facilitates a participatory process for planning and implementation of specific project activities by the resources users, relevant state agencies and NGOs in the selected geographic areas within the sub watersheds. It is under the direction of Water Resources Management Team (WRMT) established at field level and the Provincial Steering Committee (PSC) at provincial level. SCOR follows a learning process approach in the planning and implementation of the project.

2. HURULUWEWA WATERSHED

2.1 Watershed area

For purpose of SCOR, Huruluwewa watershed is defined as the area covered by the catchment of Huruluwewa tank up to Habarana wewa, water-spread area of Huruluwewa reservoir, and the area between Huruluwewa dam to the point of confluence of Adappan Oya with Yan Oya. The latter area includes the command area under Huruluwewa reservoir, highlands, and drainage area. The watershed consists of Yan Oya and Huruluwewa irrigation system and, a large number of minor tanks. It is actually the upper part of Yan Oya watershed. It falls within the Divisional Secretariat areas of Galenbindunuwewa, Palugaswewa, Kekirawa and Horowpatana. The total area covered is about 47,700 ha.

The important present land uses are shifting cultivation (chena), irrigated agriculture, forests, homestead and degraded areas. The main problems are lack of water in the Yala and weak management in Maha (dry & wet seasons, respectively), degradation of the resource base and unorganized resource users.

2.2 Geographical areas of work

A few tank cascade systems and sub-watersheds within the main Huruluwewa watershed have been identified for intervention in the initial two years. These specific areas have been initially selected jointly by the SCOR team and Land Use Policy Planning Division (LUPPD) of the Ministry of Lands, on the basis of scientific studies undertaken by them in the watersheds. The main geographic areas identified for the implementation of SCOR activities in Huruluwewa are listed below:

1. Meegaswewa subwatershed
2. Mahadivulwewa subwatershed
3. Kiulekadawewa subwatershed
4. Drainage area of Huruluwewa irrigation system from Nikawewa upto Ilukwewa anicut.
5. Huruluwewa command area
6. Tract 6 area of Huruluwewa including homesteads.

In addition to the above six areas, the Mahaweli feeder canal from Lenadora to Habaranawewa has been included as a special area of intervention by the SCOR.

It should be noted that some interventions such as integrated planning and coordination will not be confined to any geographic area, but will spread over the entire watershed and the province.

2.3. Themes for interventions

During the planning workshops held in October, 1993 at which the SCOR team and other relevant officers participated, eight main themes and intervention areas were identified. Those were subsequently refined on the basis of field reconnaissance and discussions with field level agency officials, community based organizations, NGOs and individual users. The final themes culminated at the above efforts are listed below.

a. Stabilization of chena and encroached state lands.
b. Regeneration of tank eco-systems.
c. Integrated water management in Huruluwewa watershed.
d. Sharing resources for improving homesteads.
e. Ground water development and management.
f. Land consolidation in minor tanks.
g. Organizing user groups/user organizations/sub-user councils for production, protection and related services.
h. Integrated planning and coordination.

2.4 Rationale for selection of themes

a. Stabilization of chena and encroached state lands:

In the Huruluwewa watershed, chena cultivation on both government and private lands is very high. Several hundreds of encroached areas are being turned over to the people under various programmes.

Forest lands in the watershed have already been degraded to an alarming level. The process of destruction of forest land will probably continue. Because of the rapid rate of degradation of forests, drying up of water courses, dwindling of wildlife habitats and several other problems have already cropped up. The necessity to protect the existing forests and to increase reforestation of badly degraded lands have been stressed in several government policy documents.

b. Regeneration of tank eco-systems

The eco-systems of all the minor tanks and the Huruluwewa reservoir have been degraded badly over time. It is generally accepted that the destruction of tank eco-systems contributes substantially to the siltation of tanks and development of alkalinity, and affects the tank inflows. Its restoration is vital both from production and protection perspectives.

c. Integrated water management in Huruluwewa watershed

Huruluwewa is a water deficit area. Huruluwewa tank is supplemented by the diversions from Mahaweli system via Huruluwewa feeder canal, and its command by a number of minor tanks. A number of Agro-wells too have been constructed in the watershed. Thus, shallow ground water is now available to augment the surface water sources.

