INFORMATION TECHNOLOGY FOR POLICY ANALYSIS AND CHANGE IN SUSTAINABLE INTEGRATED WATERSHED RESOURCES MANAGEMENT

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Gamini P. Batuwitage

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Paper presented at the Training Course on The Use of Information Technology for Sustainable Development organized by the Asian and Pacific Development Center, Kuala Lumpur, Malaysia, on 16.08.1994.

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Modelling processes for watershed resources management is a complex task. This task has become a challanging one in view of the need to strike a balance between production and protection, integrating economic and ecological perspectives for sustainable productivity of resources. The use of information technology (IT) is complementary to this process since the interaction of both human and physical resources are involved. This paper draws attention to several issues encountered by the planners in watershed resources management under the Shared Control of Natural Resources project (SCOR)[1] in Sri Lanka in influencing policy changes. The paper highlights the supportive role of the IT, in a developing country context.

Figure 1 indicates the major factors considered in the analysis of poverty in the economic perspective. Poverty is a condition and manifestation of resource degradation. So long as resources remain outside of the market domain, they do not reflect the true value of scarcity resulting in the overuse and/or under use i.e. mismanagement (Panayatou 1992) leading to degradation and poverty. Figure 2 presents the cause to this status in the economic perspective as the absence of ownership of the resources. Figure 3 offers the policy advocacy as Panayatou (1992)[2] advanced in which secured, exclusive and enforceable property rights could bring resources into the market domain so that market forces could ensure, through price mechanism, the sustainable productivity of resources.

While recognizing the validity of the market logic of this policy advocacy, SCOR project interprets it in the Sri Lankan context in which the appropriate policy is to ensure a sense of ownership through shared control among resources users and state. Figure 4 shows how shared control motivate users to value the resources with the sense of ownership that would lead to undertake practices making better use of them resulting in high returns from the resources while protecting the resource base.

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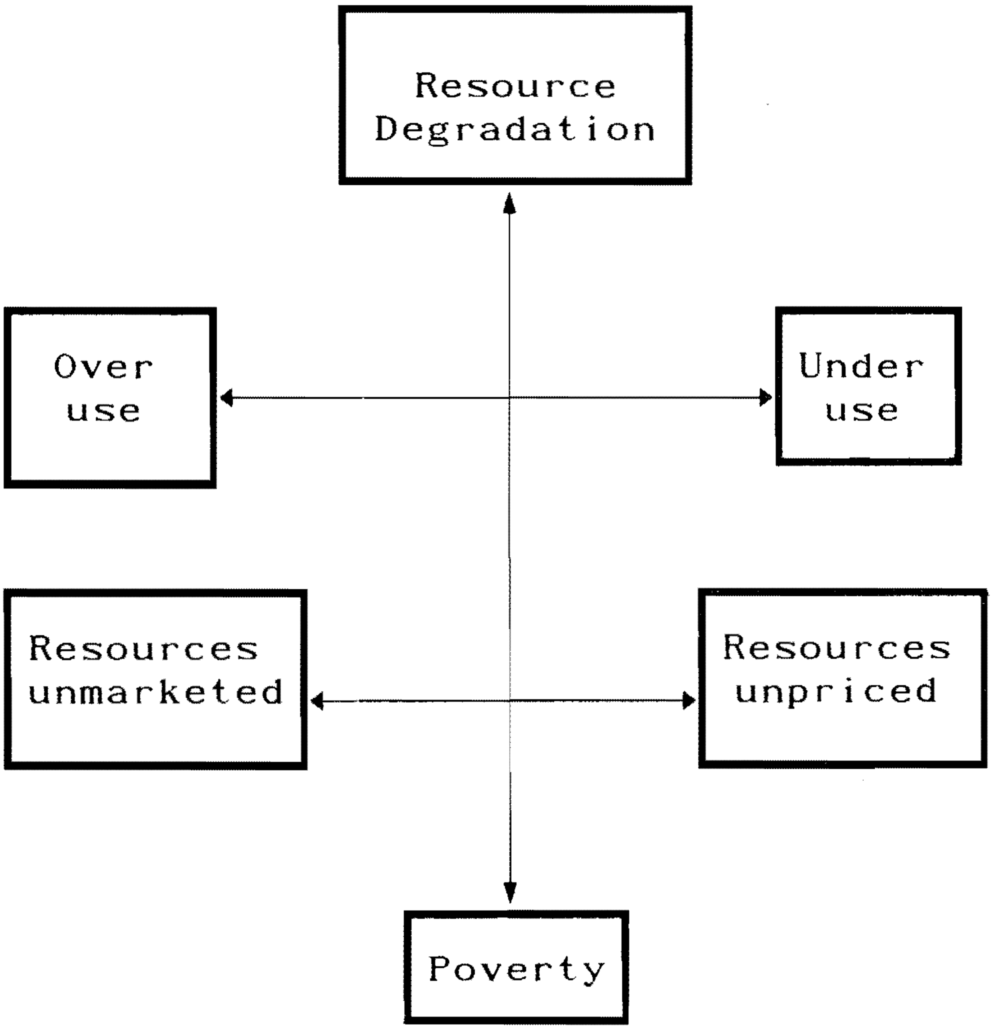
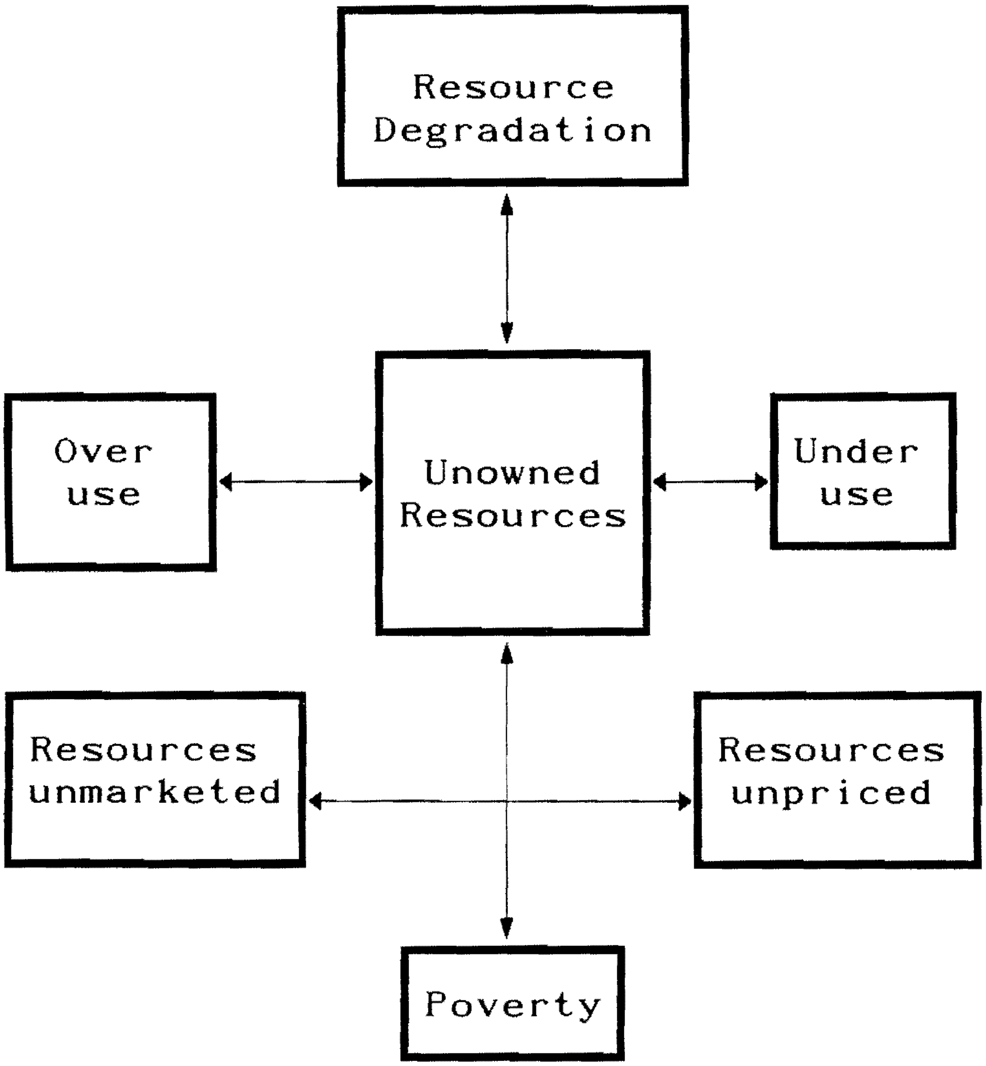
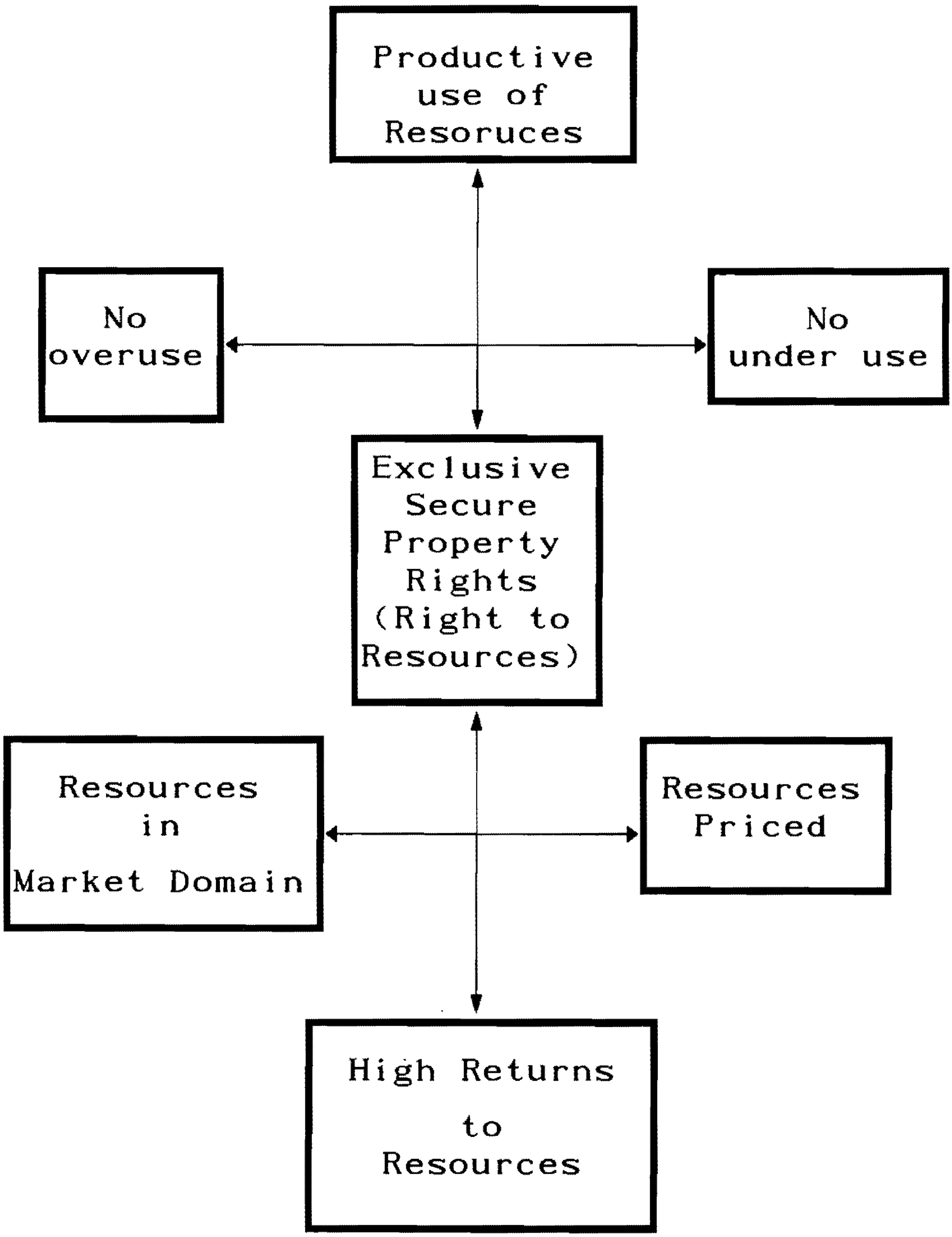
NEXUS OF RELATIONS
RESOURCES DEGRADATION AND POVERTY



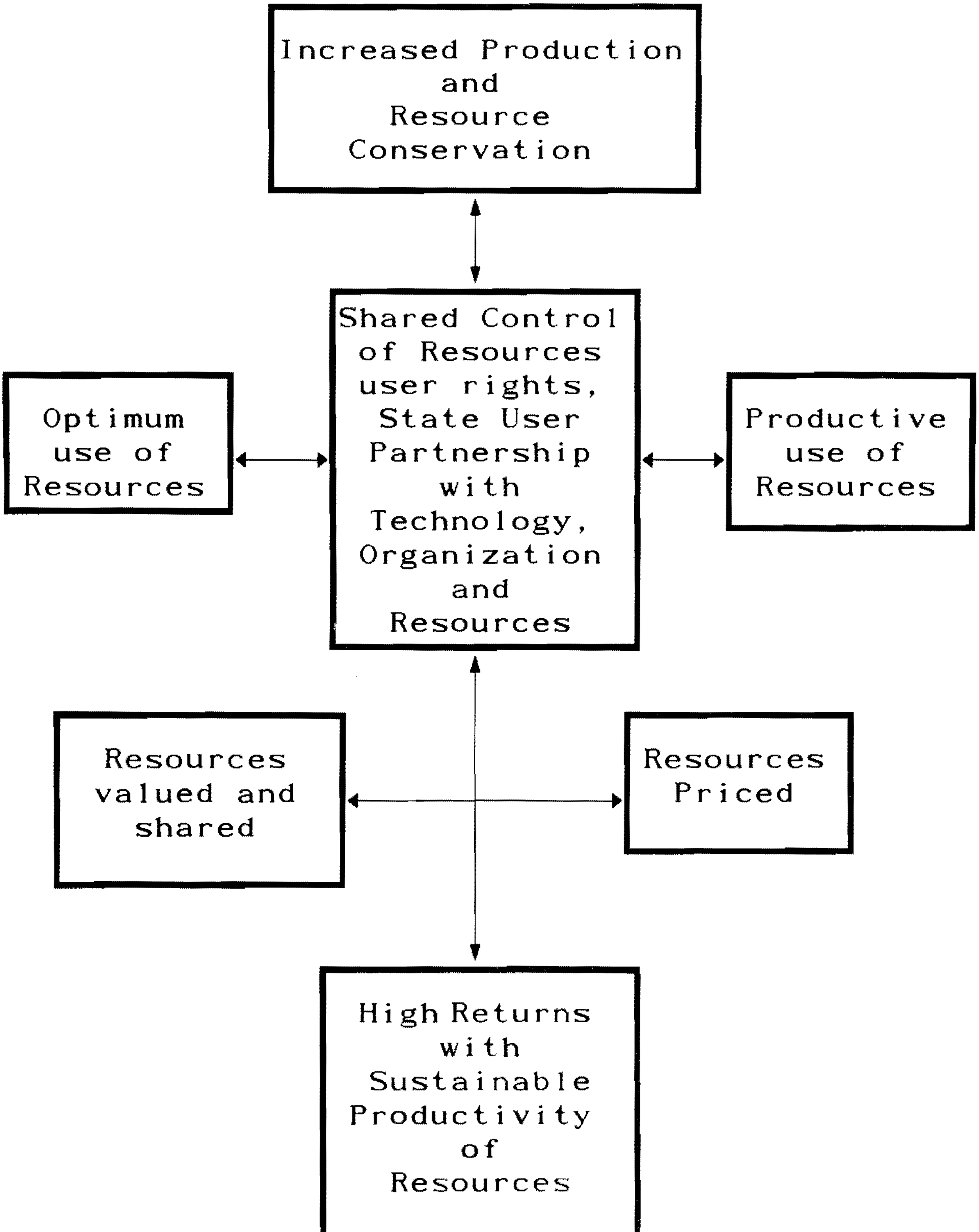
EXPLANATION I



POLICY/PROCEDURAL CHANGE 1



POLICY/PROCEDURAL CHANGE 2



This interpretation is very important in the Sri Lankan context where nearly 80% of the land resource is under state control under different forms of permits and leases. The public policy of the successive governments since independence was to prevent the transfer of ownership of the lands from the poor to other better off groups by preventing the sale of lands alienated to the landless. In a developing country like Sri Lanka where imperfect markets prevail with less factor mobility, it was not possible to make the bold decision of exposing the poor to market forces which, through price mechanism, respond not for the need but for the demand backed by purchasing power, the consequences of which are widely known.

SCOR experienced the fact that in changing policy, action is needed first so that policy follows action internalizing and formalizing the proven mechanisms as policy. "Policy first action next" is not the reality especially in regard to changing land and water resource use. Unless models are demonstrated with acceptable results, it would be difficult to influence changing the public policy that has been in place for a long time, or enacting new policy that would be seen radical.

An illustrative example can be cited from the experience of SCOR project. The catchments of reservoirs and stream reservations held by the state have been encroached by people for short term uses. SCOR observed that wherever the state has issued permits for such reserved lands, they are in many cases only annual permits. The user has no motivation to plant trees or take protective measures such as conservation bunds so long as he/she has no sense of ownership to his/her capital investment, fruits of which come in the long run. This makes the user to engage in activities such as short term annual cropping which turns and disturbs the soil on such strips of lands quite often which should not be the desirable practice of land use on such vulnerable degraded lands.

Since the current public policy implies that protection of the reserved lands is the responsibility of the state, state action is limited to issue a short term permit not allowing any permanent structures to come, retaining the ownership of such lands with the state. This policy neither responds to the need for preventing the environmental consequences that are already visible due to the degradation of such lands nor it does promote a productive use from such lands.

Although the suggested policy change to issue usufructuary rights to such land users is attractive, it has become necessary to demonstrate such land use changes where production and protection are combined assuming the use right of the fruits of the user's investment is secured. This has become a prerequisite in formulating new policy responding to other consequences that are not foreseen.

SCOR project has taken this challenge and now in action with the resources users, the state agencies, NGOs and private sector investors in effecting change in the current practice of resources use.

In this effort, SCOR is guided by the logical framework presented in figure 5 based on the following constraints assumed.[4]

(1) The lack of a production environment that permits the resource user to effectively manage the combination of resources essential to maximize economic production.

(2) The lack of an effective combination of education, incentives and mechanisms to enforce penalties that induce and internalization of environmental considerations into management decisions.

(3) The lack of adequate information about the land and water resources at appropriate levels

(4) Institutional constraints including inadequate co-ordination among projects/activities of land and water resources development.

The project sets the following objectives having shared control as the purpose.

1. To ensure productivity and sustainability of land and water resources through,
   (a) improved incentives and institutional arrangement;
   (b) appropriate production and protection technologies;
   (c) state-user partnerships.

2. To get resources user groups and officials to:
   (a) consider environmental implications of land and water resources;
   (b) internalize environmental implications in decision making and implementation,

SCOR PROJECT - LOGFRAME

Figure 5

AL

Increase the sustainable productivity of land and water Resources "PRODUCTION AND PROTECTION"

other factors

UB
OAL"

Land and water users adopt more sustainable and productive practices

other factors

RPOSE

Increase Shared Control of Land and Water Resources

CTIVITY
REAS

* Strengthen user group capabilities
* Improve Resource Tenure Arrangements
* Strengthen government, NGOs and private sector capacities
* Improve Co-ordination and Linkage - "Projects to Program"

3. To enhance government, user groups, and users, understanding on potentials of resources base for production and protection.

4. To strengthen the capacity of the government authorities (national,provincial, and divisional) in planning for resources use in an integrated manner, gradually transforming the strategy of development of water resources from "project" to Programme mode.

Figure 6 presents the organization of SCOR through which translation of SCOR concepts into practice is effected. It has the resources user groups in the main focus with their vertical integration to better interact with the state administrative system represented by a large number of state agencies and personnel with various mechanisms to ensure coordination and collaboration.

A continuous flow of information is required to enrich this participatory process facilitating interaction, debate and resolution. The prudent use of information technology in the generation, process and analysis of the volumes of information that are needed in this exercise is crucial to support the planning, implementation and evaluation process. The following section highlights the process and the use of IT in the SCOR project.

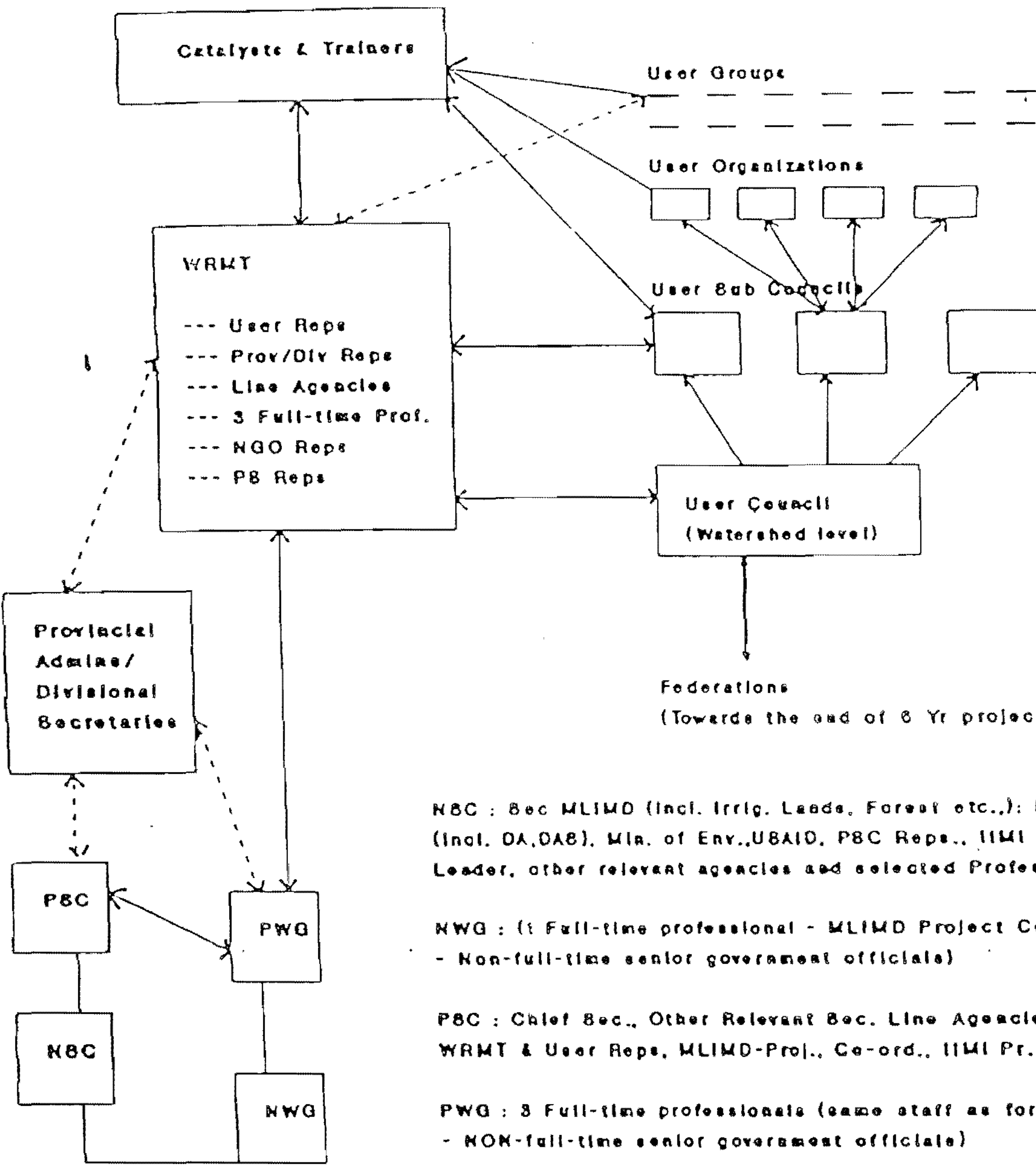
SCOR operates in two pilot watersheds one in the dry zone (annual average precipitation 1200 - 1900 mm) and the other in the wet zone (annual average precipitation 2000 -4000 mm) (See map 1). The strategy adopted by SCOR has the following steps.