However, a high degree of illicit water tapping is reported along the feeder canal from Mahaweli system to Huruluwewa tank. The efficiency of water use along the cascade of minor tanks en-route of Mahaweli water to Huruluwewa tank too is reported to be low. The augmentation of Huruluwewa system by the minor tanks situated in the periphery of the command too takes place without much planning and coordination. Drainage return flows from Huruluwewa irrigation system are tapped by the local people for cash crop production by lift irrigation. Utilization of ground water through agro-wells is carried out by farmers on individual basis. On the whole, there is no proper coordination between Mahaweli authorities, Agrarian Services Department, Provincial Irrigation Department, and the Irrigation department and individual users for the management of water for its optimum use. There is proven potential to improve the water use and management with the participation of the relevant agency officials and the users on a collective basis.

d. Sharing resources for improving homesteads

The capacity of the homesteads in generating food and employment has not been utilized satisfactorily. The homesteads should become the focus of integrated crop and livestock husbandry to facilitate continued income generation, food supply and employment. There has not been any programme focused on this important component of the farming system within this watershed.

e. Ground water development and management

A large number of agro-wells have been constructed in Huruluwewa watershed over the past few years by the government and individuals for irrigated agriculture. However, the ground water development through agro-well construction has been done without carrying out proper scientific studies. As a result, no accepted norms and regulations have been adopted for the construction of agro-wells.

While accepting the fact that the ground water can be effectively used for crop production and to supplement surface water in Huruluwewa command, the haphazard development and use of ground water will be detrimental to the long term sustainability of irrigated agriculture as well as to the environment. Signs of deteriorating water quality, falling water tables, and declining water yields from existing wells are beginning to appear. Thus, a study focusing on the proper development and management of ground water is very timely.

f. Land consolidation in minor tanks.

Consolidation of small and fragmented lands particularly under the minor irrigation systems is an important determinant of productivity in the dry zone. A few pilot interventions done in Sri Lanka provides evidence that consolidation of fragmented land holdings scattered over an irrigation

command area of a minor tank, which are owned by a large number of farmers is practically possible with the willingness and participation of the land owners. In the present setting, land consolidation is crucial in improving efficiency of water use, productivity and total production.

g. Organize groups for production, protection, marketing and related services:

Increased production and improved protection require effective organizational mechanisms for sustainability. The lessons and experience in Sri Lanka and elsewhere adequately justify the need for organizing groups and linking the groups through proper coordinating arrangements such as organizations, committees and councils. Evidence from several pilot programmes conducted in the dry zone clearly shows that the basis for efficient use of resources has to come from organized groups. There is also high scope for providing services required for production and protection through organized groups.

Strengthening the existing user groups and formation of new user groups, organizations and user councils will enhance the production, productivity, incomes, equity and sustainability of production and related markets and services. Organization of groups is therefore the key to success in production, protection, marketing and other services in the watershed.

h. Integrated planning and coordination

It is noted that land and water resources management projects and activities are implemented by NGOs, CBOs and state agencies in the watershed. Planning of these interventions are done on an ad-hoc assessment of the resources base and resources potential, and analysis of production constraints. The role of resources users in planning is minimal. Also, specific projects and activities are implemented in isolation by various agencies and NGOs in their respective fields of specialization with little focus on the key problems affecting production, productivity and protection. More often the interventions and activities of projects come to a complete halt once the projects are withdrawn.

Much potential exists to strengthen integrated planning and coordination within the Divisional Secretary's division and the Province. SCOR can facilitate the development of data and information base, monitoring and evaluation systems and training of officials, NGOs and resource users on constraint analysis, rapid appraisal of problems and situations, self monitoring and evaluation of programmes etc. At the end, it is required to transform from the present 'project' mode to 'programme' *in conceptualizing, planning, implementing, coordinating and evaluating specific development* interventions in the watershed by line agencies, NGOs and resources users.

3. UPPER NILWALA WATERSHED

3.1 Watershed area

The entire Nilwala watershed covers a total area of 146,280 ha. It comprises of the upper Nilwala watershed selected for initial interventions by SCOR, and the lower watershed, including the area falling under the Nilwala Ganga Flood Protection and Drainage Scheme (NFPDS). SCOR will not have

any interventions in the lower watershed, including the area covered by the NFPDS during the first phase. The area selected within the upper watersheds for SCOR interventions falls within the Divisional secretaries divisions of Kotapola, Pasgoda, Neluwa and Pitabeddra. However, SCOR activities during the first phase will be mainly within the first three DS divisions.

The main land and land use types within the upper watershed are protected forest, other state forests, highlands and homesteads covered with tea, paddy, rubber, coconut, kithul and fruit trees. Tea is the dominant agricultural crop. A significant area of the watershed is degraded.

3.2 Geographical area of work

A few sub watersheds were initially selected jointly by the SCOR team and the Land Use Policy Planning Division (LUPPD) of the Ministry of Lands, on the basis of topography, ecology, land use, land tenure, production and marketing constraints, and the present status of environmental degradation, homesteads and resources users. A rapid appraisal of these sub watersheds was done by the SCOR team with the LUPPD team through field visits during the planning workshop. As a result, the following four sub watersheds have been selected for SCOR interventions and activities during the first phase.

1. Aninkanda
2. Diyadawa-Tenipita (Deniyaya)
3. Millewa
4. Horagala.

In addition, the interventions in relation to integrated planning and coordination will not be confined to the above geographic areas, but will spread over the entire watershed and the province.