1) Observe and assess the interaction between the human resources and the physical resource base especially land and water resources in the location of interest with the resources users.

2) Map the typical landscape indicative of the typical land cover and land use types and particular functions of the geographic space within the sub system in the watershed.

3) Articulate a vision for a possible future with the available information gathered from the resources users, and from the knowledge so far generated.

SCOR Project Organizational Structure



NSC : Sec MLIMD (Incl. Irrig. Lands, Forest etc.,): MADR (Incl. DA,DAS), Min. of Env.,USAID, PSC Reps., IIMI Pr. Leader, other relevant agencies and selected Professionals

NWG : (1 Full-time professional - MLIMD Project Co-ord.
- Non-full-time senior government officials)

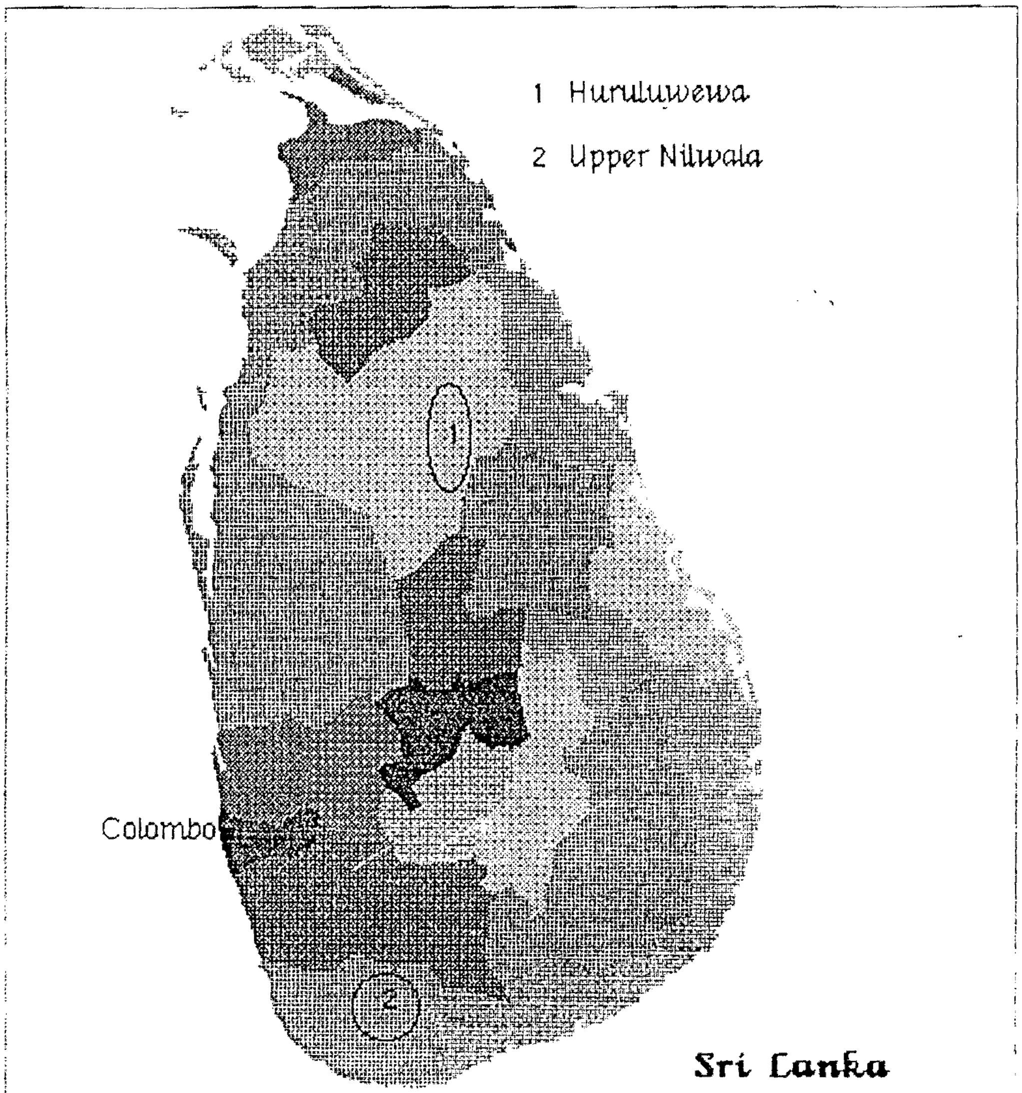
PSC : Chief Sec., Other Relevant Sec. Line Agencies, WRMT & User Reps, MLIMD-Proj., Co-ord., IIMI Pr. Leaders

PWG : 3 Full-time professionals (same staff as for WRMT
- NON-full-time senior government officials)

Legend :

WRMT - Watershed Resources Management Team
PSC - Provincial Steering Committee
PWG - Provincial Working Group
NSC - National Steering Committee
NWG - National Working Group
PROV - Provincial
REPS - Representation
PS - Private Sector

LOCATIONS OF PILOT WATERSHEDS - SCOR PROJECT



4) Undertake constraint analysis with the resource users on the gap between the current and the envisioned landscape and resource use.

5) Identify opportunities for bringing about the desired change.

6) Articulate a set of interventions and the required collaboration needed.

7) Map out practices that would indicate the required technology, organization and resources(TOR).

8) Facilitate the provision of the required TOR.

9) Monitor the process and action and evaluate.

10) Formulate required policy/procedural change.

11) Effect\internalize policy/procedural change.

Information needed for the tasks under 4,5 and 6 above, are substantial. Figure 7 lists the basic data requirements to gain knowledge on the watershed. Figure 8 and 9 shows the typical landscape and the perceived future vision indicating the types of data needs and the technological possibilities. The following are the issues confronted by the planners in collecting the required data.

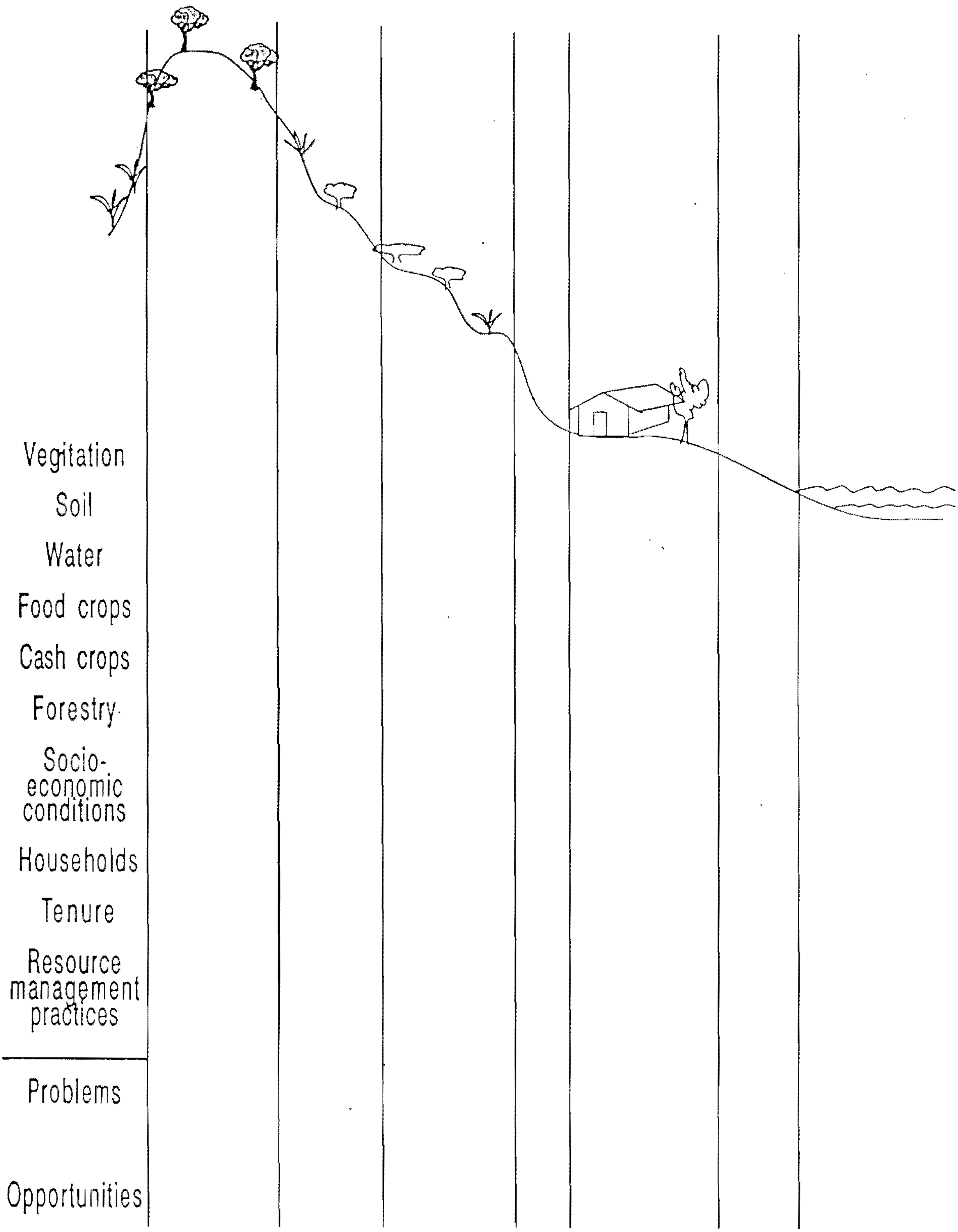
1. Land use/land cover data not available timely in order to undertake a detailed resource analysis. The land use data available in map form had been compiled 8 years ago.

2. Land use data are not available in a sufficient scale. Maps of 1:50,000 or 1:10,000 are not detailed enough to capture certain types of information. Plot level information were not available at all.

2. Computerizing available data takes time and difficult to match the time requirements of data needs for initial planning. Digitizing complex contour maps involves a lot of time

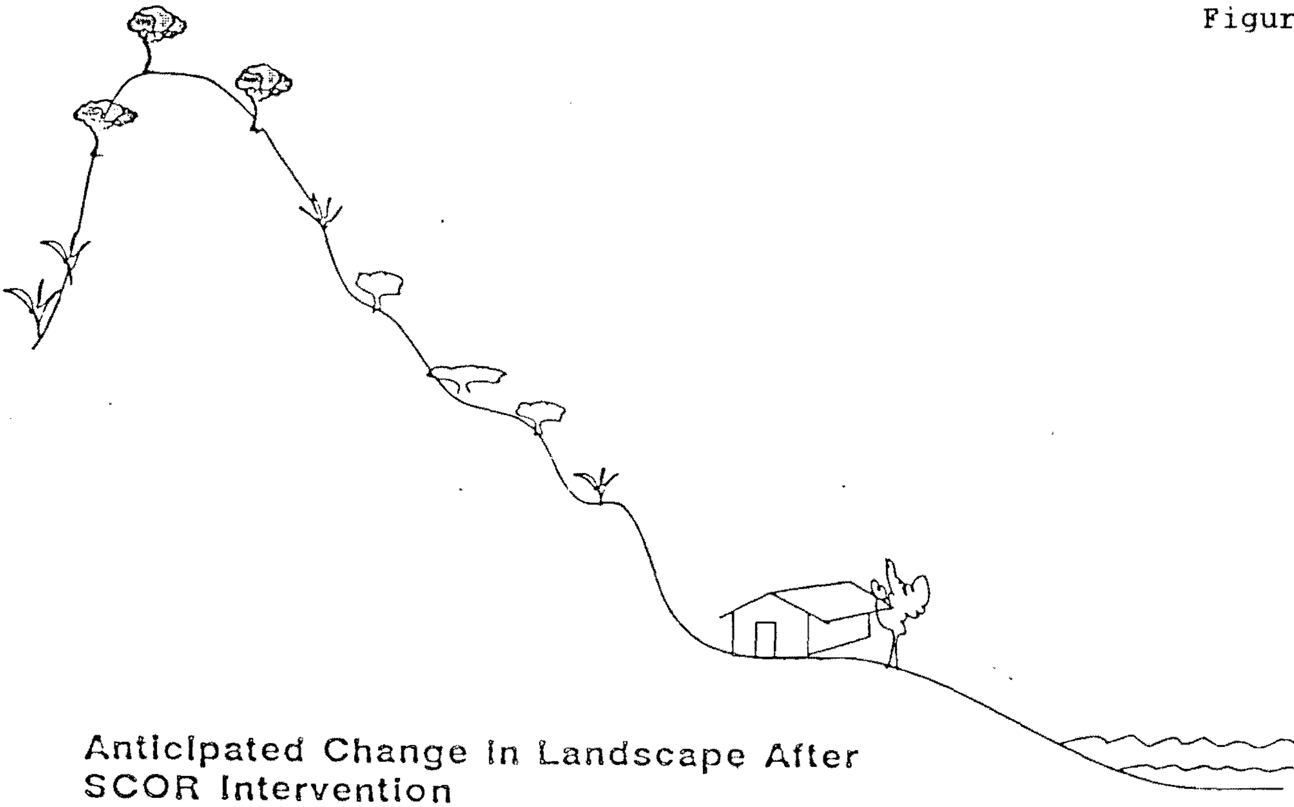
Data gathering for Model Sub-watershed

Figure 7



A Typical Landscape Profile Calling for Intervention In Upper Nilwala Watershed

Figure 8



Anticipated Change in Landscape After SCOR Intervention

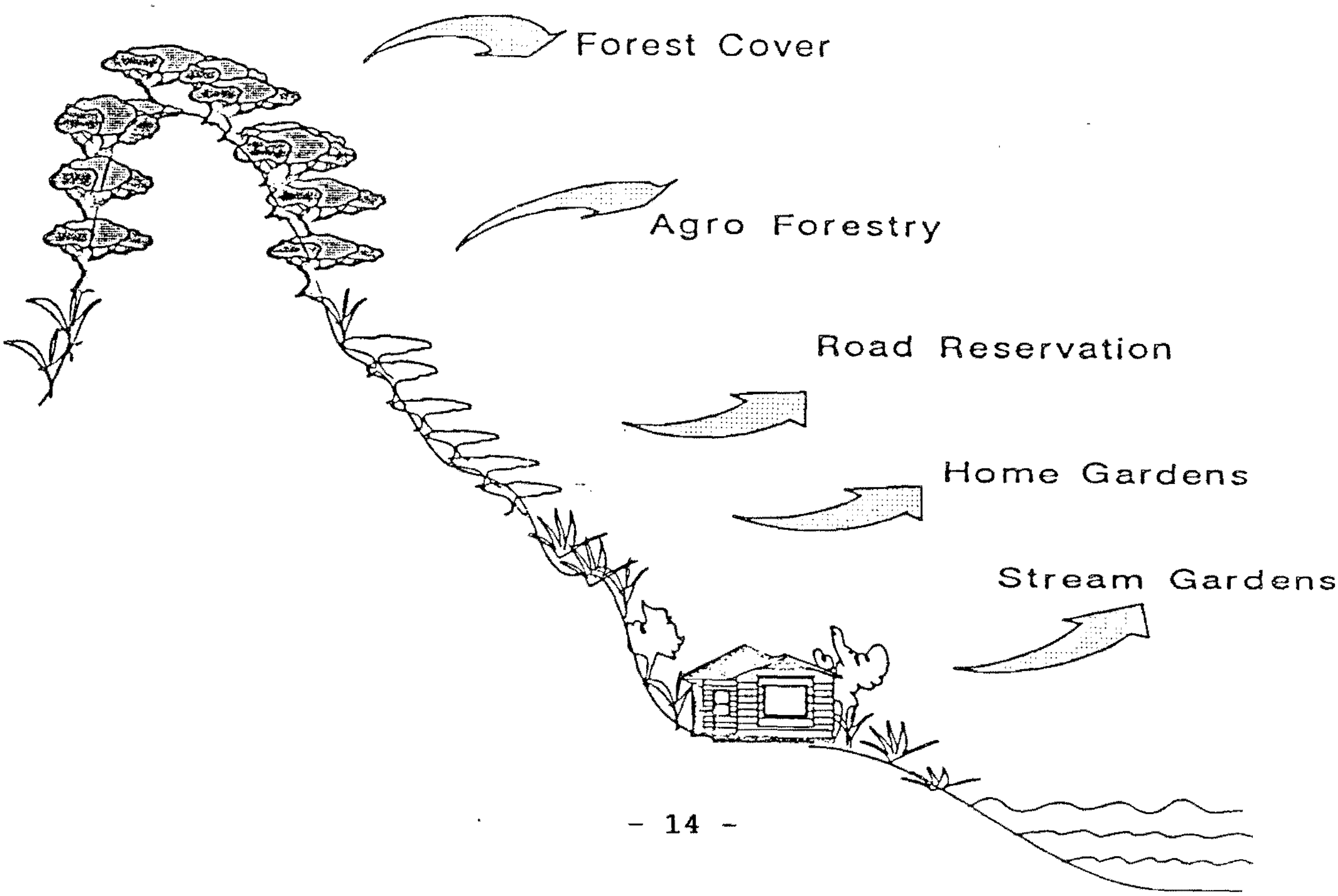
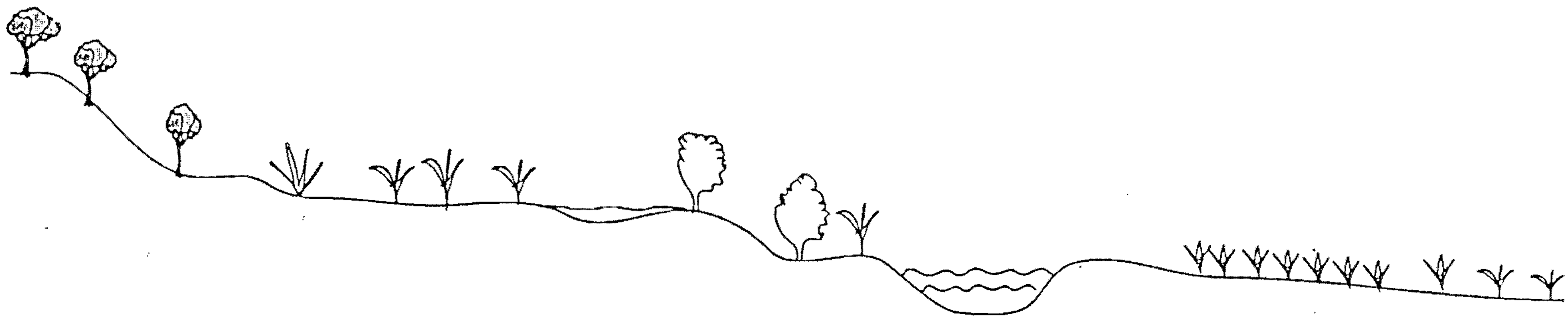
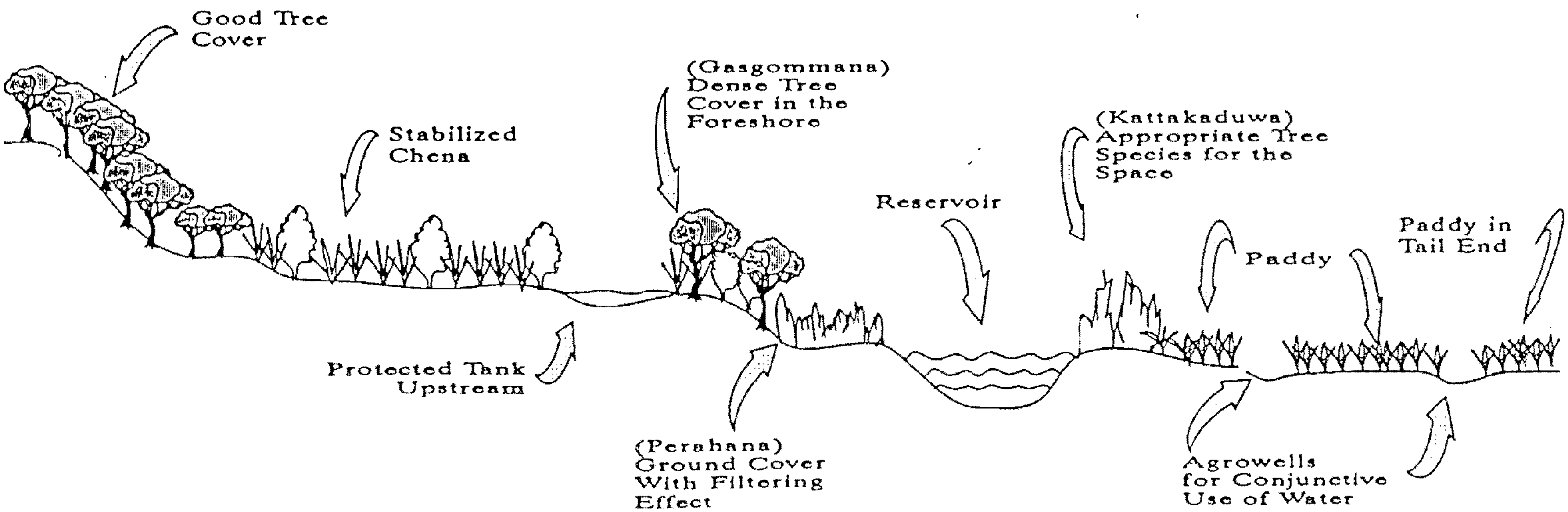


Figure 9

Typical Landscape Profile - Huruluwewa Watershed



SCOR Perception of a Possible Future



unless adequate capacity of output is not built in to the project.

3. The use of satellite data is expensive and the needed remote sensing skills are not readily available. The technology for GIS is also not widely available so far in Sri Lanka.

4. The use of area sampling techniques, timely measurement of baseline conditions, and mobilising capacity that would represent personnel, equipment and information systems for such baseline data collection involves timely decisions on the scale of evaluation studies and research in advance. The designing of systems for such involvements depends on the resource availability and the commitment for future in respect of investments.

5. Managing information systems while being engaged in a process of catalizing and interventions in a participatory mode make heavy demand on staff time.

SCOR adopted mechanisms to deal with the above issues in a more pragmatic way. The following actions are worth mentioning.