3.3 Themes for SCOR interventions

Five themes have been identified by the SCOR team for Upper Nilwala watershed on the basis of the consensus arrived at the planning workshop and through subsequent field reconnaissance and discussions with field level agency officials, community based organizations (CBOs), NGOs and individual resource users. The themes embrace the five basic SCOR concepts identified as production, protection, shared control, watershed approach and focus on poverty. They are stated below.

i. Sharing management of land and water resources.
II. Sharing resources for improving homesteads.
III Improving tea/paddy culture.
IV. Organizing groups for production, protection and related services.
v. Integrated planning and coordination.

3.4 Rationale for selection of themes

i. Sharing management of land and water resources:

Distortion of river flows, as evident from increased flood peaks and reduced base flow distribution accompanied with severe erosion and loss of fertile soils, have become characteristic phenomena in river Nilwala and other streams over few decades. There is consensus among the government officials, NGOs and the users of land and water resources that haphazard exploitation and use of lands including reserved forests, other state forests, large tea plantations and tea smallholdings, homesteads, river banks, stream and road reservations is largely responsible for this situation. It is noted that encroachment of state lands in forests, river banks, stream/ road reservations for growing tea is common in the upper watershed. The remaining natural tropical forests too are subject to the threat of encroaching by people for the cultivation of tea. The gravity of the situation is evident from the fact that about 1500 acres of Diyadawa forest reserve had been encroached recently. The ignorance of farmers for the adoption of appropriate soil and moisture conservation in cultivated areas, particularly in encroached and private tea smallholdings, has aggravated the threat to land and water resources base.

In the past, the government agencies and NGOs implemented a number of reforestation and afforestation projects to combat the threat to resource base. In addition, they enforced law and order against encroachers of state lands and destructors of forests through the governmental regulatory mechanisms. These efforts may not sustain because of lack of collective concern of the community and participation and support from the local people for those efforts. Also, production-oriented, income generating protection and conservation strategies that provide incentives for encroachers and farmers have been notably absent in those efforts. As a result, it is noted that the degree of encroachment, forest destruction, soil erosion, loss of fertility and drying of water courses continue to take place at an alarming level.

On the hand, there are complexities in tenure arrangements with regard to encroached lands. Some encroached lands have been given to the people, while others not. The formalities including land survey work in respect of some lands have not yet been finalized. The protection and conservation of lands alienated to people remain to be a serious problem.

Time is, therefore, opportune to adopt an innovative approach to motivate and mobilize local people to protect the lands in upper watershed. The participation of the local people has to be obtained on collective basis, while the conservation efforts have to be rewarded through the introduction of conservation techniques and strategies that will generate financial gains and new land use and tenure arrangements that will guarantee the access and acquisition of the benefits of conservation by the people.

ii. Sharing resources for improving homesteads:

Homestead is a key mosaic of the upper watershed. Tea plants have replaced many traditional food crops in homesteads, particularly after the increased price for tea in early 1980s. Thus, tea plantation constitute a greater part of homesteads as well as the upper watershed. Although, it is true that the people derive satisfactory incomes from homesteads, further economic benefits can be obtained by

harnessing the full production potential of the homesteads. This production base can be intensified through the introduction of fruit crops, livestock husbandry, and other avenues such as apiculture, floriculture growing, horticultural plants and medicinal herbs, which will bring additional financial benefits to the smallholder. However, in the past, no programmes have focused on integrated homestead development. SCOR could act the catalysing and facilitating role to the NGOs, private sector and the relevant line agencies to: promote new production and related value-adding opportunities in the homesteads; organize activity based user groups and organizations; and establish markets and other service links for primary and value-added products.

iii. Improve Tea-paddy culture:

The cross-section of the watershed can be typically characterized as tea-paddy culture, which is analogous to typical paddy-chena culture in the dry zone. Typically, many tea smallholder do not adopt proper agronomic practices and soil and moisture conservation measures. It is also noted that a prolonged period of dryness prevails during early months of the year, resulting in yield reduction of tea and substantial plant causalities due to soil-moisture stress. There is potential for minimizing yield reductions and losses by introducing proper agronomic practices and soil and moisture conservation measures to tea small holdings. SCOR can play a key role in facilitating this task. Testing the technical feasibility and economics of supplementary irrigation of tea is another possible area of intervention.

Status of both irrigated and rain-fed paddy cultivation is not very satisfactory. The best use of paddy lands and available water is greatly hindered by fragmentation of paddy allotments, poor condition of irrigation facilities due to neglected maintenance, and low preference to paddy cultivation by farmers due to high economic returns from tea growing. SCOR can intervene in motivating and mobilizing farmers through organized groups to rehabilitate and maintain irrigation facilities by sharing capital investments.

iv. Organizing groups for production, protection and related services.

Same as sub-section (g) of section 2 above.

v. Integrated Planning and Co-ordination.

Same as sub-section (h) above.