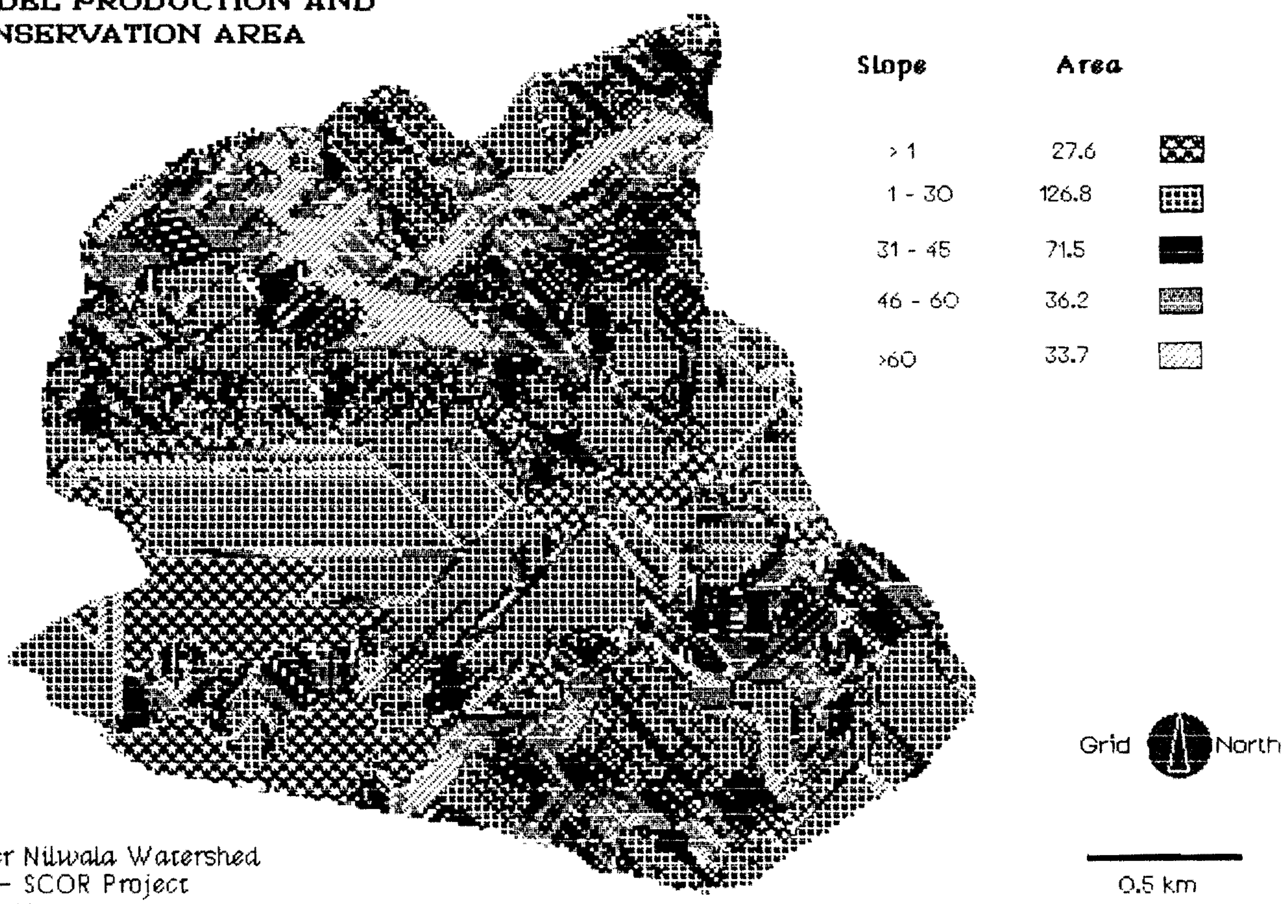
1. Involve local officials of the relevant agencies and the resources users in participatory resources use survey and mapping. This was a valuable exercise due to the involvement of the relevant functionaries who need the data and who can own the data for analysis. Such an approach brings the necessary conditions to focus that could influence planning. Land use, tenure, cultivation practices and other relevant socio-economic and resource use data were gathered on both sides of an irrigation channel 24 miles long, just in 5 days by groups of officials and resources users in one of the watersheds.

2. The data were computerized using PC-ArcInfo and IDRISI GIS. 1:10,000 scale maps were blown to the scale of 1:5000 in computer and made available to those who were involved in the survey work to undertake plot level mapping maintaining accuracy.

3. IDRISI GIS was used to undertake overlay operations to examine critical features for site selection for interventions within the already identified sub-watersheds. The elevation data were used to create digital elevation models and to create slope maps (see map 2).

**ANNINKANDA
MODEL PRODUCTION AND
CONSERVATION AREA**

SLOPE



Upper Nilwala Watershed
IIMI - SCOR Project
July 1994

IDRISI

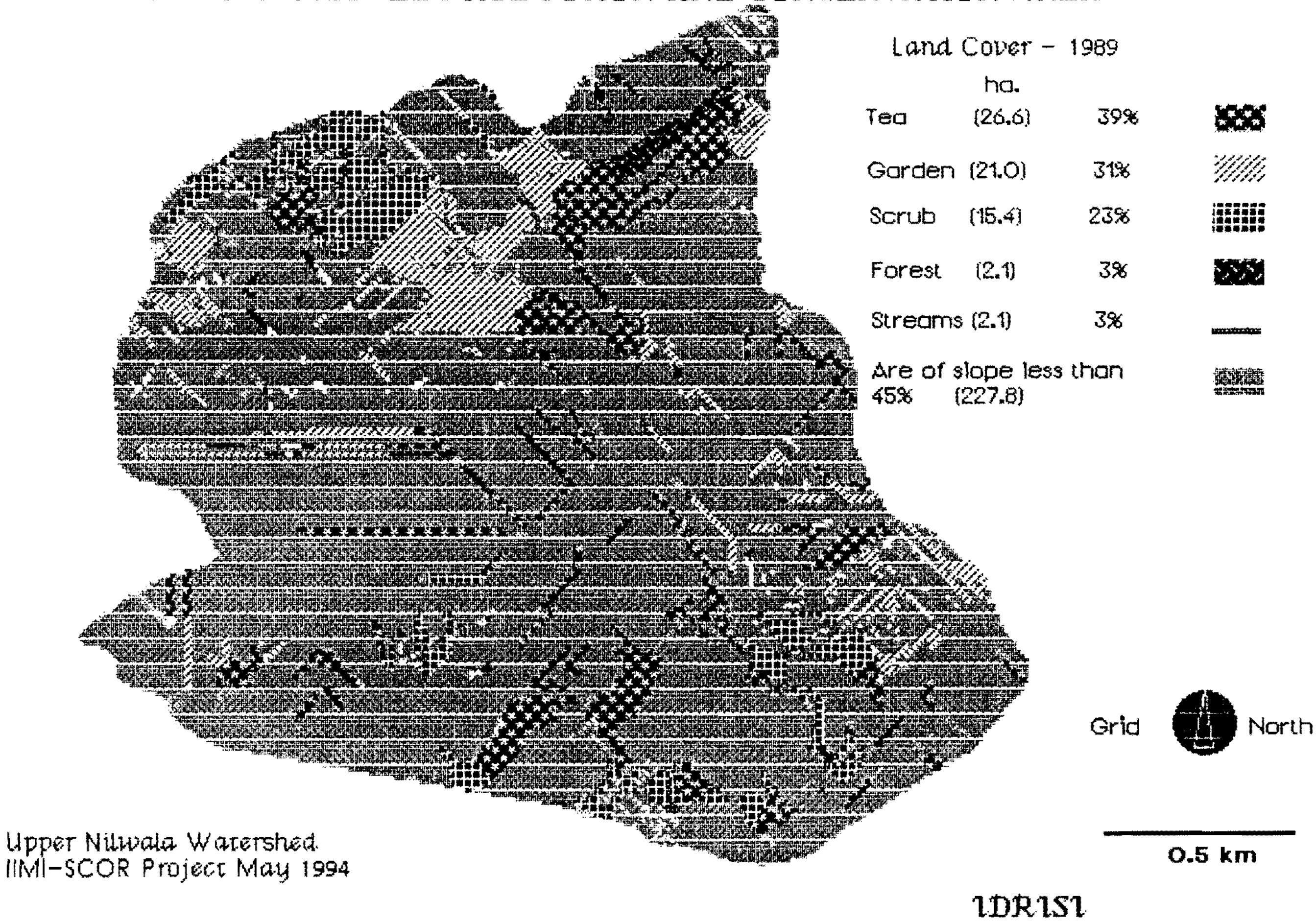
Land cover images were superimposed on the terrain images (map 3). It was possible to view the form in which land and water resources are available with terrain and drainage in focus in a three dimensional view. Such a view helps understanding of the particular functions of the land in various locations and facilitated the articulation of a possible future vision for the area (map 4) It also helps understanding of the spatial aspects of the interventions correctly interpreting resources and their functions.

4. The participatory resources use survey and map data were computerized and used with elevation data so that detailed plot level information could be made available. Map 5 shows plots on slopes showing which plots exist on the more stressed areas. The map is linked to a data base that carries all the collected information in respect of each plot. This facilitates detailed planning with the resources users whose investment behaviour will have to be changed if there should be a change in the land use. The ability to mass produce such information and timely availability would be a requirement that could complement such resource management effort in a participatory mode.

5. A computerized database for a village where a mini-project has been designed that covers the entire village helps managing the external resources to be mobilized for the project. Map 6 shows such a map linked to a database that carries production and socio-economic data in respect of all the land holdings. Database management has become an essential function and contribution by the facilitators for forecasting to help the farmer organization to manage the business venture developed by this project.

6. An operations study carried out on the main reservoir of the Dry Zone watershed generated information helping the working out of different crop combinations under different scenarios to provide information to the farmers for decision making at the seasonal cultivation planning meetings. A study has already been undertaken to gain better knowledge of the whole system and its water resources and the functioning of the subsystems and the relationships for planning water efficiency and its sustainable use. Figure 10 is a schematic presentation as a base map for modelling the inputs and outputs under different conditions for planning, establishment of measuring points for data collection and future evaluation.[5]

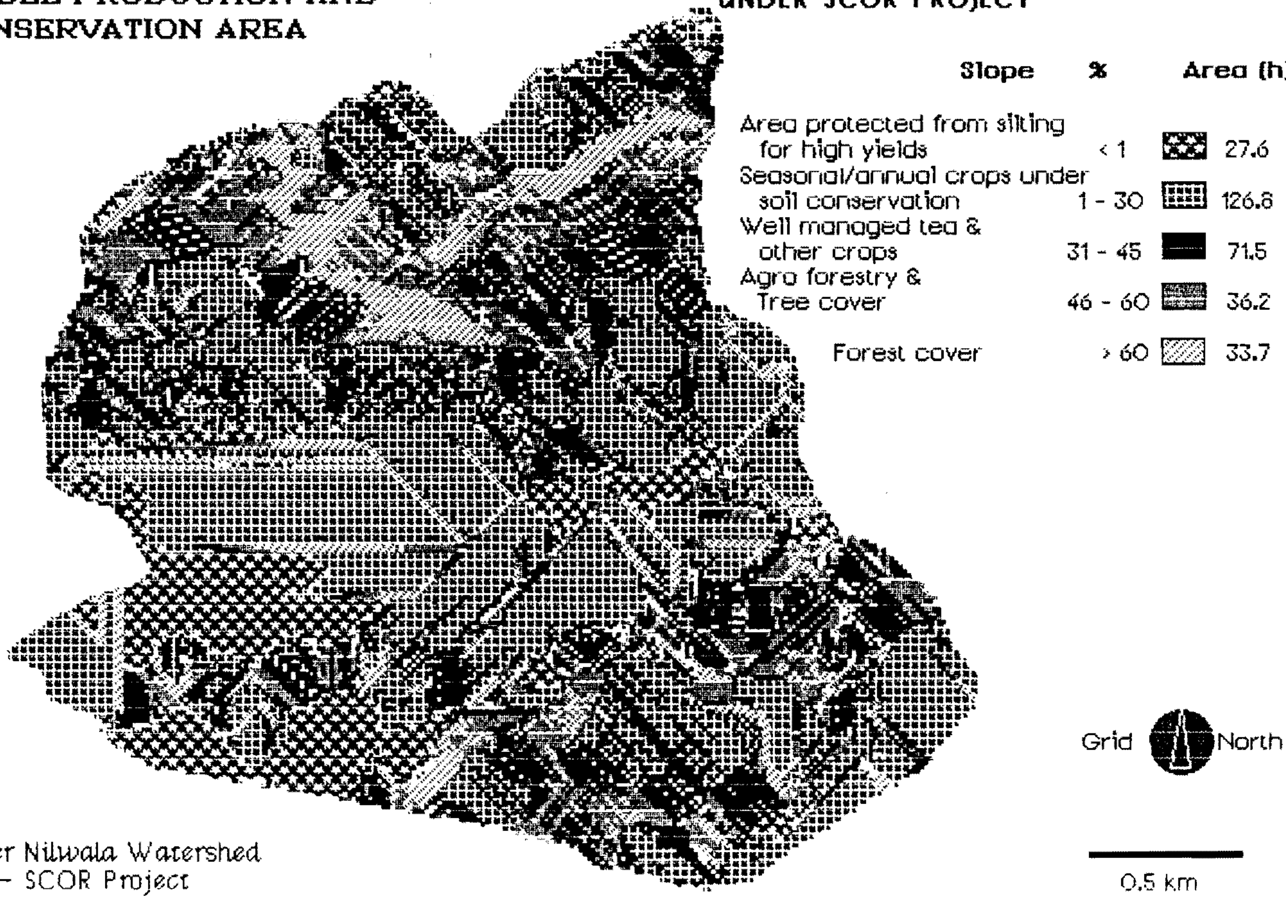
AREA OF SLOPE GREATER THAN 45%
ANNINKANDA MODEL PRODUCTION AND CONSERVATION AREA



Map 4

ANNINKANDA MODEL PRODUCTION AND CONSERVATION AREA

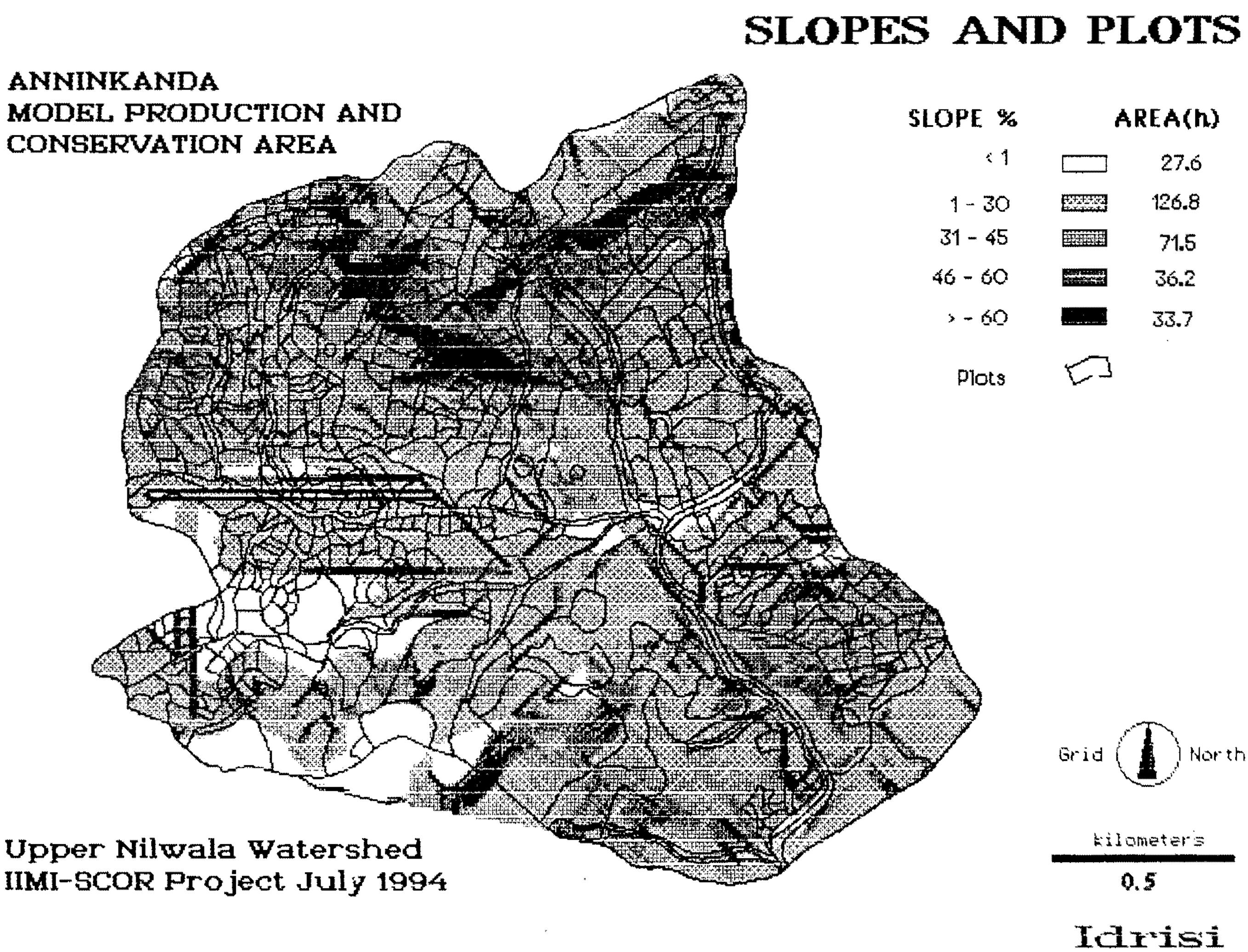
ANTICIPATED CHANGE IN LAND USE UNDER SCOR PROJECT



Upper Nilwala Watershed
IIMI - SCOR Project
July 1994

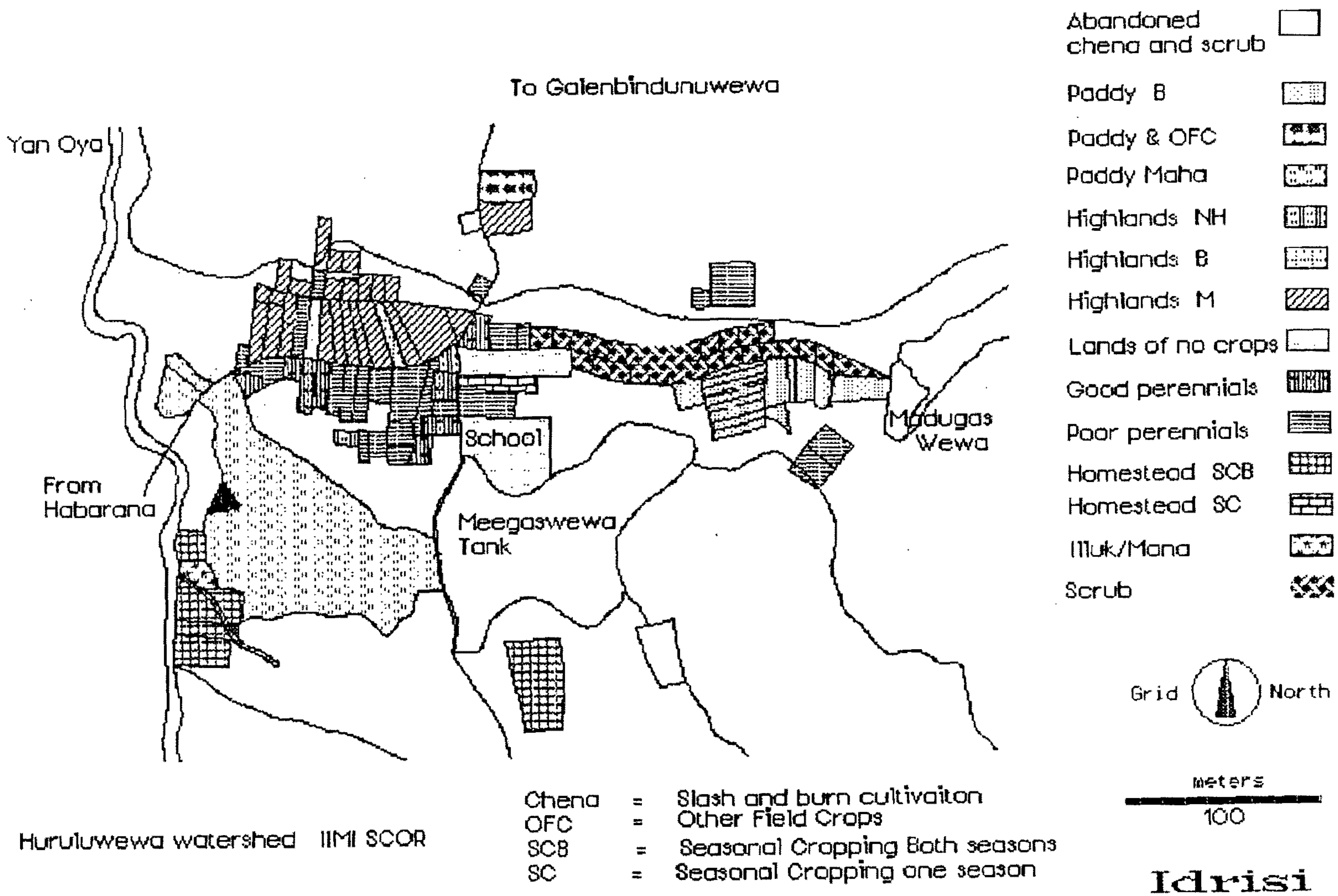
IDRISI

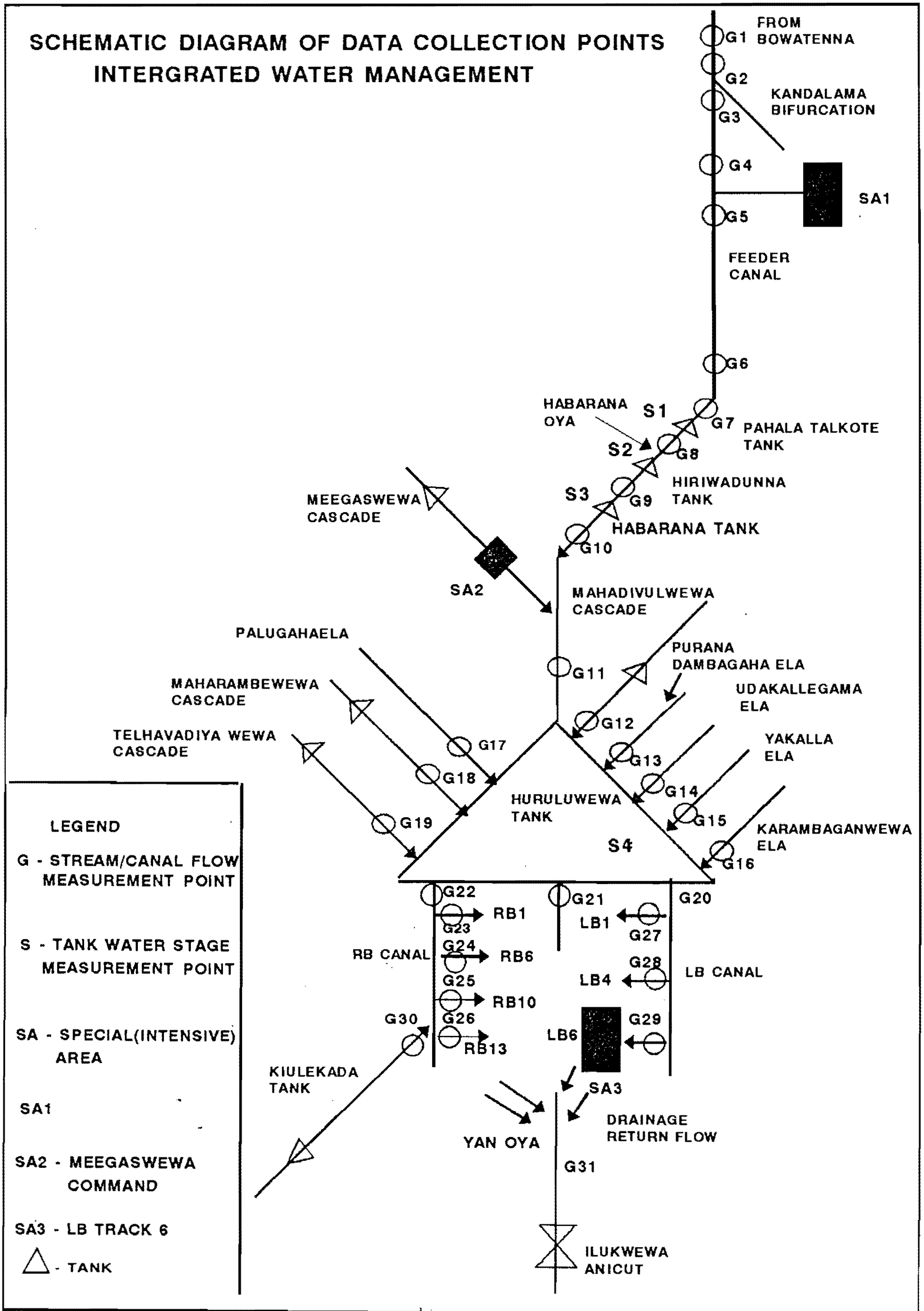
Map 5


SLOPES AND PLOTS
ANNINKANDA
MODEL PRODUCTION AND
CONSERVATION AREA
SLOPE %
AREA(h)
< 1
27.6
1 - 30
126.8
31 - 45
71.5
46 - 60
36.2
> - 60
33.7
Plots
Grid
North
kilometers
0.5
Idrisi
Upper Nilwala Watershed
IIMI-SCOR Project July 1994

MAHAMEEGASWEWA LAND USE - JANUARY 1994

Map 6

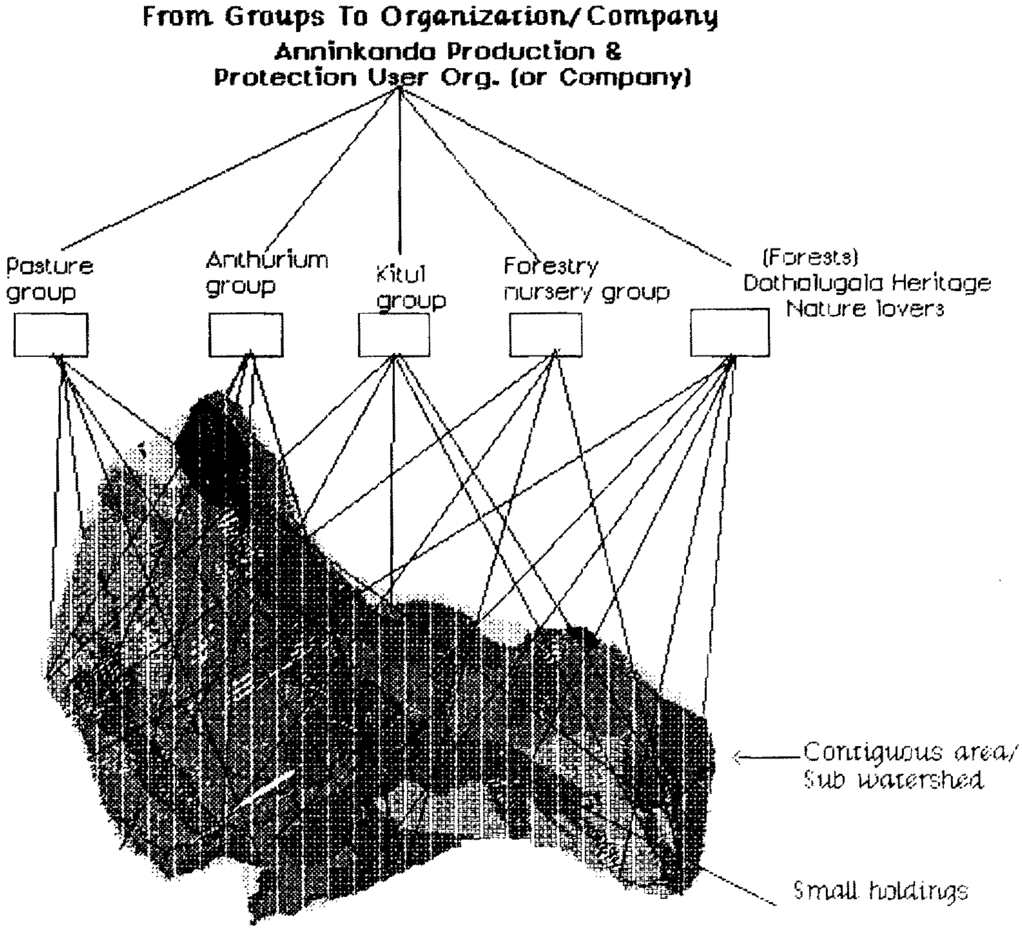


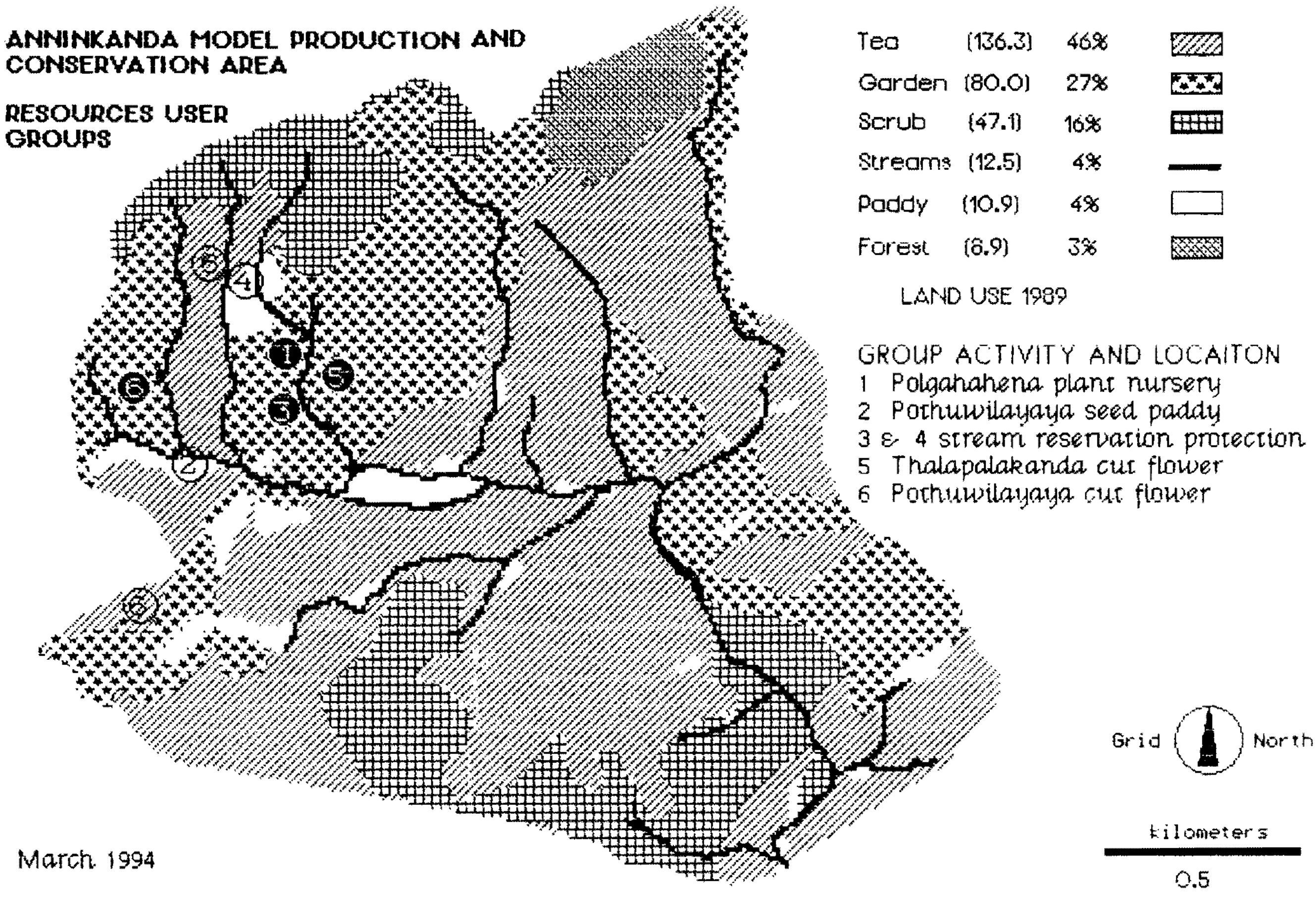

SCHEMATIC DIAGRAM OF DATA COLLECTION POINTS
INTERGRATED WATER MANAGEMENT
FROM BOWATENNA
G1
G2
KANDALAMA BIFURCATION
G3
G4
SA1
G5
FEEDER CANAL
G6
HABARANA OYA
S1
G7
PAHALA TALKOTE TANK
S2
G8
HIRIWADUNNA TANK
S3
G9
HABARANA TANK
G10
MEEGASWEWA CASCADE
SA2
MAHADIVULWEWA CASCADE
PALUGAHAELA
G11
PURANA DAMBAGAHA ELA
UDAKALLEGAMA ELA
MAHARAMBEWEWA CASCADE
G12
TELHAVADIYA WEWA CASCADE
G17
G13
YAKALLA ELA
G18
HURULUWEWA TANK
G14
G19
G15
KARAMBAGANWEWA ELA
S4
G16
G22
G21
G20
RB1
LB1
G23
G27
RB CANAL
G24
RB6
G28
LB CANAL
G25
LB4
RB10
G30
G26
G29
LB6
RB13
KIULEKADA TANK
SA3
YAN OYA
DRAINAGE RETURN FLOW
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

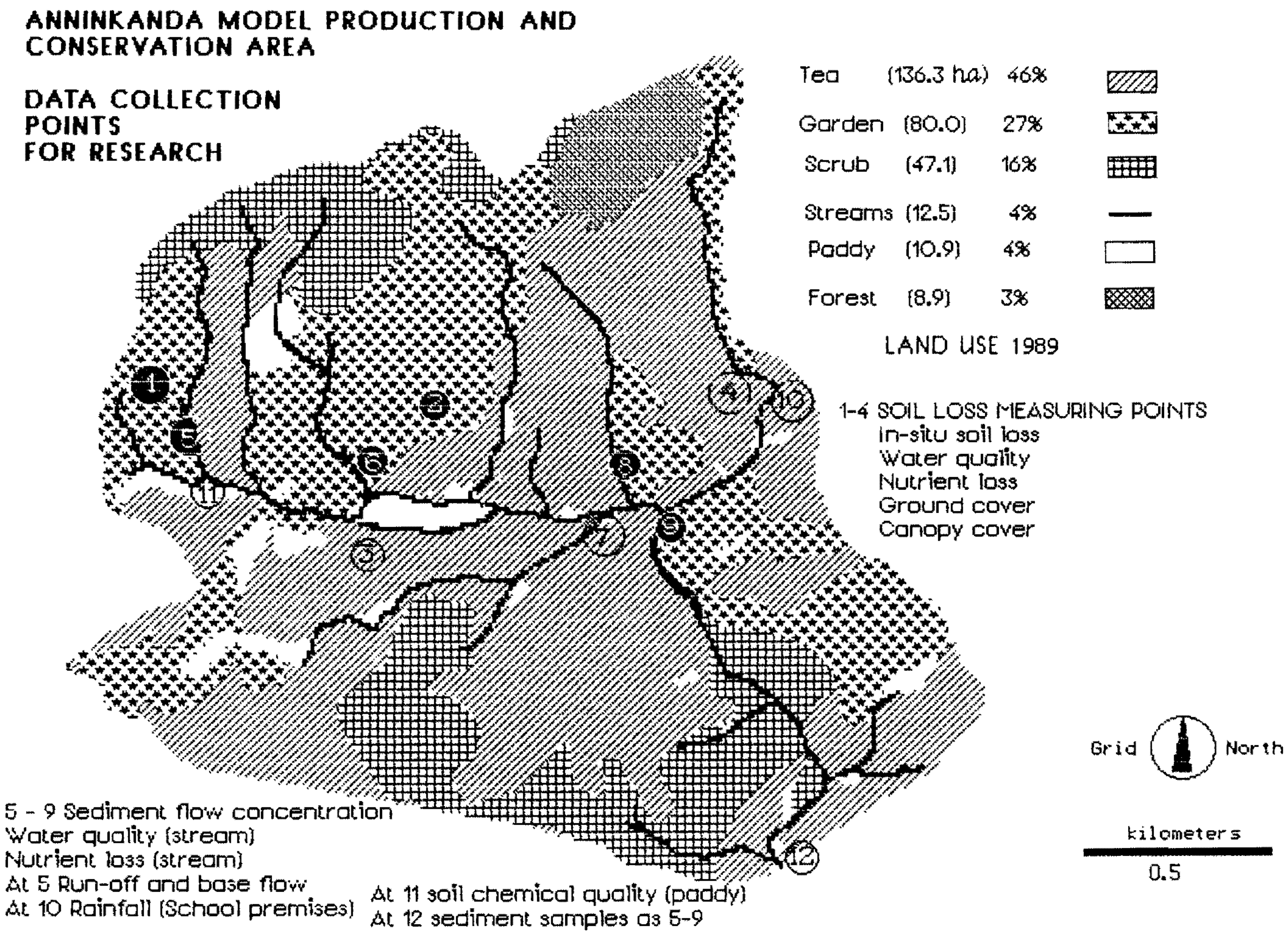
7. The interactions among the resources users and their action on landscape is organized through group work. Map 7 shows the model for the horizontal and vertical integration of resources user groups working on the physical landscape effecting change. Map 8 and 9 illustrate how group work has been linked to a set of data bases so that the data generated are used to extract information for the purposes of monitoring and evaluation. Map 10 shows the arrangements to collect data on relevant key indicators of change for evaluation. Figure 11 illustrates the Management Information System and the operation of the Monitoring and Evaluation system of the SCOR project.

SCOR is the first attempt in Sri Lanka to produce a model of watershed resources management using the watershed as the basic unit of planning and implementation in a participatory mode. The mechanisms described above illustrates elements of a pragmatic approach responding to the challenging tasks involved. More than 50 different international organizations are in the mailing list of the project for sharing information relevant to watershed resources management. An elaborate research programme has been designed and research areas have been listed for support. The correct choice of information technology appears to be crucial in this effort that could produce the required information in the required formats in a usable way, for replication and effecting necessary policy change.

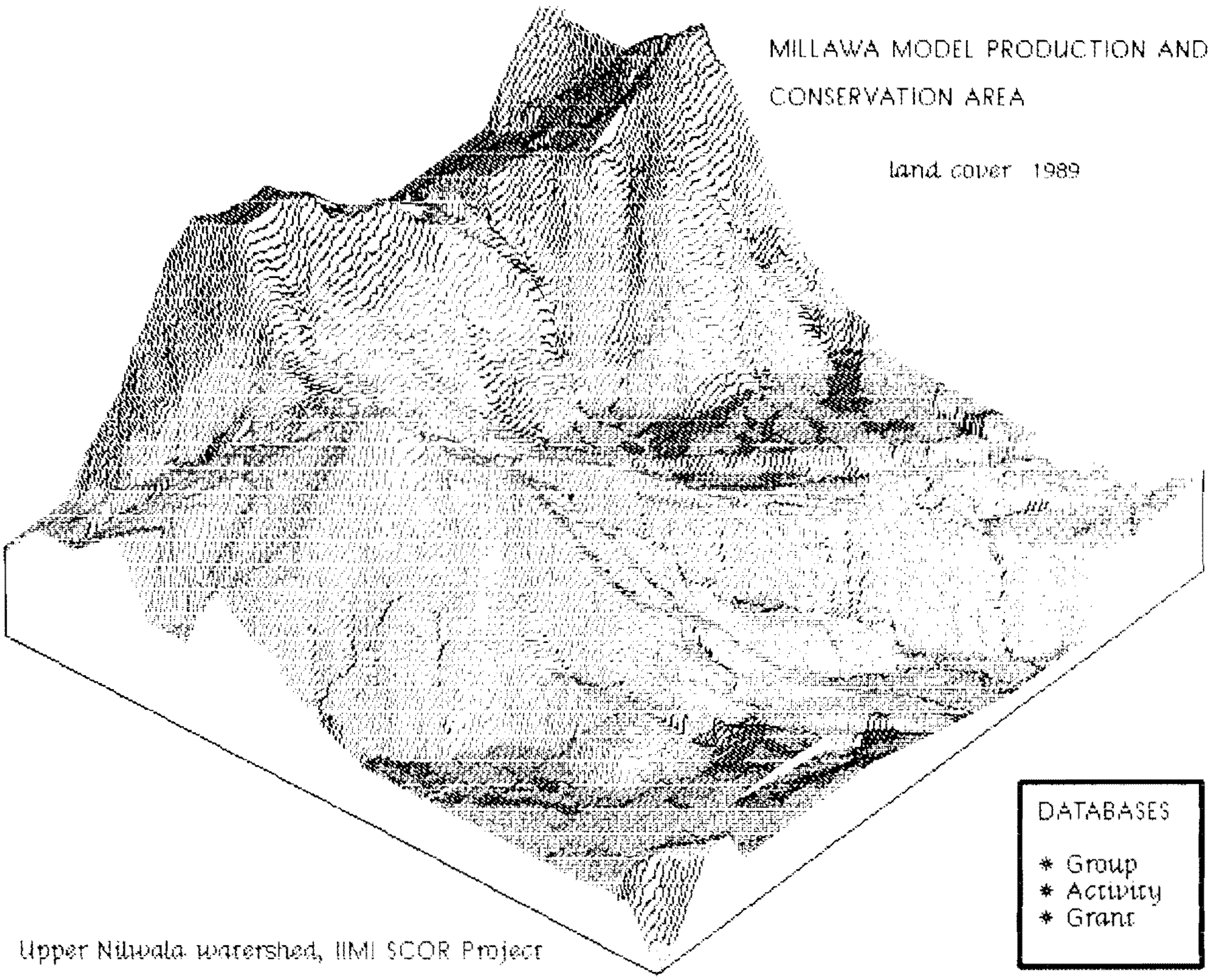
A SCHEMATIC PRESENTATION TO ILLUSTRATE GROUP, ORGANIZATIONS AND (SUB) COUNCIL FORMATION IN A MICRO WATERSHED/CONTIGUOUS PILOT AREA




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 (6.9) 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
Grid North
kilometers
0.5
March 1994


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
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
Grid North
kilometers
0.5

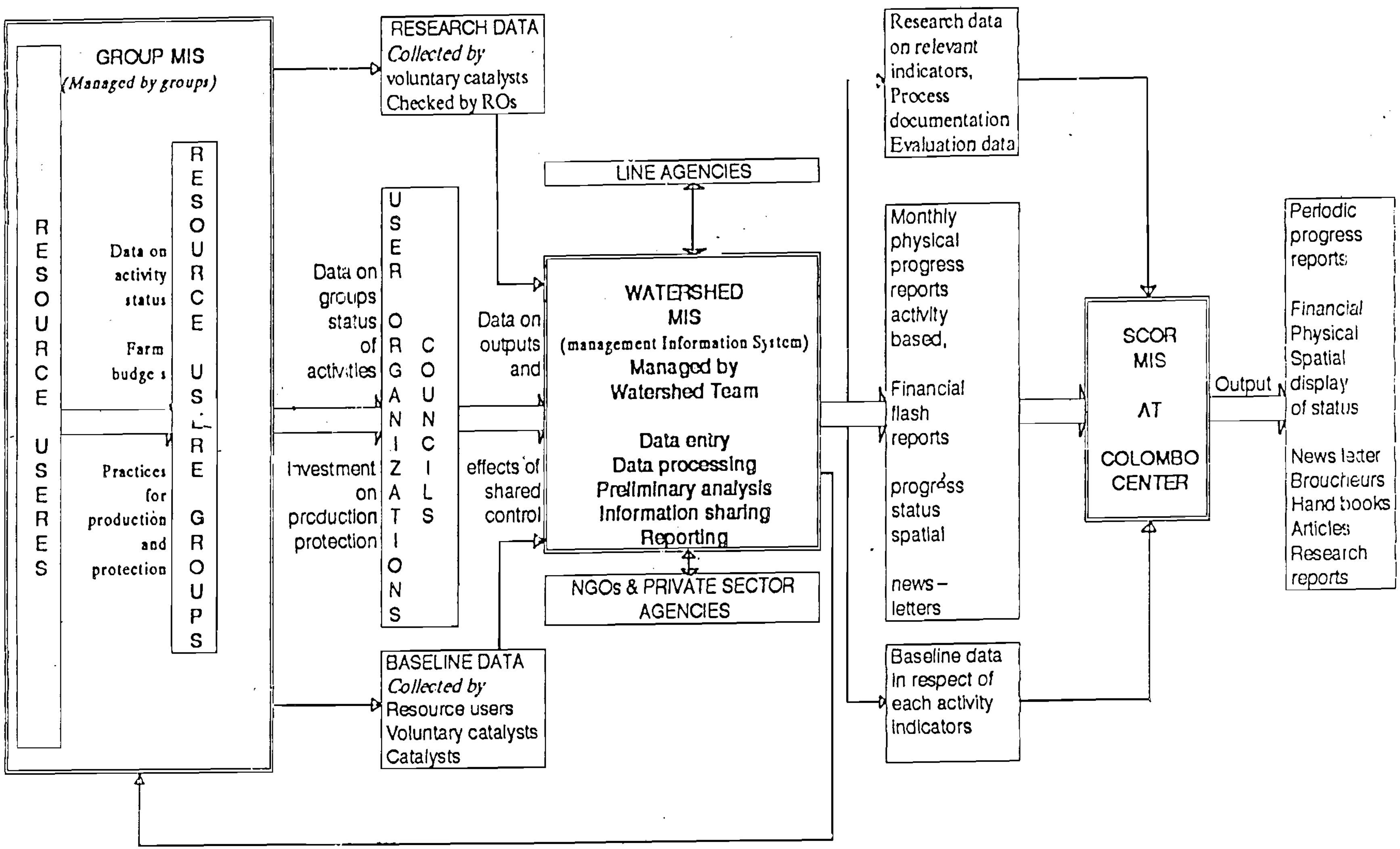
Map 10



MILLAWA MODEL PRODUCTION AND
CONSERVATION AREA
land cover 1989
DATABASES
* Group
* Activity
* Grant
Upper Nilwala watershed, IIMI SCOR Project

Figure 11

OPERATION OF M&E SYSTEM OF SCOR PROJECT



NOTES

1. Shared Control Of Natural Resources(SCOR) project is a collaborative effort of the Government of Sri Lanka, the International Irrigation Management Institute, and the United States Agency for International Development.

2. See end note 3.

3. Keynote address delivered on the integration of economy and ecology in sustainable development and its implications for policy by Dr. Theodore Panayatou of Harvard Institute for International Development at a conference on the role of environmental economics in National Development, 1992.

4. SCOR Log frame, assumptions and objectives are quoted from the Technical proposal of Shared Control of Natural Resources (SCOR) Project - 30 April, 1993.

5. Figure 10 is an output of the initial work on the study of the system as a whole with the main reservoir and the minor systems (small tanks and cascade systems) by Nihal Fernando, the water resource engineer and research associate of SCOR project.